Planning and Environmental Consultants

Environmental Impact Assessment Report

Proposed Croagh Wind Farm, Co. Leitrim and Co. Sligo

Volume 1

Non-Technical Summary and Main Report



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Table of Contents

Non-Technical Summary

1. **INTRODUCTION** 1-1

1.1 Introduction 1-1
1.2 Legislative Context of Environmental Impact Assessment 1-2
1.2.1 EIAR Guidance 1-3
1.2.2 Wind Energy Development Guidelines for Planning Authorities 1-3
1.3 The Applicant 1-4
1.4 Brief Description of the Proposed Development 1-4
1.5 Need for the Proposed Development 1-6
1.5.1 Overview 1-6
1.5.2 Recreational Benefits 1-12
1.6 Purpose and Scope of the EIAR 1-13
1.7 Structure and Content of the EIAR 1-13
1.7.1 Description of Likely Significant Effects and Impacts 1-14
1.8 Project Team 1-17
1.8.1 Project Team Responsibilities 1-17
1.8.2 Project Team Members 1-19
1.9 Viewing and Purchasing the EIAR 1-28

2. **BACKGROUND** 2-1

2.1 Introduction 2-1
2.2 Renewable Energy Policy and Targets 2-1
2.2.1 Renewable Energy Resources 2-1
2.2.2 EU Legislation 2-2
2.2.3 National Energy Policy 2-7
2.2.4 Summary of Compliance with Renewable Energy Policy and Targets 2-12
2.3 Climate Change Policy and Targets 2-13
2.3.1 Introduction 2-13
2.3.2 Impacts on Climate Change 2-13
2.3.3 International Policy 2-14
2.3.4 Kyoto Protocol Targets 2-14
2.3.5 National Climate Change Policy 2-18
2.3.6 The proposed development will aid in reinforcing grid infrastructure and greater interconnection. Strategic Planning Policy Context 2-25
2.3.7 Other Relevant Guidelines 2-39
2.4 Site of the Proposed Development 2-44
2.4.1 Site Location 2-44
2.4.2 Access 2-44
2.4.3 Physical Characteristics of the Study Area and Surrounding Lands 2-44
2.5 Planning History 2-44
2.5.1 Planning History in Vicinity of the Application Site 2-45
2.6 Scoping and Consultations 2-53
2.6.1 Scoping Replies 2-53
2.7 Other Consultation 2-63
2.7.1 Community Engagement 2-63
2.7.2 Pre-Planning Meetings 2-64
2.8 Cumulative Impact Assessment 2-66
2.8.1 Methodology for Cumulative Assessment of Projects 2-66

3. CONSIDERATION OF REASONABLE ALTERNATIVES 3-1

3.1 Introduction 3-1
3.1.2 Methodology 3-2
3.2 'Do-Nothing' Alternative 3-2
3.3 Alternative Locations 3-4
3.3.1 Strategic Site Screening 3-4
3.3.2 Results of the Screening Process 3-5
3.3.3 Suitability of the Candidate Site 3-5
3.4 Alternative Renewable Energy Technologies 3-9
3.4.1 Alternative Turbine Numbers and Turbine Models 3-10
3.5 Alternative Turbine Layout and Development Design 3-11
3.5.1 Detailed Constraints Mapping 3-12
3.5.2 Turbine Layout 3-13
3.5.3 Road Layout 3-16
3.5.4 Location of Ancillary Structures 3-18
3.6 Alternative Transport Route 3-24
3.6.1 Port of Entry 3-24
3.6.2 Site Access and Turbine Delivery Route 3-25
3.6.3 Alternative Mitigation Measures 3-28

4. DESCRIPTION OF THE PROPOSED DEVELOPMENT 4-1

4.1 Introduction 4-1
4.2 Development Layout 4-2
4.3 Development Components 4-2
4.3.1 Wind Turbines 4-2
4.3.2 Site Roads 4-6
4.3.3 Borrow Pits 4-9
4.3.4 Peat and Spoil Management Plan 4-11
4.3.5 Electricity Substation 4-13
4.3.6 Site Cabling 4-14
4.3.7 Grid Connection Cabling 4-14
4.3.8 Meteorological Mast 4-15
4.3.9 Temporary Construction Compounds 4-15
4.3.10 Tree Felling and Replanting 4-16
4.3.11 Site Activities 4-17
4.4 Access and Transportation 4-20
4.4.1 Site Entrances 4-20
4.4.2 Turbine and Construction Materials Transport Route 4-22
4.4.3 Traffic Management 4-22
4.5 Community Gain Proposal 4-23
4.5.1 Renewable Energy Support Scheme 4-23
4.5.2 Community Benefit Fund 4-24
4.5.3 Community Investment Opportunity 4-24
4.6 Recreation and Amenity Proposals 4-24
4.6.1 Recreation and Amenity Facilities 4-25
4.6.2 Further Potential 4-26
4.7 Site Drainage 4-26
4.7.1 Introduction 4-26
4.7.2 Existing Drainage Features 4-26
4.7.3 Drainage Design Principles 4-27
4.7.4 References 4-28
4.7.5 Drainage Design 4-28
4.7.6 Forestry Felling Drainage Measures 4-35
4.7.7 Borrow Pit Drainage 4-36
4.7.8 Floating Road Drainage 4-36
4.7.9 Cable Trench Drainage 4-37
4.7.10 Site and Drainage Management 4-37
4.8 Construction Phasing and Timing 4-38
4.8.1 Construction Sequencing 4-38

4.8.2 Construction Phase Monitoring and Oversight 4-40
4.9 Construction Methodologies 4-41
4.9.1 Turbine Foundations 4-41
4.9.2 Site Roads and Crane Pad Areas 4-42
4.9.3 Proposed Clear-span Watercourse Crossings 4-42
4.9.4 Onsite Electricity Substation and Control Building 4-43
4.9.5 Temporary Construction Compounds 4-44
4.9.6 Grid Connection Cable Trench 4-44
4.9.7 Proposed Demolition Works 4-48
4.10 Operation 4-49
4.11 Decommissioning 4-49

5. **POPULATION AND HUMAN HEALTH 5-1**

5.1 Introduction 5-1
5.1.1 Statement of Authority 5-1
5.2 Population 5-1
5.2.1 Receiving Environment 5-1
5.2.2 Population 5-2
5.2.3 Employment and Economic Activity 5-5
5.2.4 Land-use 5-8
5.2.5 Services 5-8
5.3 Tourism 5-9
5.3.1 Tourist Numbers and Revenue 5-9
5.3.2 Tourist Attractions 5-10
5.3.3 Tourist Attitudes to Wind Farms 5-12
5.4 Public Perception of Wind Energy 5-14
5.4.1 Sustainable Energy Ireland Survey 2003 5-14
5.4.2 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005 5-16
5.4.3 IWEA Interactions Opinion Poll on Wind Energy 5-17
5.5 Health Impacts of Wind Farms 5-17
5.5.1 Health Impact Studies 5-17
5.5.2 Turbine Safety 5-21
5.5.3 Electromagnetic Interference 5-22
5.5.4 Assessment of Effects on Human Health 5-22
5.5.5 Vulnerability of the Project to Natural Disaster 5-23
5.6 Property Values 5-23
5.7 Shadow Flicker 5-26
5.7.1 Background 5-26
5.7.2 Guidance 5-28
5.7.3 Shadow Flicker Prediction Methodology 5-29
5.7.4 Shadow Flicker Assessment Criteria 5-29
5.7.5 Shadow Flicker Assessment Results 5-31
5.8 Residential Amenity 5-34
5.9 Likely Significant Impacts and Associated Mitigation Measures 5-35
5.9.1 'Do-Nothing' Scenario 5-35
5.9.2 Construction Phase 5-35
5.9.3 Operational Phase 5-42
5.9.4 Decommissioning Phase 5-48
5.9.5 Cumulative Effects 5-48

6. **BIODIVERSITY 6-1**

6.1 Introduction 6-1
6.2 Requirements for Ecological Impact Assessment 6-2
6.3 Relevant Guidance 6-4
6.3.1 Statement of Authority 6-5
6.4 Methodology 6-5
6.4.1 Desk Study 6-6

6.4.2 Scoping and Consultation 6-6
6.4.3 Field Surveys 6-8
6.4.4 Methodology for Assessment of Impacts and Effects 6-12
6.5 Establishing the Ecological Baseline 6-15
6.5.1 Desk Study 6-15
6.5.2 Conclusions of the Desk Study 6-28
6.6 Description of the Existing Environment 6-29
6.6.1 Description of Habitats 6-29
6.6.2 Protected Flora 6-42
6.6.3 Invasive species 6-42
6.6.4 Fauna in the Existing Environment 6-43
6.6.5 Importance of Ecological Receptors 6-48
6.7 Ecological Impact Assessment 6-52
6.7.1 Do-Nothing Effect 6-52
6.7.2 Effects on Designated Sites 6-52
6.7.3 Likely Significant Effects During Construction Phase 6-53
6.7.4 Likely Significant Effects During Operational Phase 6-61
6.7.5 Likely Significant Effects During Decommissioning phase 6-63
6.8 Cumulative impact 6-63
6.8.1 Assessment of Plans 6-64
6.8.2 Assessment of Projects 6-71
6.8.3 Existing Habitats and Land Uses 6-74
6.8.4 Assessment of Cumulative Effects 6-74
6.9 Conclusion 6-76
6.10 Bibliography 6-77

7. **ORNITHOLOGY 7-1**

7.1 Introduction 7-1
7.1.1 Description of the Proposed Development 7-1
7.1.2 Legislation, Guidance and Policy Context 7-2
7.1.3 Statement of Authority and Competence 7-3
7.2 Assessment Approach and Methodology 7-3
7.2.1 Desk Study 7-3
7.2.2 Consultation 7-4
7.2.3 Identification of Target Species and Key Ornithological Receptors 7-5
7.2.4 Field Surveys 7-6
7.2.5 Ornithological Evaluation Criteria and Impact Assessment Methodology 7-9
7.2.6 Survey Justification 7-13
7.4 Baseline Conditions and Receptor Evaluation 7-14
7.4.1 Identification of Designated Sites within the Likely Zone of Influence of the Development 7-14
7.4.2 Breeding and Wintering Bird Atlas Records 7-20
7.4.3 Bird Sensitivity Mapping Tool 7-21
7.4.4 Irish Wetland Bird Survey (I-WeBS) Records 7-22
7.4.5 NPWS Rare and Protected Species Dataset 7-22
7.5 Additional Boleybaun Surveys (offsite) 7-23
7.6 Field Survey Results 7-24
7.6.1 Whooper Swan 7-24
7.6.2 Golden Plover 7-25
7.6.3 Hen Harrier 7-26
7.6.4 Merlin 7-26
7.6.5 Peregrine 7-27
7.6.6 Red Grouse 7-27
7.6.7 Woodcock 7-28
7.6.8 Curlew 7-29
7.6.9 Buzzard 7-29
7.6.10 Sparrowhawk 7-30
7.6.11 Kestrel 7-31
7.6.12 Snipe 7-31
7.6.13 Passerines (Red Listed) 7-32

7.7 Evaluation 7-33
7.7.1 Whooper Swan 7-33
7.7.2 Golden Plover 7-33
7.7.3 Hen Harrier 7-35
7.7.4 Merlin 7-35
7.7.5 Peregrine 7-35
7.7.6 Red Grouse 7-36
7.7.7 Woodcock 7-36
7.7.8 Curlew 7-36
7.7.9 Buzzard 7-37
7.7.10 Sparrowhawk 7-37
7.7.11 Kestrel 7-37
7.7.12 Snipe 7-37
7.7.13 Passerines (Red Listed) 7-37
7.8 Identification of Key Ornithological Receptors 7-38
7.9 KOR Sensitivity Determination 7-44
7.10 Likely and Significant Effects 7-44
7.10.1 Do-Nothing Effect 7-45
7.10.2 Effects on Key Ornithological Receptors during Construction and Operation 7-46
7.10.3 Effects on Key Ornithological Receptors during Decommissioning 7-64
7.11 Effect Associated with the Grid Connection and Access Road Route 7-65
7.12 Effects on Designated Areas 7-65
7.13 Mitigation and Best Practice Measures 7-66
7.13.1 Mitigation by Design 7-66
7.13.2 Mitigation During Construction, Operation and Decommissioning 7-66
7.14 Enhancement 7-67
7.15 Monitoring 7-68
7.15.1 Commencement and Pre-Construction Monitoring 7-68
7.15.2 Post Construction Monitoring 7-68
7.17 Residual Effects 7-69
7.18 Assessment of Cumulative Effects 7-69
7.18.1 Other Plans and Projects 7-69
7.18.2 Plans Considered in the Cumulative Impact Assessment 7-70
7.18.3 Projects Considered in the Cumulative Impact Assessment 7-70
7.19 Conclusion 7-76

8. **LAND SOILS AND GEOLOGY 8-1**

8.1 Introduction 8-1
8.1.1 Background and Objectives 8-1
8.1.2 Statement of Authority 8-1
8.1.3 Relevant Guidance 8-2
8.2 Schedule of Works 8-2
8.2.1 Desk Study 8-2
8.2.2 Baseline Monitoring and Site Investigations 8-2
8.2.3 Scoping and Consultation 8-3
8.2.4 Impact Assessment Methodology 8-4
8.3 Existing Environment 8-7
8.3.1 Site Description and Topography 8-7
8.3.2 Soils and Subsoils 8-8
8.3.3 Bedrock Geology 8-9
8.3.4 Geological Resource Importance 8-11
8.3.5 Geological Heritage and Designated Sites 8-11
8.3.6 Soil Contamination 8-11
8.3.7 Economic Geology 8-11
8.3.8 Peat Stability Assessment 8-12
8.4 Characteristics of the Proposed Development 8-15
8.5 Likely Significant Effects and Associated Mitigation Measures 8-16
8.5.1 Do Nothing Scenario 8-16
8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures 8-17

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures 8-21
8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures 8-22
8.5.5 Cumulative Effects 8-22
8.5.6 Post Construction Monitoring 8-22
8.5.7 Assessment of Health Effects 8-23

9. **WATER 9-1**

9.1 Introduction 9-1
9.1.1 Background and Objectives 9-1
9.1.2 Statement of Authority 9-1
9.1.3 Scoping and Consultation 9-2
9.1.4 Relevant Legislation 9-3
9.1.5 Relevant Guidance 9-4
9.2 Methodology 9-5
9.2.1 Desk Study & Preliminary Hydrological Assessment 9-5
9.2.2 Site Investigations 9-5
9.2.3 Impact Assessment Methodology 9-6
9.3 Receiving Environment 9-6
9.3.1 General Site Description 9-6
9.3.2 Water Balance 9-7
9.3.3 Regional and Local Hydrology 9-8
9.3.4 Local & Site Drainage 9-9
9.3.5 Baseline assessment of site runoff 9-11
9.3.6 Flood Risk Identification 9-12
9.3.7 Surface Water Hydrochemistry 9-13
9.3.8 Hydrogeology 9-21
9.3.9 Groundwater Vulnerability 9-22
9.3.10 Groundwater Hydrochemistry 9-22
9.3.11 Water Framework Directive Water Body Status & Objectives 9-23
9.3.12 Groundwater Body Status 9-23
9.3.13 Surface Water Body Status 9-23
9.3.14 Designated Sites & Habitats 9-23
9.3.15 Water Resources 9-24
9.3.16 Receptor Sensitivity 9-25
9.4 Characteristics of the Proposed Development 9-26
9.4.1 Development Interaction with the Existing Forestry Drainage Network 9-26
9.4.2 Proposed Drainage Management 9-27
9.5 Likely Significant Effects and Associated Mitigation Measures 9-27
9.5.1 Overview of Impact Assessment Process 9-27
9.5.2 Do Nothing Scenario 9-29
9.5.3 Construction Phase - Likely Significant Effects and Mitigation Measures 9-29
9.5.4 Operational Phase - Likely Significant Effects and Mitigation Measures 9-44
9.5.5 Decommissioning Phase - Likely Significant Effects and Mitigation Measures 9-47
9.5.6 Assessment of Cumulative Effects 9-47
9.5.7 Post Consent Monitoring 9-49

10. **AIR AND CLIMATE 10-1**

10.1 Air Quality 10-1
10.1.1 Introduction 10-1
10.1.2 Air Quality Standards 10-1
10.1.3 Air Quality Zones 10-6
10.1.4 Existing Air Quality 10-6
10.1.5 Sulphur Dioxide (SO_2) 10-6
10.1.6 Likely and Significant Impacts and Associated Mitigation Measures 10-9
10.1.7 Operational Phase 10-11
10.2 Climate 10-12
10.2.1 Climate Change and Greenhouse Gases 10-12
10.2.2 Climate and Weather in the Existing Environment 10-21

10.2.3 Calculating Carbon Losses and Savings from the Proposed Development 10-25
10.2.4 Likely Significant Effects and Associated Mitigation Measures 10-29
10.3 Cumulative Assessment 10-30

11. **NOISE & VIBRATION 11-1**

11.1 Introduction 11-1
11.1.1 Background & Objectives 11-1
11.1.2 Statement of Authority 11-1
11.2 Fundamentals of Acoustics 11-2
11.3 Assessment Methodology 11-3
11.3.1 EPA Description of Effects 11-4
11.3.2 Guidance Documents and Assessment Criteria 11-4
11.3.3 Special Characteristics of Turbine Noise 11-11
11.3.4 Comments on Human Health Impacts 11-15
11.3.5 Vibration 11-17
11.3.6 Noise Conditions for Other Wind Farm Developments 11-17
11.3.7 Background Noise Assessment 11-17
11.3.8 Turbine Noise Calculations 11-27
11.3.9 Assessments of Construction Impacts 11-31
11.4 Receiving Environment 11-32
11.4.1 Background Noise Levels 11-32
11.4.2 Wind Turbine Noise Criteria 11-43
11.5 Likely Significant Effects and Associated Mitigation Measures 11-45
11.5.1 Do-Nothing Scenario 11-45
11.5.2 Construction Phase Potential Impacts 11-45
11.5.3 Operational Phase Potential Impacts 11-53
11.5.4 Construction Phase Mitigation 11-66
11.5.5 Operational Phase Mitigation 11-68
11.5.6 Decommissioning Phase 11-69
11.6 Description of Residual Effects 11-69
11.6.1 Construction and Decommissioning Phase 11-69
11.6.2 Operational Phase 11-71
11.6.3 Cumulative Effects 11-72

12. **LANDSCAPE AND VISUAL 12-1**

12.1 Introduction 12-1
12.2 Statement of Authority 12-1
12.2.1 Proposed Development Description 12-1
12.2.2 Scoping Replies/Pre-Planning Meetings 12-2
12.3 Brief Methodology and Assessment Criteria 12-3
12.3.1 Scope and Definition of Landscape and Visual Impact (LVIA) Study Area 12-3
12.3.2 Guidelines 12-4
12.3.3 Baseline Landscape and Visual Information 12-5
12.3.4 Assessment of Potential Impacts 12-5
12.4 Landscape Baseline 12-5
12.4.1 Landscape Designations 12-6
12.4.2 Landscape Character of the Proposed Development Site 12-14
12.4.3 Indications of Landscape Value 12-21
12.4.4 Landscape Character of the Study Area 12-22
12.4.5 Landscape Receptor Preliminary Assessment 12-26
12.5 Visual Baseline 12-28
12.5.1 Visual Receptors 12-28
12.5.2 Visual Receptor Preliminary Assessment 12-39
12.6 Cumulative Baseline 12-43
12.7 Likely or Significant Landscape and Visual Effects 12-44
12.7.1 'Do-Nothing' Scenario' 12-44
12.7.2 Construction Phase Effects 12-44

12.7.3 Operational Phase Effects 12-44
12.7.4 Decommissioning Phase Effects 12-60
12.8 Conclusion 12-60
12.8.1 Landscape Effects 12-60
12.8.2 Cumulative Landscape Effects 12-61
12.8.3 Visual Effects 12-61
12.8.4 Cumulative Visual Effects 12-61

13. ARCHAEOLOGY AND CULTURAL HERITAGE 13-1

13.1 Introduction 13-1
13.1.1 Proposed Development 13-1
13.1.2 Statement of Authority 13-1
13.1.3 Legislation and Guidelines 13-1
13.1.4 Location and Topography 13-6
13.2 Methodology 13-8
13.2.1 Geographical Information Systems 13-8
13.2.2 Desktop Assessment 13-8
13.2.3 Field Inspection 13-10
13.2.4 Assessment of Likely Significant Effects 13-10
13.2.5 Methodology for the assessment of impacts on visual setting (indirect effects) 13-11
13.3 Existing Environment 13-12
13.3.1 Archaeological Heritage – The Proposed Wind Farm 13-12
13.3.2 Architectural and Cultural Heritage – The proposed wind farm 13-74
13.3.3 The Proposed Underground Grid Connection Cable Route 13-77
13.3.4 Construction Access Road 13-83
13.4 Likely Significant Effects and Associated Mitigation Measures 13-99
13.4.1 Construction Phase Potential Impacts (Indirect) 13-99
13.4.2 Construction Phase Potential Impacts (Direct) 13-99
13.4.3 Operational Phase Potential Impacts (Indirect) 13-116
13.4.4 Proposed New roads and Amenity Facilities 13-120
13.4.5 Operational Phase Potential Impacts (Direct) 13-123
13.5 Cumulative Impacts 13-123
13.5.1 Cumulative Impacts (Direct Impacts) 13-123
13.5.2 Cumulative Impacts (Indirect Impact on Setting) 13-124
13.5.3 Cultural Heritage Assets within 5km of the proposed Croagh turbines 13-127
13.6 Decommissioning Phase 13-127

14. MATERIAL ASSETS 14-1

14.1 Traffic and Transport 14-1
14.1.1 Introduction 14-1
14.1.2 Receiving Environment 14-3
14.1.3 Existing Traffic Volumes 14-5
14.1.4 Proposed Development and Traffic Generation 14-8
14.1.5 Construction Traffic Design Vehicles 14-13
14.1.6 Traffic Effects During Construction and During Operation 14-14
14.1.7 Traffic Management of Large Deliveries 14-22
14.1.8 Route Assessment 14-22
14.1.9 Provision for Sustainable Modes of Travel 14-24
14.1.10 Likely and Significant Effects and Associated Mitigation Measures 14-25
14.2 Telecommunications and Aviation 14-29
14.2.1 Introduction 14-29
14.2.2 Methodology and Guidance 14-29
14.2.3 Background 14-30
14.2.4 Preventing Electromagnetic Interference 14-30
14.2.5 Likely Significant Effects and Associated Mitigation Measures 14-33

15. INTERACTION OF EFFECTS 15-1

15.1 Introduction 15-1
15.1.1 Statement of Authority 15-3
15.2 Interactions 15-3
15.2.1 Population and Human Health 15-3
15.2.2 Biodiversity 15-4
15.2.3 Ornithology 15-5
15.2.4 Land, Soils and Geology 15-6
15.2.5 Air and Climate 15-6
15.2.6 Landscape and Visual 15-6
15.3 Mitigation and Residual Impacts 15-6

16 SCHEDULE OF MITIGATION 16-1

16.1 Introduction 16-1
16.2 EIAR Mitigation and Monitoring Measures 16-2

BIBLIOGRAPHY

Volume 2 – Photomontage Booklet

Volume 3 – Appendices 2-1 to 14-2

NON-TECHNICAL SUMMARY

Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared by MKO on behalf of Coillte who intends to apply to Sligo County Council and Leitrim County Council for planning permission for a proposed wind farm development located on north-eastern slopes of Carrane Hill on the boundary of Counties Leitrim and Sligo.

The townlands in which the wind farm site, ancillary works and grid connection are located, are listed in Table 1.

Table 1 Townlands within which the proposed development is located

Townland	
Co. Leitrim	**Co. Sligo**
Bargowla	Carrowmore
Boleymaguire	Carrownyclowan
Braudphark	
Derreens	
Derryboffin	
Derrycullinan	
Derrycullinan Beg	
Drummanacappul	
Garvagh	
Garvagh Glebe	
Glassalt	
Lisfuiltaghan	
Seltan	
Sheena	
Tinnybeg	

This EIAR complies with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU. The Environmental Impact Assessment (EIA) of the proposed project will be undertaken by Leitrim County Council and Sligo County Council, as the competent authorities.

Applicant

Coillte have been involved in the development of 4 operating wind farms including Raheenleagh (Wicklow), Sliabh Bawn (Roscommon), Cloosh (Galway) and Castlepook (Cork) which have a combined total capacity of over 300 megawatts (MW). This project is part of a wider Coillte ambition to support the delivery of a further 1 GW of renewable energy and therefore make a significant contribution to the ambitions outlined in the All of Government Climate Action Plan 2019.

Brief Description of the Proposed Development

The proposed development comprises the construction of 10 No. wind turbines and all associated works. The proposed turbines will have a blade tip height of up to 170metres above the top of the foundation. The applicant is seeking a ten-year planning permission. The full description of the proposed development, is as follows:

i. *Construction of up to 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
ii. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, wastewater holding tank and all ancillary works;*
iii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
v. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
vi. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
vii. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access road works in the townlands of Sheena and Derrybofin to provide a link road for construction traffic off the R280;*
viii. *1 no. borrow pit;*
ix. *2 no. peat and spoil repository areas*
x. *2 no. temporary construction compounds;*
xi. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
xii. *Site Drainage;*
xiii. *Permanent Signage;*
xiv. *Forestry Felling; and*
xv. *All associated site development works*

This application is seeking a ten-year permission and 30 year operational life from the date of commissioning of the renewable energy development.

Modern wind turbine generators typically have an output of between 3.0 and 5MW. For the purposes of this EIAR it is assumed that the wind turbine model installed as part of the proposed renewable energy development will have a rated output of 4.8MW. Therefore, based on 10 no. wind turbines, the proposed wind turbines will have a combined output of approximately 48MW and no greater than 50MW.

Need for the Proposed Development

It is now clear that Ireland will not meet its 2020 target for renewable energy, with the Sustainable Energy Authority of Ireland (SEAI) reporting in May 2019 that 13 per cent of Ireland's energy will

come from renewable sources by 2020, three per cent short of our European target of 16 per cent (SEAI, May 2019). Ireland faces significant challenges to its efforts to meet EU targets for renewable energy by 2030 and its commitment to transition to a low carbon economy by 2050. Further detail can be found in Section 2.3.3 of this EIAR.

In March 2019, the Government announced a renewable electricity target of 70% by 2030. The proposed development is likely to be operational before 2030 and would therefore contribute to this 2030 target. More recently, the EPA reported that Ireland is set to fall far short of all of its carbon emissions reduction targets for 2030, despite climate action measures in the National Development Plan (EPA, June 2019). As such, the proposed Croagh wind energy development is critical to helping Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels.

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment (DoCCAE). The CAP sets out an ambitious course of action over the coming years to address the impacts which climate change may have on Ireland's environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption. The CAP identifies a need for 8.2GW of onshore wind generation. Only 3.7GW is in place as of December 2019, therefore Ireland needs to more than double its installed capacity of wind generation. The CAP presents clear and unequivocal support for the provision of additional renewable energy generation and presents further policy support for increased wind energy. Further information relating to the Climate Action Plan can be found in Chapter 2, Section 2.4.5.

Section 2.4 in Chapter 2 of this EIAR on Background to the Proposed Development, presents a full description of the international, national and regional renewable energy policy context for the proposed project. Section 2.4 addresses climate change, including Ireland's current status with regard to meeting greenhouse gas emission reduction targets.

Economic Benefits

The proposed development will have several significant long-term and short-term benefits for the local economy including job creation, local authority commercial rate payments and a Community Benefit Scheme.

The annual commercial rate payments from the proposed development to Leitrim and Sligo County Councils, will be redirected to the provision of public services within those counties. These services include items such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

It is estimated that the proposed project will create approximately 80-100 jobs during the construction phase and 2-3 jobs during the operational and maintenance phases of the proposed development. During construction, additional employment will be created in the region through the supply of services and materials to the development. In addition to this, there will also be income generated by local employment from the purchase of local services i.e. travel and lodgings.

Should the proposed development receive planning permission, there are substantial opportunities available for the local area in the form of Community Benefit Funds. Based on the current proposal, a Community Benefit Fund in the region of €5 million will be made available over the lifetime of the project. The value of this fund will be directly proportional to the energy produced at the site and the premise of the fund is that it should be used to bring about significant, positive change in the local area. Further details on the proposed Community Gain proposals are presented in Section 4.5 and Appendix 2-2 of this EIAR.

The Renewable Energy Support Scheme (RESS) sets out that future renewable energy project proposals enable the possibility for local communities to invest in projects in a meaningful way as a means to

directly gain from the financial dividends that a project can provide. Coillte aim to work with the community during 2020/2021, to continue to explore this exciting possibility and see how best to embed its design within the community

Purpose and Structure of this EIAR

The purpose of this EIAR is to document the current state of the environment in the vicinity of the proposed development site and to quantify the likely significant effects of the proposed development on the environment. The EIAR submitted by the applicant provides the relevant environmental information to enable the Environmental Impact Assessment (EIA) to be carried out by the competent authority, in this case Leitrim & Sligo County Councils.

The EIAR project team comprises a multidisciplinary team of experts with extensive experience in the assessment of wind energy developments and in their relevant area of expertise. Each chapter of this EIAR has been prepared by a competent expert in the subject matter. The chapters of this EIAR are as follows:

1. *Introduction*
2. *Background to the Proposed Development*
3. *Consideration of Reasonable Alternatives*
4. *Description of the Proposed Development*
5. *Population and Human Health*
6. *Biodiversity*
7. *Ornithology*
8. *Land, Soils and Geology*
9. *Hydrology and Hydrogeology*
10. *Air and Climate*
11. *Noise and Vibration*
12. *Landscape and Visual*
13. *Archaeological and Cultural Heritage*
14. *Material Assets (including Traffic and Transport, Telecommunications and Aviation)*
15. *Interactions of the Foregoing*
16. *Schedule of Mitigation*

A Natura Impact Statement has also been prepared in line with the requirements of the Habitats Directive and will be submitted to the Planning Authority as part of the planning application documentation.

Background to the Proposed Development

This chapter of the Environmental Impact Assessment Report (EIAR) presents information on renewable energy and climate change policy and targets, the strategic planning context for the proposed development, the site selection and design process, a description of the proposed development site and planning history, the assessment of reasonable alternatives, scoping and consultation, and the cumulative impact assessment process.

Energy and Climate Change Targets

Renewable energy development is recognised as a vital component of Ireland's strategy to tackle the challenges of combating climate change and ensuring a secure supply of energy. The June 2018 'Off Target Report' published by the Climate Action Network (CAN) Europe, which ranks EU countries ambition and progress in fighting climate change, listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate and renewable energy targets and is also off course for it's unambitious 2030 emissions target.

The Department of Climate Change, Action & Environment (DCCAE) reported in their 'Fourth Progress Report on the National Renewable Energy Action Plan' December 2017 that Ireland will achieve 13% of its 16% RES target by 2020. SEAI in their report 'Ireland's Energy Targets – Progress, Ambition & Impacts' (April 2016) estimates that Irelands inability to achieve its 2020 renewable energy targets will result in fines of between €65 million and €130 million per percentage shortfall on its overall binding target after 2020 until it meets its targets. The latest data available from Eurostat show that as of the 2018 figures, Ireland is still considerably below meeting its 16% target and at the end of 2018 sat at 11.1%.

The SEAI's 'Energy in Ireland 2019' report provides the most up to date figures available (from 2018) in relation to energy production and consumption in Ireland. The 2019 report found that wind generation accounted for 28.1% (normalised) of all electricity generated, further, wind energy accounted for 84% of the renewable energy generated in 2018. In relation to the findings of this SEAI report it is clear that wind energy represents the strongest and most deployable renewable energy resource available to reduce dependence on fossil fuels in Ireland. While it is clear that additional deployment is on-going, it is also apparent that it is unlikely that the 2020 targets for renewable electricity generation will be met.

Local Policy

The site of the proposed development occurs along the Leitrim – Sligo border, with some of the proposed renewable energy infrastructure located in each of the two counties. As the proposed development will occur within the functional area of two local authorities it is necessary to submit two separate planning applications, one to each of the relevant authorities for that portion of the development which occurs in their functional area.

Leitrim County Development Plan 2015-2021

The Leitrim County Development Plan 2015-2021 (LCDP) is the principal instrument that is used to manage change in land use in the County. The CDP sets out the Council's strategic land use objectives and policies for the overall development of the County up to 2021. The Plan seeks to develop and improve, in a sustainable manner, the social, economic, cultural and environmental assets of the County.

Under the County Development Plan the following strategic goals have been set under Section 2.2.1 'Resources' with regards to energy/renewable energy:

- *"To support energy generation from renewable resources where practicable and appropriate";*
- *"To ensure an adequate supply of energy, including renewable energy, is available to meet the social, commercial and economic needs of the entire County;"*

The LCDP states that

> *"The Council recognises the potential of the County for generating electricity by means of windfarms and is favourably disposed towards their development subject to the protection of the environment and visual amenity" (Page 198 LCDC refers)*

Under Section 3.4 of the LCDP it is detailed that Leitrim County Council will support development and expansion of the County's Green Infrastructure.

Section 4.11.5 of the CDP notes the council's vision for wind farms within the county over the lifetime of the plan. The Council acknowledges the role which wind energy has, mainly in reducing the reliance

on non-renewable sources of energy, reducing the dependency on imported fuels and in moving towards a 'low carbon' society.

- ***Policy 128:***

It is the policy of the Council that all wind farm applications will be assessed on the full range of criteria including those mentioned herein and those identified in the Wind Farm Development Guidelines, 2006 (or any subsequent update) published by the Department of Environment, Heritage and Local Government.

- ***Policy 135:***

It is the policy of the Council to support national policy on reducing carbon emissions and increasing energy generation from renewable sources.

Sligo County Development Plan 2017-2023

The Sligo County Development Plan 2017 – 2023 (SCDP) was adopted in July 2017 and came into operation in August 2017. Section 10.6 of the SCDP examines climate change within the county, it is noted that:

"It is widely accepted that climate change is a reality which is happening on an ongoing basis"

The SCDP acknowledges that energy efficiency and the use of renewable energy help to reduce GHG emissions and therefore play a key role in tackling climate change. The following policies are listed in relation to climate change:

- ***P-CAM-1***

"Support the implementation of the National Climate Change Adaptation Framework 2012, by including relevant measures in any forthcoming adaptation plans. Such plans shall be in accordance with national guidance issued by the DoECLG and EPA and undertaken in collaboration with the Northern and Western Regional Assembly, Mayo County Council, Roscommon County Council, Leitrim County Council and Donegal County Council."

- ***P-CAM-4***

"Raise public awareness and build local resilience in relation to climate adaptation."

- ***P-CAM-4***

"Facilitate and assist County Sligo's transition to a low-carbon economy and society."

- ***P-CAM-5***

Promote, support and implement measures that reduce man-made GHGs, including energy management, energy efficiency, compact development patterns, low-carbon buildings and sustainable transport

- ***P-CAM-8***

"Promote and support the use of renewable energy in all sectors."

- ***P-CAM-9***

"Support community participation in, and benefit from, renewable energy and energy efficiency projects."

Chapter 11 indicates the Council's views surrounding energy within the county over the lifetime of the plan. It is recognised that the availability of suitable and adequate energy is of critical importance to social and economic development. Furthermore, being rich in renewable energy resources, County Sligo is well-placed to lay solid foundations for a sustainable energy future. Sligo County Council will promote and support the development and diversification of the local energy sector in accordance with EU, national and regional policy. The plan acknowledges that Sligo's mountainous landscape and exposed location on the western seaboard combine to create good conditions for the generation of wind power. It is a challenge for the Council to achieve a reasonable balance between:

a) *responding to government policy on renewable energy; and*

b) enabling the wind energy resources of the County to be harnessed in an environmentally sustainable manner.

The policies of Sligo County Council in relation to wind energy include:

- ***Policy SP-EN-1**: "Support the sustainable development, upgrading and maintenance of energy generation, transmission, storage and distribution infrastructure, to ensure the security of energy supply and provide for future needs, as well as protection of the landscape, natural, archaeological and built heritage, and residential amenity and subject to compliance with the Habitats Directive."*
- ***Policy SP-EN-2**: "Facilitate the sustainable production of energy from renewable sources, energy conversion and capture in forms such as wind power, hydro-power, wave-generated energy, bioenergy, solar technology and the development of Waste to Energy/Combined Heat and Power schemes at appropriate locations and subject to compliance with the Habitats Directive. All such development proposals will be assessed for their potential impact on urban and rural communities, Natura 2000 sites, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes and scenic views, as well as in accordance with strict location, siting and design criteria."*
- ***Policy SP-EN-6**: "Support the implementation of relevant programmes arising from the Government's Energy White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' (or any successor document)."*
- ***Policy SP-EN-7**: "Protect significant landscapes from the visual intrusion of large-scale energy infrastructure."*

It is an objective of Sligo County Council to:

- ***Objective SO-EN-2**: "Undertake an analysis of suitable areas for wind energy and prepare a map showing County Sligo's Landscape Suitability for Wind Energy Developments, in accordance with Section 3.5 of the Wind Energy Guidelines (2006) and any subsequent revisions."*

The Sligo Development Plan includes a range of policies in relation to natural heritage as follows:

- ***Policy P-DSNC-1 which is to:***

"Protect and maintain the favourable conservation status and conservation value of all natural heritage sites designated or proposed for designation in accordance with European and national legislation and agreements. These include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), Ramsar Sites, Statutory Nature Reserves. In addition, the Council will identify, maintain and develop non-designated areas of high nature conservation value which serve as linkages or 'stepping stones' between protected sites in accordance with Article 10 of the Habitats Directive."

- ***Policy P-DSNC-4:***

"Consider development within, or with the potential to affect, Natural Heritage Areas or proposed Natural Heritage Areas, where it is shown that such development, activities or works will not have significant negative impacts on such sites or features, or in circumstances where impacts can be appropriately mitigated"

- ***Policy P-DSNC-3 is also relevant, stating:***

"Carry out an appropriate level of assessment for all development plans, land-use plans and projects that the Council authorises or proposes to undertake or adopt, to determine the potential for these plans or projects to impact on designated sites, proposed designated sites or associated ecological corridors and linkages in accordance with the Habitats Directive, All appropriate assessments shall be in compliance with the provisions of Part XAB of the Planning and Development Act 2000."

Wind Energy Development Guidelines

The relevant considerations under the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government (DOEHLG), 2006) have also been taken into account during the preparation of this EIAR.

The '*Wind Energy Development Guidelines for Planning Authorities*' (DoEHLG, 2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the document '*Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review*' (December 2013), the '*Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach*' (June 2017), and the Draft Wind Energy Development Guidelines (December 2019). A consultation process in relation to the 2019 document concluded on the 19th of February 2020.

At time of writing, the Draft Guidelines have not yet been adopted, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects, it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. Towards this end it is anticipated that the Croagh Wind Farm will be capable of adhering to the relevant noise and shadow flicker standards.

Planning History

The relevant planning history of the proposed development site, the planning applications in the vicinity of the site along with other wind energy applications within the wider area are provided under Section 2.5 within this EIAR. .

Scoping and Consultation

A comprehensive scoping and consultation exercise was undertaken during the preparation of this EIAR. A scoping report, providing details of the application site and the proposed development, was prepared by MKO and circulated in December 2018. MKO requested the comments from relevant personnel/bodies in their respective capacities as consultees with regards to the EIAR process.

Pre-application consultations were also held with Leitrim County Council and Sligo County Council in which the proposed development was introduced, detailed discussions were held with regards to the proposed development.

Coillte has undertaken a comprehensive community engagement programme over the 2018/2019 period liaising with near neighbours and those in the wider area with regard to the proposed wind farm. Community engagement commenced in June 2018 with the appointment of a community liaison officer (CLO) for the proposed project. The full scope of the community consultation is provided under Section 2.7.1 and Appendix 2-2 of this EIAR.

Consideration of Reasonable Alternatives

This chapter of the EIAR includes a description of the reasonable alternatives studied by the developer which are relevant to the project and its specific characteristics and an indication of the main reasons for the option chosen, taking into account the environmental effects. The consideration of alternatives typically refers to alternative design, technology, location, size and scale. A 'Do Nothing Scenario' i.e. an outline of what is likely to happen to the environment should the Project not be implemented, should also be included.

In 2014, Coillte's Renewable Energy Development Team undertook a detailed screening process, through Geographical Information Spatial software (GIS), using a number of criteria and stages to assess the potential of a large number of possible sites, on lands within its stewardship (c. 441,000 hectares), suitable to accommodate a wind energy development. The GIS database drew upon a wide array of key spatial datasets such as forestry data, ordnance survey land data, house location data, transport, existing wind energy and grid infrastructure data and environmental data such as ecological designations, landscape designations and wind energy strategy designations available at the time. The application of the above criteria to identify a site relevant to the project and its specific characteristics, resulted in the selection of a site known as Croagh, located on the northwestern slopes of Carran Hill as a candidate site to be brought forward for more detailed analysis. Four other sites, located in Clare, Donegal, Cork and Kilkenny, also emerged from the site selection process which Coillte intend to bring forward for wind energy development.

Although the 2014 screening exercise was based on identifying lands for wind development; a reasonable alternative source of renewable electricity generation namely solar was considered based on the scale and current land-use of the Croagh site that emerged. A wind energy development was considered to be the most efficient method of electricity production at this site. A solar array development would have a higher potential enviroumental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity and Birds (habitat loss, glint and glare) at the site.

The design of the proposed development has been an informed and collaborative process from the outset, involving the designers, developers, engineers, environmental, hydrological and geotechnical, archaeological specialists and traffic consultants. The aim of the process being to reduce the potential for environmental effects while designing a project capable of being constructed and viable.

The final proposed turbine layout takes account of all site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on a combination of the results of all site investigations that have been carried out during the EIAR process and the community engagement process that began in June 2018. As information regarding the site of the proposed development was compiled and assessed, the proposed layout has been revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas in which no turbines could be located, as well as cumulative impacts.

It was decided at an early stage during the design of the proposed development that maximum possible use would be made of existing roadways and tracks where available to minimise the potential for impacts by using new roads. Constructing an entirely new road network, having no regard to existing roads or tracks. This approach was not favourable, as it would create the potential for additional significant environmental effects to occur in relation to land, soils and geology (increased excavation and aggregate requirements), hydrology (increased number of new watercourse crossings) and biodiversity (increased habitat loss).

The use of multiple temporary construction was deemed preferable to the alternative of a single large compound at the southern end of the site for a number of reasons. Principally, it will facilitate more efficient construction practices and will result in shorter distances for traffic movements within the site during construction. As a result, vehicle emissions and the potential for dust arising will be reduced.

Three alternative substation locations were considered at a very early stage of the design of the proposed development. The chosen location is shown in Figure 4-1 of the EIAR. While the alternative locations would have decreased the required length of the grid connection cabling to the nearest existing substations, the footprint of the proposed development would have increased as existing roads to any of these locations would have required widening and the alternative locations would have also required the construction of new roads, thereby resulting in greater habitat loss, increased traffic movements and an increased requirement for construction materials.

The proposed grid connection route was one of three grid connection routes considered at the outset of the design process of the proposed development. The proposed grid connection route to the existing Garvagh substation was chosen due to the fact that it did not require the construction of any additional new access road, it does not pass by any residential dwellings and it is located within lands under the control of the applicant for its entire length.

The proposed borrow pit location was selected due to the presence of competent or usable rock at an acceptable level below existing surface level. Developing borrow pits at the alternative locations that were subject to site investigations, would result in a significant increase in the volumes of peat and spoil to be excavated in order to access the usable rock underneath and therefore much higher volumes of excavated material that would need to be managed onsite. The excavation of such increased volumes of peat and spoil has the potential to lead to adverse environmental effects in relation to peat instability and dust emissions.

The alternatives considered for the port of entry of wind turbines into Ireland for the proposed development include Dublin Port and the Port of Galway. Dublin Port is the county's principal seaport catering for approximately two-thirds of Ireland's port traffic. The Port of Galway also offers a roll-on roll-off procedure to facilitate import of wind turbines. Both ports and indeed others in the State (including Cork and Shannon-Foynes), offer potential for the importing of turbine components and therefore are equally viable alternatives.

An assessment of three site access route options was carried out, taking account of criteria such as third-party land requirements, existing road upgrade and new road construction requirements and associated environmental effects. The proposed site access route between the R280 and the site was the chosen option given the availability of land under the control of the applicant and other participating third-party landowners between the village of Drumkeeran and the main site entrance in the townland of Boleymaguire.

Description of the Proposed Development

The overall layout of the proposed development is shown on Figure 4-1. This drawing shows the proposed locations of the wind turbines, electricity substation, construction compounds, internal roads layout and the site entrances. Detailed site layout drawings of the proposed development are included in Appendix 4-1 to this EIAR.

The 10 no. proposed wind turbines will have a tip height of up to 170 metres. Within this size envelope, various configurations of hub height, rotor diameter and blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 170 metres above top of foundation. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics, with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. It is proposed that the turbines would be of an off-white or light grey colour so as to blend into the sky background.

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level on a grannlar sub-base after the excavation of soil and peat. The size of the foundation will be determined by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. The turbine foundation transmits any load on the wind turbine into the ground. Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position.

To provide access within the site of the proposed development and to connect the wind turbines and associated infrastructure, approximately 7.5 kilometres of new access roads will need to be constructed including the upgrade 11.1km of existing access road.

It is proposed to construct a 38kV electricity substation within the site of the Proposed Development as shown in Figure 4-1. The proposed substation site is located within an area of forestry adjacent to an existing access road in the northern part of the site.

One wind farm control building will be located within the substation compound. The wind farm control building will include staff welfare facilities for the staff that will work on the proposed development during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.

Each turbine will be connected to the on-site electricity substation via an underground 33 kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in cable ducts laid in trenches approximately 1.3 metres below the ground surface, along the sides of or underneath the internal roadways. A connection between the proposed development and the national electricity grid will be necessary to export electricity from the proposed wind farm. This connection will originate at the proposed onsite substation and will be connected to the national grid via either an underground grid connection cable which will connect into the existing 110 kV Garvagh substation, located within the townland of Seltan. The grid connection cabling route is approximately 6.2 kilometres in length.

One permanent meteorological mast is proposed as part of the wind farm development. The meteorological mast will be equipped with wind monitoring equipment at various heights. The mast will be a slender free-standing structure up to 100 metres in height.

Two temporary construction compounds are proposed as part of the proposed development. The construction compounds will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors.

It is estimated that approximately 406,830m^3 of peat and spoil will be excavated during the construction of the proposed development. This peat and spoil will be managed by means of placement within the proposed borrow pit or the proposed peat and spoil repository areas. Crushed stone is required for the construction of the proposed development it is proposed to source the majority of this stone from the on-site borrow pit. It is anticipated that a certain volume of finer, crushed stone, used to provide the final surface layer for site roads and hardstanding areas will be brought to the site from local, appropriately authorised quarries.

A total of approximately 55.1 hectares of forestry will be permanently felled within and around the footprint of the Proposed Development in order to facilitate infrastructure construction and turbine erection. The area of forestry that will be permanently felled for the footprint of the turbines and the other infrastructure and turbine erection will be replaced or replanted on a hectare for hectare basis as a condition of any felling licence that might be issued in respect of the proposed wind farm. This can occur anywhere in the state subject to licence. Three forestry replacement sites have been identified for the purposes of assessment in this EIAR. These sites are located in Cavan, Roscommon and Wicklow and have all been granted technical approval for afforestation by the Forest Service.

During the construction of the proposed development, the Croagh Wind Farm site will be accessed via a proposed new construction phase entrance and access road off the L4282 Local Road in the townland of Derrycullinan, Co. Leitrim. This entrance will be used as the primary site entrance during the construction phase of the proposed development. The boundary with the L4282 will be reinstated with

fencing upon the completion of the construction stage. The main site entrance that will be used to access the wind farm site, during both the construction and operational phases of the proposed development, is an existing entrance off the L4282 in the townland of Boleymaguire. This entrance will be used as the primary site entrance during the operational phase for the access and egress of operational and maintenance staff.

The site of the proposed development is currently accessed, from the R280 to the west, via the local road network. In order to facilitate the delivery of large turbine components and other abnormal loads to the site, this application includes for the construction of:

- a link road through a farmyard and agricultural land, between the R280 in the village of Drumkeeran and the L4282 in the townland of Derryboffin; and,
- a construction phase access road between the L4282 at Derrycullinan and the same local road at Bargowla.

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the M4 Motorway which becomes the N4 National Primary Route at Knocksimon, Co. Westmeath. The delivery vehicles will continue northwest on the N4 before turning will turning on to the R299 Regional Road at Drumsna, Co. Leitrim. From here the delivery vehicles will travel northwest before turning right on to the R280 Regional Road and continuing north before turning left onto the proposed link road in the village of Drumkeeran. The delivery vehicles will turn south onto the L4282 in the townland of Derrybofin and continue west along the L4282 to the proposed new construction site access road at Derrycullinan. The delivery vehicles will travel southeast along the proposed construction access road before switching back in a westerly direction and then turning south again onto the L4282 and continue south towards the main site entrance in the townland of Boleymaguire.

Coillte expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy it will be adjusted accordingly .If this project is constructed as currently designed we estimate that a total of approximately €5 million will be available in the local area for community funding over the lifetime of the project.

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, the first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. Coillte aim to commence this work in autumn 2020.

In addition to the economic benefits of the proposed development, there will be potential social and recreational benefits associated with the recreational and amenity proposals that will form part of the project. The proposed development and all its associated infrastructure creates a unique opportunity to develop an amenity area for use by members of the local and wider community alike. The upland nature of the site is attractive to both locals and visitors to the area. It is proposed to develop some recreational walks as part of the Croagh Wind Farm project. These proposed walks will utilise existing forest tracks, new wind farm roads and proposes trails, a boardwalk area together with a viewing area adjacent to Lough Nacroagh. In addition, areas around the proposed amenities will be targeted for planting with broadleaves and berried trees to create areas of interest for small birds and increase the biodiversity habitat of the area. The proposed amenity facilities will allow for a safer and improved visitor experience and allow the site to be more openly available to walkers, trail runners, cyclists and other recreational users, as outlined in Section 4.6 of Chapter 4 of this EIAR.

The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. The proposed development drainage design has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways have been selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones around the existing natural drainage features have been used to inform the layout of the proposed development.

It is estimated that the construction phase will take approximately 12 to 18 months from starting onsite to the full commissioning of the wind farm. The construction phase can be broken down into three main phases, 1) civil engineering works: 18 months, 2) electrical works: 18 months, and 3) turbine erection and commissioning: 9 months.

During the operational phase, each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation and site tracks will also require periodic maintenance.

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the proposed development may be decommissioned. The onsite substation will remain in place as it will be under the ownership of the ESB.

Population and Human Health

One of the principle concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values, shadow flicker, noise and health and safety.

The proposed development site boundary is located adjacent to the village of Drumkeeran, Co. Leitrim at its closest point (the closest proposed turbine is located 4.8km from the village) and 7.3 km southeast of the town of Dromahair, Co. Leitrim, in which the main services and local amenities including a community centre, church and shop are located. There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself although it is proposed to develop a recreational and amenity facility as part of the Proposed Development.

The Study Area for the Population and Human Health assessment was defined by the 3 No. District Electoral Division (DED)s within and adjacent to the development site. The population of the DEDs within the Study Area decreased by 3.8% between 2011 and 2016, falling from 704 to 677 persons, respectively, with the rate of population change unevenly distributed between the DEDs. The percentage labour force for the Study Area population was 55.3% which is lower than for the State as a whole (61.4%) and Counties Leitrim (59.5%) and Sligo (57.9%); however, the percentage of the Study Area labour force in employment is slightly higher than the State and Counties Leitrim and Sligo, at 87.9%. Similarly, the percentage of the Study Area labour force who are unemployed is lower that the State and Counties Leitrim and Sligo at 10.1%.

As stated above, approximately 80 – 100 jobs could be created during the construction, operation and maintenance phases of the proposed development with most construction workers and materials sourced locally, thereby helping to sustain employment in the construction trade. This will have a Short-Term Siguificant Positive Impact.

There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised in Chapter 5 of this EIAR. Although there have been no empirical studies carried out in Ireland on the effects of wind farms on property prices, it is a reasonable assumption based on the available international literature that the provision of a wind farm at the proposed location would not impact on the property values in the area.

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Shadow flicker effect lasts only for a short period of time and happens only in certain specific combined circumstances. Current guidelines recommend that shadow flicker at neighbouring dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. Just 5 No. dwellings are located within 1km of any proposed wind turbine location with only one of these dwellings being occupied and is 850m from the nearest proposed turbine.

The potential flicker that will occur at houses located within the area surrounding the proposed development was calculated using the WindFarm software package and a regional sun factor of 26.6% was applied. Of the 24 No. residential properties modelled, it is predicted that 13 No. properties may experience daily shadow flicker in excess of the 2006 DoEHLG guideline threshold of 30 minutes per day. However, this prediction does not consider wind direction or screening provided by intervening vegetation and topography.

Where shadow flicker exceedances are experienced,suitable mitigation measures as outlined in Chapter 5 will be employed at the potentially affected properties to ensure that the current adopted 2006 DoEHLG guidelines are complied with at any dwelling within the 1km study area. The same mitigation strategies also demonstrate that the proposed Croagh Wind Farm can be brought in line with the shadow flicker requirements of the Draft Revised Wind Energy Development Guidelines (2019) should they be adopted while this application is in the planning system.

Impacts on human beings during the construction and operational phases of the proposed development are described in Chapter 5 in terms of health and safety, employment and investment, population, land-use, noise, dust, traffic, tourism, residential amenity, renewable energy production and reduction in greenhouse gas emissions, shadow flicker and interference with communication systems. Where a negative impact was identified, the appropriate mitigation measures will be put in place to ensure that there will be No Adverse Impacts on human health in the surrounding area.

Following consideration of the residual effects (post-mitigation), the proposed development will not result in any significant effects on population and human health. Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on population and human health are not anticipated at international, national or county or local scale

Biodiversity

This chapter assesses the likely siguificant effects (both alone and cumulatively with other projects) that the proposed development may have on Biodiversity, Flora and Fauna and sets out the mitigation measures proposed to award, reduce or offset any potential siguificant effects that are identified.

Multidisciplinary walkover surveys and detailed botanical surveys were undertaken on the 14th June 2017, 25th September 2017, 24th April 2019, 26th April 2019, 24th June 2019, 5th July 2019, 14th August 2019, 19th August 2019, 21st August 2019, 30th August 2019, 13th September 2019 and 31st January 2020. The survey timings were targeted to generally fall within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith et al., 2011). A comprehensive walkover of the entire site was completed.

The habitats on the site of the proposed development were the subject of a detailed survey and assessment and a habitat mapping. This habitat mapping and assessment was undertaken following the 'A Guide to Habitats in Ireland' (Fossitt, 2000). Peatland and grassland habitats have also been categorised to plant communities from the National Survey of Upland Habitats (Perrin et al. 2014) and the Irish Vegetation Classification.

The majority of the study area (580 hectares/86.3% of the study area) is dominated by plantation forestry, comprising mainly of Sitka spruce (Picea sitchenis) and Lodgepole pine (Pinus contorta). Upland blanket bog (PB2) habitat occurs within the west of the site, as well as a small pocket in the centre of the site. This habitat is typically degraded where it occurs within the site boundary associated with historic and more recent turbary. Only Turbine 1, and part of the associated access road, is located within Upland blanket bog (PB2) habitat. This represents 0.55% of the habitat loss to the development footprint. This area is surrounded by bog that has been cutover in the past and shows evidence of drying-out. Poor fen and flush (PF2) habitat was recorded within the Upland blanket bog (PB2) within a low lying area and subsequent movement of ground and surface water through this area of peatland.

The construction of the proposed windfarm and associated infrastructure will result in the direct loss of approximately 0.91 hectares (1.47%) of the total study area, of Upland blanket bog (PB2) as a result of the proposed Turbine 1 and associated site access track. The remainder of the peatland habitats within the site have been entirely avoided in the design of the project with no potential for any effect thereon. There will be no significant habitat loss associated with the proposed development and a Biodiversity Management Plan has been prepared. The proposed development provides for the replacement of peatland habitat through the restoration of forestry (WD4) back to peatland, located adjacent to Turbine 7. It is also proposed to undertaken enhancement of this area of peatland, covering an area of 3.74 hectares, through drain blocking and the removal of encroaching conifers (establishing as a result of natural seed dispersal). Following the implementation of the Biodiversity Management Plan, the proposed development has the potential to result in a positive impact on biodiversity within the study area.

In general, given the highly modified nature of the site, dominated by commercial coniferous forestry (WD4), limited suitable habitat occurs on site for protected faunal species. A number of badger setts were recorded within the study area and were restricted to the haul road within plantation forestry. Evidence of fox, red deer, red squirrel, pine marten, Irish hare and otter were recorded within the site. In addition, detailed bat and fisheries assessments have been undertaken as part of the detailed baseline assessment. The detailed results of which are provided in technical appendices to this EIAR. No evidence of populations of these species being significant at more than a local level was recorded. No signs of any additional protected fauna were recorded within the study area during the field surveys.

No significant effects on surface water quality, groundwater quality or the hydrological/ hydrogeological regime were identified during either construction nor operation.

Provided that the proposed development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant impacts on ecology are not anticipated.

Ornithology

This chapter assesses the likely significant effects that the proposed development may have on bird species. Firstly, a brief description of the proposed development is provided. This is followed by a comprehensive description of the methodologies that were followed in order to obtain the information necessary to complete a thorough assessment of the potential effects of the proposed development on bird species. The survey data is presented in full in the EIAR Appendices, with a summary of the information presented within this chapter. An analysis of the results is then provided, which discusses the ecological significance of the birds recorded within the study area. The potential effects of the proposed development are then described in terms of the construction, operation and decommissioning phases of the development. An accurate prediction of the effects is derived following a thorough understanding of the nature of the proposed development along with a comprehensive knowledge of bird activity within the study area. The identification of Key Ornithological Receptors and the assessment of effects followed a precautionary approach.

The potential for effects on designated sites is fully described in the Natura Impact Statement that accompanies this application. The findings presented in the NIS are that the proposed development, by itself or in combination with other plans and projects, in light of best scientific knowledge in the field, will not adversely affect the integrity of the relevant European sites and no reasonable scientific doubt remains as to the absence of such effects.

Based on the detailed assessment, it is considered that the potential effects of the proposed development upon birds will not be significant. Effects associated with habitat loss, disturbance displacement, collision risk and cumulative effects have been assessed to be no greater than Long-term slight negative effect (EPA, 2017) and low effect significance (Percival, 2003).

The implementation of the prescribed mitigation measures will render any potential effects on avian receptors to low significance. In conclusion, no significant effects as a result of the proposed development are foreseen on key ornithological receptors of the study area.

Land, Soils and Geology

This chapter assesses the likely significant effects that the proposed development may have on land, soils and geology and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

The geology of the site predominately comprises blanket peat overlying glacial subsoil deposits which in turn are underlain by mainly shale and mudstone bedrock. Numerous trial pits and several boreholes were undertaken to investigate the geological conditions below the peat.

Peat depths recorded within the proposed infrastructure envelope ranged from 0 to 6.0m with an average of 2.1m. Peat depths recorded at the turbine locations varied from 0.3 to 4.5m with an average depth of 2.0m.

With respect to the existing and proposed access roads, peat depths are typically less than 3m with localised depths of up to 5m. Approximately 10km of existing access roads are present across the site and based on Coillte records have been in operation for a number of decades.

Construction of the wind farm infrastructure will require the removal of peat, soil and rock to competent foundation. Excavation of bedrock from the proposed on-site borrow pit will provide material for access road, turbine bases and general hard-standing construction. Removal of soil, peat and bedrock represents a permanent direct impact on the geology of the site which is considered to be an acceptable part of economic progression and development.

During the construction phase sources of contaminants (such as oil based substances or other hazardous chemicals) will not be stored at the site except where this is done within safely bunded areas that safely contain all spillages and prevent the migration of contaminants into soil, peat and bedrock. Refueling will be done with a double skinned bowser with spill kits on the ready in case of accidental spillages. The risk is considered to be low once mitigation measures are implemented.

The extensive peat stability assessment undertaken at the site shows that the site has an acceptable margin of safety for the proposed development. A number of control measures are given, in Appendix 8-1 of this EIAR, in the peat stability assessment to ensure the correct management any potential risks associated with peat instability during the construction phase.

A Peat Management Plan has been prepared for the development which details management of peat during construction works and long term storage thereafter. Peat removed during the excavation works will be deposited in the proposed on-site borrow pit and placed in two proposed peat and spoil repositories.

These methods will reduce the requirement for stock piling and prevent potential slope failure and erosion. Drainage and erosion prevention measures will be put in place at the peat storage areas. Overburden excavated along the grid connection route will be reinstated.

The potential residual impacts associated with soil or ground contamination and subsequent health effects are negligible.

The geological impact assessment undertaken in this chapter outlines that significant effects will not occur due to the localised nature of the construction works and therefore there is no potential for cumulative effects.

No significant impacts on land, soil and geological environmental are anticipated.

Hydrology and Hydrogeology

Hydro-Environmental Services (HES) was engaged by MKO to undertake an assessment of the potential direct, indirect and cumulative effects of the proposed Croagh Wind Farm development on water aspects (hydrology and hydrogeology) of the receiving environment.

With respect to regional hydrology, the Proposed Development is located in 2 no. river basins and 2 no. regional surface water catchments. The southern half of the wind farm site is located in the Shannon River surface water catchment within the Shannon International River Basin District (SHIRBD). The northern half of the wind farm site is located in the Garvogue River surface water catchments. The Garvogue River is located within the North Western International River Basin District (NWIRBD). With respect to turbine distribution, 4 no. are located in the Shannon River surface water catchment and 6 no. are located in the Garvogue River surface water catchment.

In terms of local hydrology, the southern half of the windfarm site is located in the Arigna River surface water catchment. The Arigna River flows into Lough Allen approximately 16km downstream of the site. The northern half of the windfarm site is located in the Bonet River surface water catchment. The Bonet River flows into Lough Gill approximately 15km downstream of the site. Approximately 6km of the construction access road drains directly to Lough Allen via the Owengar River.

Along with the local internal stream network, there are numerous manmade drains that are in place predominately to drain the forestry plantations. The integration of the proposed wind farm infrastructure with the existing forestry drainage in a manner that avoids water quality impacts in downstream water bodies is a key component of the wind farm design.

The bedrock underlying the site is classified as predominately poor in terms of well water yield potential. This was confirmed by drilling several investigation holes on-site. The bedrock has little or no open cracks which means groundwater movement within the aquifer is very localised. Groundwater at the site can be classed as sensitive in terms of potential impacts from the proposed development. However, the majority of the bedrock is covered in peat which acts as a protective cover to groundwater quality. The low potential for pollutant travel within the bedrock groundwater makes surface water bodies such as streams more sensitive to pollution than groundwater at this site. There will be no impact on private wells as a result of the development.

Designated sites that receive surface water runoff from the proposed wind farm development or grid connection route include Lough Gill SAC and Lough Forbes Complex SAC. These designated sites are considered very sensitive in terms of potential impacts. Comprehensive surface water mitigation and controls are proposed to ensure protection of all downstream receiving waters. Any introduced drainage works at the site will mimic the existing drainage regime thereby avoiding changes to flow volumes leaving the site.

Due to the nature of wind farm developments, being shallow construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from hydrocarbon spillage and leakages at the borrow pit or during refueling. These are common potential impacts to all construction sites (such as road works and industrial sites). These potential contamination sources will be carefully managed at the site during the construction and operational phases of the development and measures are proposed within the EIAR to deal with these potential minor local impacts.

Two methods will be employed to control drainage water within the site during construction, thereby protecting downstream surface water quality and aquatic habitats. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt, to allow settlement and cleaning prior to its release. During the construction phase all runoff will be treated to a high quality prior to being released. There will be no risk of increased flooding down-gradient of the site as a result of the proposed development due to these drainage measures. Any potential impacts on water quality as a result of the wind farm will be imperceptible. A surface water monitoring programme will be put in place during the construction phase.

During the operational phase drainage control measures will ensure that surface runoff from the developed areas of the site will continue to be of good quality and will therefore not impact on the quality of down-stream rivers and streams. The present drainage regime of the site will not be altered in any way. No impacts on surface water quality are anticipated during the operational phase.

In terms of cumulative hydrological effects arising from all elements of the Proposed Development and work design, no significant effects are expected, and this is largely due to the proposed works being located in 2 no. separate regional surface water catchments.

Overall, the proposed development presents no significant impacts to surface water and groundwater quality provided the proposed mitigation measures are implemented.

No significant cumulative impacts on any of the regional surface water catchment or groundwater bodies will occur from the Proposed Development associated grid connection or forestry replacement sites.

Air and Climate

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the construction, operation and decommissioning of the proposed development.

The Environmental Protection Agency (EPA) has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Clean Air for Europe (CAFE) Directive (as amended) and the Fourth Daughter Directive. The site of the proposed development lies within Zone D, which represents rural areas located away from large population centres.

Due to the non-industrial nature of the proposed development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR.

The production of energy from wind turbines has no direct emissions as is expected from fossil fuel-based power stations. Harnessing more energy by means of wind farms will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. Some minor short term or temporary indirect emissions associated with the construction of the wind farm include vehicular and dust emissions.

A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-4 of the EIAR) and includes dust suppression measures. In addition, turbines and construction materials will be transported to the site on specified haul routes only. The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary.

Climate Change and Carbon Balance Calculations

Climate change is one of the most challenging global issues facing us today and is primarily the resnlt of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in energy use. Changing climate patterns are linked to increased frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel-driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

In June 2019, the EPA published an update on Ireland's Greenhouse Gas Emission Projections to 2040. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).

Projected greenhouse gas emissions up to 2040 are obtained using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 are implemented. The 'With Additional Measures' scenario assumes the implementation of the "With Existing Measures" scenario and further implementation of the governments renewable and energy efficiency policies

including those set out in the National Renewable Energy Action Plan (NREA), the National Energy Efficiency Action Plan (NEEAP) and the National Development Plan 2018-2027.

The EPA Emission Projections Update notes that Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 5% and 6% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction. Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 10 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 9 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The report concludes:

- "Projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52-67Mt CO_2 equivalent with the gap potentially narrowing to 7-22 Mt CO_2 equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised."
- "To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections."
- "Ireland still faces significant challenged in meeting EU 2030 targets in the non-ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans."

The carbon balance of proposed wind farm developments in peatland habitats has attracted siguificant attention in recent years. When development such as wind farms are proposed for peatland areas, there will be direct impacts and loss of peat in the area of the development footprint. There may also be indirect impacts where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

A methodology for calculation carbon losses was published in June 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the excel based versions of the tool, was released in 2016. The tool provides a transparent and easy to follow method for estimating the impacts of wind farms on the carbon dynamics of peatlands and was used to assess the effects of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage and operation of wind farm. The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and carbon losses due to peatland disturbance. The model also calculates the carbon savings associated with the proposed wind farm development.

In total, it is estimated that **1,655,640** tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the wind farm

Construction of the proposed development will have a Short-Term, Imperceptible Negative Effect as a result of greenhouse gas emissions from construction plant and vehicles. Operation of the proposed development will have a Direct Long-Term Moderate Positive Impact on climate as a result of reduced greenhouse gas emissions.

Noise and Vibration

AWN Consulting Limited were commissioned to conduct an assessment into the likely environmental noise and vibration impacts of the proposed Croagh Wind Farm development.

The methodology adopted for assessing the noise impact of the wind energy development is based on the guidance in the document 'Wind Energy Development Guidelines for Planning Authorities' published by the Department of Environment, Community and Local Government, which are based on the UK document ETSU-R-97 The Assessment and Rating of Noise from Wind Farms which describes a detailed method for deriving maximum values of wind turbine noise, when measured at an external location in the vicinity of a house. Maximum values, or limits, are primarily based on the background noise levels and how it varies with wind speed, in the absence of wind farm.

The background noise environment has been established through noise monitoring surveys undertaken at several noise sensitive locations (NSLs) surrounding the proposed development. Typical background noise levels for day and night periods at various wind speeds have been measured in accordance with best practice guidance contained in the Institute of Acoustics document 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (IoA GPG). Prevailing noise levels are primarily attributable to wind noise in foliage, local road traffic noise and other agricultural and anthropogenic sources in the area.

When considering a development of this nature, the potential noise and vibration effects on the surroundings must be considered for two stages: the short-term construction phase and the long-term operational phase.

The assessment of construction noise and vibration and has been conducted in accordance best practice guidance contained in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise and BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration. Subject to good working practice as recommended in the EIAR Chapter, noise associated with the construction phase is not expected to exceed the recommended limit values. The associated noise and vibration are not expected to cause any siguificant effects.

Based on detailed information on the site layout, turbine noise emission levels and turbine height, worst-case turbine noise levels have been predicted at all surrounding properties, termed NSLs in the guidance documents, for a range of operational wind speeds. The predicted noise levels associated with the proposed development will be within best practice noise limits recommended in Irish guidance, therefore it is not considered that a significant effect is associated with the development.

Noise from replacement substation has also been assessed and found to be within the adopted criteria.

No significant vibration effects are associated with the operation of the site.

In summary, the noise and vibration impact of the proposed development is not siguificant in the context of current national guidance.

Landscape and Visual

This chapter of the Environmental Impact Assessment Report (EIAR) addresses the potential landscape and visual impacts of the Croagh Wind Farm. The emphasis in this chapter is on the likely siguificant effects of the proposed development. It covers the assessment methodology, a description of the proposed development and the existing landscape based on relevant gnidance. It includes a description of the landscape policy of Counties Leitrim and Sligo with specific reference to wind energy and the study area in which the proposed development site is located.

Due to the topography of the study area and in particular the upland areas around the site, the turbines will be screened by landform from areas within the 20 km visual study area as illustrated by Zone of Theoretical Visibility (ZTV) mapping. Additionally, wide-spread mature hedgerow and trees will provide additional screening. The forestry plantation trees while subject to cyclical felling are only felled in limited areas, leaving adjacent mature or semi-mature trees to provide continued screening.

The proposed wind energy development site is located in an area with a long history of wind energy development. Wind turbines have been a feature of this landscape for many decades. Therefore, while the proposed turbines add to the existing wind turbines, they do not introduce a new landscape element.

Landscape designations and policies were identified in Counties Leitrim, Sligo and Roscommon. There will be no landscape effects on designations in County Roscommon.

In County Leitrim the Areas of Outstanding Natural Beauty and High Visual Amenity Areas have theoretical visibility indicated in some areas, but distance and screening mean that the effects will be very minor.

The vast majority of scenic routes in Co. Sligo will not be affected by the proposed development. The two routes that will have some visibility of the proposed development, No's. 3 and 66, will experience an 'Imperceptible' and 'Slight' visual effect, respectively.

Using the Landscape Character Assessments of Counties Leitrim and Roscommon the Landscape Character Areas (LCAs) were identified within 15 km of the proposed turbines. In the absence of a County Sligo Landscape Character Assessment a provisional assessment was carried out as part of this EIAR and provisional LCAs were identified by a qualified landscape architect. Only Leitrim's LCA 11 Corry Mountain and the provisional LCA for Sligo LCA1 Carrane Hill, in which the proposed turbines are located, would experience direct effects on landscape character as a result of the proposed development. Any other effects on other LCAs would be moderate, indirect and a slight increase in visible turbines additional to the existing and permitted turbines, as the proposed development might be visible within the LCAs but located outside those other LCAs and thus be a landscape element seen in the distance.

Within the 20km study area existing and permitted wind turbines were identified and mapped in order to assess the cumulative landscape and visual effects.

Although, it was found that the proposed turbines would add to the cumulative landscape status, it would not change the character of the individual LCAs in terms of wind energy and therefore the cumulative landscape effects are considered Low.

Key visual receptors, such as scenic routes and views, settlements, recreational destinations and routes as well as major transport routes were identified within the study area, after which those where visibility could be excluded due to ZTV mapping or site surveys were screened out. The remaining visual receptors were selected as 15 viewpoints, along with 2 viewpoints within 2 kilometres, for which photomontages were prepared to assess the visual effects on the visual receptors. The visual assessment concluded that residual visual effects of "Moderate" was deemed to arise at one of the 17 viewpoint locations. All other viewpoints were assessed as resulting in Slight (3), Not Significant (9) or Imperceptible (4) residual visual effects. None of the visual receptors identified in County Roscommon will be affected.

Cumulative visual effects were assessed in terms of increase in spatial extent of turbines within the views of the selected viewpoints, visual separation of the proposed turbines from the permitted turbines and the perceived difference of scale between the existing/permitted turbines and the proposed turbines.

No cumulative effects will arise at two viewpoints. In the remaining 15 viewpoints it was found that the increase in spatial extent was predominantly 'Slight' to 'Moderate' While complete visual separation of the proposed turbines from the permitted turbines is achieved in one viewpoint, mostly 'Slight' to 'Moderate' separation was seen. The assessment of the perceived difference of scale was also predominantly 'Slight' to 'Moderate' with one viewpoint showing a 'Negligible' difference in scale. At no viewpoint was the difference in scale perceived as 'Substantial'.

Therefore, the cumulative visual effects are considered acceptable, in terms of increase in spatial extent, visual separation and difference in scale.

A comparative ZTV shows that the cumulative theoretical visibility of wind turbines in the study area over that of the existing and permitted turbines will increase by less than one percent due to the addition of the proposed Croagh turbines.

Archaeology and Cultural Heritage

This chapter comprises an assessment of the potential impact of the proposed development on the Cultural Heritage resource. Cultural heritage includes archaeology, architectural heritage and any other tangible assets. The assessment was based on GIS based mapping, ZTV and Viewshed analysis to assist with the assessment of impacts on setting followed by a desktop analysis of all baseline data and a comprehensive programme of field inspection of the EIAR site boundary.

No recorded monuments, National Monuments, RPS, NIAH or new archaeological sites are located within the EIAR boundary. No direct impacts to any of the aforementioned sites will occur therefore.

Indirect effects on the setting of National Monuments within 10km, RMPs within 5km and RPS/NIAH within 5km were included in order to assess impacts on setting in the wider landscape. Viewshed analysis, a review of the ZTV and site visits to National Monuments in State Care was undertaken to establish the nature and degree of impacts on the setting of such monuments. These potential impacts are considered to be 'not significant'. Impacts to setting of RMPs was undertaken and this included 95 monuments within 5km, the majority occurring between 4 and 5km of the nearest proposed turbine. Impacts to RMPs in the wider setting is considered to be 'slight'. Impacts to built heritage within 5km of the proposed turbines is also considered to be 'not significant' since none are located within the immediate vicinity.

The grid connection cable route was assessed and all cultural heritage assets within 100m of either side of the route was reviewed. An assessment of the route shows that no cultural heritage assets will be impacted by the proposed cable route. Whilst no direct impacts to the monuments will occur given the location of the cable route within the public road take, some mitigation measures are required during construction to alleviate/remove any negative effects to sub-surface features. An assessment of the construction access road was also undertaken which concluded that no known monuments are located along the route. A number of water crossings and townland boundaries (not subject to statutory protection) will be traversed by the proposed road and therefore some mitigation measures are necessary to alleviate the impacts.

An assessment of cumulative impacts was also undertaken taking into consideration projects within 20km of the proposed Croagh turbine development. Cumulative impacts on setting will increase slightly when considering RMPs (within 5km) to the north and north west of the site. No other cumulative impacts will occur.

Material Assets

Traffic and Transport

The traffic and transport assessment of the proposed development considers the effects that traffic generated by the proposed development, including the abnormal-size vehicles required to deliver the turbine plant equipment, would have on the surrounding highway network. It should be noted that abnormal weight loads are not a feature of the turbine delivery vehicles. They are abnormal in size only. All construction and delivery vehicles for the proposed development will be subject to the standard axle weight requirements set out under Road Traffic Regulations and therefore the loadings from construction traffic will not exceed the relevant standards.

The delivery route to the site for the abnormally sized loads required to transport the turbine components to the site (blades, towers and nacelles) turns left off the R280 in Drumkeeran onto a new proposed link road that passes through an existing farmyard to connect with the L-4282 at Derryboffin. The route then travels west on the L-4282 before turning left onto a proposed construction access road at Derrycullinan. The proposed construction access road comprises sections of upgraded forestry road and sections of new road and links back into the L-4282 by means of a new junction at Bargowla. From there the route follows the L-4282 south before heading northwest to the proposed site access. General construction traffic and site staff may approach Drumkeeran on the R280 from either the north or the south, and will continue onto the site via the L-4282 and the proposed construction access road.

The types of vehicles, delivering large turbine components, that will be required to negotiate the local network will be up to 76 metres long with a blade length of 70 metres. An assessment of the geometric requirements of the delivery vehicles was undertaken on the delivery routes. Locations where it was established that the existing road geometry will not accommodate all of the vehicles associated with the proposed development are highlighted, with the extent of remedial works indicated.

In terms of daily traffic flows it is estimated that the impact of the development traffic on the delivery routes will be as follows:

- During the 10 days when the concrete foundations are poured the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 5% on the N4 to a 3 fold increase (203%) on the L-4282 leading to the site. It is noted that the high percentage increase forecast for the L-4282 is due to the low volume of background traffic. The direct effect will be temporary, and will be slight.
- During the remaining 245 days for the site preparation and ground works when deliveries to the site will take place, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 2% on the N4, to an increase of 59% on the L-4282 approaching the site. On these days, the direct effect will be temporary and will be slight.
- During the 10 days of the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will result in a negative impact on the surrounding road network, increasing traffic levels, ranging from 1% on the N4, to an increase of 3 on the R280 and 3% on the L-4282 leading to the site. The direct effect during this period will be temporary and will be slight.
- During the 18 days when the various component parts of the wind turbine plant are delivered to the site using extended articulated HGVs, the effect of the additional traffic on these days will be moderate due to the size of vehicles involved, resulting in increased traffic volumes of between 2.0% on the N4 to 7% on the R280, and 65% on the L-4282 leading to the site, but will be temporary. The direct effect will be reduced to slight if the delivery of the large plant is done at night, as is proposed.

It was determined that all links in the study area and the junction between the R280 and the L-4282 will operate within operational capacity for all days within the construction period.

Once the facility is operational the traffic impact created by maintenance staff will be negligible.

The successful completion of this project will require significant coordination and planning, and a comprehensive set of traffic management measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional temporary traffic generated by the proposed wind farm. The range of measures are set out in the Traffic Management Plan which will be implemented during construction and these measures include the appointment of a traffic management coordinator, agreement of a delivery programme with Leitrim County Council, use of temporary signage, management of site access and provision of information to local residents.

Telecommunications and Aviation

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path.

RTÉ Transmission Network (operating as 2rn), stated that that there is a risk of disruption to television reception for viewers to the south of the site. To mitigate against interference on viewers' television sets and/or broadcast radio receivers, RTÉ have recommended that a protocol agreement, between 2rn and the developer, be put in place for the wind farm development. The Protocol Document will ensure that the appropriate mitigation is carried out, by the wind farm developer, in the event of any unanticipated broadcast interference arising to RTÉ television or radio reception as a result of the proposed wind farm.

Of the scoping responses received from telephone, broadband and other telecommunications operators only Eir and Three had telecommunication links in the area and requested that buffers be added to these. The requested buffers have been incorporated into the final proposed turbine layout and therefore, the proposed development does not overlap with any of the telecoms links or clearance zones as requested by operators.

In February 2019, a scoping response was received from the Department of Defence (DoD) which set out lighting requirements for turbines, as follows:

- *Single turbines or turbines delineating corners of a wind farm should be illuminated by high intensity obstacle strobe lights (Red).*
- *Obstruction lighting elsewhere in a wind farm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight.*
- *Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (NM) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light.*

In January 2019, a scoping response was received from the Irish Aviation Authority (IAA). The requirements of the IAA include the following:

- *Agree an aeronautical obstacle warning light scheme for the wind farm development.*
- *Provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location.*

- *Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.*

All of the above requests will be complied with should the proposed development receive a grant of planning permission.

In summary, there will be no significant impact on telecommunications and aviation as a result of the proposed development.

Interactions of the Foregoing

Chapters 5 to 14 of this EIAR identify the potential significant environmental effects that may occur in terms of Population and Human Health, Biodiversity, Ornithology, Land, Soils and Geology , Hydrology and Hydrogeology, Air and Climate, Noise and Vibration, Landscape and Visual, Cultural Heritage and Material Assets, as a result of the proposed development. All of the potential significant effects of the proposed development and the measures proposed to mitigate them have been outlined in the main EIAR. However, for any development with the potential for significant environmental effects there is also the potential for interaction between these potential significant effects. The result of interactive effects may exacerbate the magnitude of the effects or ameliorate them or have a neutral effect.

A matrix is presented in Chapter 15 of the EIAR to identify interactions between the various aspects of the environment already discussed in the EIAR. The matrix highlights the occurrence of potential positive or negative impacts during both the construction and operational phases of the proposed development. Where any potential interactive impacts have been identified, appropriate mitigation is included in the relevant sections (Chapters 5–14) of the EIAR.

1. INTRODUCTION

1.1 Introduction

This Environmental Impact Assessment Report (EIAR) has been prepared by McCarthy Keville O'Sullivan Ltd. (MKO) on behalf of Coillte, who intend to apply to both Leitrim County Council and Sligo County Council (the local authorities) for planning permission to construct a wind energy development that straddles the border between Co Leitrim and Co Sligo, comprising up to 10 no. wind turbines and associated infrastructure, near Drumkeeran, Co. Leitrim. The proposed development is being brought forward in response to local, national, regional and European policy regarding Irelands transition to a low carbon economy and associated climate change policy objectives.

Of the proposed turbines, 8 No. turbines and associated infrastructure are located within the functional area of Leitrim County Council and 2 No. turbines and associated infrastructure are located in the functional area of Sligo County Council. A planning application will be submitted to each local authority with respect to the development and works required in each of the relevant functional areas. This EIAR accompanies the planning applications for the proposed development submitted to the local authorities. The planning applications are also accompanied by a Natura Impact Statement ('NIS').

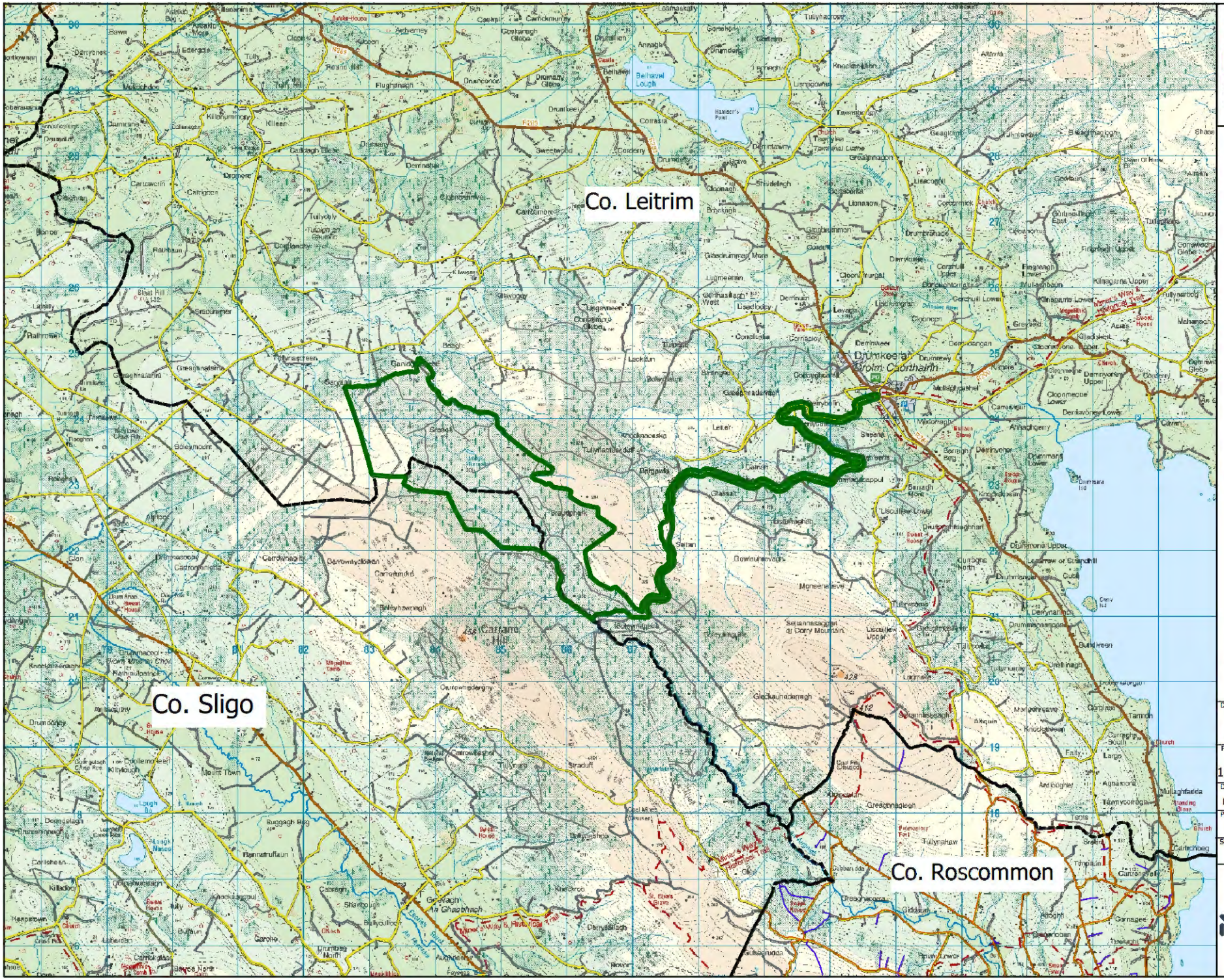
The core of the proposed development site is located within existing commercial forestry approximately 5.0 kilometres west of the village of Drumkeeran, Co. Leitrim and 7.0 kilometres southeast of the town of Dromahair, Co. Leitrim. Access to the site will be via an existing farmyardentrance off the R280 in the village of Drumkeeran and a combination, thereafter, of, the L4282 Local Road proposed new roads and existing roads to be upgraded.

It is proposed to connect the development to the national electricity grid via an underground cable which will connect the proposed onsite substation to the existing Garvagh substation, located adjacent to the proposed development site. The grid connection cabling route will measure approximately 6.2km in length. . This connection and all associated works form part of the planning applications. A full description of the development is contained in Chapter 4 of this EIAR.

The townlandswithin which the proposed site and ancillary works are located as well as the proposed grid connection route and proposed site access route, are listed in Table 1-1 Townlands within which the Proposed Development is located.. The location of the site is shown on Figure 1-1.

Table 1-1 Townlands within which the Proposed Development is located.

Townland	
Co. Leitrim	**Co. Sligo**
Bargowla	Carrowmore
Boleymaguire	Carrownyclowan
Braudphark	
Derreens	
Derryboffin	
Derrycullinan	
Derrycullinan Beg	



Map Legend

- EIAR Site Boundary
- County Boundary

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Drawing Title

Site Location Context

Project Title

180511 - Croagh Wind Farm EIAR

Drawn By	Checked By
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Project No.	Drawing No.
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Townland	
Drummanacappul	
Garvagh	
Garvagh Glebe	
Glassalt	
Lisfuiltaghan	
Seltan	
Sheena	
Tinnybeg	

1.2 Legislative Context of Environmental Impact Assessment

The consolidated European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive'), has been transposed into Irish planning legislation by the Planning and Development Act 2000 as amended and the Planning and Development Regulations 2001 as amended. Directive 2011/92/EU was amended by Directive 2014/52/EU which has been transposed into Irish law with the recent European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018). Most of the provisions of the new regulations came into operation on the 1st of September 2018 with a number of other provisions coming into operation on the 1st of January 2019.

This EIAR complies with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU.The Environmental Impact Assessment (EIA) of the proposed project will be undertaken by Leitrim County Council and Sligo County Council, as the competent authorities.

Article 5 of the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU provides where an EIA is required, the developer shall prepare and submit an environmental impact assessment report (EIAR). The information to be provided by the developer shall include at least:

a) *a description of the project comprising information on the site, design, size and other relevant features of the project;*
b) *a description of the likely significant effects of the project on the environment;*
c) *a description of the features of the project and/or measures envisaged in order to avoid, prevent or reduce and, if possible, offset likely significant adverse effects on the environment;*
d) *a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment;*
e) *a non-technical summary of the information referred to in points (a) to (d); and*
f) *any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected.*

In addition, Schedule 6 to the Planning and Development Regulations 2001 to 2020 sets out the information to be contained in an EIAR, with which this EIAR complies.

MKO was appointed as environmental consultant on the proposed project and commissioned to prepare this EIAR in accordance with the requirements of the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU.

The relevant classes/scales of development that require Environmental Impact Assessment (EIA) are set out in Schedule 5 of the Planning and Development Regulations 2001 to 2020. The relevant class of development in this case relates to "installations for the harnessing of wind power for energy production (wind farms) with more than 5 turbines or having a total output greater than 5 megawatts", as per paragraph 3(i) of Part 2 of Schedule 5. The proposed development exceeds 5 turbines and 5 Megawatts in scale, and therefore is required to be subject to EIA.

The EIAR provides information on the receiving environment and assesses the likely significant effects of the proposed project on it and proposes mitigation measures to avoid or reduce these effects. The function of the EIAR is to provide information to allow the competent authorities to conduct the Environmental Impact Assessment (EIA) of the proposed project.

All elements of the project, (including the wind turbines and associated infrastructure, substation, grid connection, replanting and turbine delivery route) have been assessed as part of this EIAR.

1.2.1 EIAR Guidance

The Environmental Protection Agency (EPA) published its *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017), which is intended to guide practitioners preparing an EIAR in line with the requirements set out in the European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

In preparing this EIAR regard has also been taken of the provisions of the '*Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment*', published by the Department of Housing, Planning and Local Government (DHPLG) in August 2018 to the extent these guidelines are relevant having regard to the enactment of the revised EIA Directive.

The European Commission also published a number of gnidance documents in December 2017 in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU as amended by 2014/52/EU) including '*Guidance on Screening*', '*Guidance on Scoping*' and '*Guidance on the preparation of the Environmental Impact Assessment Report*'. MKO has prepared the EIAR with regard to these gnidelines also.

1.2.2 Wind Energy Development Guidelines for Planning Authorities

The relevant considerations under the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Enviroument, Heritage and Local Government (DOEHLG), 2006) have also been taken into account during the preparation of this EIAR.

The '*Wind Energy Development Guidelines for Planning Authorities*' (DoEHLG, 2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the document '*Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review*' (December 2013), the '*Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach*' (June 2017), and the Draft Wind Energy

Development Guidelines (December 2019). A consultation process in relation to the 2019 document concluded on the 19th of February 2020.

At time of writing, the Draft Guidelines have not yet been adopted, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects, it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. Towards this end it is anticipated that the Croagh Wind Farm will be capable of adhering to the relevant noise and shadow flicker standards.

1.3 The Applicant

Coillte have been involved in the development of 4 operating wind farms including Raheenleagh (Wicklow), Sliabh Bawn (Roscommon), Cloosh (Galway) and Castlepook (Cork) which have a combined total capacity of over 300 megawatts (MW). This project is part of a wider Coillte ambition to support the delivery of a further 1 GW of renewable energy and therefore make a significant contribution to the ambitions outlined in the All of Government Climate Action Plan 2019.

1.4 Brief Description of the Proposed Development

The proposed development comprises the construction of 10 No. wind turbines and all associated works. The proposed turbines will have a blade tip height of up to 170 metres above the top of the foundation. The applicant is seeking a ten-year planning permission. The full description of the proposed development, as per the public planning notices, is as follows:

Overall Development Description

i. *Construction of 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
ii. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
iii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
v. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
vi. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
vii. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;*
viii. *1 no. borrow pit;*
ix. *2 no. peat and spoil repository areas*
x. *2 no. temporary construction compounds;*
xi. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
xii. *Site Drainage;*
xiii. *Permanent Signage;*
xiv. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
xv. *All associated site development works*

Leitrim County Council – Planning Notice Project Description

i. *Construction of 8 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
ii. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
iii. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
iv. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
v. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
vi. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;*
vii. *1 no. borrow pit;*
viii. *2 no. peat and spoil repository areas*
ix. *2 no. temporary construction compounds;*
x. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
xi. *Site Drainage;*
xii. *Permanent Signage;*
xiii. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
xiv. *All associated site development works*

Sligo County Council – Planning Notice Project Description

i. *Construction of 2 No. wind turbines with a maximum overall blade tip height of up to 170 metres and associated hardstand areas;*
ii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iii. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm 38kV electricity substation (which is proposed to be located in the townland of Garvagh Glebe, Co. Leitrim);*
iv. *Upgrade of existing tracks, roads and provision of new site access roads;*
v. *Recreation and amenity works, including marked trails and associated recreation and amenity signage*
vi. *Site Drainage;*
vii. *Permanent Signage;*
viii. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
ix. *All associated site development works*

This application is seeking a ten-year permission and 30 year operational life from the date of commissioning of the renewable energy development.

Current and future wind turbine generator technology will ensure that the wind turbine model, chosen for the proposed development, will have an operational lifespan greater than the 30 year operational life that is being sought as part of this application.

Modern wind turbine generators typically have an output of between 3.0 and 5MW. For the purposes of this EIAR it is assumed that the wind turbine model installed as part of the proposed renewable energy development will have a rated output of 4.8MW. Therefore, based on 10 no. wind turbines, the proposed wind turbines will have a combined output of 48MW.

The layout of the proposed development has been led by consideration of constraints and facilitators, thereby avoiding the environmentally sensitive parts of the site. The roads layout for the proposed development maximises the use of the existing onsite access roads and tracks where possible, with approximately 11.1 kilometres of existing roadway/ tracks requiring upgrading and approximately 7.5 kilometres of new access road to be constructed.

The EIAR Site Boundary for the proposed development encompasses an area of approximately 670 hectares, the majority of which comprises commercial forestry plantation. Where the 'site' is referred to in this EIAR, this means the primary study area for the EIAR. Generally, the study area extends beyond the planning application site boundary depending on the requirements of individual assessments. Where this occurs, the extent of the study area will be outlined in the relevant chapter, as required. The proposed permanent footprint of the proposed development measures approximately 36 hectares, which represents approximately 5.3% of the primary study area.

The EIAR Site Boundary is illustrated on Figure 1-2. An aerial view of the EIAR Site Boundary is shown in Figure 1-3. The Planning Application Site Boundary is shown in Appendix 4-1 of this EIAR.

The proposed grid connection forms part of the planning application and is assessed as part of the EIAR. It is proposed to construct a 38 kV substation within the site and to connect from here to the existing Garvagh substation, located adjacent to the site. Connection will be via underground cabling located within existing forestry and local county roads. The cabling route measures approximately 6.2 km in total.

The majority of the EIAR Site Boundary is currently used for commercial forestry, a small proportion of which will be felled to accommodate the wind farm development. A total area of approximately 55.1 hectares of commercial forestry will require replacement elsewhere in the State and this forms part of the project for assessment purposes. Details regarding the area to be felled are outlined in Chapter 4 of this EIAR.

The Forest Service policy on the granting of felling licences requires replanting of forestry on a hectare-by-hectare basis. Three potential forestry replacement areas have been identified for assessment purposes, with an availability of 59.33 hectares, located in Stranamart, Co. Cavan, Brackloon, Co. Roscommon and Ballard, Co. Wicklow. These lands has been granted Forest Service Technical Approval[1] for afforestation, and these or similarly approved lands will be used for replanting should the proposed development receive planning permission.

A significant minimum separation distance from houses of 850m from proposed wind turbines has been achieved with the project design. There are 5 no. dwellings located within 1 kilometre of any proposed wind turbine location with one of these dwellings being occupied. This occupied dwelling is located approximately 850 metres north of the closest proposed turbine location.

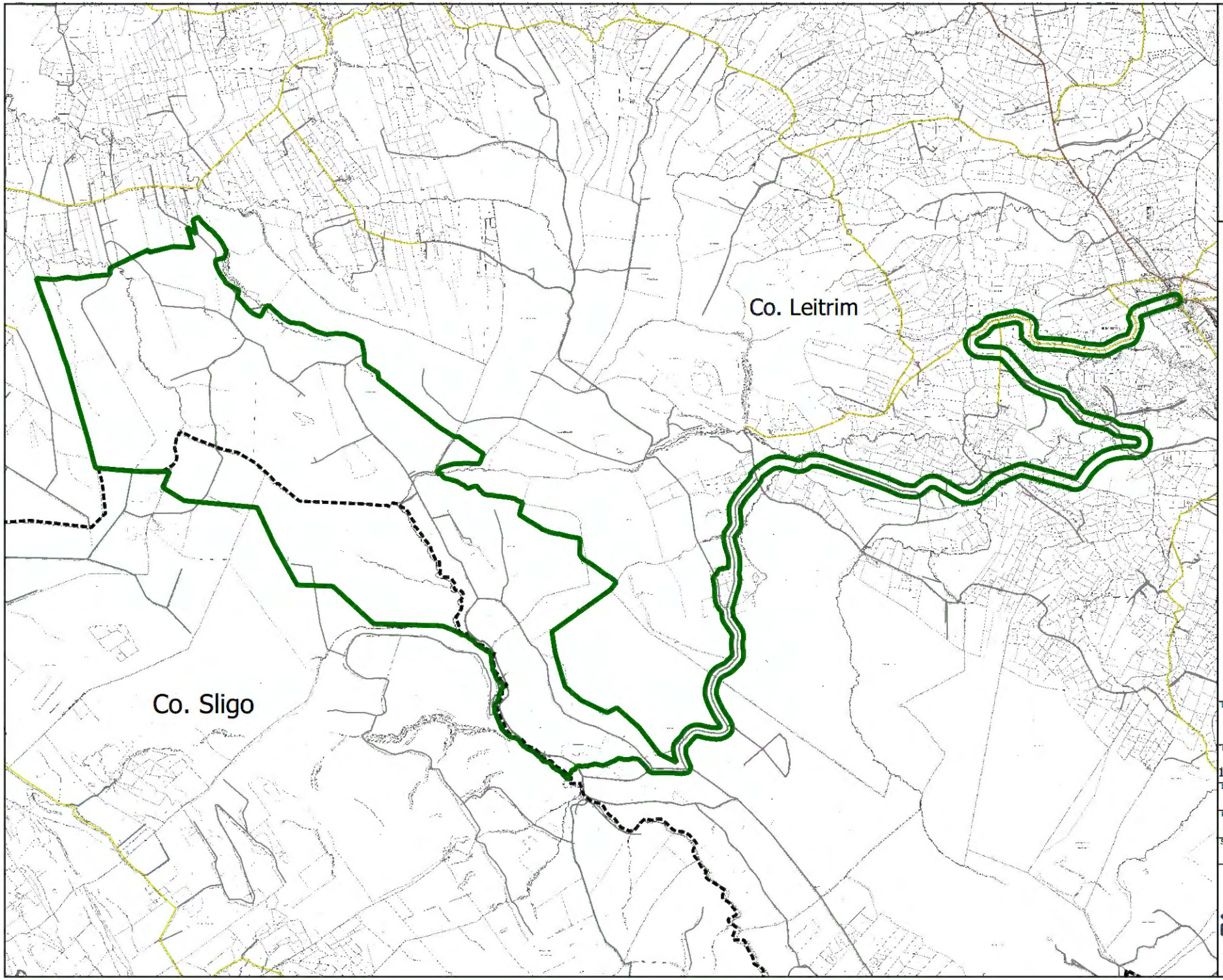
The proposed development is described in detail in Chapter 4 of this EIAR.

1.5 Need for the Proposed Development

1.5.1 Overview

It is now clear that Ireland will not meet its 2020 target for renewable energy with the Sustainable Energy Authority of Ireland (SEAI) reporting in May 2019 that 13 per cent of Ireland's energy will come from renewable sources by 2020, three per cent short of our European target of 16 per cent (SEAI, May 2019). Ireland faces significant challenges to its efforts to meet EU targets for renewable

[1] *All proposed forestry developments where the area involved is greater than 0.1 hectare must receive the prior written approval of the Forest Service. The application for approval is known as Pre-Planting Approval – Form 1.*



Map Legend

- EIAR Site Boundary
- County Boundary
- Regional Roads
- Local Roads
- Local Access Roads/ Existing Forestry Tracks

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Drawing Title

Site Boundary

Project Title

180511 - Croagh Wind Farm EIAR

Drawn By	Checked By
Daire O'Shaughnessy	Eoin McCarthy
Project No.	Drawing No.
180511	Fig 1.2
Scale	Date
1:75,000	12.06.2020

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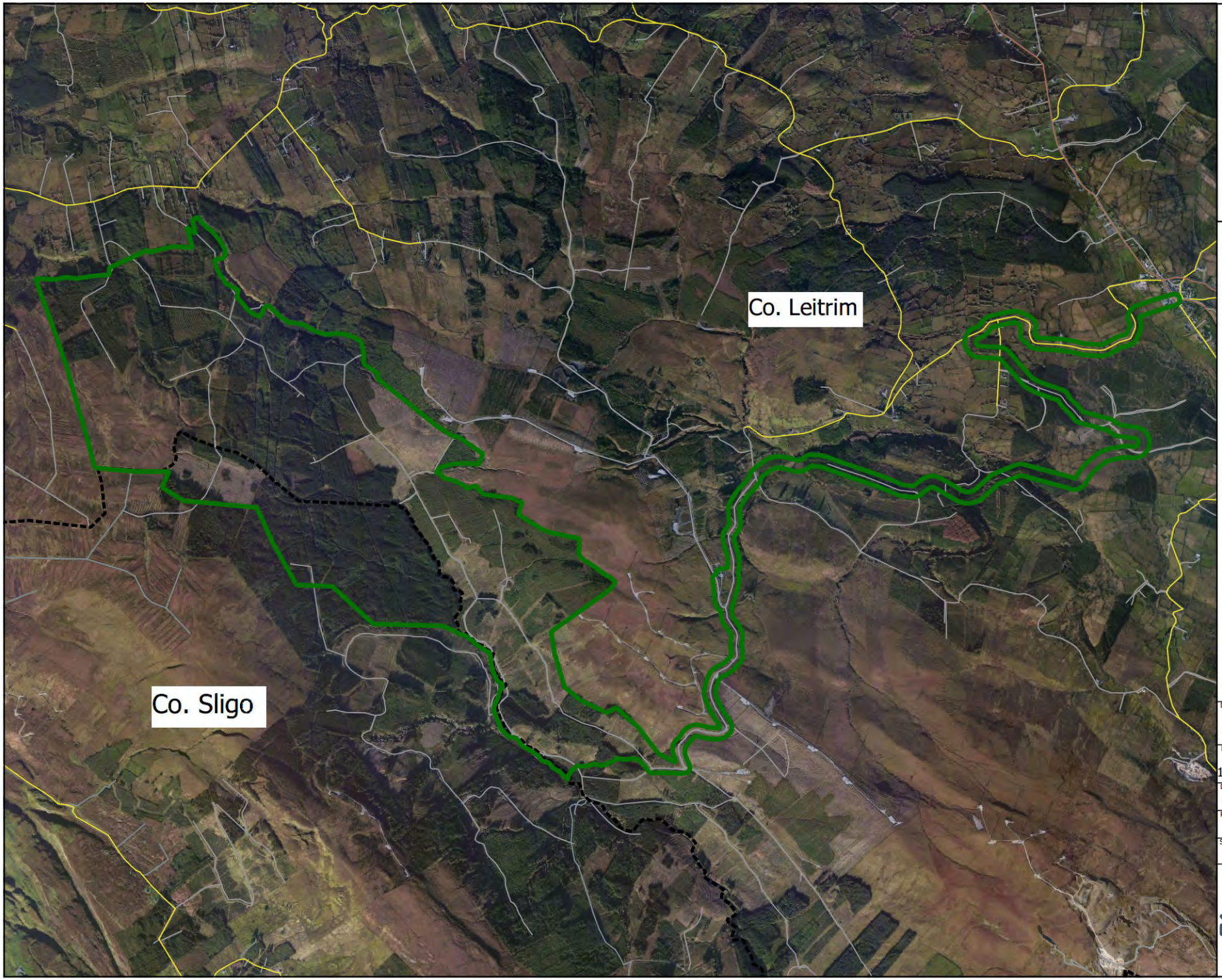

Map Legend

- EIAR Site Boundary
- County Boundary
- Regional Roads
- Local Roads
- Local Access Roads/ Existing Forestry Tracks

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Drawing Title

Site Boundary

Project Title

180511 - Croagh Wind Farm EIAR

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Project No.	Drawing No.
180511	Fig 1.3
Scale	Date
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energy by 2030 and its commitment to transition to a low carbon economy by 2050. Further detail can be found in Section 2.3.3 of this EIAR.

In March 2019, the Government announced a renewable electricity target of 70% by 2030. The proposed development is likely to be operational before 2030 and would therefore contribute to this 2030 target. More recently, the EPA reported that Ireland is set to fall far short of all of its carbon emissions reduction targets for 2030, despite climate action measures in the National Development Plan (EPA, June 2019). As such, the proposed Croagh wind energy development is critical to helping Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels.

The need for the proposed project is driven by the following factors:

1. *A legal commitment from Ireland to limit greenhouse gas emissions under the Kyoto protocol to reduce global warming (Section 1.5.1.1);*
2. *A requirement to increase Ireland's national energy security as set out in the Energy White Paper (Section 1.5.1.2);*
3. *A requirement to diversify Irelands energy sources, with a view to achievement of national renewable energy targets and an avoidance of significant fines from the EU (the EU Renewables Directive) (Section 1.5.1.3 to Section 1.5.1.5);*
4. *Increasing energy price stability in Ireland through reducing an over reliance on imported fossil fuels; and*
5. *Provision of cost-effective power production for Ireland which would deliver local benefits (Section 1.5.1.6).*

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment (DoCCAE). The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption. The CAP identifies a need for 8.2GW of onshore wind generation. Only 3.7GW is in place as of December 2019, therefore Ireland needs to more than double its installed capacity of wind generation. The CAP presents clear and unequivocal support for the provision of additional renewable energy generation and presents further policy support for increased wind energy. Further information relating to the Climate Action Plan can be found in Chapter 2, Section 2.4.5.

Section 2.4 in Chapter 2 of this EIAR on Background to the Proposed Development, presents a full description of the international, national and regional renewable energy policy context for the proposed project. Section 2.4 addresses climate change, including Ireland's current status with regard to meeting greenhouse gas emission reduction targets.

1.5.1.1 Climate Change and Greenhouse Gas Emissions

At the Paris climate conference (COP21) in December 2015, 195 countries adopted the first-ever universal, legally binding global climate deal the Paris Agreement. The Paris Agreement sets out a global action plan to avoid dangerous climate change by limiting global warming to well below 2°C above pre-industrial levels. Under the Paris Agreement, the EU and Governments also agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries and to undertake rapid reductions thereafter in accordance with the best available science.

The International Panel on Climate Change (IPCC) has put forward its clear assessment that the window for action on climate change is rapidly closing and that renewable energy sources such as wind will have to grow from 30% of global electricity at present to 80% by 2050 if we are to limit global

warming to below 2 degrees[2] and in accordance with the COP 21 agreement to limit global warming to well below 2°C above pre-industrial levels.

In this regard, the Government enacted the Climate Action and Low Carbon Development Act 2015, which provides for the approval of plans by the Government in relation to climate change for the purpose of pursuing the transition to a low carbon, climate resilient and environmentally sustainable economy.

The Energy White Paper, published by the Government in 2015, notes that "The use of renewables in electricity generation in 2014 reduced CO_2 emissions by 2.6 Mt and avoided €255 million in fossil fuel imports".

It is estimated that the proposed renewable energy development with a potential output of approximately 48MW from the proposed wind turbines will result in the net displacement of between approximately 55,188 tonnes of Carbon Dioxide (CO_2) per annum. The carbon offsets resulting from the proposed development are described in detail in Section 10.2.3 of Chapter 10: Air and Climate.

1.5.1.2 Energy Security

At a national level, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas. In 2015, the cost of all energy imports to Ireland was approximately €4.6 billion, with Ireland being one of the most energy import-dependent countries in the European Union, importing 88% of its fuel that year, up from 85% in 2014. This fell to €3.4 billion in 2016 (due mainly to reduced gas imports), rose to approximately €4 billion in 2017 and to approximately €5 billion in 2018. Ireland's import dependency in 2018 was 67%, down 21% from 2015, however, Ireland is still one of the more import dependent countries in the EU, with the EU average being just over 50% ('Energy in Ireland 2019', SEAI, 2019).

Ireland continues to be hugely energy import-dependent leaving it exposed to large energy price fluctuations as a minimum and possibility of fuel shortages if a major energy crisis were to occur. The international fossil fuel market is growing increasingly expensive and is increasingly affected by international politics which can add to price fluctuations. This volatility will be increased as carbon prices increase in the future. This has implications for every Irish citizen.

The SEAI has stated that our heavy dependence on imported fossil fuels "is a lost opportunity in terms of keeping this money here in Ireland and further developing our abundant renewable resources".

The cost of carbon credits is included in all electricity traded, and the price of electricity generated by coal is particularly vulnerable due to its high carbon emissions per unit of electricity generated. Coal still generates almost 25% of Ireland's electricity, but the National Climate Policy[3] calls for an aggregate reduction in carbon dioxide emissions of at least 80% (compared to 1990 levels) by 2050. Any steps to reduce this dependence on imported fossil fuels will add to financial autonomy and stability in Ireland. The use of Ireland's indigenous energy resources, such as wind, will contribute to a reduction in energy imports.

The Energy White Paper 2015 notes "There will be a substantial increase in the cost of carbon in the short and medium term, through the EU Emissions Trading Scheme". Any steps to reduce dependence on imported fossil fuels will add to financial autonomy and stability in Ireland. As the White Paper notes:

2 IPCC Fifth Assessment Synthesis Report, Intergovernmental Panel on Climate Change AR5 Report

3 Department of Communications, Climate Action and Environment, National Climate Policy, available at: https://www.dccae.gov.ie/en-ie/climate-action/topics/climate-action-at-a-national-level/Pages/default.aspx

"In the longer term, fossil fuels will be largely replaced by renewable sources".

1.5.1.2.1 Supports for Wind Energy

While Ireland has a range of renewable resources, as the White Paper states "[Onshore Wind] is a proven technology and Ireland's abundant wind resource means that a wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."

In fact, the cost of support is more than offset by the fact that adding large quantities of wind to the wholesale market drives down auction prices in any half hour trading period when the wind is blowing, i.e. for 80% of the hours of the year. Wind is capable of an average capacity factor of 31.7%[4], which is its average output throughout the year relative to its maximum output. However, wind is generating power at some level for 80% of the hours of the year. EirGrid's website has more detailed information. A Poyry study from 2015 showed that reaching our targets in 2020 would reduce wholesale prices by more than costs of new grid infrastructure, backup and the subsidies paid to wind, resulting in a net saving of €43m per year in 2020. The EU has noted that Ireland has one of the lowest costs of supporting renewables mainly because onshore wind is on a par with the cost of power from conventional generation when a full cost benefit analysis is undertaken.

1.5.1.3 EU 2020 Renewable Energy Targets

The burning of fossil fuels for energy creates greenhouse gases, which contribute significantly to climate change. These and other emissions also create acid rain and air pollution. Sources of renewable energy that are utilised locally with minimal impact on the environment are necessary to meet the challenges of the future. The EU adopted Directive (2009/28/EC) on the Promotion of the Use of Energy from Renewable Sources in April 2009, which includes a common EU framework for the promotion of energy from renewable sources.

The Directive sets a mandatory national target for the overall share of energy from renewable sources for each Member State. This package is designed to achieve the EU's overall 20:20:20 environmental target, which consists of a 20% reduction in greenhouse gases, a 20% share of renewable energy in the EU's total energy consumption and a 20% increase in energy efficiency by 2020. To ensure that the mandatory national targets are achieved, Member States must follow an indicative trajectory towards the achievement of their target as outlined in Ireland's National Renewable Energy Action Plan (NREAP).

Ireland's mandatory national target is to supply 16% of its overall energy needs from renewable sources by 2020. This target covers energy in the form of electricity (RES-E), heat (RES-H) and transport fuels (RES-T). The contribution of renewables to gross final consumption (GFC) was 11% in 2018, compared to the 2020 target of 16% ('Energy in Ireland – 2019 Report, SEAI, December 2019). Furthermore, the Department of Communications, Climate Action & Environment (DoCCAE) reported most recently in their 'Fourth Progress Report on the National Renewable Energy Action Plan' (December 2017) that Ireland will achieve 13% of its 16% RES target by 2020.

For RES-E alone, Ireland has set a national target of 40% by 2020 as outlined in NREAP. Government policies identify the development of renewable energy, including wind energy, as a primary strategy in implementing national energy policy.

Noted above and further emphasised in the most recent SEAI report, 'Energy in Ireland – 2019 Report' (SEAI, December 2019); the share of renewable electricity (RES-E) was recorded at 33.2% in 2018, out

[4] *Energy in Ireland 2019 Report (Table 17) (SEAI, December 2019). Report available at: https://www.seai.ie/publications/Energy-in-Ireland-2019-.pdf*

of their 40% target; further reporting that Ireland is not on track to meet its 2020 renewable energy target.

In April 2020, the SEAI released an update to its 2019 'Renewable Energy in Ireland' report. The update report confirms that Ireland is not on track to meet any of its 2020 renewable energy targets and ranks second last of the 28 European countries (including the UK) in terms of progress towards 2020 targets. Renewable sources made up just 11% of Ireland's energy consumption in 2018, which is significantly short the 16% goal for 2020. The report notes that Ireland's dependence on fossil fuels for heating requirements (over 93%) was the primary cause for failing to achieve its overall renewable energy target.

Furthermore, analysis from EirGrid, has shown that 32% of electricity demand in Ireland during 2018 was met by renewable sources[5]. This shows a positive increase in renewable energy in Ireland from that previously recorded in 2017, but still highlights a shortfall relative to the 2020 target and the significant progress required to meet our targets and beyond 2020.

1.5.1.4 EU 2030 Renewable Energy Targets

In March 2019, the Minister for Communications, Climate Action & Environment, Richard Bruton, announced a renewable electricity target of 70% by 2030 for Ireland. The Joint Committee on Climate Change Action recommended in their recent report, 'Climate Change: A Cross- Party Consensus for Action' (March 2019), that new climate change legislation be enacted by the Oireachtas in 2019 to include:

- A target of net zero economy-wide GHG emissions by 2050;
- A provision for a 2030 target, consistent with the GHG emissions reduction pathway to 2050 to be set by 2020 by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council;
- Provision for five-yearly carbon budgets, consistent with the emissions reduction pathway to 2030 and 2050 targets, to be set by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council; and
- A target for the renewable share of electricity generation of 70% by 2030.

As noted previously, Ireland will not meet its 2020 renewable energy targets. It is now more critical than ever that we continue to progress renewable energy development in Ireland so that we are successful in meeting our 2030 target. Further detail on the EU 2030 targets including the implications of the Climate Action Plan 2019 is noted in Chapter 2, Section 2.4.

1.5.1.5 Reduction of Carbon Emissions and Other Greenhouse Gases

The production of renewable energy from the proposed development will assist in achieving the Government's and EU's stated goals of ensuring safe and secure energy supplies, promoting an energy future that is sustainable and competitively priced to consumers whilst combating energy price volatility and the effects of climate change. The Energy White Paper in 2015 outlines an ambitious Greenhouse gas reduction target of between 80% to 95%, compared to 1990 levels, by 2050. Furthermore, if national carbon emissions targets are divided out amongst each county, each Local Authority may be responsible for meeting its own targets.

5 http://www.eirgridgroup.com/newsroom/renewables-demand-record/index.xml

Recent EU and World Health Organisation reports estimate that poor air quality accounted for premature deaths of almost 600,000 people in Europe in 2012[6]. In Ireland, the premature deaths attributable to air pollution are estimated at 1,200 people as outlined in 'Ireland's Environment – An Assessment' (EPA, 2016.) The report states that the pollutants of most concern are NO_x, (the collective term for the gases nitric oxide and nitrogen dioxide, PM (particulate matter) and O_3 (ozone). The EPA report goes on to state that:

> *"Ireland has considerable renewable energy resources, only a fraction of which are utilised to address our energy requirements.*
>
> *Wind, ocean, solar, hydro and geothermal energy do not produce GHG (greenhouse gas) emissions or emissions of air pollutants such as particulates, sulphur dioxide and nitrogen dioxide. Use of these renewable resources can have* ***considerable co-benefits for human health and ecosystems****. Meeting energy requirements from renewable resources can provide significant economic and employment benefits at local to national scales."*

The proposed development therefore represents an opportunity to further harness Ireland's significant renewable energy resources, with valuable benefits to air quality and in turn to human health. The consumption of fossil fuels for energy results in the release of particulates, sulphur dioxide and nitrogen dioxide to our air. The use of wind energy, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, results in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2, thereby resulting in cleaner air and associated positive health effects.

1.5.1.6 Economic Benefits

In addition to helping Ireland avoid significant fines and reducing environmentally damaging emissions, the proposed project will have significant economic benefits. At a national level, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas. As detailed above, in 2018 the cost of all energy imports to Ireland was approximately €5 billion with imported fossil fuels accounting for 67% of all energy consumed ('Energy in Ireland 2019', SEAI, 2019).

The SEAI report 'Energy in Ireland 2019' indicated that renewable electricity (mostly wind energy) during 2018 and compared to 2016:

- Displaced €430 million in fossil fuel imports;
- Reduced CO_2 emissions by 4 million tonnes; and
- Did not add to consumer bills.

The 2014 report 'The Value of Wind Energy to Ireland', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

The proposed development will be capable of providing power to supply approximately 35,040 households every year, as presented in the calculations in Section 4.3.1.6 of of this EIAR.

At a Regional Level, the proposed development will help to supply the rising demand for electricity, resulting from renewed economic growth. The 'All-island Generation Capacity Statement 2017 – 2026' (SONI and Eirgrid, 2017) notes that electricity demand on the island of Ireland is expected to grow by 17% over the next ten years.

6 www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report

The proposed development will have several significant long-term and short-term benefits for the local economy including job creation, local authority commercial rate payments and a Community Benefit Scheme.

The annual commercial rate payments from the proposed development to Leitrim and Sligo County Councils, will be redirected to the provision of public services within those counties. These services include items such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

It is estimated that the proposed project will create approximately 80-100 jobs during the construction phase and 2-3 jobs during the operational and maintenance phases of the proposed development. During construction, additional employment will be created in the region through the supply of services and materials to the development. In addition to this, there will also be income generated by local employment from the purchase of local services i.e. travel and lodgings.

Should the proposed development receive planning permission, there are substantial opportunities available for the local area in the form of Community Benefit Funds. Based on the current proposal, a Community Benefit Fund in the region of €5 million will be made available over the lifetime of the project. The value of this fund will be directly proportional to the installed capacity and/or energy produced at the site and will support and facilitate projects and initiatives including youth, sport and community facilities, schools, educational and training initiatives, and wider amenity, heritage, and environmental projects.

Further to the above, the recent Renewable Energy Support Scheme (RESS) Terms and Conditions, published by the Department of Communications, Climate Action and Environment on the 27th February, make some high level provisions for how this type of benefit fund will work. Any project which wants to export electricity to the national grid must abide by these broad principles. These include the following:

1. *a minimum of €1,000 shall be paid to each household located within a distance of a 1 kilometre radius from the Project;*
2. *a minimum of 40% of the funds shall be paid to not-for-profit community enterprises whose primary focus or aim is the promotion of initiatives towards the delivery of the UN Sustainable Development Goals, in particular Goals 4, 7, 11 and 13, including education, energy efficiency, sustainable energy and climate action initiatives;*
3. *a maximum of 10% of the funds may be spent on administration. This is to ensure successful outcomes and good governance of the Community Benefit Fund.*
4. *the balance of the funds shall be spent on initiatives successful in the annual application process, as proposed by clubs and societies and similar not-for-profit entities, and in respect of Onshore Wind RESS 1 Projects, on "near neighbour payments" for households located outside a distance of 1 kilometre from the Project but within a distance of 2 kilometres from such Project.*

Further details on the proposed Community Gain proposals are presented in Section 4.5 and Appendix 2-2 of this EIAR.

1.5.2 Recreational Benefits

In addition to the economic and environmental benefits of the proposed development, there will be potential social and recreational benefits associated with the recreational and amenity proposals that will form part of the project.

The proposed development and all its associated infrastructure creates a unique opportunity to develop an amenity area for use by members of the local and wider community alike. The upland nature of the site is attractive to both locals and visitors to the area. It is proposed to develop some recreational walks as part of the Croagh Wind Farm project. These proposed walks will utilise existing forest tracks, new

wind farm roads and proposes trails,a boardwalk area together with a viewing area adjacent to Lough Nacroagh. In addition, areas around the proposed amenities will be targeted for planting with broadleaves and berried trees to create areas of interest for small birds and increase the biodiversity habitat of the area.. This proposal is based on the current use of the wider area as an informal walking route; where the proposed amenity facilities will allow for a safer and improved visitor experience and allow the site to be more openly available to walkers, trail runners, cyclists and other recreational users, as outlined in Section 4.6 of Chapter 4 of this EIAR.

This will provide a long-term benefit to both the local community and visitors to the area.

1.6 Purpose and Scope of the EIAR

The purpose of this EIAR is to document the current state of the environment in the vicinity of the proposed development site and to quantify the likely significant effects of the proposed development on the environment in accordance with the requirements of the EIA Directive, as amended. The compilation of this document served to highlight any areas where mitigation measures may be necessary in order to protect the surrounding environment from the possibility of any negative impacts arising from the proposed development.

It is important to distinguish the Environmental Impact Assessment (EIA) to be carried out the competent authorities, from the EIAR and the accompanying planning application. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive, the direct and indirect significant effects of the proposed development on the following:

- Population and Human Health,
- Biodiversity, with particular attention to species and habitats protected under Directive 92/43/EEC and Directive 2009/147/EC
- Land, Soil, Water, Air, Climate,
- Material Assets, Cultural Heritage and the Landscape
- Interactions between these factors.

The EIAR provides the relevant environmental information to enable the EIA to be carried out by the competent authorities. The information to be contained in the EIAR is prescribed in Article 5 of the EIA Directive, as amended and described in Section 1.4 above.

1.7 Structure and Content of the EIAR

Volume 1 of this EIAR uses the grouped structure method to describe the existing environment, the potential impacts of the proposed development thereon and the proposed mitigation measures. Background information relating to the proposed development, scoping and consultation undertaken and a description of the proposed development are presented in separate sections. The grouped format sections describe the impacts of the proposed development in terms of population and human health, biodiversity, ornithology soils and geology, hydrology and hydrogeology, air and climate, noise and vibration, landscape and visual, cultural heritage and material assets such as traffic and transportation, together with the interaction of the foregoing.

The chapters of this EIAR are as follows:

- Introduction
- Background to the Proposed Development
- Consideration of Reasonable Alternatives
- Description of the Proposed Development
- Population and Human Health

- Biodiversity (excluding Birds)
- Ornithology
- Land, Soils and Geology
- Hydrology and Hydrogeology
- Air and Climate
- Noise and Vibration
- Landscape and Visual
- Archaeological, Architectural and Cultural Heritage
- Material Assets (including Traffic and Transport, Telecommunications and Aviation)
- Interactions of the Foregoing
- Schedule of Mitigation and Monitoring Measures

The EIAR also includes a Non-Technical Summary, which is a condensed and easily comprehensible version of the EIAR document. The non-technical summary is laid out in a similar format to the main EIAR document and comprises a description of the proposed development followed by the existing environment, impacts and mitigation measures presented in the grouped format.

The photomontage booklet, pertaining to Chapter 12: Landscape and Visual, is included as Volume 2 of this EIAR.

Appendices to the chapters listed above are included in Volume 3 of this EIAR.

1.7.1 Description of Likely Significant Effects and Impacts

As stated in the Draft *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports'* (EPA, 2017), an assessment of the likely impacts of a proposed development is a statutory requirement of the EIA process. The statutory criteria for the presentation of the characteristics of potential impacts requires that potential significant impacts are described with reference to the extent, magnitude, complexity, probability, duration, frequency, reversibility and trans-frontier nature (if applicable) of the impact.

The classification of impacts in this EIAR follows the definitions provided in the Glossary of Impacts contained in the following guidance documents produced by the European Commission (EC) and the Environmental Protection Agency (EPA):

- *'Environmental Impact Assessment of Projects: Guidance on the preparation of the Environmental Impact Assessment Report'* (EC, 2017)
- *'Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017'* (EPA, 2017).
- *'Revised Guidelines on the Information to be contained in Environmental Impact Statements – Draft September 2015'* (EPA, 2015)
- *'Advice Notes for Preparing Environmental Impact Statements – Draft September 2015'* (EPA, 2015).
- *'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003)
- *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002)

Error! Not a valid bookmark self-reference., below, presents the glossary of impacts as published in the EPA guidance documents. Standard definitions are provided in this glossary, which permit the evaluation and classification of the quality, significance, duration and type of impacts associated with a proposed development on the receiving environment. The use of pre-existing standardised terms for the classification of impacts ensures that the EIA employs a systematic approach, which can be replicated across all disciplines covered in the EIAR. The consistent application of terminology throughout the EIAR facilitates the assessment of the proposed development on the receiving environment.

Table 1-2 Impact Classification Terminology (EPA, 2017)

Impact Characteristic	Term	Description
Quality	Positive	A change which improves the quality of the environment
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative	A change which reduces the quality of the environment
Significance	Imperceptible	An effect capable of measurement but without significant consequences
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends
	Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
	Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
	Profound	An effect which obliterates sensitive characteristics
Extent & Context	Extent	Describe the size of the area, number of sites and the proportion of a population affected by an effect
	Context	Describe whether the extent, duration, or frequency will conform or contrast with established (baseline) conditions

Impact Characteristic	Term	Description
Probability	Likely	Effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
	Unlikely	Effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented
Duration and Frequency	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effect lasting over sixty years
	Reversible	Effects that can be undone, for example through remediation or restoration
	Frequency	Describe how often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Type	Indirect	Impacts on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create larger, more significant effects.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out
	Worst Case'	The effects arising from a project in the case where mitigation measures substantially fail
	Indeterminable	When the full consequences of a change in the environment cannot be described

Impact Characteristic	Term	Description
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost
	Residual	Degree of environmental change that will occur after the proposed mitigation measures have taken effect
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents

Each impact is described in terms of its quality, significance, extent, duration and frequency and type, where possible. A 'Do-Nothing' impact is also predicted in respect of each environmental theme in the EIAR. Residual impacts are also presented following any impact for which mitigation measures are prescribed. The remaining impact types are presented as required or applicable throughout the EIAR.

Any potential interactions between the various aspects of the environment assessed throughout this EIAR are presented in Chapter 15: Interaction of the Foregoing.

1.8 Project Team

1.8.1 Project Team Responsibilities

The companies and staff listed in Table 1.3 were responsible for completion of the EIAR of the proposed development. Further details regarding project team members are provided below.

The EIAR project team comprises a multidisciplinary team of experts with extensive experience in the assessment of wind energy developments and in their relevant area of expertise. The qualifications and experience of the principal staff from each company involved in the preparation of this EIAR are summarised in Section 1.8.2 below. Each chapter of this EIAR has been prepared by a competent expert in the subject matter. Further details on project team expertise are provided in the Statement of Authority at the beginning of each impact assessment chapter.

Table 1-3 EIAR Project Team

Consultants	Principal Staff Involved in Project	EIAR Input
McCarthy Keville **O' Sullivan Ltd.** Block 1 GFSC Moneenageisha Road Galway	Brian Keville Michael Watson Jimmy Green Meabhann Crowe Lorraine Meehan Eoin McCarthy Pat Roberts	Project Managers, Scoping and Consultation, Preparation of Natura Impact Statement, Report Sections: › 1. Introduction › 2. Background to the Proposed Development › 3. Consideraton of Alternatives › 4. Description of the Proposed Development

Consultants	Principal Staff Involved in Project	EIAR Input
	Dervla O' Dowd Padraig Cregg David McNicholas John Hynes James Owens Dr. Úna Nealon David Naughton Ian Hynes Joanna Mole Owen Cahill Stephen Corrigan Eoin Gilson Paul Sweeney James Newell Joseph O'Brien	› 5. Population & Human Health › 6. Biodiversity › 7. Ornithology › 10. Air & Climate › 12. Landscape & Visual › 14. Material Assets (non-Traffic) › 15. Interaction of the Foregoing › 16. Schedule of Mitigation Measures
Hydro Environmental Services 22 Lower Main Street Dungarvan Co. Waterford	Michael Gill David Broderick	Flood Risk Assessment, Drainage Design, Preparation of Report Sections: › 8. Land, Soils & Geology › 9. Water
Fehily Timoney & Company (formerly Applied Ground Engineering Consultatnts Ltd.) The Grainstore Singletons Lane	Gerry Kane Paul Jennings	Preparation of Geotechnical & Peat Stability Assessment and Peat & Spoil Management Plan

Consultants	Principal Staff Involved in Project	EIAR Input
Bagnelstown Co. Carlow		
AWN Consulting The Tecpro Building Clonsgaugh Business & Technology Park Dublin 17	Dermot Blunnie Leo Williams Mike Simms	Baseline Noise Survey, Preparation of Report Section 11: Noise and Vibration
Tobar Archaeological Services Saleen Midleton Co. Cork	Annette Quinn Miriam Carroll	Preparation of Report Section 13: Cultural Heritage and Archaeology
Alan Lipscombe Traffic and Transport Consultants Claran, Headford, Co. Galway	Alan Lipscombe	Swept Path Analysis, Preparation of Report Section14: Material Assets – Roads and Traffic

1.8.2 Project Team Members

1.8.2.1 MKO

Brian Keville B.Sc. (Env.)

Brian Keville has over 19 years' professional experience as an environmental consultant having graduated from the National University of Ireland, Galway with a first class honours degree in

Environmental Science. Brian was one of the founding directors of environmental consultancy, Keville & O'Sullivan Associates Ltd., prior to the company merging in 2008 to form McCarthy Keville O'Sullivan Ltd., and whom recently rebranded as MKO (March 2019). Brian's professional experience has focused on project and environmental management, and environmental impact assessments. Brian has acted as project manager and lead-consultant on numerous environmental impact assessments, across various Irish counties and planning authority areas. These projects have included large infrastructural projects such as roads, ports and municipal services projects, through to commercial, mixed-use, industrial and renewable energy projects. The majority of this work has required liaison and co-ordination with government agencies and bodies, technical project teams, sub-consultants and clients.

Michael Watson, MA; Miema CEnv PGeo

Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland and then a prominent private environmental & hydrogeological consultancy prior to joining MKO in 2014. Michael's professional experience includes managing Environmental Impact Assessments, EPA License applications, hydrogeological assessments, environmental due diligence and general environmental assessment on behalf of clients in the wind farm, waste management, public sector, commercial and industrial sectors nationally. Michaels key strengths include project strategy advice for a wide range and scale of projects, project management and liaising with the relevant local authorities, Environmental Protection Agency (EPA) and statutory consultees as well as coordinating the project teams and sub-contractors. Michael is a key member of the MKO senior management team and as head of the Environment Team has responsibilities to mentor various grades of team members, foster a positive and promote continuous professional development for employees. Michael also has a Bachelor of Arts Degree in Geography and Economics from NUI Maynooth, is a Member of IEMA, a Chartered Environmentalist (CEnv) and Professional Geologist (PGeo).

Jimmy Green BA, MRUP; MIPI

Jimmy Green holds the position of Senior Planner in MKO and has a wide range of experience in project management and coordination, planning research, analysis, and retail planning. Jimmy has extensive planning experience in both the public and private sectors having worked as an Assistant Planner in Donegal County Council and subsequently as both an Executive and Senior Executive Planner in Galway County Council prior to joining private practice in October 2004. Since moving into the private sector he has provided consulting services to a wide range of private and public sector clients, and his experience includes planning application project management, environmental impact assessment preparation, retail impact assessment, development potential reporting, preparation of linguistic impact statements and submissions to Development Plans/Local Area Plans. Jimmy has a Bachelor of Arts Degree in Human and Physical Geography from National University Ireland Galway and a Masters in Regional and Urban Planning from University College Dublin. Jimmy is also a corporate member of the Irish Planning Institute.

Meabhann Crowe BA (Hons.), MURP, MRTPI

Meabhann Crowe is a Project Planner with McCarthy O'Sullivan Ltd with over 10 years private sector experience. She is a fully chartered member of the Royal Town Planning Institute (MRTPI). Meabhann holds a BA (Hons) in Geography, Sociological and Political Science and a Masters in Urban and Regional Planning. Prior to taking up her position with McCarthy Keville O'Sullivan in October 2018, Meabhann was employed as an Associate Director with Colliers International in their Edinburgh office, prior to which she was employed for several years with Halliday Fraser Munro. In her time in the industry Meabhann has been active on a number of instructions across a broad spectrum of mixed-use, residential, commercial, renewable energy and retail projects.

Meabhann brings particular expertise in initial development feasibility appraisals and development strategies. Her experience in managing large multi-disciplinary teams in the preparation of local and major planning applications across residential and mixed-use and retail developments means she has a wealth of knowledge to draw on in the early stages of development. She has particular experience in preparing and managing site strategies which include both responding to emerging planning policy whilst also preparing and progressing planning applications and appeals.

Lorraine Meehan B.Sc. (Env.)

Lorraine Meehan is a Project Environmental Scientist with MKO with over 10 years of experience. Lorraine graduated from NUI Galway in 2006 with a first class honours degree in Environmental Science and has gained extensive experience since joining the company in 2007, working primarily as an Environmental Scientist and Project Manager on a wide range of projects and plans requiring environmental assessment. Key project experience includes renewable energy projects up to 100 Megawatts (MW) in scale, electricity infrastructure, roads, waste management facilities, and municipal services projects. Lorraine's key strengths and responsibilities relate to the efficient and effective management of projects, including coordination of multidisciplinary project teams, engagement with the relevant authorities, stakeholders and members of the public on proposed and ongoing projects, organisation of extensive scoping and consultation exercises, and coordination and production of final project outputs, including Environmental Impact Statements/Environmental Impact Assessment Reports, Strategic Environmental Assessment Environmental Reports, and Constraints & Feasibility and Site Selection Studies. Within MKO, Lorraine is also involved in the training of junior members of staff and review of outputs, and completes mapping, desk studies and report-writing for a range of development and strategy-related projects.

Eoin McCarthy B.Sc. (Env.)

Eoin is a Project Environmental Scientist with McCarthy O'Sullivan Ltd. with over 8 years of environmental consultancy experience. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Eoin took up his position with McCarthy Keville O'Sullivan in June 2011. Eoin's key strengths and areas of expertise are in project management, environmental impact assessment, wind energy site selection and feasibility assessment. Since joining MKO Eoin has been involved as a Graduate, Assistant and Project Environmental Scientist on a significant range of energy infrastructure, tourism, waste permit, flood relief scheme and quarrying projects. He has overseen some of the largest SID wind energy in Ireland in recent years. In his role as project manager, Eoin works with and co-ordinates large multidisciplinary teams including members from MKO's Environmental, Planning, Ecological and Ornithological departments as well as sub-contractors from various fields in the preparation and production of EIARs. Eoin is also involved in the development of project strategy for the projects that he manages. He has held the role of project manager on over 500MW worth of wind energy projects. Within MKO Eoin plays a large role in the management of and sharing of knowledge with junior members of staff and works as part of a large multi-disciplinary team to produce EIA Reports.

Pat Roberts B.Sc. (Env.)

Pat Roberts is a Senior Ecologist and director of the Ecology team with McCarthy O'Sullivan Ltd. with over 14 years post graduate experience of providing ecological services in relation to a wide range of developments at the planning, construction and monitoring stages. Pat holds B.Sc.(Hons) in Environmental Science. Pat has extensive experience of providing ecological consultancy on large scale industrial and civil engineering projects. He is highly experienced in the completion of ecological baseline surveys and impact assessment at the planning stage. He has worked closely with construction personnel at the set-up stage of numerous construction sites to implement and monitor any prescribed best practice measures. He has designed numerous Environmental Operating Plans and prepared many environmental method statements in close conjunction with project teams and contractors. He has worked extensively on the identification, control and management of invasive species on numerous construction sites. Prior to taking up his position with MKO in June 2005, Pat worked in Ireland, USA

and UK as a Tree Surgeon and as a nature conservation warden with the National Trust (UK) and the US National Park Service. Pats key strengths include his depth of knowledge and experience of a wide range of ecological and biodiversity topics and also in his ability to understand the requirements of the client in a wide range of situations. He currently manages the ecological team within MKO and and ensures that the outputs from that team are of a very high standard and meet the requirements of the clients and relevant legislation and guidelines. He is a full member of the Chartered Institute of Ecologists and Environmental Managers (CIEEM)

Dervla O'Dowd B.Sc. (Env.)

Dervla O'Dowd is a Senior Ecologist and Project Manager with McCarthy O'Sullivan Ltd. with over 14 years of experience in environmental consultancy. Dervla graduated with a first class honours B.Sc. in Environmental Science from NUI, Galway in 2005 and joined Keville O'Sullivan Associates in the same year. Dervla has gained extensive experience in the project management and ecological assessment of the impacts of various infrastructural projects including wind energy projects, water supply schemes, road schemes and housing developments nationwide and has also been involved in the compilation of Environmental Impact Statements, with emphasis on sections such as Flora & Fauna, and acted as EIS co-ordinator on many of these projects. Dervla has also provided site supervision for infrastructural works within designated conservations areas, in particular within aquatic habitats, and has also been involved in the development of environmental/ecological educational resource materials and major ecological surveys of inland waterways. Currently, Dervla is responsible for coordinating ecological work, in particular ornithological surveys required on major infrastructural projects, with emphasis on wind energy projects. Dervla's key strengths and areas of expertise are in project management, project strategy, business development and survey co-ordination to ensure the efficient operation of the Ornithology team's field survey schedule. Dervla holds full membership of the Chartered Institute of Ecology and Environmental Management and current Safe Pass card.

Padraig Cregg B.Sc. (Zoo.), M.Sc. (Eco.)

Padraig Cregg is a Senior Ornithologist with McCarthy O'Sullivan Ltd. with over 8 years of experience in both private practice and NGOs. Padraig holds a BSc (Hons) in Zoology and Masters in Evolutionary and Behavioural Ecology. Prior to taking up his position with McCarthy Keville O'Sullivan in December 2018, Padraig worked as a Senior Ornithologist and held previous posts with TOBIN Consulting Engineers, Energised Environments Ltd in Scotland, WSP Environment and Energy Ltd in Scotland and BirdWatch Ireland. Padraig has specialist knowledge in designing, executing and project managing ornithological assessments, primarily in the renewable industry. Padraig's key strengths and areas of expertise are in ornithology and ecology surveying and in writing Natura Impact Statements (NIS) and the Biodiversity chapter of Environmental Impact Assessment Reports (EIAR) to accompany planning applications. Since joining MKO Padraig has been involved in desiguing, executing and project managing the ornithological assessment on over 20 proposed wind farm developments. He has played a key role in project managing these planning applications through the statutory planning system, with more projects in the pipeline. Within MKO Padraig plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIAR and NIS Reports.

John Hynes M.Sc. (Ecology), B.Sc.

John Hynes is a Senior Ecologist with McCarthy O'Sullivan Ltd. with over 6 years of experience in both private practice and local authorities. John holds a B.SC in Environmental Science and a M.Sc. in Applied Ecology. Prior to taking up his position with MKO in March 2014, John worked as an Ecologist with Ryan Hanley Consulting Ltd. and Galway County Council. John has specialist knowledge in Flora and Fauna field surveys. Geographic Information Systems, data analysis, Appropriate Assessment, Ecological Impact Assessment and Environmental Impact Assessment. John's key strengths and areas of expertise are in project management. GIS and impact assessment. Since joining MKO John has been involved as a Senior Ecologist on a significant range of energy

infrastructure, commercial, national roads and private/public development projects. Within MKO John plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIS Reports. John has project managed a range of strategy and development projects across the Ireland and holds CIEEM membership.

David Naughton B.Sc. (Env.)

David Naughton is an Ecologist with over two years of professional experience, working within the Ornithology Department for MKO. David graduated with an honours B.Sc. degree in Environmental Science from NUIG in 2016. David has a wide range of ecological experience including bird surveys, vegetation surveys, terrestrial invertebrate surveys, freshwater invertebrate surveys, river surveys for salmonids and other fish species, small mammal surveys and habitat identification. David is also very accomplished in GIS software systems for use in interpreting ecological data. David has experience in report writing and has been involved the production of several EIS/EIARs for various windfarm projects as well as numerous interim bird survey reports issued to clients on an ongoing basis. David has also been responsible for the production of collision risk modelling for bird activities at several windfarm sites over the past year, many of which have been peer reviewed by experts in CRM and were found to be appropriate. David's key strengths and areas of expertise are applications of GIS systems, including viewshed analysis and collision risk modelling, project management, survey planning and analysing & interpreting large scale datasets. Since joining MKO David has been involved in a wide range of various projects, acting as project manager for many bird survey projects while providing a pivotal contact link between clients and field surveyors.

Ian Hynes B.Sc. (Env.)

Ian Hynes is a Graduate Ecologist with McCarthy Keville and O'Sullivan Ltd., joining in December of 2017. Ian holds a B.Sc. (Hons) in Environmental Science from National University of Ireland, Galway. Ian has a broad knowledge of ecology including invertebrate surveys and identification, vegetation surveys, small mammal surveys and habitat identification. Ian also has over two years of experience using GIS software systems including ArcGIS and QGIS and MapInfo to present ecological data.

As part of his final year thesis Ian gained valuable experience in report writing, data input, invertebrate and plant identification. Ian also liaised with members of the AranLIFE project and local landowners on Inis Oirr, Aran Islands in the summer of 2016 while completing his thesis.

Ians key strengths are in Data management and GIS/MapInfo software. Since joining the Ornithology team at McCarthy Keville & O'Sullivan Ltd. He has been involved in a number of windfarm projects, utilizing his skills to compile data and create maps for surveys and figures.

Una Nealon PhD, B.Sc.

Úna Nealon is a Project Ecologist with McCarthy O'Sullivan Ltd. with over 9 years of experience in consultancy, research and conservation management. After gaining a first class honours degree in Environmental Science at NUIG, Úna worked as an Environmental Consultant for OES Consulting where she gained experience in multidisciplinary ecological surveys and impact assessment. In addition, she has held research roles in Tanzania and Madagascar, studying local flora and fauna, and developing conservation management plans. Before joining MKO in June 2016, she completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. Úna's primary expertise lies in bat ecology, particularly in relation to wind farm EIA. Beyond this, she is a skilled general ecologist, with experience in flora identification, habitat classification, GIS mapping, mammal surveys, Ecological Impact Assessment and Appropriate Assessment. Since joining MKO, Úna has been responsible for managing bat survey requirements for a variety of wind and solar energy planning applications, as well as other commercial, residential and infrastructure projects. This includes scope development, roost assessments, acoustic surveying, sonogram analyses, impact assessment and report writing. Within MKO, she works as part of a multi-disciplinary team to quickly identify potential

ecological constraints and to produce EIS Reports, Appropriate Assessment Screening Reports and Natura Impact Statements. Úna is a member of the Irish Ecological Association, Bat Conservation Ireland and is Secretary of Galway Bat Group.

David McNicholas B.Sc. (Env.), M.Sc. (Env.)

David McNicholas is a Senior Ecologist at McCarthy Keville O'Sullivan, Planning & Environmental Consultants. David holds a BSc (First Class Hons) Environmental Science and an MSc (Hons) Environmental, Health and Safety Management. David has over 8 years professional ecological consultancy experience. David specialises in the preparation of EIAs, EcIAs and NISs including ecological surveys and monitoring. David has worked on all phases of wind farm development from feasibility/ scoping, ecological surveys, preparation of full EIS chapters, construction phase environmental monitoring and post-construction ecological monitoring. David has worked as an Ecological Clerk of Works (ECoW) during the construction phase of ten large scale wind farms in Ireland and Northern Ireland, gained significant experience on the implementation of the environmental and ecological measures. David is a full member of the Chartered Institute of Ecology and Environmental Management (MCIEEM).

James Owens, B.Sc.

James Owens is an Assistant Ecologist with McCarthy O'Sullivan Ltd. with over 8 years of experience in private practice. James holds BSc (Hons) in Environmental Science and BSc in Forest Management. Prior to taking up his position with McCarthy Keville O'Sullivan in March 2017, James worked as a sub-consultant ecologist while finishing a research masters in plant ecology. James also worked for a number of years in the private forestry sector and has had involvement with all stages of the forestry cycle from site selection through to felling and re-afforestation. James' key strengths and areas of expertise are in vegetation surveys, tree surveys, habitat mapping and Appropriate Assessment Screening, Natura Impact Statements and Ecological Impact Assessments. Since joining MKO James has been involved as an ecologist on a range of energy infrastructure, commercial, recreational and residential projects where he has completed AASR's, EcIA's,,NIS's and biodiversity chapters of EIA Reports along with due diligence surveys and site supervision. Within MKO James works as part of a large multi-disciplinary team on various environmental and planning projects which has involved liaising with clients and he has also assisted in business development. James holds membership with both the Botanical Society of Britain and Ireland and the Society of Irish Foresters.

Joanna Mole BSc PGDipLA MSc CMLI

Joanna Mole is a Landscape and Visual Impact Assessment Specialist and Chartered Landscape Architect with McCarthy O'Sullivan Ltd. with over 15 years of experience in both private practice and local authorities. Joanna holds a BSc (Hons) in Landscape Design & Plant Science from Sheffield University, a Postgraduate Diploma in Landscape Architecture from Leeds Beckett University, and a MSc in Renewable Energy Systems Technology from Loughborough University. Prior to taking up her position with MKO in October 2017, Joanna worked as a Landscape Architect with Kav-Banof in Israel and held previous posts with CSR in Cork, LMK in Limerick, Geo Architects in Israel and Groundwork Bridgend in South Wales. Joanna is a Chartered Landscape Architect with specialist knowledge in Landscape and Visual Impact assessments for projects ranging from individual houses to large windfarms, cycle route design and landscape contract management. Since joining MKO Joanna has been involved in projects such as energy infrastructure, extraction industry and residential projects. Joanna holds chartered membership of the British Landscape Institute since 1998 and has been an examiner for British Landscape Institute professional practice exam.

Paul Sweeney BA. MSc.

Paul Sweeney is a Graduate Planner with MKO having joined the team in April 2018. Paul holds a BA (Hons) in Geography and English and a Masters in Planning and Sustainable Development from University College Cork where he graduated in 2017. Since joining MKO, Paul has developed experience in a range of sectors through various projects and planning issues with a current focus within the Environmental and Energy sector.

Owen Cahill B.Sc., M.Sc.

Owen is an Environmental Engineer with McCarthy O'Sullivan Ltd. with over 11 years of experience in the environmental management and construction industries. Owen holds BSc. (Hons) and MSc. in Construction Management and a Masters in Environmental Engineering. Prior to taking up his position with MKO in October 2013, Owen worked as an Environmental Officer with Kepak and prior to which he held a post with Pentland Macdonald Contaminated Land & Water Specialist in Northern Ireland. Prior to working in planning and environmental consultancy, Owen was employed within the construction industry where he gained significant experience on a variety of civil, residential and commercial projects. Owen's wide ranging multi sector experience has provided him with specialist knowledge and understanding of the challenges in the planning and delivery of developments with the minimum environmental impact and with practicality and constructability in mind. Owen's key strengths and areas of expertise are in project management, environmental impact assessment, wind energy & solar energy construction & environmental management planning and waste permit management. Since joining MKO Owen has been involved as a Project Manager on a range of energy infrastructure, commercial, residential, waste facility and quarry projects as well as managing the licensing requirements of a number of EPA licensed facilities. Within MKO Owen plays a large role in the management and confidence building of junior members of staff and works as part of a large multi-disciplinary team to produce EIS Reports. Owen has project managed the Environmental Impact Assessment of a range of development projects across the Ireland and holds Affiliate Membership with the Institute of Environmental Management & Assessment and is currently awaiting interview and assessment to become a Full Member and Chartered Environmentalist.

Stephen Corrigan B.Sc.

Stephen Corrigan is an Environmental Scientist with McCarthy O'Sullivan Ltd. with over three years of experience in private and public sector positions. Stephen holds a B.SC in Environmental Science. Stephen has specialist knowledge in environmental field surveys, database management, geographic information systems and data analysis. Stephen's key strengths and areas of expertise are in data management and GIS. Since joining MKO Stephen has been involved as an Assistant Environmental scientist on a significant range of energy infrastructure and private/public development projects, hydrological and ecological monitoring projects. Within MKO Stephen has a role in site construction monitoring, report writing and database management. Stephen works as part of a large multi-disciplinary team to produce EIS Reports, operational compliance reports and monitoring reports for MKO.

Eoin Gilson B.Sc., M.Sc.

Eoin is a Graduate Environmental Scientist with McCarthy O'Sullivan Ltd. who took up his position in October 2018. Eoin holds a BSc (Hons) in Microbiology and a MSc (Hons) in Applied Environmental Science. Eoin has specialist knowledge in environmental field surveys, data analysis and renewable energy systems. Eoin's key strengths and areas of expertise are in data management, report writing and environmental monitoring and management. On joining MKO Eoin has been involved on a range of renewable energy infrastructure projects, working as part of a large multi-disciplinary team to produce EIA Reports.

James Newell

James holds the position of CAD and Information Technology Technician with MKO since joining the Company in May 2006. Prior to joining MKO, he worked as a graphic designer and illustrator for over eight years. In recent years James' role has extended to include all wind farm visual modelling completed by the company. He is proficient in the use of MapInfo GIS software in addition to AutoCAD and other design and graphics packages.

Joseph O'Brien

Joseph O'Brien holds the position of CAD Technician. Joseph holds a BA Honours Level 8 Modelmaking, Design and Digital Effect, Institute of Art Design and Technology (IADT), Dun Laoghaire & City & Guilds Level 3 2D &3D AutoCAD certificates. Joseph joined MKO in 2016 and his role entails mapping, aerial registration and detailed design drawings for renewable, commercial and residential projects. Prior to joining us, Joseph worked as a free-lance CAD Technician for various projects.

1.8.2.2 Hydro Environmental Services Ltd.

Michael Gill

Michael Gill is an Environmental Engineer with over 12 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIA/EIS assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions.

David Broderick

David Broderick is a hydrogeologist with over 9 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies. David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIAs for a range of commercial developments.

1.8.2.3 Fehily Timoney & Company

Fehily Timoney & Company Ltd. (FT) recently acquired AGEC Ltd. adding to their growing geotechnical team. The geotechnical aspects of the report, which will be incorporated into the Geology & Soils and Water sections of the EIAR, will be completed by Fehily Timoney & Company Ltd. FT (previously AGEC) has extensive experience in the production of Peat Stability Assessments for wind energy developments. They provide specialist geotechnical engineering and engineering geology advice to local authorities, contractors and consultants, particularly for infrastructure projects forming part of the National Development Plan and also for private commercial and residential developments as they move on to sites with more complex ground conditions.

Gerry Kane

Gerry Kane joined AGEC Ltd. (now part of Fehily Timoney & Company Ltd.) as a Geotechnical Engineer in 2008. Gerry graduated from IT Carlow in 2008 with a BEng (Hons) degree in Civil Engineering. Gerry is a Geotechnical Engineer with over seven years' experience in geotechnical design

and analysis, supervision and interpretation of ground investigations, foundation & earthwork design, supervision of construction of bulk earthworks and structure foundations, slope stability analysis, desk studies and walkover surveys. Previous and current experience in the wind energy field has included work for wind farm developments in Ireland, Northern Ireland, Scotland, Wales and England. This work has covered Peat Stability Assessment Reports, Soils and Geology Chapters of EIAR's, site assessments for wind farm developments and the investigation of peat failures at wind farm sites.

Ian Higgins

Ian is a geotechnical engineer with over 20 years of experience in the design and supervision of construction of bulk earthworks, geotechnical foundation design, geotechnical monitoring and reviewing, reinforced earth design, slope stability assessments and 3rd party checking of piling and ground improvement designs. Ian's experience also includes the design, supervision and interpretation of ground investigations, including desk studies, walkover surveys, hazard mapping of rock excavations and slopes.

Ian has experience in many areas of civil engineering including highways, railways, energy projects and commercial developments.

1.8.2.4 AWN Consulting Ltd.

Dermot Blunnie

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng. from the University of South Wales, a M.Sc. from the University of Derby and IOA Diploma in Acoustics and Noise Control from the Institute of Acoustics. He has over 11 years' experience as an acoustic consultant and is a member of the Institute of Acoustics. He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

Leo Williams

Leo Williams (Acoustic Consutlant) holds an MA in Mechanical Engineering and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He is also an Associate Member of the IOA. He has extensive knowledge in aspects of environmental surveying, modelling and impact assessment, particularly for wind energy developments.

Mike Simms

Mike Simms BE MEngSc MIOA MIET, Senior Acoustic Consultant at AWN, who has worked in the field of acoustics for over 19 years and has been a consultant since 1998. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential.

1.8.2.5 Tobar Archaeological Services Ltd.

Tobar Archaeological Services is a Cork-based company in its 17th year in business. They offer professional nationwide services ranging from pre-planning assessments to archaeological excavation, and cater for clients in state agencies, private and public sectors.

Tobar's Directors, Annette Quinn and Miriam Carroll, are licensed by the Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs to carry out excavations in Ireland and have carried out work directly for the National Monuments Services of the Department of the Environment, Heritage

and Local Government. Tobar Archaeological Services has a proven track record and extensive experience in the wind farm industry from EIS stage through to construction stage when archaeological monitoring is frequently required.

1.8.2.6 Alan Lipscombe Traffic and Transport Consultants

Alan Lipscombe (B.Eng. Hons.) MIHT

In January 2007 Alan Lipscombe set up an independent traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic and transport modelling and is an accomplished analyst who has experience of a wide variety of modelling packages and methods.

1.9 Viewing and Purchasing the EIAR

Copies of this EIAR will be available online, including the Non-Technical Summary (NTS), on the Planning Section of the Leitrim County Council and Sligo County Council websites, under the relevant Planning Reference Number (to be assigned on lodgement of the application).

- Leitrim County Council: http://leitrimcoco.ie/eng/Services_A-Z/Planning-and-Development/
- Sligo County Council: http://www.sligococo.ie/planning/

This EIAR and all associated documentation will also be available for viewing at the offices of both local authorities. The EIAR may be inspected free of charge or purchased by any member of the public during normal office hours at the following address:

- Leitrim County Council,
  Áras an Chontae,
  St. George's Terrace,
  Carrick on Shannon,
  Co. Leitrim

- Sligo County Council,
  County Hall,
  Riverside,
  Sligo
  F91 Y763

The EIAR will also be available to view online via the Department of Planning, Housing and Local Government's EIA Portal, which will provide a link to the planning authority's website on which the application details are contained. This EIA Portal was set up by the Department as an electronic notification to the public of requests for development consent which are accompanied by an EIAR.

(https://www.housing.gov.ie/planning/environmental-assessment/environmental-impact-assessment-eia/eia-portal)

2. BACKGROUND

This section of the EIAR presents policy information on Energy and Climate Change policy and targets, the strategic planning context for the proposed development, the site selection and design process, a description of the proposed development site, size and planning history, scoping and consultation, and the cumulative impact assessment process.

2.1 Introduction

This section of the EIAR presents the various policies and targets which have been put in place at the various levels of Government both national and international in relation to renewable energy and climate change. The details below set out the need for the proposed development to aid in Ireland meeting its national targets and European commitments in relation to climate change and decarbonisation. As is discussed throughout this chapter all of the latest projections have shown that Ireland is not set to meet its 2020 targets. Within this chapter the information is presented and assessed under the following:

- Renewable Energy Resources,
- EU Legislation,
- Progress on Targets, and,
- National Energy Projections.

The proposed development comprises the provision of a wind farm which will generate renewable energy and provide it for use onto the national grid. The need to decarbonise the economy and reduce emissions has always been imperative, however, in recent years the urgency involved has become clearer to all stakeholders. The Climate Action Plan published by the Government in 2019 has clearly identified the need for and urgency of change, it states:

> *"The accelerating impact of greenhouse gas emissions on climate disruption must be arrested. The window of opportunity to act is fast closing, but Ireland is way off course.... The shift in climate is bringing profound shifts of desertification, rising sea levels, displaced population, profound challenges to the natural world, and economic and social disruption. We are close to a tipping point where these impacts will sharply worsen. Decarbonisation is now a must if the world is to contain the damage and build resilience in the face of such a profound challenge."*

The primary driver behind the proposed development is the need to provide additional renewable energy to offset the use of fossil fuels within the electricity generating sector. Increasing electricity generation from wind power represents the most economical renewable option to reduce emissions within the power generation sector and is the most mature technology available to achieve national targets that have been established for decarbonisation.

2.2 Renewable Energy Policy and Targets

2.2.1 Renewable Energy Resources

Renewable energy resources include solar, wind, water (hydropower, wave and tidal), heat (geothermal) and biomass (wood, waste) energy. These sources are constantly replenished through the cycles of nature, unlike fossil fuels, which are finite resources that are becoming increasingly scarce and expensive to extract.

Renewable energy resources offer sustainable alternatives to our dependency on fossil fuels as well as a means of reducing greenhouse gas emissions and opportunities to reduce our reliance on imported

fuels. These resources are abundantly available in Ireland, yet only a fraction has been tapped so far (Source: Sustainable Energy Authority of Ireland (SEAI) website, www.seai.ie).

A gradual shift towards increasing our use of renewable energy resources would result in:

- Reduced carbon dioxide emissions;
- Secure and stable energy for the long-term;
- Reduced reliance on fuel imports;
- Investment and employment in our indigenous renewable energy projects; often in rural and underdeveloped areas.

Renewable energy development is recognised as a vital component of Ireland's strategy to tackle the challenges of combating climate change and ensuring a secure supply of energy. Ireland is heavily dependent on the importation of fossil fuels to meet its energy needs, with imported fossil fuels accounting for 66% of Ireland's dependency in 2017 at an estimated cost of €4 billion. This high dependency on energy imports is highly risky and Ireland is currently extremely vulnerable both in terms of meeting future energy needs and ensuring price stability. ('Energy in Ireland 2018 Report', Sustainable Energy Authority of Ireland', December 2018).

2.2.2 EU Legislation

The European Union (EU) Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC) was adopted on 23rd April 2009. This Directive establishes a binding target of 20% of overall EU energy consumption to come from renewable sources by 2020, as well as a binding 10% minimum target for energy from renewable resources in the share of transportation fuels. Ireland's target under Directive 2009/28/EC is for renewable resources to account for 16% of total energy consumption by 2020. Directive 2009/28/EC imposes a legal obligation on each Member State to:

- Ensure that its 2020 target is met.
- Introduce "appropriate measures" and outline them in a National Renewable Energy Plan. The "appropriate measures" include ensuring that grid-related measures and administrative and planning procedures are sufficient to achieve the 2020 target. The Draft National Renewable Energy Plan for Ireland was published in June 2010.

Failure to meet EU targets on the use of energy from renewable sources could result in EU sanctions ('Jobs and Investment in Irish Wind Energy', Deloitte/Irish Wind Energy Association, 2009).

Ireland's mandatory target under Directive 2009/28/EC is for renewable resources to account for 16% of total energy consumption by 2020. This will be met by 40% from renewable electricity, 12% from renewable heat and 10% from the renewable transport sector.

2.2.2.1 2030 Climate and Energy Framework, 2014

The 2030 Climate and Energy Framework was adopted by EU leaders in October 2014 and marks a further development of EU renewable energy policy. The framework defines further EU wide targets and builds on the 2020 climate and energy package.

On the 30th November 2016, the EU Commission published a proposal for a revised Renewable Energy Directive to ensure that the target of at least 27% renewables in the final energy consumption in the EU by 2030 is met.

The European Commission published its proposal for an effort sharing regulation on the allocation of national targets for greenhouse gas emissions for the period 2021-2030 in July 2016. The proposal implements EU commitments under the Paris Agreement on climate change (COP21) which is further

discussed below and marks an important milestone in the allocation to Member States of a package of climate targets that were formally adopted as part of the 2030 Climate and Energy Framework.

The EU Climate and Energy Framework 2030, adopted by EU leaders in October 2014, sets out a policy framework for climate and energy in the period from 2020 to 2030 and aims to make the European Union's economy and energy system more competitive, secure and sustainable. The framework defines further EU wide targets and builds on the 2020 climate and energy package in setting three key targets for the year 2030 as follows:

- A binding commitment at EU level of at least 40% domestic Green House Gas reduction by 2030 compared to 1990;
- An EU wide, binding target of at least 27% renewable energy by 2030; and
- An indicative EU level target of at least 27% energy efficiency by 2030.

On the 27th of June 2018 EU ambassadors endorsed the provisional agreement reached by the Bulgarian Presidency on the revision of the renewable energy directive. The new regulatory framework is expected to pave the way for Europe's transition towards clean energy sources such as wind, solar, hydro, tidal, geothermal, and biomass energy. The agreement sets a headline target of 32% energy from renewable sources at EU level for 2030.

2.2.2.2 Progress on Targets

The overall share of renewables in primary energy in Ireland stood at 11.1% in 2018 which is up from the 2017 figure of 7.3%, and 7.9 in 2016. As per the EU Renewable Energy Directive, the target for Ireland is set at 16% share of renewable energy in gross final consumption (GFC) by 2020. As per the SEAI's Energy in Ireland 2018 Report, the contribution from renewables in 2005 was 2.8%, which as of 2017, has risen to 10.6% of the GFC. The SEAI's 2018 Report continues to note that the share of electricity from renewable energy has increased fourfold between 2005 and 2017 – from 7.2% to 30.1% – an increase of 23 percentage points over 12 years. In absolute terms, there has been a fivefold increase in the volume of renewable electricity generated from 1,873 GWh in 2005 to 8,877 GWh in 2017. Of this, it was noted that Wind energy accounted for 84% of the renewable electricity in 2017.

The June 2018 'Off Target Report' published by the Climate Action Network (CAN) Europe, which ranks EU countries ambition and progress in fighting climate change, listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate and renewable energy targets and is also off course for its unambitious 2030 emissions target. The report states:

> *"Ireland has failed to prepare effective policies to align near-term climate action with EU and Paris Agreement commitments. Without new, immediate and substantive efforts to cut emissions, Ireland faces annual non-compliance costs of around €500 million."*

The Department of Climate Change, Action & Environment (DCCAE) reported in their 'Fourth Progress Report on the National Renewable Energy Action Plan' (December 2017), that Ireland will achieve 13% of its 16% RES target by 2020. SEAI in their report 'Ireland's Energy Targets – Progress, Ambition & Impacts' (April 2016) estimates that Irelands inability to achieve its 2020 renewable energy targets will result in fines of between €65 million and €130 million per percentage shortfall on its overall binding target after 2020 until it meets its targets.

The Climate Change Advisory Council similarly notes within their *2019 Annual Review* that while the share of renewable electricity generation, particularly wind, is increasing in Ireland, the pace of decarbonisation of the electricity generation sector is not compatible with a low-carbon transition to 2050. As such, Ireland can continue to 'comply' with EU targets by purchasing emission allowances; however, the expenditure of public funds to do so would not result in any domestic benefit, and furthermore, would result in a more difficult and expensive challenge for the county to meet its future

2030 targets and beyond. The *Review* concludes that continued and additional investment in capacity and technologies in the renewable energy sector is required to reach these said targets.

Plate 2.1 shows the latest data available for the share of renewable energies in gross final energy consumption according to the Eurostat online data and the targets that have been set for 2020. The share of renewables in gross final energy consumption stood at 18.0% in the EU-28 in 2018. The data shows that twelve member states have reached a share equal to or above their 2020 target. This is not the case with Ireland who, as evident in Plate 2.1, are still considerably below meeting its 2020 target. Per the 2018 data Ireland was at 11.1% of its 16% target.

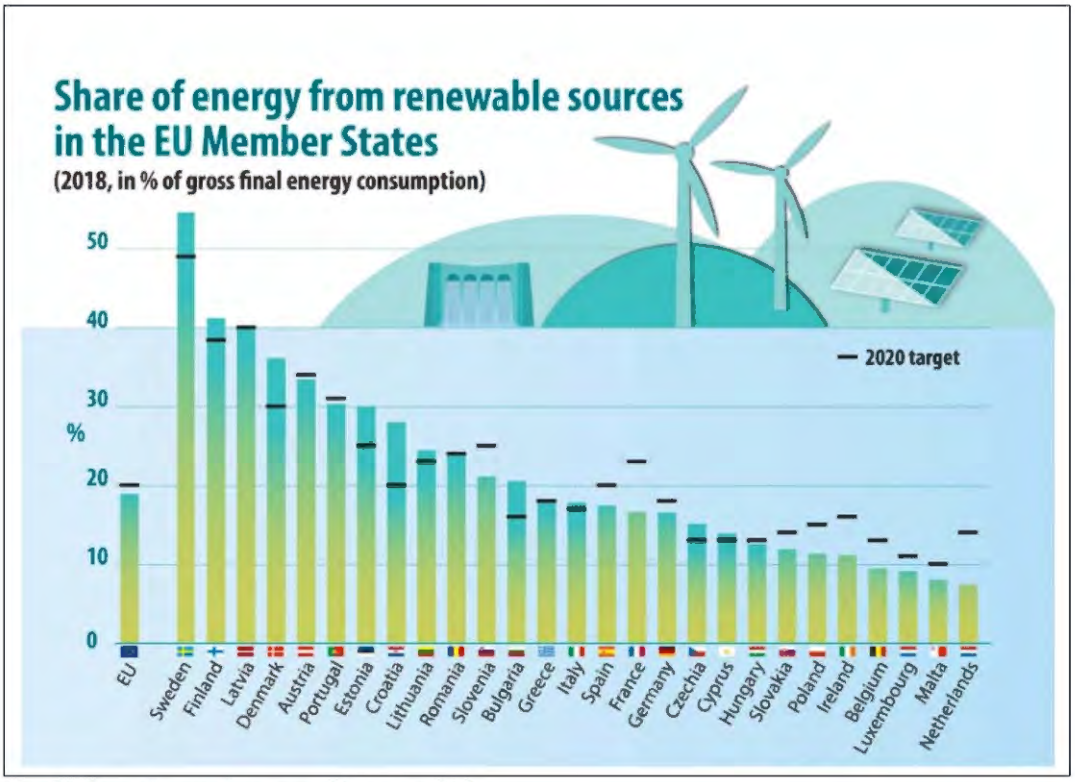

Plate 2-1 Share of energy from renewable sources, 2018

EirGrid in their '*All Island Generation Capacity Statement 2019 - 2028*' (September 2019), state that, in the absence of the National Energy and Climate Plan 2021 – 2030, it is assumed that renewable targets will be achieved largely through the deployment of additional wind powered generation in Ireland. New wind farms commissioned in Ireland in 2018 brought the total wind capacity to over 3666 MW, contributing to the increase in overall RES-E percentage to 32.5%, with wind energy accounting for 27.6%. EirGrid estimates that between 3.9 – 4.4 Gigawatts (GW) of wind may be required to meet the 2020 Renewable Energy Supply - Electricity (RES-E) target of 40%.

It is noted by EirGrid within their 2019 – 2028 statement that, at a median demand level, Ireland does not have adequate generation capacity to meet demand from 2026 once Moneypoint closes, and should any other plant close prior to this, earlier deficits may arise. This is especially pertinent with regard to the recent announcement that the Electricity Supply Board intends to close the peat-fired Shannonbridge and Lough Ree Power Stations at the end of 2020. In this context, the importance of wind energy becomes more apparent as it is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 650 homes[1].

It is noted that the key driver for electricity demand in Ireland for the next number of years is the connection of new large energy users, such as data centres. Specifically, there is currently 1000 MVA

[1] *https://www.iwea.com/about-wind/faqs*

demand capacity that is contracted to data centres and other large energy users. This statement notes that *'Large industrial connections normally do not dominate a country's energy demand forecast but this is the case for Ireland at the moment'*. EirGrid analysis shows that demand from data centres could account for 29% of all demand by 2028 in a median demand scenario (accounts for the connection of all 1400MVA of potential demand in the connection process). The median demand scenario is now higher than for last year's forecast for high demand which is indicative of additional data centre projects drawing demand from the grid and we are therefore closer to the higher demand scenario. It should be noted that each MW of additional data centre load will add at least 1 MW of wind to the 40% RES-E 2020 target[2]. Alternatively, 3 MW of wind could be required per MW of data centre electricity demand, if the data centre wants to commit to being powered by 100% renewable energy. Many data centres have made such commitments and have well-publicised company policies to use only renewable electricity for their power needs.

In October 2015, the Irish Wind Energy Association (IWEA) commissioned a study titled *'Data-Centre Implications for Energy Use in Ireland'* and concluded that an additional 1 GW of electricity demand may be required in Ireland by 2020 due to growth in data centres.

2.2.2.3 National Energy Projections - SEAI 2019

The SEAI National Energy Projections 2019, published in May 2019, details that in 2005, 5% of Ireland's energy came from renewable sources, in 2019 it is estimated that approximately 13% of Ireland's energy will be generated by renewable sources which is below the required 16% target.

The report details that there is still a significant way to go to achieving our European target of 16% and Ireland will not meet EU 2020 targets. Compared to other European countries Ireland was 22nd out of the EU-28 for overall renewable energy share and 26th out of the EU-28 for progress towards overall 2020 renewable energy target.

In the context of climate change the report states that:

> *"Climate change is now recognised as the biggest threat to life on earth, and it is now urgent that we take immediate action to reduce anthropogenic emissions of greenhouse gases to limit its damaging effects."*

With regard to the production of electricity it is noted that while Ireland has had considerable success in increasing the share of renewables in electricity generation that there is a need to continue to achieve in this sector and take full advantage of the country's abundant resources. The report also notes that as per the latest EirGrid Generation Capacity Statement there is a prediction of an increase of demand in the short terms with 3% to 5% per year listed.

The SEAI report states that the Renewable Energy Support scheme aims to increase the deployment rate, support up to 4,500 megawatts of additional renewable electricity by 2030 and diversify the renewable electricity portfolio. Policy measures that could help to meet the Government increased ambition include:

- Expediting the adoption of clear, and time bound, licensing and consenting procedures for off shore renewable energy development.
- Addressing technical grid challenges to incorporating very high levels of asynchronous renewables, for example via EirGrid's Delivering a Secure, Sustainable Electricity System (DS3) programme.

[2] *Data centres have high load factors of around 80%. Ech 1MW uses 24 x 365 x 80% = 7GWh. EU targets require that 40% or 3GWh of that should come from renewables. A 1MW wind turbine produces roughly 3GWh/yr.*

- Creating a clear, and timely, grid connection access and concession regime for offshore and new onshore renewable energy development, with due regard for methods by which the State can most cost effectively reduce or manage risk.
- Creating markets for grid services such as energy storage and other services supporting high levels of renewables on-grid.
- Supporting onshore wind farms reaching end of life, by providing clarity for re-powering investment decisions intertwined with new wind guidelines.
- Assisting the timely delivery of increased interconnection.
- Establishing corporate power purchase agreements mechanisms with mandated minimum renewable energy purchases or self-generation for large electricity demand users to leverage private investments in renewable electricity.
- Encouraging prosumers by consideration of communication methods, market mechanisms, market rules, frameworks and setting a price for export to the grid from point source generation, in line with the ambitions outlined in the Clean Energy Package.
- Developing community energy and small-scale renewable generation projects to enable a shift to a more distributed generation system with demand response capabilities.

Section 9 of the report details the effort which must be made for closing the gaps to targets. It is detailed that 'given the cumulative nature of emissions, an immediate acceleration of emissions reductions is required to put Ireland on the committed long-term trajectory'. Included as part of this is the country's commitments under the Paris Agreement. Further to this:

> *"Increased ambition and delivery targets supporting a sustainable energy transition are anticipated to be included in the upcoming All of Government Climate Action Plan being produced by DCCAE."*

It is noted under the strategy that to achieve the level of ambition set for 2020 and 2030 the country will be dependent on:

- Increased deployment rates of sustainable energy technologies and practices across the entire economy.
- The development of a national training and skills strategy to support growth of the clean energy technology sector.
- Support for changes in business models, nascent clean energy technology supply chains and the addressing of existing market failures.
- Early resolution of planning and regulatory barriers, including continued public engagement, and the development of appropriate market structures – especially for electrification of heat and transport supported with high levels of renewable electricity.
- Significant mobilisation of private investment in renewable energy and energy efficiency –additional spend on efficiency is known to achieve multiple benefits including warmer, healthier and more cost-effective buildings.
- The acceleration of iunovation and technology adoption, especially in the area of electricity demand response, grid flexibility and storage.
- The exploitation of advances in Information Communications Technology (ICT) and national strengths in this field to advance renewables and energy efficiency, particularly in relation to passenger mobility solutions.
- Aggressively adopting the 'avoid, shift and improve' transport energy policy principles – this involves managing mobility demand to avoid trips or a shift to the most efficient modes, plus improving the energy efficiency of vehicles as well as reducing the carbon intensity of fuels.
- Taking in the ethical cost of carbon consideration in all aspects of public and private enterprise planning, involving the enforcement of the polluter pays principle by including the negative external costs associated with emissions such as healthcare or environmental reparation costs.

- An approach to carbon neutrality in the agriculture and land-use sector, including forestry, that does not compromise capacity for sustainable food production.
- The promotion of an environmentally aware and concerned citizen and community ideology to combat climate change, including recognition of the impact of diet and consumerism on climate change.

2.2.2.4 SEAI Energy in Ireland 2019 Report

In December 2019 SEAI produced the Energy in Ireland 2019 report, which provides the most up to date fignres available (from 2018) in relation to energy production and consumption in Ireland. The report found that despite the increase in energy demand energy-related CO2 emissions fell slightly mainly due to (a) a reduction in the amount of coal used for electricity generation (arising from a technical fault at Moneypoint – Ireland's only coal-fired electricity generation plant) combined with (b) increased contributions from wind generation. In relation to renewable energy targets, the 2019 report found that:

- The share of electricity generated from renewable sources increased by 3.1 percentage points in 2018, to 33.2%. The 2020 target being 40%.
- The share of energy used for transport from renewable energy resources decreased from 7.4% in 2017 to 7.2% 2018. The 2020 target is 10%.
- The share of energy used for heat from renewable resources decreased from 6.7% in 2017 to 6.5% in 2018. The 2020 reduction target is 12%.

Furthermore the 2019 report also found that wind generation accounted for 28.1% (normalised) of all electricity generated. It was the second largest source of electricity generation in 2018 after natural gas. Wind energy accounted for 84% of the renewable energy generated in 2018. At the end of 2018 the installed capacity of wind generation reached 3,676MW, and during 2018 358MW of wind capacity was installed. The SEAI 2019 report also makes the following statements:

> *"EirGrid and ESB Networks note that as of 2019 there is 1,873 MW of additional wind generation planned, either with connection contracts in place or applications for connection underway. Historically, there has been a maximum of just over 500 MW installed in any one year since 2005 and on average the installation rate has been 200 MW."*

> *"In relation to the displacement of fossil fuels by renewable energy, it is estimated that in 2018 approximately €623 million in fossil fuel imports were avoided, of which €432 million was avoided by wind generation."*

In relation to the findings of this December 2019 SEAI report it is clear that wind energy represents the strongest and most deployable renewable energy resource available to reduce dependence on fossil fuels in Ireland. While it is clear that additional deployment is on-going, it is also apparent that it is unlikely that the 2020 targets for renewable electricity generation will be met. Achieving targets becomes even more challenging in the context of increasing electricity demand.

The proposed development represents an opportunity to bring forward an additional renewable energy source which will contribute towards achieving further decarbonisation of the electricity generation sector.

2.2.3 National Energy Policy

2.2.3.1 Introduction

This section of the EIAR provides a breakdown of national energy policy with regards to the proposed development. Under the national policy energy section the following are discussed:

- Ireland's Energy Policy Framework 2007-2020,
- National Renewable Energy Action Plan,
- Strategy for Renewable Energy 2012-2020
- White Paper on Energy Policy in Ireland 2015-2030,
- Ireland's Transition to a Low Carbon Energy Future 2015-2030
- Electricity Support Schemes: I-SEM Arrangements Decision Paper, 2017
- Draft National Energy & Climate Plan 2021-2030

Renewable Electricity Support Scheme RESS 2020, February 2020 National policy has developed in line with European and International policies, targets and commitments, in that the importance and urgency of decarbonising the energy generation sector, the economy in general and reducing greenhouse gas emissions has become increasingly more apparent. The proposed development complies with the nationally stated need to provide a greater amount of renewable energy onto the national grid and will further reduce the national reliance on fossil fuels for electricity generation.

2.2.3.2 Ireland's Energy Policy Framework 2007-2020

A Government White Paper entitled *'Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020'* was published by the Department for Communications, Marine and Natural Resources in 2007. Combined with our peripheral location and the fact that the majority of Irish energy requirements are imported, leaves Ireland vulnerable to supply disruption and imported price volatility, as stated in the White Paper. The primary objectives of the Government's energy policy as set out in the Paper are security of supply, environmental sustainability and economic competitiveness. The Energy Policy Framework 2007 – 2020 sets out clear actions, targets and timeframes for meeting these interlinked objectives.

Ireland's energy policy priorities are framed in the context of the European Union. Directive 2009/28/EC on the Promotion of the Use of Energy from Renewable Sources sets a target for Ireland for 16% of energy consumption to come from renewable sources by 2020. The 2007 Government White Paper sets a more ambitious target of 33% for energy consumption from renewable sources by 2020. This target was further increased to 40% by the Minister for Communications, Energy and Natural Resources, in 2008 as part of the Government's strategy to make the "green economy" a core component of its economic recovery plan.

In Ireland, it is widely acknowledged that the vast majority of the renewable electricity requirement is expected to be met through the development of indigenous wind power, as Ireland has a strong wind resource potential, with one of the best onshore wind speed averages in Europe ('The Value of Wind Energy to Ireland', Pőyry, 2014). In 2015, wind energy accounted for 84% of renewable electricity generation. 2016 was less windy than 2015 and electricity generated from wind fell by 6.5% but still accounted for 82% of renewable electricity ('Energy in Ireland 1990 – 2016', Sustainable Energy Authority of Ireland, 2017). Further, the SEAI Energy In Ireland 2019 Report (December 2019) confirms that most of the growth in renewable energy has come from wind. Wind provided 84% of all renewable energy generated in 2018.

The Energy White Paper 2007 states that renewable energy will be a critical and growing component of Irish energy supply to 2020 and beyond. The Government's strategic goals for sustainable energy include addressing climate change by reducing energy-related greenhouse gas emissions and accelerating the growth of renewable energy sources. Renewable energy and enhanced efficiency in power generation are integral to the Government's strategy to deliver Ireland's climate change targets under the Kyoto Protocol. The Paper states:

> *"Renewable energy is an integral part of our climate change strategy and sustainability objectives. The additional diversity which renewables bring to Ireland's energy demand will also make a direct contribution to our goal of ensuring secure and reliable energy supplies."*

2.2.3.3 National Renewable Energy Action Plan, 2010

Article 4 of Directive 2009/28/EC on the promotion of the use of energy from renewable sources required each Member State to adopt a national renewable energy action plan (NREAP) to be submitted to the European Commission. The NREAP sets out the Member State's national targets for the share of energy from renewable sources to be consumed in transport, electricity and heating and cooling in 2020, and demonstrates how the Member State will meet its overall national target established under the Directive.

Ireland's National Renewable Energy Action Plan (NREAP) sets out the Government's strategic approach and planned measures to deliver on Ireland's 16% target under Directive 2009/28/EC. In relation to wind energy, the NREAP states:

> *"It is noted that as a country, Ireland has immense potential for the development of renewable energy particularly wind energy, both on and offshore and wave energy. The development and expansion of the use of renewable energy, together with measures aimed at a reduction and more efficient use of energy are important as regards meeting our climate change objectives and priorities, both nationally and at European level. At a high level a significant increase in renewable energy and the protection of the environment are thus mutually reinforcing goals."*

2.2.3.4 Strategy for Renewable Energy 2012-2020

The then Department of Communications, Energy and Natural Resources publication, *Strategy for Renewable Energy 2012 – 2020*, outlines the strategic goals which underpin the Government's energy and policy objectives. The Strategy articulates the key actions to be undertaken to support the development of each of the renewable energy sectors to deliver on Ireland's binding 2020 targets under the Renewable Energy Directive. It acknowledges the national importance of developing renewable energy and confirms the Government's commitment to this.

The Strategy sets out 5 no. strategic goals, the first of which is as follows:

> *"Strategic Goal 1 - Progressively more renewable electricity from onshore and offshore wind power for the domestic and export markets."*

The proposed wind farm will produce electricity for the domestic market and have the possibility of connecting to wider markets via the existing and planned interconnectors to the UK and France.

In order to achieve Strategic Goal 1 of the Strategy sets out a number of key actions, including the following:

- Support delivery of the 40% target for renewable electricity through the existing GATE processes. A further targeted Gate may be developed, if necessary, following a review of the take-up of Gate 3 offers, while developing a next phase plan led approach for additional onshore capacity in future.
- Review with the Department of Environment and CER the scope for further streamlining authorisation and planning processes for renewable energy projects.
- Implement REFIT 2 for onshore renewable energy and maintain a predictable and transparent REFIT support framework for onshore wind which is cost competitive.

The Strategy highlights the economic benefits onshore wind projects can have on the Irish economy:

> *"Further strategic deployment of onshore wind projects will develop a base of indigenous and foreign companies and create employment in the short-term in wind farm construction, possible turbine component manufacturing and servicing, the opportunity to capture*

international supply chain opportunities and the manufacture of niche onshore renewable energy generating equipment".

2.2.3.5 White Paper on Energy Policy in Ireland 2015-2030

On 12th May 2014, *'The Green Paper on Energy Policy in Ireland'* was launched, opening the way for a public consultation process on the future of energy policy in Ireland for the medium to long-term. The paper acknowledged that energy is an integral part of Ireland's economic and social landscape; and that a secure, sustainable and competitive energy sector is central to Ireland's ability to attract and retain Foreign Direct Investment and sustain Irish enterprise. The three key pillars of energy policy are to focus on security, sustainability and competitiveness.

A Government White Paper entitled *'Ireland's Transition to a Low Carbon Energy Future 2015-2030'* was published in December 2015 by the Department of Communications, Energy and Natural Resources. This Paper provides a complete energy update and a framework to guide policy up to 2030. The Paper builds upon the White Paper published in 2007 and takes into account the changes that have taken place in the energy sector since 2007.

The policy framework sets out a vision for a low carbon future that maintains Ireland's competitiveness and ensures a supply of affordable energy. The paper advises that a range of policy measures will be employed to achieve this vision and will involve amongst many things, generating electricity from renewable sources of which there are plentiful indigenous supplies and increasing the use of electricity and bio energy to heat homes and fuel transport.

In this White Paper the DCENR confirmed that onshore wind is the cheapest form of renewable energy in Ireland:

> *(Onshore Wind) "is a proven technology and Ireland's abundant wind resources means that a wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."*

2.2.3.6 Ireland's Transition to a Low Carbon Energy Future 2015-2030

As discussed above a Government White Paper entitled 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' was published in December 2015 by the Department of Communications, Energy and Natural Resources. This Paper provides a complete energy update and a framework to guide policy up to 2030. The Paper builds upon the White Paper published in 2007 and takes into account the changes that have taken place in the energy sector since 2007.

The policy framework was developed to guide policy and actions that the Irish Government intends to take in the energy sector up to 2030 and also reaching out to 2050 to ensure a low carbon future that maintains Ireland's competitiveness and ensures a supply of affordable energy. The Energy Vision 2050, as established in the White Paper, describes a 'radical transformation' of Ireland's energy system which will result in greenhouse gas (GHG) emissions from the energy sector reducing by between 80% and 95%, compared to 1990 levels. The paper advises that a range of policy measures will be employed to achieve this vision and will involve amongst many things, generating electricity from renewable sources of which there are plentiful indigenous supplies and increasing the use of electricity and bio energy to heat homes and fuel transport.

In this White Paper, the then DCENR confirmed that onshore wind is the cheapest form of renewable energy in Ireland, stating:

> *"Onshore wind continues to be the main contributor (18.2% of total generation and 81% of RES-E in 2014). It is a proven technology and Ireland's abundant wind resource means that a*

wind generator in Ireland generates more electricity than similar installations in other countries. This results in a lower cost of support."

2.2.3.7 Electricity Support Schemes: I-SEM Arrangements Decision Paper, 2017

The Department of Communications, Climate Action and Environment (DCCAE) has updated its existing electricity support schemes supported by the Public Service Obligation (PSO) Levy (primarily for renewable energy). In May 2017, DCCAE published an information paper which outlined a number of options being considered as part of this decision-making process and set out the Department's emerging thinking on the optimal outcome. Having sought stakeholder views in relation to the options being considered (as set out in the May 2017 docnment) and drawing on the supporting analysis provided by the EirGrid modelling, the DCCAE published its final decisions on these matters in June 2018. The three published decisions are set out below, however, it should be noted that the DCCAE has reserved the right to periodically review the impact of the decisions.

- Decision 1: The market revenue calculation for the purposes of calculating the PSO levy for supported wind generation (Alternative Energy Requirement (AER), Renewable Energy Feed In Tariff (REFIT) 1 and 2) will be amended to adapt to the Integrated Single Electricity Market (ISEM). The market revenue calculation for wind generators will, for the energy component, be based on the lower of a blend of 80% of the Day Ahead Market Price and 20% of the Balancing Market Price, and the Day Ahead Market Price for all supported wind generators above 5MW capacity. For supported wind generators below 5 MW, the market revenue calculation will, for the energy component, be based on the lower of a blend of 70% of the Day Ahead Market Price and 30% of the Balancing Market Price, and the Day Ahead Market Price.
- Decision 2: The market revenue calculation for the purposes of calculating the PSO levy for other supported generation (under REFIT 1, REFIT 2, REFIT 3 and the Peat PSO Scheme) will be amended to adapt to the Integrated Single Electricity Market. For these generators (peat, hydro and biomass) supported under the PSO levy, the market revenue calculation for the energy component will be based on the Day Ahead Market Price.
- Decision 3: The market revenue calculations for the purposes of calculating the PSO levy for all supported generation will take into account only capacity market revenues and not capacity market costs.

2.2.3.8 Draft National Energy & Climate Plan (NECP) 2021-2030, December 2018

The Draft National Energy & Climate Plan (NECP) 2021-2023 was published by the Government of Ireland in December 2018. The NECP has been prepared in accordance with the Governance of the Energy Union and Climate Action Regulation. This first draft takes into account energy and climate policies developed to date, the levels of demographic and economic growth identified in the Project 2040 process and includes all of the climate and energy measures set out in the National Development Plan 2018-2027.

The NECP sets out how EU Countries (including Ireland) intend to address energy and climate related issues[3]:

- energy efficiency
- renewables
- greenhouse gas

[3] *https://ec.europa.eu/info/energy-climate-change-environment/overall-targets/national-energy-and-climate-plans-necps_en*

- emissions reductions
- interconnections
- research and innovation

Furthermore a progress report must be prepared by each country within the EU every 2 years. The consultation period for the NECP closed in February 2019, it was expected that a final version of the NECP was to be submitted in December 2019 however it appears that this deadline has been missed.

2.2.3.9 Renewable Electricity Support Scheme RESS 2020, February 2020

In February 2020 the Government of Ireland published the *'Terms and Conditions for the First Competition Under the Renewable Electricity Support Scheme RESS 2020'*. It is an aim of the RESS to promote the generation of electricity from renewable sources. The Renewable Electricity Support Scheme (RESS) is an auction scheme in which renewable energy projects bid for grid capacity. The noted document sets out the terms and conditions that will apply to the first competition to be conducted under the RESS and to the ongoing administration of awards made in the RESS 1 Auction.

The RESS lists the following points as key elements within the document:

- It has been designed to promote investment in renewable energy generation to contribute toward Ireland's ambition of 70% renewable electricity, and an EU-wide renewable energy target of 32%, by 2030, within a competitive auction based, cost effective framework.
- It has been designed to deliver on a broader range of policy objectives including:
  - the provision of pathways and supports for communities to participate directly in renewable energy projects
  - broadening the renewable electricity technology mix (the diversity of technologies);and
  - increasing energy security, energy sustainability and ensuring the cost effectiveness of energy policy.

The first auction which will take place under the RESS will be RESS1, under this eligible renewable electricity projects will compete within an auction. Eligible projects include onshore wind, offshore wind, solar, hydro along with many other renewable generation methods. Should an applicant be successful under this system they will be invited to submit an offer price on their RESS project. Following on from this stage the RESS1 auction will be conducted where the potential winning projects will be determined.

The first auction is expected to deliver up to an increase of 3,000GWh in renewable electricity generation by the end of 2022

2.2.4 Summary of Compliance with Renewable Energy Policy and Targets

Ireland faces significant challenges to meet its current 2020 targets, EU targets for renewable energy by 2030, and its commitment to transition to a low carbon economy by 2050. It is now clear that Ireland is unlikely to meet its 2020 target (all predictions and modelling point towards this fact albeit that no data analysis is yet available for 2020) as well as the longer-term movement away from fossil fuels. Furthermore, the severity of the situation was highlighted by the Irish Government, who, in 2019 declared a climate emergency. The proposed Croagh Wind Farm will help Ireland address these challenges as well as addressing the country's over-dependence on imported fossil fuels.

2.3 Climate Change Policy and Targets

2.3.1 Introduction

This section of the EIAR presents the various policies and targets which relate to climate change. The below headings and sub-headings explore climate change in the context of EU and national policy and are broken down into the following sections:

- Impacts on Climate Change
- International Policy
  - United Nations Framework Convention on Climate Change
- Kyoto Protocol Targets
  - Doha Amendment to the Kyoto Protocol
  - COP21 Paris Agreement
  - COP25 Madrid- Current Progress
  - Progress on Targets
  - Emissions Projections
- National Policy
  - National Climate Change Adaptation Framework 2012
  - National Adaptation Framework - Planning for a Climate Resilient Ireland 2018
  - National Policy Position on Climate Action and Low Carbon Development, 2014
  - Climate Action and Low Carbon Development Act 2015
  - National Mitigation Plan 2017
  - Report of the Joint Committee on Climate Action Climate Change: A Cross-Party Consensus for Action, March 2019
  - Climate Action Plan, 2019

International and national policy consistently identifies the need to reduce greenhouse gas (GHG) emissions and stresses the importance of reducing global warming. The context of international policy has altered over the last 30 years from being of a warning nature to the current almost universally accepted belief that we are in a climate crisis. The current proposed development at Croagh, as a generator of renewable energy, will contribute to the decarbonisation of the energy sector and reduce harmful emissions. In this regard, it is in broad compliance with national and international climate change policy and targets.

2.3.2 Impacts on Climate Change

Climate change, in the context of EU and national policy, refers to the change in climate that is attributable to human activity arising from the release of greenhouse gases into the atmosphere and which is additional to natural climate variability (Department of the Environment, Heritage and Local Government, 2006).

In 2008, the Environmental Protection Agency (EPA) published the results of a study entitled 'Climate Change – Refining the Impacts for Ireland', as part of the STRIVE (Science, Technology, Research and Innovation) Programme 2007 – 2013. This report stated that mean annual temperatures in Ireland have risen by 0.7° Celsius (C) over the past century. Mean temperatures in Ireland relative to the 1961 to 1990 averages are likely to rise by 1.4 to 1.8°C by the 2050's and by more than 2°C by the end of the century due to climate change.

Under a report published by the EPA titled *"Irish Climate Futures: Data for Decision-making"* (June 2019) the following is acknowledged:

"That the world has warmed since the 19th century is unequivocal. Evidence for warming includes changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; and sea level and atmospheric water vapour."

The report continues to note that should business as usual continue the Earth's average temperature is likely to increase by between 2.6°C and 4.8°C above today's levels, for Ireland, the changes listed (extreme events and sea level rise) would probably mean more frequent wet winters, dry summers and hot summers. It is acknowledged that this would pose challenges for water and flood risk management, agriculture and tourism.

Future precipitation changes are less certain to project than temperature but constitute the most important aspect of future climate change for Ireland. The study projects that winter rainfall in Ireland by the 2050's will increase by approximately 10%, while summer rainfalls will reduce by 12 – 17%. Lengthier heatwaves, much reduced number of frost days, lengthier rainfall events in winter and more intense downpours and an increased propensity for drought in summer are also projected. The STRIVE report on climate change impacts states that Ireland can and must adapt to the challenge of climate change. It notes that:

"Barriers to this, both scientific and socio-economic, are required to be identified and addressed in order that Ireland can be optimally positioned to thrive in a changing world."

2.3.3 International Policy

2.3.3.1 United Nations Framework Convention on Climate Change

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC), as a framework for international efforts to combat the challenge posed by climate change. The UNFCCC seeks to limit average global temperature increases and the resulting climate change. In addition, the UNFCCC seeks to cope with impacts that are already inevitable. It recognises that the climate system is a shared resource whose stability can be affected by industrial and other emissions of carbon dioxide and other greenhouse gases. The framework set no binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. Instead, the framework outlines how specific international treaties (called "Protocols" or "Agreements") may be negotiated to set binding limits on greenhouse gases.

Ireland is a Party to the Kyoto Protocol, which is a protocol to the UNFCCC. The Kyoto Protocol is an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding. Further details on Ireland's obligations under the Kyoto Protocol are presented below.

2.3.4 Kyoto Protocol Targets

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions of 8% below 1990 levels in the period 2008 to 2012. Ireland's contribution to the EU commitment for the period 2008 – 2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

2.3.4.1 Doha Amendment to the Kyoto Protocol

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 5% against 1990 levels. During the second commitment period, over 130 Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020; however, the composition of Parties in the second commitment period is different from the first.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

2.3.4.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the UNFCCC. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The Agreement provides for a limitation of the global average temperature rise to well below 2°C above pre-industrial levels and to limit the increase to 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

An article published by the IPCC (Intergovernmental Panel on Climate Change) on the 6th October 2018 titled 'Global Warming of 1.5oC'. The article details the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways; in the context of mitigation pathways, strengthening of the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. This report is part of an invitation contained in the Decision of the 21st Conference of Parties of the United Nations Framework Convention on Climate Change to adopt the Paris Agreement, and provides an update on the impact of climate change if emissions are not reduced.

2.3.4.3 COP25 Madrid- Current Progress

COP25, the 25th session of the COP, was held between the 2nd and 13th of December 2019 in Madrid. The conference was characterised by repeated warnings from civil society (NGOs and corporates) on emerging evidence and scientific consensus on climate change risk. Specifically, it is noted that there are only '10 years left' before the opportunity of limiting global warming to 1.5°C is no long feasible. As such, the only scenario that makes it possible is a '7.6% reduction of global GHG emissions every year between 2020 and 2030, and to reach net zero emissions by 2050'. However, there was no consensus achieved between States to finalise the operating rules of the Paris Agreement and ensure that it became operational by 2020. Three issues which emerged between States from the COP25 are summarised below:

- There was no uniform consensus between States to raise countries' climate ambitions, e.g. to make increased commitments in light of growing climate change data. Some

States were opposed to imposing any obligation on countries to submit enhanced pledges next year, arguing it should be each country's own decision. All states must submit a review of their commitments for COP 26 in 2020. At the current level of climate targets, within a decade, the objective of the Paris Agreement will no longer be achievable;

- There was no agreement on finalising Article 6, the foundations for international cooperation to combat climate change. The aim was to establish the rules for new international mechanisms for financing and transferring GHG emission reductions; and
- There was no agreement on financing (Green Climate Fund); specifically, relating to both loss and damage caused by climate change.

Despite the lack of consensus to the above challenges, the COP25 did achieve ruore limited success in the introduction of the *"San Jose Principles for High Ambition and Integrity of International Carbon Markets*", which sets out the framework on which a robust carbon market should be built. These 12 no. principles include, but are not limited to:

- Ensures environmental integrity and enables the highest possible mitigation ambition;
- Delivers an overall mitigation in global emissions, moving beyond zero-sum offsetting approaches to help accelerate the reduction of global greenhouse gas emissions;
- Prohibits the use of pre-2020 units, Kyoto units and allowances, and any underlying reductions toward Paris Agreement and other international goals; and
- Ensures that double counting is avoided and that all use of markets toward international climate goals is subject to corresponding adjustments.

These principles were supported by 23 EU, including Ireland, and Latin American countries, 5 pacific islands and 2 countries in the Caribbean.

In addition, the European Union's Green Pact was introduced on the 11th of December with agreement of the European Council and all Member States (except Poland)on the ambition of climate neutrality in 2050, supported by a financing plan of €1,000 billion over 10 years.

2.3.4.4 Progress on Targets

The *'Europe 2020 Strategy'* is the EU's agenda for growth and jobs for the current decade. The Europe 2020 Strategy targets on climate change and energy include:

- Reducing GHG emissions by at least 20% compared with 1990 levels;
- Increasing the share of renewable energy in final energy consumption to 20%; and
- Moving towards a 20% increase in energy efficiency.

The 'Europe 2020 indicators – climate change and energy' report[4] provides a summary of recent statistics on climate change and energy in the EU, with reference to the progress of Member States in meeting the required targets. In 2016, EU greenhouse gas emissions, including emissions from international aviation and indirect carbon dioxide (CO_2) emissions, were down by 22.4% when compared with 1990 levels. The EU is therefore expected to exceed its Europe 2020 target of reducing GHG emissions by 20% by 2020. In 2016, renewable energy provided 17.0% of gross final energy consumption in the EU, up from 9 % in 2005.

However, regarding the progress of individual Member States, and Ireland in particular, the Europe 2020 indicators include the following statements:

[4] (http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_climate_change_and_energy)

- 24 countries are on track to meet their GHG targets, except Austria, Belgium, Ireland and Luxembourg;
- Luxembourg emitted the most GHG per capita in the EU in 2014 followed by Estonia, Ireland, the Czech Republic and the Netherlands; and
- All EU countries have increased their renewable energy share between 2005 and 2014. Twelve have more than doubled their share, albeit from a low base. Nine have already met their 2020 targets. In 2014, France, the Netherlands, the United Kingdom and Ireland were farthest from reaching their national targets.

While the EU as a whole is projected to exceed its 2020 target of reducing GHG emissions by 20%. The Europe 2020 report emphasises the importance of continued action on climate change:

> *"Despite the EU's shrinking share in global CO2 emissions, recent findings on the potentially catastrophic impacts of climate change confirm the ongoing importance of its climate and energy goals. EU emission cuts alone cannot halt climate change, but if it can show that a low-carbon economy is feasible, and can even increase innovation and employment, it will serve as a role model to other regions. Continuous investment in advanced low-carbon technologies can also help the EU uphold technological leadership and secure export markets. A successful transformation of the energy sector ... is pivotal in this respect."*

The European Commission report *'Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions'* was published in February 2017. This report provides a comprehensive overview of renewable energy deployment in the EU and progress towards meeting the 2020 targets. The report states that the vast majority of Member States are *"well on track in terms of renewable energy deployment"*. Four Member States –Ireland, Luxembourg, the Netherlands and the United Kingdom are currently projected not to meet their national binding targets. The United Kingdom's expected gap is however very short (approximately 0.2%) so it is expected that Ireland will be one of only three Member States projected to not meet their national binding 2020 targets.

While official figures for 2020 have not been released to date, the 2019 SEAI National Energy Projections Report, published last year (2019) acknowledges that Ireland will fall short of its 2020 targets, it states "...it is expected that Ireland will fall short of its mandatory European target for an overall 16% renewable energy share by 2020, with overall achievement approximately 13%.", The report goes on to confirm *"Compared with other European Countries Ireland was 22nd out of the EU28 for overall renewable energy share and 26th out of the EU-28 for progress towards overall 2020 renewable energy target."*

2.3.4.5 Emissions Projections

In June 2019, the EPA published an update on Ireland's Greenhouse Gas Emission Projections 2018-2040. The report provides an assessment of Ireland's progress towards achieving its emission reduction targets set under the EU Effort Sharing Decision (Decision No 406/2009/EU) – i.e. to achieve a 20% reduction of non-Emission Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the 2013-2020 period.

Greenhouse gas emissions are projected to 2020 using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 are implemented. The 'With Additional Measures' scenario assumes implementation of the 'With Existing Measures' scenario in addition to further implementation of Government renewable and energy efficiency policies and measures, as set out in the NREAP and the National Energy Efficiency Action Plan (NEEAP).

The EPA Emission Projections Update notes the following key trends:

- 2019 greenhouse gas emission projections show total emission increasing from current levels by 1% and 6% by 2020 and 2030, respectively, under the 'With Existing Measures' scenario. Under 'With Additional Measures', emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030, respectively;
- Under the 'With Existing Measures', emissions from Energy Industries are projected to increase by 31% between 2018 and 2030 to 15.4 Mt CO2eq. Under the 'With Additional Measures', emissions between 2018 and 2030 are predicted to decrease by 27% to 8.6 Mt CO_2eq;
- Under 'With Existing Measures', approximately 41% of electricity generation is projected to come from renewable energy sources by 2030. In the 'With Additional Measures' scenario, it is estimated that renewable energy generation increases to approximately 54% of electricity consumption;
- Agriculture and transport dominate non-ETS sector emissions accounting for 75% and 80% of emissions in 2020 and 2030, respectively. In 2020, the sectors with the largest contribution of emissions are Agriculture, Transport and Energy Industries with 34%, 21% and 20% share in total emissions, respectively, under the With Additional Measures scenario. In 2030, this is projected to change to 38%, 22% and 16% for these sectors, respectively, which reflects the growth in emissions from agriculture and reduction of emissions from power generation; and
- Ireland has exceeded its annual binding limits in 2016 and 2017. However, even using this mechanism, Ireland will still be in non-compliance according to the latest projections.

The 2019 EPA report states that "A significant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat". Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by approximately 10.3 Mt CO2 (metric tonnes of Carbon Dioxide) under the "With Existing Measures" scenario and 9.2 Mt CO_2 under the "With Additional Measures" scenario.

2.3.5 National Climate Change Policy

2.3.5.1 National Climate Change Adaptation Framework 2012

Ireland's first National Climate Change Adaptation Framework (NCCAF), which was published in December 2012, aims to ensure that adaptation actions are taken across key sectors and also at local level to reduce Ireland's vulnerability to climate change. The NCCAF requires the development and implementation of sectoral and local adaptation plans which will form part of the national response to the impacts of climate change. Each relevant Government Department (or State Agency, where appropriate) are required to prepare adaptation plans for their sectors. Twelve sectors were identified in total including Transport, Flood Defence, Agriculture and Energy. The Climate Action and Low Carbon Development Act 2015 (see Section 2.3.1.2) puts the development of National Climate Change Adaptation Frameworks and Sectoral Adaptation Plans on a statutory basis.

The Climate Action and Low Carbon Development Act 2015 states that following Government approval of the first statutory National Climate Change Adaptation Framework it must be reviewed at least every 5 years after that.

Following approval of the statutory National Adaptation Framework, Section 6 of the Act requires the Government to request all relevant Government Ministers to prepare sectoral adaptation plans covering the relevant sectors under their remit within a specified period. The National Adaptation Framework Plan was published on the 19th January 2018 and is discussed below at Section 2.3.5.5.

2.3.5.2 National Policy Position on Climate Action and Low Carbon Development 2014

The National Policy Position on Climate Action and Low Carbon Development, published by the Department of Environment, Community and Local Government in April 2014, provides a high-level policy direction for the adoption and implementation by Government of plans to enable the State to move to a low-carbon economy by 2050. The position paper acknowledges that the evolution of climate policy in Ireland will be an iterative process, based on the adoption by Government of a series of national plans over the period to 2050. Statutory authority for the plans is set out in the Climate Action and Low Carbon Development Act 2015.

2.3.5.3 Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act 2015 was signed into law on 10th December 2015. The Climate Action and Low Carbon Act 2015 provides for the establishment of a national framework with the aim of achieving a low carbon, climate resilient, and environmentally sustainable economy by 2050, referred to in the Act as the "national transition objective".

The Act provides the tools and structures to transition towards a low carbon economy and it anticipates that it will be achieved through a combination of:

- A National Mitigation Plan (to lower Ireland's greenhouse gas emissions levels); - see below
- A National Adaptation Framework (to provide for responses to changes caused by climate change);
- Tailored sectoral plans (to specify the adaptation measures to be taken by each Govemment ministry); and
- Establishment of the Climate Change Advisory Council to advise Ministers and the Government on climate change matters.

2.3.5.4 National Mitigation Plan 2017

Ireland's first statutory National Mitigation Plan (NMP), published in July 2017, gives effect to the provisions of the Climate Action and Low Carbon Development Act 2015, and represents a landmark national milestone in the evolution of climate change policy in Ireland and provides for the statutory basis for the transition to a low carbon, climate resilient and environmentally sustainable economy by 2050.

The NMP reaffirms Ireland's commitruent to concerted and multilateral action to tackle climate change following the adoption of the legally-binding Paris Agreement of which Ireland is a co-signatory. Under the Paris Agreement, the EU is committed to reducing greenhouse gas emissions by at least 40% by 2030, compared with 1990 levels. The Paris Agreement represents a landmark accord in tackling climate change, which is recognised by all parties as the defining global issue of this generation.

The NMP outlines a range of measures to lay the foundations for transitioning Ireland to a low-carbon, climate-resilient and environmentally sustainable economy by 2050.

The NMP reiterates that the objective of a low-carbon future will involve radically changing our behaviour as citizens, industry and Government and becoming significantly more energy-efficient. In this regard, the NMP has made it clear that Ireland has abundant, diverse and indigenous renewable energy resources, which will be critical to decarbonising our energy system, including electricity generation. The NMP confirms that "Onshore wind has, to date, been the most cost-competitive renewable electricity technology in Ireland, accounting for 22.8% of overall electricity generation in 2015."

The NMP addresses the role of local authorities in facilitating the transition towards a low-carbon economy and recognises that this requires engagement from all levels of Government and that a bottom-up approach is also essential to promote awareness and engagement within individual communities across Ireland.

The NMP further states that there "is also recognition within the Local Authority sector of the need for the sector to assume a leadership role within their local communities to encourage appropriate behavioural change". Moreover, the Plan emphasises that local authorities also have a key role to play "in addressing climate change mitigation action and are well placed to assess, exploit and support opportunities within their administrative areas, in cooperation with each other and with national bodies, and through the involvement and support of local communities".

Specifically, in relation to wind energy the National Mitigation Plan notes the following:

> *"To date, wind energy has been the largest driver of growth in renewable electricity. The total amount of renewable generation connected to the grid at December 2016 was 3,120MW, of which wind generation was approximately 2,796MW, hydro was 238MW and biomass was 86MW19. Eirgrid estimates that a total of between 3,900MW and 4,300MW of onshore renewable generation capacity will be required to allow Ireland to achieve 40% renewable electricity by 2020. This leaves a further requirement of between 780MW and 1,180MW to be installed by 2020 if the 2020 electricity target is to be reached, requiring an increased rate of installation."*

2.3.5.5 National Adaptation Framework- Planning for a Climate Resilient Ireland 2018

Ireland's first statutory National Adaptation Framework (NAF) was published on 19th January 2018. The NAF sets out the national strategy to reduce the vulnerability of the country to the negative effects of climate change and to avail of positive impacts. The NAF was developed under the Climate Action and Low Carbon Development Act 2015. The NAF builds on the work already carried out under the National Climate Change Adaptation Framework (NCCAF, 2012). It is detailed that under the NAF a number of Government Departments will be required to prepare sectoral adaptation plans and strategies in relation to climate change. The NAF can be broken down as follows:

Chapter 1 provides a summary of observed and projected global climate change and the international and European policy drivers for adaptation to climate change. It also contains a summary of observed and projected climate change impacts in Ireland. The following Key Messages are set out in the NAF:

- "Warming of the global climate system is unequivocal and it is extremely likely that human influence has been the dominant cause of the observed warming since the mid-20th century.
- Observations show that global average temperatures have increased by 0.85℃ (in the range 0.65 to 1.06°C) since 1850.
- In recent decades, changes in climate have caused impacts on natural and human systems on all continents and across the oceans.
- Increasing magnitudes of warming increase the likelihood of severe, pervasive and irreversible impacts.
- Uncertainties exist in relation to the extent and rate of future climate change. Addressing uncertainties is a challenge, but should not be read as an excuse for inaction as there is overall agreement on the robustness of trends and projections.
- The impacts and risks of climate change can be reduced and managed through mitigation and adaptation actions.
- Changes in Ireland's climate are in line with global trends. Temperatures have increased by about 0.8°C since 1900, an average of about 0.07°C per decade over that

period, and changes in precipitation regimes, sea level rise and extreme events (storms, flooding, sea surges and flash floods) are also being observed.
- Climate change will have diverse and wide ranging impacts on Ireland's environment, society, economic development, including managed and natural ecosystems, water resources, agriculture and food security, human health and coastal infrastructures and zones.
- The overall trend in Ireland is consistent with global patterns of change, with a high degree of climate variability and associated uncertainties in relation to extreme events."

The Framework quotes the Intergovernmental Panel on Climate Change (IPCC, 2013) in which it was concluded that there is 95% probability that the global warming of the last 50 years is a result of human activities, with the main contribution to this warming coming from the burning of fossil fuels.

Chapter 2 sets out the progress to date on climate change adaptation planning in Ireland, including work undertaken at sectoral and local government level and initiatives involving civil society and the research community.

Chapter 3 provides a number of guiding principles for adaptation at national level. It includes steps for creating an enabling environment for adaptation planning. It sets out the sectors for which adaptation plans under the NAF are to be prepared, along with proposals for local authority or regional level adaptation strategies. Chapter 3 of the framework includes the guiding principles for adaptation, regardless of how successful efforts to mitigate GHG emissions prove to be, the impact of climate change will continue over the coming decades because of the delayed impacts of past and current emissions. There is no choice, therefore, but to take adaptation measures to deal with the unavoidable impacts of climate change and associated economic, environmental and social costs. This is recognised at international, European Union and national level. The NAF states that:

> *"Adaptation not only depends on action by all levels of government but also on the active and sustained engagement of all stakeholders, including sectoral interests, the private sector, communities and individuals. Everybody has a role to play in making sure Ireland is taking appropriate adaptation action to achieve a climate resilient future. This is a joint responsibility where "climate proofing" our country is an undertaking for which all of society is responsible and everyone has a role to play."*

Furthermore under chapter 3 it is noted that each local authority should make and adopt local adaptation under the Low Carbon Act 2015. The local authority adaptation plans are discussed further in the below sections.

Chapter 4 outlines how the Framework will be implemented with revised Governance and reporting arrangements as well as actions and supporting objectives that are to be progressed.

2.3.5.6 Report of the Joint Committee on Climate Action Climate Change 2019

In March 2019 the Joint Committee on Climate Action Change released a report detailing a cross-party consensus for action. The report in its introduction notes that "Irelands performance in meeting international obligations has to date been poor". The Committee places concern that predictions of emissions indicate that the state is off track in meeting its 2020 and 2030 targets under the Kyoto protocol and the EU Directives.

The committee recommended that new climate change legislation be enacted by the Oireachtas in 2019. The following recommendations have been listed:

1. *A target of net zero economy-wide Green House Gas (GHG) emissions by 2050;*
2. *A provision for a 2030 target, consistent with the GHG emissions reduction pathway to 2050 to be set by 2020 by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council;*
3. *Provision for five-yearly carbon budgets, consistent with the emissions reduction pathway to 2030 and 2050 targets, to be set by Statutory Instrument requiring the formal approval of both Houses of the Oireachtas following receipt of advice from the Climate Action Council;*
4. *A target for the renewable share of electricity generation of 70% by 2030.*

Further to this, the committee acknowledge that the measures which are currently in place along with the measures suggested within the report will not be sufficient in meeting Irelands targets.

Chapter 7 of the report outlines the committee's recommendations for developing Ireland's capacity in renewable energies and renewable electricity in particular. It is noted that the transformation of Ireland's energy system will be required for the country to meet its GHG emission targets. To reach net zero emissions by 2050 the report recognises that the country will be required to fully decarbonize electricity generation. Section 7.5 relates to onshore renewable energy generation, it is acknowledged that onshore wind energy is currently the primary source of renewable electricity within Ireland, accounting for 84% of renewable power generated in 2017, it is also detailed that, *'onshore wind alone will not supply Ireland with sufficient electricity to become self-sufficient, it is evident that it must be used alongside other sources of renewable energy'.*

Under its recommendations the Committee encourages the upgrading of existing onshore wind turbines where this will yield additional potential. While acknowledging that there are challenges in relation to securing additional on-shore wind generated renewable energy.

The Report fully supports the increased provision of on-shore wind farm development at appropriate locations (such as that of the current proposal) and acknowledges that on-shore wind has a pivotal role to play in achieving climate action targets.

2.3.5.7 Climate Action Plan 2019

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption.

Chapter 1 of the CAP sets out the nature of the challenge which Ireland faces over the coming years. The CAP notes that the evidence for warming of our climate system is beyond dispute with observations showing that global average temperatures have increased by more than 1°C since pre-industrial times. These changes will cause extensive direct and indirect harm to Ireland and its people, as well as to other countries more exposed and less able than we are to withstand the associated impacts, which are predicted to include:

- Rising sea-levels threatening habitable land and particularly coastal infrastructure,
- Extreme weather, including more intense storms and rainfall affecting our land, coastline and seas,
- Further pressure on our water resources and food production systems with associated impacts on fluvial and coastal ecosystems,
- Increased chance and scale of river and coastal flooding,
- Greater political and security instability,

- Displacement of population and climate refugees,
- Heightened risk of the arrival of new pests and diseases,
- Poorer water quality,
- Changes in the distribution and time of lifecycle events of plant and animal species on land and in the oceans.

It is also recognised within the Plan that in addition to the above many of the pollutants associated with climate change are also damaging to human health.

It is the ambition of the CAP to deliver a step-change in our emissions performance over the coming decade, so that we will not only meet our EU targets for 2030 but will also be well placed to meet our mid-century decarbonisation objectives. The proposed development through the generation of renewable energy can aid in delivering this ambition both for the 2030 target and the ongoing 2050 target.

Plate 2.2 below depicts Irelands decarbonisation pathway up to the year 2030. The below will be used to manage Ireland's decarbonisation pathway and details the path for the various sectors:

	Technology	NDP 2030	Uptake to meet 2030 targets (Based on MACC analysis) 2025	2030
Electricity	Total RES in Generation mix[4], %	55	52	70
	• Onshore wind, GW	~7	~6.5	~8.2
	• Offshore wind, GW	1.8	~1.0	~3.5
	• Solar PV, GW	1.5	~0.2	~0.4
Transport	Electric Vehicles, #	498,000	181,500	936,000
	• Passenger EVs, #	355,000	57,000	550,000
	• Passenger PHEVs, #	118,000	94,000	290,000
	• Electric delivery vans, #	19,000	30,000	61,000
	• Electric trucks, #	n.a	0	34,000
	• Electric buses, #	1,250	500-600	1,000-1,200
	Bioethanol blend, Volume	E10	E10	E10
	Biodiesel blend, Volume	B12	B12	B12
Built Environment	Retrofitted homes[1], cumulative 2021-30, #	450,000	300,000	500,000
	Electric heating sources, total residential, #	370,000	350,000	600,000
	• New buildings, #	200,000	50,000	200,000
	• Existing buildings, #	170,000	300,000	400,000
	Electric heating sources, total commercial, #	15,000[3]	15,000	25,000
Enterprise	Emissions, $MtCO_2eq.$	9	8	8
	• Alternative fuels in cement fuel mix, %	N/A	65%	80%
	• CO2-neutral heat generation in food industry[2], %	N/A	~70%	~80%
Agriculture	Emissions, $MtCO_2eq.$	21	19	18
	• Fertilizers CAN replacement, %	N/A	40%	50%
	• Trailing-shoe slurry spreading, %	N/A	30%	50%
Other (e.g. waste)	Emissions, $MtCO_2eq.$	3.2	3.2	3.2

Solar PV, some electrification of buses, and biofuel blending are identified in 2030 the NDP scenario but are not showing as cost-effective in MACC. Despite MACC analysis these technologies may remain in plan given other factors (e.g., exchequer cost, ease of implementation, need for public sector leadership)

1 Retrofit to B2 BER fabric equivalent
2 Includes biomass and electricity
3 Not specified in NDP, estimated based on residential ratio
4 RESS competitive auction determines the final mix

Plate 2.2 Irelands Decarbonisation Pathway Dashboard to 2030 [Source: CAP, 2019]

Chapter 7 of the CAP details the plans considerations, state of play and actions in relation to electricity. Within Ireland electricity accounting for 19.3% of Ireland's greenhouse gases in 2017, the following is noted:

> *"It is important that we decarbonise the electricity that we consume by harnessing our significant renewable energy resources by doing this we will also become less dependent on imported fossil fuels."*

In 2017 within Ireland a total of 30.1% of electricity produced came from renewable sources, the target to be achieved by 2020 is set at 40%. The CAP goes on to note that 'given our 40% target is based on a percentage of total energy demand, this rising demand makes meeting our 2020 target even more challenging and latest forecasts indicate we may miss this target by 3 to 4 percentage points'. Further to

this while decarbonising electricity is a key aspect of the strategy it is noted that this is against the background of rapid projected growth in electricity demand. It is expected that demand for electricity is forecast to increase by 50% above existing capacity in the next decade. Generation electricity builds of a renewable nature rather than fossil fuels has been marked as essential.

The CAP goes on to note that with regards to policy measures to date that they will not achieve the level of decarbonisation required in the electricity sector to meet the 2030 emissions reduction targets, as such it is listed that 'we must 'reduce our electricity sector emissions to 4-5 Mt in 2030'. In relation to emissions the following is noted:

> *"In 2017, emissions from electricity were 12 Mt and in 2030, despite implementation of Project Ireland 2040 measures, emissions are projected to be 8 Mt. This clearly demonstrates the need for a significant step-up in ambition over existing policy, not only to meet our 2030 targets, but to set us on course to deliver substantive decarbonisation of our economy and society by 2050."*

In the electricity sector, reaching a 70% share of renewable electricity would require 50-55% emissions reduction by 2030.

Under section 7.2 the following targets have been set out:

- Reduce CO2 eq. emissions from the sector by 50–55% relative to 2030 Pre-NDP projections
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation
- Increase electricity generated from renewable sources to 70%, indicatively comprised of:
  - at least 3.5 GW of offshore renewable energy
  - up to 1.5 GW of grid-scale solar energy
  - up to 8.2 GW total of increased onshore wind capacity
- Meet 15% of electricity demand by renewable sources contracted under Corporate Power Purchase Agreements (PPAs)

Achieving 70% renewable electricity by 2030 will involve phasing out coal- and peat-fired electricity generation plants, increasing our renewable electricity, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries), and putting systems in place to manage intermittent sources of power, especially from wind.

Section 7.2 of the CAP notes the 'Measures to deliver targets' in which efforts to meet the 2030 ambitions includes increased harnessing of renewable energy. CAP identifies a need for 8.2GW of onshore wind generation and states that in 2017 there was 3.3GW in place, therefore Ireland needs to more than double its installed capacity of wind generation. Accordingly, the CAP presents clear and unequivocal support for the provision of additional renewable energy generation, and presents yet further policy support for increased wind energy.

The proposed Croagh Wind Farm is in line with the overall provisions handed down within the CAP. The proposed development through the production of renewable energy will aid in Ireland meeting its binding targets. The development can also aid to contribute to the above referred target of '8.2GW total of increased onshore wind capacity'. Furthermore the proposed development will contribute in the following:

- Provide renewable energy which will connect to the national grid (Target- 8.2 GW total of increased onshore wind capacity),
- Aid in the decarbonisation of the energy system (Target- Reduce CO2 eq. emissions from the sector by 50–55% relative to 2030),
- The proposed development can contribute toward achieving 70% renewable electricity by 2030.

2.3.6 The proposed development will aid in reinforcing grid infrastructure and greater interconnection. Strategic Planning Policy Context

2.3.6.1 Introduction

This section of the EIAR provides the strategic planning context of the proposed development. As is examined below, the proposed development is in line with national, regional and local policies, frameworks, guidelines and plans. This section has been broken down to the following sections:

- National Planning Framework 2018,
  - Key Sustainability Elements of National Planning Framework
- Draft Renewable Electricity Policy and Development Framework, 2016
- Regional Policy
  - Regional Policy - Regional Spatial and Economic Strategy, Northern and Western Region, 2018
- Local Policy
  - Leitrim County Development Plan 2015-2021
  - Leitrim County Council Climate Adaptation Strategy 2019-2024
  - Sligo County Development Plan 2017 – 2023
  - Sligo County Council Draft Climate Adaption Strategy 2019-2024
- Material Considerations
  - Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017
  - DoEHLG Wind Energy Guidelines 2006
  - Draft Revised Wind Energy Development Guidelines 2019
  - Department Circular PL5/2017
  - IWEA Best Practice Guidelines for the Irish Wind Energy Industry 2012
  - IWEA Best Practice Principles in Community Engagement and Community Commitment 2013
  - Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement 2016
  - IWEA Community Engagement Strategy 2018
  - Renewable Energy Support Scheme (RESS)
  - Forest Service Guidelines

As a renewable energy project the current proposal is broadly consistent with the overall national policy objectives to increase penetration and deployment of renewable energy resources and has been designed in the context of the relevant wind energy and other guidelines. The specific compliance with the County Development Plan provisions are dealt with in detail in the County Development Plan section below.

2.3.6.2 National Policy

2.3.6.2.1 *National Planning Framework 2018 - 2040*

The National Planning Framework (NPF), published in February of 2018, aims to shape and guide the future growth and development of Ireland up to 2040. The NPF forms the top tier of the national planning policy structure, accordingly establishing the policy context for the forthcoming Regional Spatial and Economic Strategies and local level development plans. In an effort to move away from developer led development to one informed by the needs and requirements of society, a number of objectives and policies have been put in place in order for the country to grow and develop in a sustainable manner.

The NPF notes that the population of Ireland is projected to increase by approximately 1 million people by 2040 which will result in a population of roughly 5.7 million. This population growth will place further demand on both the built and natural environment. In order to strengthen and facilitate more environmentally focused planning at the local level, the NPF states that future planning and development will need to

> "*Tackle Ireland's higher than average carbon-intensity per capita and enable a national transition to a competitive low carbon, climate resilient and environmentally sustainable economy by 2050, through harnessing our country's prodigious renewable energy potential.*"

The NPF notes that while the overall quality of the country's environment is good it is not without challenges. Furthermore they note that the manner in which we plan for the potential issues is important.

> *"While the overall quality of our environment is good, this masks some of the threats we now face. Key national environmental challenges include the need to accelerate action on climate change, health risks to drinking water, treating urban waste water, protecting important and vulnerable habitats as well as diminishing wild countryside and dealing with air quality problems in urban areas. It is also important to make space for nature into the future, as our population increases."*

The NPF seeks to achieve ten strategic priorities surrounding:

1. Compact Growth
2. Enhanced Regional Accessibility
3. Strengthened Rural Economies and Communities
4. Sustainable Mobility
5. A Strong Economy, supported by Enterprise, Innovation and Skills
6. High-Quality International Connectivity
7. Enhanced Amenity and Heritage
8. Transition to a Low Carbon and Climate Resilient Society
9. Sustainable Management of Water and other Environmental Resources
10. Access to Quality Childcare, Education and Health Services

Relevant to the proposed development, **National Strategic Priority No. 8** – (Transition to a Low Carbon and Climate Resilient Society) seeks to achieve this transition by 2050. The transition will *"shape investment choices over the coming decades in line with the National Mitigation Plan and the National Adaptation Framework. New energy systems and transmission grids will be necessary for a more distributed, renewables-focused energy generation system, harnessing both the considerable on-shore and off-shore potential from energy sources such as wind, wave and solar and connecting the richest sources of that energy to the major sources of demand."*

A key aspect of the NPF surrounds the long-term sustainability of the environment, it aims to ensure that decisions that are made today meet our future needs in a sustainable manner.

> *"The manner in which we plan is important for the sustainability of our environment. Our planning system has influence across a wide range of sectors, both directly and indirectly and interacts with many common issues related to effective environmental management, including water services, landscape, flood risk planning, protection of designated sites and species, coastal and marine management, climate mitigation and adaptation, and land use change."*

The Government will address environmental and climate challenges through the following overarching aims as listed under 'Resource Efficiency and Transition to a Low Carbon Economy':

- Sustainable Land Management and Resource Efficiency
- Low Carbon Economy

- Renewable Energy
- Managing Waste

In order to meet legally binding targets agreed at EU level, it is a national objective for Ireland to make a transition and become a competitive low carbon economy by the year 2050. To aid in meeting these targets the National Planning Framework notes that the Government will aim to support the following objectives:

- Integrating climate considerations into statutory plans and guidelines. In order to reduce vulnerability to negative effects and avoid inappropriate forms of development in vulnerable areas.
- More energy efficient development through the location of housing and employment along public transport corridors, where people can choose to use less energy intensive public transport, rather than being dependent on the car.

The NPF highlights that Ireland's national energy policy is focused on three pillars: (1) sustainability, (2) security of supply and (3) competitiveness. Furthermore it is noted that *"The Government recognise that Ireland must reduce greenhouse gas emissions from the energy sector by at least 80% by 2050, compared to 1990 levels, while at the same time ensuring security of supply of competitive energy sources to our citizens and businesses."* The NPF notes that our transition to a low carbon energy future requires:

- A shift from predominantly fossil fuels to predominantly renewable energy sources
- Increasing efficiency and upgrades to appliances, buildings and systems
- Decisions around development and deployment of new technologies relating to areas such as wind, smartgrids, electric vehicles, buildings, ocean energy and bio energy
- Legal and regulatory frameworks to meet demands and challenges in transitioning to a low carbon society

National Policy Objective 55 of the NPF specifically relates to renewable energy, it states that it is an objective to:

> *"Promote renewable energy use and generation at appropriate locations within the built and natural environment to meet national objectives towards achieving a low carbon economy by 2050".*

Section 10 of the NPF sets out a series of desired National Strategic Outcomes, underpinned by the national planning objectives set out in the NPF in combination with governance arrangements and aligned with capital investment. The transition towards a low carbon and climate resilient society is identified as one of the national strategic outcomes to guide the implementation of the NPF.

The NPF further emphasises that new energy systems and transmission grids will be necessary for a more distributed, more renewables focused energy generation system to harness the considerable on-shore and off-shore potential from energy sources such as wind, wave and solar and "connecting the richest sources of that energy to the major sources of demand". The NPF recognises that the development of on-shore and off-shore renewable energy is critically dependent on the development of enabling infrastructure including grid facilities to connect to major sources of energy demand.

In achieving this desired National Strategic Outcome of a transition to sustainable energy, the NPF re-emphasises the following national policy target of delivering "40% of our electricity needs from renewable sources by 2020 with a strategic aim of in excess of 50% by 2030 and more by 2040 and beyond using wind, wave, solar, biomass and hydro sources".

2.3.6.3 Draft Renewable Electricity Policy and Development Framework (DCCAE)

The Draft Renewable Electricity Policy and Development Framework has been formulated to ensure Ireland meets its future needs for renewable electricity in a sustainable manner compatible with environmental and cultural heritage, landscape and amenity considerations.

The Framework will contribute toward meeting Ireland's future energy needs, particularly up to 2030 and beyond, as informed by national and European policy, and be reviewed at five-yearly intervals. The Policy and Development Framework will be primarily for the guidance of An Bord Pleanála, planning authorities, other statutory authorities, the general public and persons seeking development consent in relation to large scale projects for the generation of renewable electricity on land. It will set out policy in respect of environmental considerations, community engagement and in relation to potential, future export of renewable electricity. It will seek to broadly identify suitable areas in the State, where large-scale renewable electricity projects can be developed in a sustainable manner. The existing system for planning permission applications to local authorities or An Bord Pleanála will remain unchanged in respect of renewable electricity projects. These will still require planning permission, including environmental impact assessment where appropriate. It is proposed that the Policy and Development Framework will be focused on providing for renewable electricity projects of large scale.

The most recent publicly circulated documentation in relation to the REPDF (July 2018) has indicated that the updated REPDF will have the following objectives:

- To maximise the sustainable use of renewable electricity resources in order to develop progressively more renewable electricity for the domestic and potentially, for future export markets.
- To assist in the achievement of targets for renewable energy, enhance security of supply and foster economic growth and employment opportunities. It will identify appropriate parts of the country for large renewable electricity projects and will assess the environmental impact of renewable electricity projects at various scales at a national level.
- To identify strategic areas on land for large scale renewable energy generation and this analysis will include a spatial component.
- In addition, the amended scope will include renewable electricity projects below this threshold (including wind and solar PV) at a national level.

The updated scope will also include an assessment of available grid capacity in relation to the location of large and medium-scale renewable electricity generation plants. This analysis will support the strategic planning and location decision making process for Data Centres in Ireland.

2.3.6.4 Regional Policy

2.3.6.4.1 *Regional Policy- Regional Spatial and Economic Strategy, Northern and Western Region 2020*

The Regional Spatial and Economic Strategy (RSES) came into effect in January 2020 to provide a high-level development framework for the Northern and Western Region that supports the implementation of the National Planning Framework (NPF) and the relevant economic policies and objectives of Government. It provides a 12-year strategy to deliver the transformational change that is necessary to achieve the objectives and vision of the Assembly.

A key issue for the strategy is how climate change will impact on land-use change and increasing demands on natural resources into the future. The strategy recognises that:

> *"There is marked evidence that Ireland's climate is changing with projections for Ireland indicating that there is a likelihood of a rise in sea levels, changes in rainfall events, increased frequency of storm events, changes to air and soil temperate and periods of increased drought."*

Furthermore it is also recognised that climate change commitments and EU targets mean that power generation, transport and heat increasingly have to be produced from sustainably produced electricity. As an EU member state, as well as a signatory to the UN Paris Agreement, Ireland has committed itself to a reduction of greenhouse gases along with a multitude of other sustainability-related measures. The strategy notes that how we produce our energy is going to play a major role in determining how successful the country is in tackling climate change targets, especially GHG emissions.

Section 4.5.2 of the RSES lists the strategy surrounding '*renewable energy and low carbon future*'. The section opens with the following statement:

> *"Energy is needed for economic growth, and access to affordable, reliable energy is an essential development objective. Historically most incremental energy demand has been met through fossil fuels, however in future that energy will have to be low-carbon and ultimately zero-carbon. Decarbonisation can and needs to happen and it is an objective of the NPF that Ireland becomes a Low Carbon Economy by 2050. This reflects the Government's 2014 National Policy Position on Climate Action and Low Carbon Development and is also a binding EU requirement."*

The RSES defines renewable energy as energy developed from sources that are constantly replenished through the cycles of nature and, unlike fossil fuels, are not finite. It is regarded as important that the region sets out its ambitions concerning renewable energy in this context and shows its ability to help contribute to achieving national targets. This will build on the present provision of renewable energy success from sources including hydropower and onshore wind energy infrastructure. The RSES considers the region to have a unique natural endowment of ample carbon-neutral, energy supplies that gives an opportunity of forging and leading the new clean economy of the future. To achieve the noted policies and targets the strategy noted that the following must be encouraged:

- Practices to reduce the production of CO_2
- Increase in our energy security
- Reduced cost of electrical power for domestic purposes, and regional development of value-adding of primary production
- Increased industry development of modern high-efficiency building materials
- Increased efficiency in the development of renewable energy production
- Improved efficiency of freight and passenger transport systems
- Greater protection of areas of high primary production value
- Greater protection of environmentally sensitive areas
- Increase cluster of R&D focused on technological application to renewable energy

The following regional policy objectives have been included under this section:

- **RPO 4.19:** The NWRA shall co-ordinate the identification of potential renewable energy sites of scale in collaboration with Local Authorities and other stakeholders within 3 years of the adoption of the RSES. The identification of such sites (which may extend to include energy storage solutions) will be based on numerous site selection criteria including environmental matters, and potential grid connections.
- **RPO 4.17**: To position the region to avail of the emerging global market in renewable energy by: [inter alia]
  - stimulating the development and deployment of the most advantageous renewable energy systems" ....

- **RPO 4.18**- Support the development of secure, reliable and safe supplies of renewable energy, to maximise their value, maintain the inward investment, support indigenous industry and create jobs.

Section 8.2 of the RSES notes the strategy surrounding the electricity grid network, again it is recognised that the West region is particularly rich in renewable energy resources. Within the region it is noted that the existing transmission network is predominantly lower capacity in this regard developing the grid will enable the transmission system to safely accommodate more diverse power flows from surplus regional generation and also to facilitate future growth in electricity demand. The following relevant regional policy objectives are listed:

- **RPO 8.1**- The Assembly support the development of a safe, secure and reliable electricity network, and the transition towards a low carbon economy centred on energy efficiency and the growth projects outlined and described in this strategy.
- **RPO 8.3**- The Assembly support the necessary integration of the transmission network requirements to allow linkages with renewable energy proposals at all levels to the electricity transmission grid in a sustainable and timely manner.
- **RPO 8.4**- That reinforcements and new electricity transmission infrastructure are put in place and their provision is supported, to ensure the energy needs of future population and economic expansion within designated growth areas and across the Region can be delivered in a sustainable and timely ruanner and that capacity is available at local and regional scale to meet future needs. Ensure that development minimises impacts on designated areas.

2.3.6.5 Local Policy

The site of the proposed development occurs along the Leitrim – Sligo border, with some of the proposed renewable energy infrastructure located in each of the two counties. In this regard two turbines and their associated works (incl. access roads, cabling and drainage etc.) are located in County Sligo and the remainder of the project works are located in County Leitrim.

As the proposed development will occur within the functional area of two local authorities it is necessary to submit two separate planning applications, one to each of the relevant authorities for that portion of the development which occurs in their functional area. In this regard please note that this EIAR assesses the entirety of the proposed development, and as such the same document is being submitted to each local authority so that they are aware of the full details of the project to allow each consenting authority to complete its own comprehensive EIA in relation to the project.

2.3.6.5.1 *Leitrim County Development Plan 2015-2021*

The Leitrim County Development Plan 2015-2021 (LCDP) is the principal instrument that is used to manage change in land use in the County. The CDP sets out the Council's strategic land use objectives and policies for the overall development of the County up to 2021. The Plan seeks to develop and improve, in a sustainable manner, the social, economic, cultural and environmental assets of the County.

At the time of writing Leitrim County Council have begun commencing the review of the existing Leitrim County Development Plan 2015-2021 and preparing the new Leitrim County Development Plan for the period 2022-2028. As of June 2020 Leitrim County Council were at the pre-draft stage.

Under the County Development Plan the following strategic goals have been set under Section 2.2.1 'Resources' with regards to energy/renewable energy:

- "To support energy generation from renewable resources where practicable and appropriate";

- "To ensure an adequate supply of energy, including renewable energy, is available to meet the social, commercial and economic needs of the entire County;"

The LCDP states that

> *"The Council recognises the potential of the County for generating electricity by means of windfarms and is favourably disposed towards their development subject to the protection of the environment and visual amenity"* (Page 198 LCDC refers)

Under Section 3.4 of the LCDP it is detailed that Leitrim County Council will support development and expansion of the County's Green Infrastructure.

Section 4.11.5 of the CDP notes the council's vision for wind farms within the county over the lifetime of the plan. The Council acknowledges the role which wind energy has, mainly in reducing the reliance on non-renewable sources of energy, reducing the dependency on imported fuels and in moving towards a 'low carbon' society.

In deciding on the suitability of an area to accommodate windfarm development, the Council will be guided by the Department of Environment, Heritage and Local Government Wind Energy Guidelines 2006 or any updated version of the Guidelines.

Environmentally sensitive areas have been identified in the Plan. These include:-

- The Natura 2000 network (cSAC's and SPA's)
- Special Areas of Protection
- Natural Heritage Areas
- Proposed Natural Heritage Areas
- Areas of Outstanding Natural Beauty
- Areas of High Visually Amenity
- Outstanding Views and Prospects
- Areas of Archaeological Importance including those recorded on the list of Protected Monuments
- Areas of Geological Importance including those established under the Irish Geological Heritage (IGH) Programme.

With regards to the above the following can be noted in relation to the current proposed development:

- In relation to the Natura 2000 network and potential for ecological impacts arising these have been fully assessed within the Natura Impact Statement (NIS)/Appropriate Assessment Screening Report (AASR) prepared in relation to the proposed development and the Biodiversity and Birds Chapter of this EIAR. The comprehensive documentation that has been prepared demonstrates beyond reasonable scientific doubt that, in view of best scientific knowledge and on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, will not adversely affect the integrity of the sites.

- The potential impact of the proposed development on landscape is discussed further below, a comprehensive visual and landscape analysis is also presented in Chapter 12 of this EIAR.

- The proposed development site is neither in an 'Area of Outstanding Natural Beauty' or 'High Visual Amenity Area' as per the LCDP.

- In relation to archaeology and cultural heritage Chapter 13 of this EIAR (which provides a comprehensive analysis of Heritage and Cultural Heritage in the context of

the proposed development) notes that no recorded monuments, National Monuments, Record of Protected Structures, items identified in the National Inventory of Architectural Heritage (NIAH) or newly identified archaeological sites are located within or in the vicinity of the proposed development footprint.

In relation to natural heritage areas a comprehensive analysis is provided under Chapter 6 of this EIAR. Further to the above the following criteria which must be considered for the accommodation of wind farms has also been included within the LCDP:

- Ground conditions, including peat stability (Chapter 8 of this EIAR);
- Site drainage and hydrological effects, such as water supply and quality and watercourse crossings (Chapter 9 of this EIAR);
- Size, scale and layout and the degree to which the wind energy project is visible over certain areas (Chapter 12 of this EIAR);
- Potential impact of the project on natural heritage, to include direct and indirect effects on protected sites, on habitats of ecological sensitivity and biodiversity value and, where necessary, management plans to deal with the satisfactory co-existence of the wind energy development and the particular species/habitat identified (Chapter 13 of this EIAR);
- Assessment of all noise and shadow flicker etc (Chapters 11 and 5 of this EIAR);
- Potential impact on habitable dwellings. All habitable dwellings within 750m radius of all turbines should be plotted and shown (Chapter 5 of this EIAR);
- Potential impact of the project on the built heritage including archaeological heritage (Chapter 13 of this EIAR);
- Potential visual impact on the Landscape and Rural Character (Chapter 12 of this EIAR);
- Impact of ancillary development, such as connection to the electrical grid or access roads (Chapter 4 of this EIAR);
- Local environmental impacts including noise, shadow flicker, electromagnetic interference, etc; (Chapters 11, 5 and 4 of this EIAR)
- Adequacy of local access road network to facilitate construction of the project and transportation of large machinery and turbine parts to site (Chapter 14 of this EIAR);
- Information on any cumulative effects due to other projects, including effects on natural heritage and visual effects (Various chapter of this EIAR);
- Information on the location of quarries to be used or borrow pits proposed during the construction phase and associated remedial works thereafter (Chapter 4 of this EIAR);
- Disposal or elimination of waste/surplus material from construction/site clearance, particularly significant for peatland sites (Included in the Construction Environmental Management Plan and Chapter 14 of this EIAR);
- Decommissioning and site restoration, including details of the financial costs involved (Chapter 4); and
- Aircraft safety and navigation (Chapter 2 and Chapter 14 of this EIAR).

The above criteria have all been considered during the design period of the proposed development and comprehensive detail and analysis in relation to the above has been incorporated and presented throughout the relevant Sections of this EIAR. It should be noted in the context of the above that there is a 850 meter separation from dwellings. Furthermore the project documentation includes a detailed Construction and Environmental Management Plan (CEMP) which demonstrates how all construction activities will be carried out in an appropriate manner, and a comprehensive suite of mitigation measures that have been incorporated to minimise any impacts that could potentially arise.

The LCDC also states that if a development *"can clearly demonstrate to the satisfaction of the Planning Authority that it would not have a significant adverse impact on the amenities of a dwelling or a building occupied, or capable of being occupied by people, or would not compromise the integrity of an environmentally sensitive area"*, it will be deemed as 'Open to Consideration" to wind farm development. In this regard it should be noted that there is a separation distance of 850m from the

nearest dwelling. With the proposed mitigation measures put forward and as demonstrated within this EIAR there will be no adverse impact on the amenities of any residential amenity.

Policy 128 of the Leitrim County Development Plan states:

- It is the policy of the Council that all wind farm applications will be assessed on the full range of criteria including those mentioned herein and those identified in the Wind Farm Development Guidelines, 2006 (or any subsequent update) published by the Department of Environment, Heritage and Local Government.

Section 4.11.9 details the Council's plans with regards to renewable energy, the Council recognise that Ireland is legally obliged to ensure that by 2020, at least 16% of all energy consumed in the state is from renewable sources, in this regard the following policy has been listed:

- **Policy 135:**
  It is the policy of the Council to support national policy on reducing carbon emissions and increasing energy generation from renewable sources.

Section 4.8.7 of the Development Plan refers to landscape designations including Areas of Outstanding Natural Beauty (AONB) and Areas of High Visual Amenity (HVA). Outstanding views and prospects are also identified. These designations are shown on Map 4.12 of the Development Plan. Neither of these landscape designations apply to the proposed development site and those falling within the study area are outlined in detail and any potential impact assessed under Chapter 12 of the EIAR.

The proposed development site is neither in an AONB or an HVA, the closest AONB is A6 - O'Donnell's Rock and Boleybrack, 8.1 kilometres north-east. The closest HVA is B7 - Corry Mountain, 1.2 kilometres east of the proposed development site.

The two nearest 'Outstanding Views or Prospects' to the proposed development site are located 2.3 kilometres west (View 20: View from Gleaghnafarnagh from Local Road LT42533) and 2.2 kilometres northeast (View 19: View towards Bellhavel Lake from Local Road LT42461) of the site respectively. Neither view is directed towards the proposed wind farm site.

The 'Landscape Assessment of County Leitrim' was published by Leitrim County Council in 2002 and identifies 14 Landscape Character Areas (LCAs) within Co. Leitrim. The proposed development site is located within the Corry Mountain LCA, the key characteristics of which are described as follows:

- Extensive, mountainous uplands bordering Lough Allen.
- Rough grazing on moorland hills and plateau.
- Extensive areas of coniferous forestry.
- Sparsely populated. Small houses associated with outbuildings are evident across many of the lower, gentler farmed slopes.
- Impressive views from higher ground.
- Moorland plateau retains sense of isolation despite access roads and infrastructure.
- Field boundaries create strong patterns on lower hill slopes but show signs of dereliction in places.
- Distinctive upland valleys sheltering small farming communities.
- Semi-natural woodlands on steeper slopes and around farms.

Wind farms are listed as one of three Key Issues for Corry Mountain and one of the Principles for Landscape Management states that *"site new wind farms/ communication masts close to existing development on the plateau to minimise impact on more remote areas of upland".* The proposed development is located in a contiguous way to the existing wind turbines in the vicinity and it represents what is essentially the last potential wind farm site along this ridge. Furthermore, there are existing wind turbines in the landscape in the vicinity of the proposed development and accordingly the proposed development will not be introducing a new feature within the wider landscape.

In summary the County Development Plan acknowledges the importance of combating climate change and deriving more energy from renewable sources. As noted in the above it is an aim of Leitrim County Council to support energy generation from renewable resources as well as ensuring that there is an adequate supply of energy (including renewable energy). Leitrim County Council also recognise the potential of the County for generating electricity by means of wind farms and is 'favourably disposed towards their development subject to the protection of the environment and visual amenity'.. Furthermore, there is a range of policy in place which supports the development of renewable energy. The Biodiversity and Landscape sections of this EIAR demonstrate that the proposal will not give rise to significant impacts on natural heritage, landscape or visual amenity. The Noise and Shadow flicker assessments also show that the proposed development will not give rise to significant adverse impacts on residential amenity. Accordingly the proposed development is compliant with the relevant provisions of the Leitrim County Development Plan 2015-2021.

2.3.6.5.2 *Leitrim County Council Climate Adaptation Strategy 2019-2024*

The Leitrim County Council Climate Adaptation Strategy 2019-2024 (the adaptation strategy) forms part of the National Adaptation Framework (NAF) which was published in response to the provisions of the Climate Action and Low Carbon Development Act 2015. Within the foreword it is noted that 'climate change is now recognised as a global challenge with policy responses required in terms of both mitigating the causes of climate change and in adapting to the now inevitable consequences of our changing climate'.

The local authority adaptation strategy takes on the role as the primary instrument at local level to:

i. ensure a proper comprehension of the key risks and vulnerabilities of climate change
ii. bring forward the implementation of climate resilient actions in a planned and proactive manner
iii. ensure that climate adaptation considerations are mainstreamed into all plans and policies and integrated into all operations and functions of the local authority

The adaptation strategy noted that there is evidence that Ireland's climate is changing in line with global trends of climate change. Climate change has diverse and wide ranging impacts on Ireland's economic and natural resources including:

- More intense storms and rainfall events giving rise to disruption to society
- Increased river and coastal flooding
- Water shortages in summer
- Increased risk of new pests and diseases
- Adverse impacts on water quality
- Changes in the distribution and phenology of plant and animal species on land and in the oceans

With regards to climate adaptation the strategy describes it in this context as:

> *"planning proactively to take action and make adjustments to minimise or avoid the existing and anticipated impacts from climate change."*

It is a noted aim to build climate resilient communities, to protect people, ecosystems, businesses, infrastructure, and buildings from the negative impacts of climate change.

This Climate Change Adaptation Strategy is based around seven thematic areas that are developed further as high levels goals. These goals identify the desired outcomes anticipated through the effective implementation of the Climate Change Adaptation Strategy.

- **Theme 1: Local Adaptation Governance and Business Operations: Goal:**

Climate Change adaptation considerations are mainstreamed and integrated successfully into all functions and activities of the local authority, ensuring operational protocols, procedures and policies, implement an appropriate response in addressing the diversity of impacts associated with climate change.

- **Theme 2: Infrastructure and Built Environment:**
  Goal: Increased capacity for climate resilient structural infrastructure is centred around the effective management of climate risk, informed investment decisions and positive contribution towards a low carbon society.
- **Theme 3: Land-use and Development:**
  Goal: Sustainable policies and measures are devised influencing positive behavioural changes, supporting climate adaptation actions and endorsing approaches for successful transition to low carbon and climate resilient society.
- **Theme 4: Drainage and Flood Management:**
  Goal: Greater understanding of risks and consequences of flooding and successful management of a co-ordinated approach to drainage and flooding
- **Theme 5: Natural Resources and Cultural Infrastructure:**
  Goal: Fostering meaningful approaches to protecting natural and key cultural assets through an appreciation for the adaptive capacity of the natural environment to absorb the impacts of climate change.
- **Theme 6: Community Health and Wellbeing:**
  Goal: Empowered and cohesive communities with strong understanding of climate risks, increased resilience to impacts of climate change with capacity to champion climate action at local level.
- **Theme 7: Economic Development:**
  Goal: Promote projects and business opportunities that will contribute economically towards a climate resilient community in County Leitrim.

2.3.6.5.3 *Sligo County Development Plan 2017-2023*

The Sligo County Development Plan 2017 – 2023 (SCDP) was adopted in July 2017 and came into operation in August 2017. Section 10.6 of the SCDP examines climate change within the county, it is noted that:

> *"It is widely accepted that climate change is a reality which is happening on an ongoing basis"*

Further it is noted that the burning of fossil fuels for energy has contributed significantly to the build-up of greenhouse gases (GHGs) and the resulting increase in global warming. The SCDP acknowledges that energy efficiency and the use of renewable energy help to reduce GHG emissions and therefore play a key role in tackling climate change. The following policies are listed under the climate section:

- **P-CAM-1**
  "Support the implementation of the National Climate Change Adaptation Framework 2012, by including relevant measures in any forthcoming adaptation plans. Such plans shall be in accordance with national guidance issued by the DoECLG and EPA and undertaken in collaboration with the Northern and Western Regional Assembly, Mayo County Council, Roscommon County Council, Leitrim County Council and Donegal County Council."
- **P-CAM-4**
  "Raise public awareness and build local resilience in relation to climate adaptation."
- **P-CAM-4**
  "Facilitate and assist County Sligo's transition to a low-carbon economy and society."
- **P-CAM-5**
  Promote, support and implement measures that reduce man-made GHGs, including energy management, energy efficiency, compact development patterns, low-carbon buildings and sustainable transport
- **P-CAM-8**

"Promote and support the use of renewable energy in all sectors."

- **P-CAM-9**
  "Support community participation in, and benefit from, renewable energy and energy efficiency projects."

Chapter 11 indicates the Council's views surrounding energy within the county over the lifetime of the plan. It is recognised that the availability of suitable and adequate energy is of critical importance to social and economic development. Furthermore, being rich in renewable energy resources, County Sligo is well-placed to lay solid foundations for a sustainable energy future. Sligo County Council will promote and support the development and diversification of the local energy sector in accordance with EU, national and regional policy.

Section 11.1.2 notes the Council's considerations on wind energy, the plan acknowledges that Sligo's mountainous landscape and exposed location on the western seaboard combine to create good conditions for the generation of wind power. It is a challenge for the Council to achieve a reasonable balance between:

a) responding to government policy on renewable energy; and
b) enabling the wind energy resources of the County to be harnessed in an environmentally sustainable manner.

The policies of Sligo County Council in relation to wind energy include:

- **Policy SP-EN-1**: *"Support the sustainable development, upgrading and maintenance of energy generation, transmission, storage and distribution infrastructure, to ensure the security of energy supply and provide for future needs, as well as protection of the landscape, natural, archaeological and built heritage, and residential amenity and subject to compliance with the Habitats Directive."*
- **Policy SP-EN-2**: "*Facilitate the sustainable production of energy from renewable sources, energy conversion and capture in forms such as wind power, hydro-power, wave-generated energy, bioenergy, solar technology and the development of Waste to Energy/Combined Heat and Power schemes at appropriate locations and subject to compliance with the Habitats Directive. All such development proposals will be assessed for their potential impact on urban and rural communities, Natura 2000 sites, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes and scenic views, as well as in accordance with strict location, siting and design criteria."*
- **Policy SP-EN-6**: *"Support the implementation of relevant programmes arising from the Government's Energy White Paper 'Ireland's Transition to a Low Carbon Energy Future 2015-2030' (or any successor document)."*
- **Policy SP-EN-7**: *"Protect significant landscapes from the visual intrusion of large-scale energy infrastructure."*

It is an objective of Sligo County Council to:

- **Objective SO-EN-2**: "Undertake an analysis of suitable areas for wind energy and prepare a map showing County Sligo's Landscape Suitability for Wind Energy Developments, in accordance with Section 3.5 of the Wind Energy Guidelines (2006) and any subsequent revisions."

The Development Plan will have regard to the DoEHLG's Wind Energy Development Guidelines (June 2006) and any revised guidelines, when considering wind energy applications. The Plan also states that *"In assessing proposals for wind farms, the Council will require detailed information to Environmental Impact Assessment (EIA) standards. Assessment in accordance with government guidelines will have regard to visual impact...noise, electro-magnetic interference, ecological impact, safety...and land use implications."*

Furthermore *"Proposals will generally be discouraged in or close to pNHA's, cSAC's, SPA's, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes, protected view, Zones of Archaeological Potential."*

The Sligo Development Plan includes a range of policies in relation to natural heritage as follows:

- **Policy P-DSNC-1 which is to:**
  "Protect and maintain the favourable conservation status and conservation value of all natural heritage sites designated or proposed for designation in accordance with European and national legislation and agreements. These include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), Ramsar Sites, Statutory Nature Reserves. In addition, the Council will identify, maintain and develop non-designated areas of high nature conservation value which serve as linkages or 'stepping stones' between protected sites in accordance with Article 10 of the Habitats Directive."
- **Policy P-DSNC-4:**
  "Consider development within, or with the potential to affect, Natural Heritage Areas or proposed Natural Heritage Areas, where it is shown that such development, activities or works will not have significant negative impacts on such sites or features, or in circumstances where impacts can be appropriately mitigated"
- **Policy P-DSNC-3 is also relevant, stating:**
  "Carry out an appropriate level of assessment for all development plans, land-use plans and projects that the Council authorises or proposes to undertake or adopt, to determine the potential for these plans or projects to impact on designated sites, proposed designated sites or associated ecological corridors and linkages in accordance with the Habitats Directive, All appropriate assessments shall be in compliance with the provisions of Part XAB of the Planning and Development Act 2000."

The application site is located to the north of Carrane Hill Bog Natura Heritage Area ('NHA'). The project team are aware of the proposed development's proximity to the NHA and have considered this in this EIAR, specifically at Chapter 5: Biodiversity, Flora and Fauna. Ultimately it is concluded that the NHA will not be impacted upon.

Section 7.4 of the Sligo County Development Plan 2017 – 2023 sets out the policies in regard to landscape character. The Landscape Characterisation Map classifies the county according to its visual sensitivity and capacity to absorb new development without compromising the scenic character of certain areas, and includes the following designations: Normal Rural Landscape, Sensitive Rural Landscape, Visually

Vulnerable Areas and Scenic Routes

The southwestern boundary of the proposed development site adjoins but is not within an area of Sensitive Rural Landscape for approximately 53 metres. These areas are defined in the Sligo County Development Plan as*:*

> *"areas that tend to be open in character, highly visible, with intrinsic scenic qualities and a low capacity to absorb new development – e.g. Knocknarea, the Dartry Mountains, the Ox Mountains, Aughris Head, Mullaghmore Head etc.".*

Part of the proposed development site and the two turbines within County Sligo are within an area of '*Normal Rural Landscape'*. However, for approximately 53 metres the southwestern boundary of the proposed development site adjoins but is not within an area of *'Sensitive Rural Landscape'*. The ridgeline along the peak of Carrane Hill is also marked as a Visually Vulnerable Area in the Landscape Characterisation Map. Proposals in these areas, which include coastlines, lakeshores, ridgelines and hill/mountain tops, must demonstrate that the development will not to impinge in any significant way on the integrity, distinctiveness and unique visual character of the area when viewed from the

surroundings, especially from designated Scenic Routes and the environs of archaeological and historical sites. This is dealt with in full under Chapter 12 and Chapter 14 of this EIAR.

The Carrane Hill Landscape Character Area includes the upland area surrounding Carrane Hill and its south-western slopes. There are extensive mountain moorland areas covering the summit. While it is apparent that Carrane Hill Bog has been subject to turf-cutting there are large areas of undisturbed moorland. Commercial conifer plantation is spread throughout this LCA, wind turbines are also an established feature at this location. Assessment of the LCAs included at Chapter 12 of this EIAR concludes that in the Carrane Hill LCA, the magnitude of change arising as a result of the proposals is slight, and the significance of the landscape character effect is moderate. The assessment further concludes that only Leitrim's LCA 11 Corry Mountain and the provisional LCA for Sligo LCA1 Carrane Hill, in which the proposed turbines are located, would experience direct effects on landscape character as a result of the proposed development. Any other effects on other LCAs would be indirect, as the proposed development might be visible within the LCAs but located outside those other LCAs.

The greatest landscape effects ("Significant") will be experienced in Co. Leitrim's *LCA 11 Corry Mountain*, where the majority of the turbines will be located. However, and as noted in Chapter 12 of this EIAR extensive tree cover will greatly contributes to screening the proposed turbines from a large part of this LCA and thus mitigating the landscape effects.

The Sligo County Development Plan acknowledges that energy efficiency and the use of renewable energy help to reduce GHG emissions and therefore play a key role in tackling climate change. As is clear within this section there is a vast range of supporting policies and objectives which demonstrate that the proposed development is acceptable in principle. The Biodiversity and Landscape sections of this EIAR demonstrate that the proposal will not give rise to significant adverse impacts on natural heritage, landscape or visual amenity. The Noise and Shadow flicker assessments also show that the proposed development will not give rise to significant adverse impacts on residential amenity. Accordingly the proposed development is compliant with the relevant provisions of the Sligo County Development Plan 2017-2023.

2.3.6.5.4 Sligo County Council Draft Climate Adaptation Strategy 2019-2024

Sligo County Council recognises the risks associated with the increased frequency of climate change related events such as flooding, wind & rain storms and extended periods of warm or cold weather. The Adaptation Strategy sets out the strategic priorities, measures and responses for adaptation in County Sligo over the next five years; as required by the Climate Action and Low Carbon Development Act 2015.

The strategy notes that Ireland's climate is changing in line with global patterns. The following observed changes are listed:

- Temperatures are rising across all seasons.
- The timing and spatial distributions of precipitation is changing.
- Sea levels are rising.
- The frequency and intensity of extreme weather events are changing.

The strategy further notes that these changes are expected to continue and intensify into the future with a wide range of economic, environmental and social impacts. For Ireland, the key long-term climate change trends are:

- Temperatures are increasing and are expected to continue to increase everywhere and across all seasons.
- When compared with temperature, projections of precipitation are less certain. However, significant reductions in levels of average precipitation are expected in Summer and Autumn while projections indicate the increased occurrence of extreme precipitation events, particularly during winter.

- Projections show little change in average wind speed and direction. However the frequency of extreme wind conditions are expected to increase, particularly during winter.
- Sea levels will continue to increase by up to 0.81m by 2100.

The strategy notes that While working to reduce GHG emissions the County must also prepare for the unavoidable impacts of climate change. The overall mission of Sligo County Council as is set out in the Corporate Plan, is

> *"to improve the quality of life for people living in Sligo and enhance the attractiveness of the County as a place to live in, work, enjoy and invest"*

The preparation of this Climate Adaptation Strategy is noted as the start of process to deliver a wide range of actions and measures to adapt County Sligo to the impacts of climate change. Sligo's adaption journey is a flexible process and subject to regular reviews in terms of the appropriateness of projects, policies and programmes, as well as climate projections. The following is noted under the strategy:

> *"To ensure the integration of climate adaptation actions listed in this strategy, it is imperative that all strategic documents including the County Development Plan, Corporate Plan, Local Economic Community Plan, Operational Policies and Procedures be reviewed."*

2.3.7 Other Relevant Guidelines

2.3.7.1 DoHPCLG Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017

In July 2017, the Department of Housing, Planning, Community and Local Government (DoHPCLG) published 'Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change' under Section 28 of the Planning and Development Act 2000. Planning authorities are obliged to have regard to guidelines issued pursuant to Section 28 in the performance of their functions under the Planning and Development Act 2000 (as amended).

The guidelines state that it is a specific planning policy requirement under Section 28(1C) of the Act, that in making a development plan with policies or objectives that relate to wind energy developments that a Planning Authority must:

1. *"Ensure that overall national policy on renewable energy as contained in documents such as the Government's 'White Paper on Energy Policy - Ireland's Transition to a Low Carbon Future', as well as the 'National Renewable Energy Action Plan', the 'Strategy for Renewable Energy' and the 'National Mitigation Plan', is acknowledged and documented in the relevant development plan or local area plan;*
2. *Indicate how the implementation of the relevant development plan or local area plan over its effective period will contribute to realising overall national targets on renewable energy and climate change mitigation, and in particular wind energy production and the potential wind energy resource (in megawatts); and*
3. *Demonstrate detailed compliance with item number (2) above in any proposal by them to introduce or vary a mandatory setback distance or distances for wind turbines from specified land uses or classes of land use into their development plan or local area plan. Such a proposal shall be subject to environmental assessment requirements, for example under the SEA and Habitats Directives. It shall also be a material consideration in SEA, when taking into account likely significant effects on climatic factors, in addition to other factors such as landscape and air, if a mandatory setback or variation to a mandatory setback proposed by a planning authority in a development plan or local area plan would create a significant limitation or constraint on renewable energy projects, including wind turbines, within the administrative area of the plan."*

2.3.7.2 DoEHLG Wind Energy Guidelines 2006

In June 2006, the then Department of Environment, Heritage and Local Government (DoEHLG) published 'Wind Energy Development Guidelines for Planning Authorities' (the Guidelines) under Section 28 of the Planning and Development Act, 2000. The aim of these guidelines was to assist the proper planning of wind power projects in appropriate locations around Ireland. The Guidelines highlight general considerations in the assessment of all planning applications for wind energy. They set out advice to planning authorities on planning for wind energy through the development plan process and in determining applications for planning permission. They contain guidelines to ensure consistency of approach throughout the country in the identification of suitable locations for wind energy development.

Each wind project has its own characteristics and defining features, and it is therefore impossible to write specifications for universal use. Guidelines should be applied practically and do not replace existing national energy, environmental and planning policy. The Department of the Environment, Community and Local Government published proposed revisions to the guidelines in December 2013 as part of a targeted review relating to Noise, Proximity and Shadow Flicker for discussion. The Department is continuing this review, and the draft updated Guidelines have now been published and are discussed in more detail below.

2.3.7.2.1 *Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change 2017*

In July 2017, the Department of Housing, Planning, Community and Local Government (DoHPCLG) published '*Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change*' under Section 28 of the Planning and Development Act 2000. Planning Authorities are obliged to have regard to guidelines issued pursuant to Section 28 in the performance of their functions under the Planning and Development Act 2000 (as amended).

The guidelines state that it is a specific planning policy requirement under Section 28(1C) of the Act, that in making a development plan with policies or objectives that relate to wind energy developments that a Planning Authority must:

1. "Ensure that overall national policy on renewable energy as contained in documents such as the Government's 'White Paper on Energy Policy - Ireland's Transition to a Low Carbon Future', as well as the 'National Renewable Energy Action Plan', the 'Strategy for Renewable Energy' and the 'National Mitigation Plan', is acknowledged and documented in the relevant development plan or local area plan;
2. Indicate how the implementation of the relevant development plan or local area plan over its effective period will contribute to realising overall national targets on renewable energy and climate change mitigation, and in particular wind energy production and the potential wind energy resource (in megawatts); and
3. Demonstrate detailed compliance with item number (2) above in any proposal by them to introduce or vary a mandatory setback distance or distances for wind turbines from specified land uses or classes of land use into their development plan or local area plan. Such a proposal shall be subject to environmental assessment requirements, for example under the SEA and Habitats Directives. It shall also be a material consideration in SEA, when taking into account likely significant effects on climatic factors, in addition to other factors such as landscape and air, if a mandatory setback or variation to a mandatory setback proposed by a planning authority in a development plan or local area plan would create a significant limitation or constraint on renewable energy projects, including wind turbines, within the administrative area of the plan."

2.3.7.3 Department Circular PL5/2017

On the 3rd of August 2017, the Department of Housing, Planning and Local Government issued Circular PL5/2017 to provide an update on the review of the wind energy and renewable policies in development plans, and the advice contained within a previous Departmental Circular PL20-13. Circular PL20-13 advised that local authorities should defer amending their existing Development Plan policies in relation to wind energy and renewable energy generally as part of either the normal cyclical six-yearly review or plan variation processes and should instead operate their existing development plan policies and objectives until the completion of a focused review of the Wind Energy Development Guidelines 2006. The new circular (PL05/2017) reconfirms that this continues to be the advice of the Department.

The Department circular also sets out the four key aspects of the preferred draft approach being developed to address the key aspects of the review of the 2006 Wind Energy guidelines as follows:

- The application of a more stringent noise limit, consistent with World Health Organisation noise standards, in tandem with a new robust noise monitoring regime, to ensure compliance with noise standards;
- A visual amenity setback of 4 times the turbine height between a wind turbine and the nearest residential property, subject to a mandatory minimum distance of 500 metres between a wind turbine and the nearest residential property;
- The elimination of shadow flicker; and
- The introduction of new obligations in relation to engagement with local communities by wind farm developers along with the provision of community benefit measures.

The release of Circular Letter PL05/2017 and the Interim Guidelines coincide with the publication of Irelands first statutory National Mitigation Plan (previously discussed above).

2.3.7.4 Draft Revised Wind Energy Guidelines December 2019

The Department of Housing, Planning and Local Government published the Draft Wind Energy Guidelines (referred to as the Draft Revised Guidelines) in December 2019. The draft Guidelines were open to public submissions up until the 19th of February 2020. These submissions are now being considered by the Department. At time of writing the guidelines in place remain the 2006 guidelines pending the Department publishing a final version of any revised guidance.

The Draft Revised Guidelines clearly sets out the recognition that the proper planning and sustainable development of areas and regions must be taken into account when local authorities prepare their development plans and assess planning applications, irrespective of the significant role renewable energy has to play in tackling climate change.

The Draft Revised Guidelines note that potential impacts of wind energy development proposals on the landscape, including the natural and built environment, must be considered along with the legitimate concerns of local communities. With this in mind, and in line with the previously stated "preferred draft approach", the 2019 Draft Guidelines primarily focus on addressing a number of key aspects including, but not limited to:

- Acceptable noise thresholds and monitoring frameworks;
- Visual amenity setback;
- Control of shadow flicker;
- Compliance with Community consultation and dividend requirements, as included within the obligatory Community Report; and
- Consideration of the siting, route and design of the proposed grid connection as part of the whole project.

The design of the proposed project has taken account of the *"preferred draft approach"* as articulated by the Department in June 2017, and accordingly, has been developed with the provisions of the Draft 2019? guidelines in mind(for example in relation to set back from dwellings and layout).

The submission period for the Draft Revised Guidelines closed in February 2020. Under the consultation it was evident that a number of submissions made appeared to have observations surrounding similar points, these include but are not limited to themes such as noise, visual amenity set back and shadow flicker. With regards to noise a number of the received submissions noted that the provisions put forward in the Draft Revised Guidelines were unworkable, as such it was considered that should the noise measures be implemented there is the potential for an on-going impact on the development onshore wind energy in the future. In relation to set back distances there was strong criticism with regards to this distance being measured to the curtilage of a property, it was strongly considered that this measurement was ambiguous and difficult to implement. The measurement of a set back distance to the curtilage of a property was also deemed to be ambiguous. Furthermore questions were raised surrounding the strict measures which have been put in place surrounding shadow flicker, the Draft Revised Guidelines put forward the provision that 'there will be no shadow flicker at any existing nearby dwelling or other relevant existing affected sensitive property'. While the overall provision is possible a number of clarification where sought to ensure that this provision could be implemented in a reasonable manner.

At time of writing the Draft Guidelines are not yet in force, and the relevant guidelines remain those published in 2006. Notwithstanding this, however, due to the timelines associated with the planning process for renewable energy projects it is possible that a version of the draft guidelines may be finalised during the consideration period for the current proposed development. Towards this end it is anticipated that the Project will be capable of adhering to the relevant noise and shadow flicker standards, and furthermore detailed community consultations have been carried out.

2.3.7.5 IWEA Best Practice Guidelines for the Irish Wind Energy Industry 2012

The Irish Wind Energy Association (IWEA) published updated Wind Energy Best Practice Guidelines for the Irish Wind Industry in 2012. The guidelines aim to encourage and define best practice development in the wind energy industry, acting as a reference document and guide to the main issues relating to wind energy developments. The purpose of the guidelines is to encourage responsible and sensitive wind farm development, which takes into consideration the concerns of local communities, planners, and other interested groups. The guidelines outline the main aspects of wind energy development with emphasis on responsible and sustainable design and environmental practices, on aspects of development which affect external stakeholders, and on good community engagement practices. In approaching the development of IWEA's guidelines the aim was to be complementary to the Department of the Environment Heritage and Local Government's 'Wind Energy Development Guidelines' (2006).

2.3.7.6 IWEA Best Practice Principles in Community Engagement and Community Commitment 2013

Following on from the IWEA published Best Practice Guidelines in March 2012, the Association extended its guidance with the publication of this Best Practice in Community Engagement and Commitment. IWEA and its members support the provision of financial contributions by wind farm operators to local communities and have sought to formulate best practice principles for the provision of a community commitment. The document sets out IWEA's best practice principles for delivering extended benefits to local communities for wind farm developments of 5 Megawatts (MW) or above. Best Practice Principles of community engagement when planning the engagement strategy and preparing associated literature are also outlined in the document. The aim of these guidelines is to ensure that the views of local communities are taken into account at all stages of a development and that local communities can share in the benefits.

Further details on the community engagement that has been undertaken as part of the proposed development are presented in Section 2.6.1 below.

2.3.7.7 DCCAE Code of Practice for Wind Energy Development Ireland- Guidelines for Community Engagement 2016

In December 2016, the Department of Communications, Climate Action and Environment (DCCAE) issued a Code of Practice for wind energy development in relation to community engagement. The Code of Good Practice is intended to ensure that wind energy development in Ireland is undertaken in adherence with the best industry practices, and with the full engagement of local communities. Community engagement is required through the different stages of a project, from the initial scoping, feasibility and concept stages, right through construction to the operational phase. The methods of engagement should reflect the nature of the project and the potential level of impact that it could have on a community. The guidelines advise that ignoring or poorly managing community concerns can have long-term negative impacts on a community's economic, environmental or social situation. Not involving communities in the project development process has the potential to impose costly time and financial delays for projects or prevent the realisation of projects in their entirety.

2.3.7.8 Renewable Energy Support Scheme (RESS)

The Climate Action Plan, published in June 2019, is the Government's plan to give Irish people a cleaner, safer and more sustainable future. The Plan sets out actions across every sector which will ensure we meet our future climate commitments. A key part of the Plan is a move to 70% renewable electricity by 2030, a measure which will be driven by the introduction of the Renewable Electricity Support Scheme ('RESS').

The RESS is an auction-based scheme which invites renewable electricity projects to bid for capacity and receive a guaranteed price for the electricity they generate and replaces the previous "Gate" scheme of securing grid connection offers. The Terms and Conditions for the first competition (RESS 1:2020) were published in February 2020 and will provide support to renewable electricity projects in Ireland. The RESS will deliver, amongst other policy objectives:

> *"An ambitious renewable electricity policy to 2030 increasing energy security, energy sustainability and ensuring the cost effectiveness of energy policy"*

The Scheme will provide for a renewable electricity (RES-E) ambition of up to 70% by 2030, subject to determining the cost-effective level which will be set out in the draft National Energy and Climate Plan (NECP). The first RESS-1 auction will take place within the timelines set out in the Climate Action Plan. All projects looking for support under the new RESS will need to meet pre-qualification criteria and qualified applicants that submit eligible Offers will compete against each other on the basis of three Preference Categories, namely: (i) the Community Preference Category; (ii) the Solar Preference Category; and (iii) the All Projects Preference Category. As noted in Section 2.2.3.8 'Terms and Conditions for Participation in the First Auction Under the Renewable Electricity Support Scheme the first auction is expected to deliver up to an increase of 3,000GWh in renewable electricity generation by the end of 2022.

2.3.7.9 Forest Service Guidelines

The Forest Service is responsible for ensuring the development of Forestry within Ireland in a manner and to a scale that maximises its contribution to national socio-economic well-being on a sustainable basis that is compatible with the protection of the environment. The forestry works (felling/planting) associated with the proposed development will be carried out under the relevant licence and guidance from the Forest Service. All proposed forestry developments where the area involved is greater than 0.1 hectare must receive the prior written approval of the Forest Service.

2.4 Site of the Proposed Development

2.4.1 Site Location

The proposed development site is located in an upland area on the north-eastern slopes of Carrane Hill on the boundary of Counties Leitrim and Sligo. The core of the site is located approximately 5 kilometres west of Drumkeeran and approximately 7.5 kilometres southeast of Dromahair. The Grid Reference coordinates for the approximate centre of the site are E 584840 N 823450.

2.4.2 Access

The site is accessed via a number of local roads and Coillte forestry roads, including the L4282 local road from the east and the L8281 from the north. These local roads adjoin the R280 Regional Road which travels through Drumkeeran, east of the site. To provide access within the site and to deliver the turbines and associated infrastructure, existing tracks will need to be upgraded and new access roads will require to be constructed.

2.4.3 Physical Characteristics of the Study Area and Surrounding Lands

The site covers an area of approximately 604hectares, and ranges in elevation from approximately 200 metres above ordnance datum (mOD) to 325 m OD and is located within both counties Leitrim and Sligo. The peak of Carran Hill is located approximately 1.7 kilometres southwest of the site, at 458 m OD.

The proposed development site lies within the northwest part of the Lough Allen Upland, which typically comprises plateaux and ridges with steep sides separated by valleys. The site is covered in blanket peat with undulating terrain. Peat depths vary across the site depending mainly on topography.

The site lies on the watershed divide between the Arigna River to the southeast and the Bonet River to the northwest. Lough Nacroagh is located within the site boundary. The Arigna River rises on the site and flows to the southeast. A number of streams drain the northern portion of the site. Beyond the site, the streams pass across drumlinised terrain and enter the Bonet River some 5 kilometres to the northwest of the site. The Bonet River flows into Lough Gill.

The proposed development site is used for commercial forestry, with widespread young to mature forestry coverage. Wind energy is also a significant land-use in the vicinity, and includes the operating Garvagh Glebe, Black Banks, Carran Hill and Geevagh wind farms. The Garvagh Glebe wind farm is located adjacent to the boundary of the proposed development site. In addition to forestry and wind energy, other land-uses in the surrounding area include agriculture, peat-cutting and low-density residential. Grid infrastructure in the area includes the 110kV overhead line between the Garvagh and Corderry 110 kV substations.

2.5 Planning History

This section of the EIAR sets out the planning history of the study area and other wind farm sites within the wider area. It also describes other infrastructure projects which are existing or proposed within the wider area.

2.5.1 Planning History in Vicinity of the Application Site

A review of the Planning Registers for both Leitrim (LCC), Roscommon (RCC) and Sligo (SCC) County Council's shows that there has been a number of renewable energy and energy infrastructure planning applications within the vicinity of the application site.

Table 2-1 below sets out the planning applications identified in relation to wind energy (and associated works) within approximately 5 kilometres of the proposed development site:

Table 2-1 Applications Within 5km of the Proposed Wind Farm

Planning Ref:	Name/Location	Description	Status
LCC 95/12501	Spion Kop, Co. Leitrim	2 x 600 kW wind turbines 40 meters in height with blade diameter of 40 meters, and all associated works	Grant 13/06/1996
LCC 96/12794	Corry Mountain, Co. Leitrim	Erect 8 wind turbines 42 metres high to the Nacelle with rotor blades of 42 metres making a total height of 63 metres at Seltannasaggart Townland and Liscuillew Upper Townland, Co Leitrim	Grant 25/10/1996
LCC 97/13602	Boleymaguire and Seltan Tds, Co. Leitrim	Erect 12 Wind Turbines with towers of a height not exceeding 50 metres and rotor diameter not exceeding 48 metres with control building and ancillary equipment at Boleymaguire and Seltan Townlands, Co. Leitrim	Grant 27/01/1999
SCC 98/533	Carrane Hill, Co. Sligo	Extension of Duration application - erection of 4 no. wind turbines with towers not exceeding 46 metres in height and rotor diameter not exceeding 54.25 metres with control building and ancillary equipment for generation of electricity.	Refused SCC 11/02/1999; Granted by ABP Ref: 21.110572 07/10/1999
SCC 98/861	Geevagh, Co. Sligo	Extension of Duration application – erection of 6 no. wind turbines, 45-50m in height with rotor diameter not exceeding 55m and a wind measuring mast, height not exceeding 50m, site roads, notice boards, control building, ancillary equipment etc	Grant 24/02/2000
LCC 98/14248	Seltannasaggart, (Corry Mountain), Co Leitrim	Erection of 2 No. Monitoring Wind Masts close to an existing turbine each to a maximum height of 54.75 metres.	Grant 28/07/1999
LCC 00/7	Moneenatieve, Co. Leitrim	Extend existing windfarm by installing 6 wind turbines, 1 substation, 1 - 40 metre monitoring mast and associated equipment on Moneenatieve Td, Co Leitrim .	Grant by LCC which was upheld by An Bord

Planning Ref:	Name/Location	Description	Status
			Pleanála on the 28/11/2000
RCC 00/1979	Altagowlan, Arigna, Carrick-On-Shannon, Co. Roscommon	To extend an existing windfarm by installing 9 wind turbines, 1 sub-station, 1 - 45 metre monitoring mast and associated equipment	Grant 21/09/2001
RCC 02/1374	S.H.H., Convent, Co. Roscommon.	The development of one wind turbine, a site entrance and a site access road	Grant 23/04/2003
RCC 03/1486	Tullynahaw Arigna, Co. Roscommon	For a wind energy project comprising 11 wind turbines and all associated works.	Grant, 14/06/2004
LCC 03/257	Garvagh Glebe, Co. Leitrim	The development of a Wind Energy Project comprising thirteen wind turbines, and all associated works.	Grant 11/08/2003
RCC 03/1486	Tullynahaw Arigna, Co. Roscommon	For a wind energy project comprising 11 wind turbines and all associated works.	Grant, 14/06/2004
SCC 04/1315	Carrane Hill, Co. Sligo	Retention and completion of all works (670 metres of road) under Pl.Ref.98/533 and permission for the erection of 4 wind turbines and ancillary equipment for the generation of electricity	Granted by SCC 23/06/2005
SCC 06/136	Carrane Hill, Co. Sligo	Erection of 2 wind turbines with towers 44 metres in height and rotor diameter of 52 metres and ancillary equipment for the generation of electricity (being an extension to the wind farm referred to in planning ref no. 04/1315.	Grant 22/05/2006
LCC 07/498	Seltan, Co Leitrim	Erect a 70m anemometer mast for the measurement of wind speed and directions for the lifetime of the wind farm already permitted	Grant 27/07/2007
RCC 08/430	Seltannaveeney, Co. Roscommon	To erect 1 no. wind turbine generator; with onsite underground electrical cabling and ancillary works	Grant 19/01/2009
RCC 08/466	Seltannaveeny, Co. Roscommon	To construct 1 no. electricity sub-station; with onsite underground electrical cabling and ancillary works.	Grant 26/11/2008
LCC 08/602	Garvagh Glebe, Co. Leitrim	Extension of Duration (for Pl.Ref.03/257) application - wind energy project of 13no. wind turbines.	Granted 25/07/2008

Planning Ref:	Name/Location	Description	Status
LCC 09/76	Seltan, Arigna, Co. Leitrim	Alter Garvagh Gleve 110kV/MV Substation (Planning Ref. PL12.VA0001) to include a sewage treatment system and raised percolation area	Grant 19/05/2009
LCC 09/378	Boleymaguire, Arigna, Co. Leitrim	Alter Garvagh Glebe Wind Farm (Planning Ref. No. 03/257) to install a 67 metre high guyed lattice anemometer mast in substitution for a previously approved 50 metre high guyed pole anemometer mast	Grant 03/12/2009
RCC 09/451	Tullynahaw, Arigna, Carrick-On-Shan, Co. Roscommon	The development will consist of alteration to Tullynahaw Wind Farm (Planning Ref . PD/03/1486) to install a 67 metre high guyed lattice anemometer mast in substitution for a previously approved 50 metre high guyed pole anemometer mast	Grant 23/10/2009
LCC 15/35	Garvagh Glebe, Garvagh, Co. Leitrim	Construction of an extension to the existing Garvagh Glebe 110kV substation, comprising of the construction of a 110kV grid connection substation compound with switchgear housing, equipment plinths, bunds and fencing, oil interceptor and associated site development works	Grant 14/01/2016
LCC 18/45	Seltan and Boleymaguire, Co. Leitrm	The installation of approximately 0.46km of underground cable ducting, 1 no. joint bay and ancillary development laid primarily within the public road corridor, with a section of circa. 0.07km within private lands at Seltan.	Refused 05/08/2018; Granted by ABP (Ref: 301812-18) 18/06/2018
LCC 19/230	Spion Kop, Co. Leitrim	(a) decommissioning and removal from site of 2 no. existing wind turbines and associated ancillary infrastructure (95/12501); and (b) the erection of 1 no. wind turbine with an overall tip height of up to 125 metres and all associated site development/works.	Granted 19/06/2020
ABP PL21 .300811	Counties Leitrim, Roscommon and Sligo	Substitute Consent Application for installed portion of grid connection from consented Derrysallagh Windfarm Substation to Garvagh Glebe Substation, through townlands of Seltan, Boleymaguire, Leitrim, Gubbaruddda (Roscommon), Carrowcashel, Tulllynure, Straduff, Glen, and Ballynashee, Co. Sligo.	ABP Granted Permission 05/02/2019

Table 2-2 below lists planning applications relating to wind energy developments which are located outside of the approximate 5km distance surrounding the proposed site. The below table captures applications between a 5-20km distance of the proposed development:

Table 2-2 Applications Within a 5-20km radius of the Proposed Wind Farm

Planning Ref:	Name/Location	Description	Status
RCC 94/582	Largan, Co. Roscommon	Erect 10 wind turbines, substation, roads, car park and meteorological mast	Grant by RCC 06/03/1994
RCC 02/1094	Seltenaveeny, Co. Roscommon	Development to consist of two wind turbines, electrical sub-station, site entrance and access roads	Grant, 28/01/2003
LCC 03/301	Lackagh, Killarga, Leitrim	Construct a windfarm consisting of 25 wind turbines of 60m hub height with associated transformers and associated works. This application is accompanied by an Environmental Impact Statement (EIS).	Grant by LCC, Refused by ABP 02/06/2004.
LCC 03/331	Tullynamoyle, Killarga, Co Leitrim	Develop an electricity generating windfarm consisting of twelve (12) wind turbines	Granted by LCC, Refused by ABP on the 02/06/2004
LCC 05/691	Tullynamoyle, Co. Leitrim	Erect an electricity generating windfarm consisting of six (6) wind and site works	Grant by LCC, upheld by ABP on the 14/05/2008
LCC 10/152	Carrickheeney, Co. Leitrim	Windfarm comprising 4 wind turbines, 20Kv substation building.	Refused LCC; 24/10/2011; ABP Grant (PL12.239133) 24/10/2011
SCC 12/133	Derrysallagh, Co. Sligo.	A 10 year permission for construction of a wind farm consisting of 12 wind turbines, a sub-station including a control building and associated equipment, new internal access roads, and the upgrading of an existing road.	Grant 26/04/2013
LCC 13/52	Tullynamovle Extension 1, Co. Leitrim	Ten year planning permission for an extension to an existing wind farm development permitted under planning reference 05/691. The development will consist of six (6) electricity generating wind turbines and all site works.	Grant 12/08/2013
LCC 15/93	Tullynamoyle Td, Killaraga, Co. Leitrim	Development at existing wind farm for the erection of 2 turbines previously granted permission under Leitrim County Council	Grant 31/08/2015

Planning Ref:	Name/Location	Description	Status
		Planning Ref. 05/691 and An Bord Pleanála Ref: PL 12.218384, as part of a 6 turbine wind farm (4 turbines already commissioned) and upgrade of an existing forest track.	
LCC 15/164	Tullynamovle Extension 2, Co. Leitrim	Development consisting of twelve (12) electricity generating wind turbines (4 operational, 6 under construction and two permitted). The overall development will consist of 15 turbines	Grant 01/02/2016
SCC 17/93	Tawnaghmore, Co. Sligo	A ten year permission for erection of four wind turbines and associated works.	Grant 03/06/2017
LCC 19/26	Tullynamoyle, Killarga, Co. Leitrim	A thirty year planning permission for an additional four (4) wind turbines to an existing fifteen (15) turbine windfarm.	Grant 18/05/2020
LCC 20/20	Corderry, Co. Leitrim	Installation of battery arrays located within container units (16 no.), control building, transformer and new site entrance.	Ongoing

The existing and permitted wind energy developments located within 20km of the Croagh Wind Farm site are shown in Figure 2-1.

A range of other (non-renewable energy related) planning applications exist within 2km of the proposed wind farm development site and in the vicinity of the access road works. Many of the noted applications relate to agricultural developments and/or signal residential developments. Table 2-3 below lists the planning applications identified within the vicinity of the development site are provided in Table 2-3 below:

Table 2-3 Other Applications in the Vicinity of the Proposed Wind Farm

Planning Ref:	Description	Status
LCC 01/699	Renovate and extend existing public bar and private living accommodation, demolish existing storage area to rear and replace with natural stone boundary wall connect to mains sewer including all ancillary works	Grant 30/11/2001
LCC 01/760	Provide septic tank and percolation area.	Grant 07/01/2002
LCC 01/795	Erect single storey extension to existing dwelling house and connect to mains sewer at No. 6a, Sheena Td., Drumkeeran	Grant 14/01/2002
LCC 01/1001	Erect a house on site at Sheena Td., Drumkeeran.	Grant 15/10/2002

Map Legend

- Corrie Mountain Turbines - Existing
- Spion Kop Turbines - Existing
- Garvagh Tullyhaw Turbines - Existing
- Atlagowlan Turbines - Existing
- Faughary Turbines - Existing
- Carrickheeney Turbines - Existing
- Monaneenatieve Turbines - Existing
- BlackBanks Turbines - Existing
- Kilronan Turbines - Existing
- Caranne Hill Turbine - Existing
- Geevaghs Turbine - Existing
- Derrysallagh Turbines - Existing
- Tullynamoyle Turbines - Existing
- Seltannaveeny Turbines - Existing
- Garvagh Glebe Turbines - Existing
- Tullynamoyle Ext. Turbines - Permitted
- Croagh Turbines - Proposed
- Distance from Proposed Croagh Wind Turbines
- County Boundary

Fermanagh
Leitrim
Sligo
Cavan
Roscommon
5 km
10 km
20 km

MAP TITLE: Other Wind Farms		MAP NO.: Figure 2.1	SCALE: 1:150,000
PROJECT TITLE: 180511 - Croagh Wind Farm			DATE: 05-06-2019
DRAWING BY: Lorraine Meehan	CHECKED BY: Michael Watson		ISSUE NO.: 180511-2020.06.05-F

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Planning Ref:	Description	Status
02/951	Change of use from a holiday house to a dwelling house	Grant 15/07/2002
02/976	Erect a bungalow type dwelling, septic tank, percolation area, provide new site entrance, connection to existing group water scheme and associated site works.	Grant 15/10/2002
LCC 04/484	Elevational alterations including alterations to site boundaries to previously granted development under Planning Reference P00/01243 to erect 4 no. two storey semi detached dwellinghouses , connect to mains sewer, provide new site entrances including all ancillary works	Grant 14/07/2004
LCC 04/979	(1) construct 2 storey residential group home, consisting of 20 No. single bedroom apartments, 1 No. caretakers apartment, kitchen with dining hall and daycare facilities (total floor area 1528.7sq.m) (2)connect to public utilities (3) to carry out all ancillary site works	Grant 07/04/2005
LCC 04/1912	(1) construct 6 no. 3 bed townhouses, connect to public utilities and carry out ancillary works	Grant 14/12/2005
LCC 04/207	Erect 1 one and a half storey dwelling house, domestic garage, mechanical effluent treatment unit and percolation area to E.P.A Guidelines 2000, provide new site and access road.	Grant 27/05/2004
LCC 04/431	Erect dwelling house, domestic garage, proprietary effluent treatment system and constructed wetland	Grant 06/10/2004
LCC 05/175	Convert part of existing bedroom to bathroom and install treatment unit and polishing filter	Grant 06/07/2005
LCC 05/765	Erect one number single storey dwelling, proprietary effluent treatment system, entrance piers, gates, new site access and all associated ancillary works	Grant 21/08/2006
LCC 06/787	Erect one no. single storey type dwelling, garage, proprietary sewerage treatment system, entrance piers, new site access and all associated ancillary works	Grant 19/09/2006
LCC 06/798	Construct a dwelling house with sewage treatment system and percolation area and all associated site works	Grant 19/09/2006
LCC 06/827	Construct a proprietary sewerage treatment system and all associated ancillary works	Grant 11/08/2006

Planning Ref:	Description	Status
LCC 06/1205	Erect one number single storey type dwelling, proprietary sewerage treatment system, entrance piers, new site access and all associated ancillary works	Grant 27/03/2007
LCC 06/1231	Erect one number dormer type dwelling, proprietary sewerage treatment system, entrance piers, new site access and all associated ancillary works	Grant 28/03/2007
LCC 07/140	Construct a proprietary sewerage treatment system at an existing dwelling and all associated ancillary works	Grant 19/07/2007
LCC 07/170	Erect 11 No. dwelling houses consisting of the following: 7 No. two-storey detached, 4 No. two-storey semi detached, provide new site entrance and access road, connect to public services including all ancillary works necessary to complete the development in lieu of 15 dwellinghouses	Grant 08/01/2008
LCC 07/265	Erect one number single storey type dwelling, proprietary sewerage treatment system, entrance piers, new site access and all associated ancillary works	Grant 25/07/2007
LCC 07/282	Retain disabled bathroom extension with effluent treatment unit and percolation on site	Grant 10/09/2007
LCC 07/374	Retain existing shop front facade and all associated ancillary works	Grant 22/06/2007
LCC 07/498	Erect a 70m anemometer mast for the measurement of wind speed and directions for the lifetime of the wind farm already permitted	Grant 27/07/2007
SCC 07/502	Continued operation of existing quarry within an overall site of 287 hectares.	Grant 12/05/2009
LCC 07/601	Restore and extend the existing School House	Grant 08/01/2008
LCC 07/773	Erect one number slatted agricultural livestock storage shed, concrete yard and all associated ancillary works	Grant 07/05/2008
LCC 07/776	Erect one number dry bedded agricultural livestock storage shed, sheep dipping unit, new site entrance, concrete yard and all associated ancillary works	Grant 15/04/2008
LCC 08/223	1. carry out alterations to elevations 2. revise internal floor layouts 3. provide an additional 1 bedroom residential unit,. 4. revise ancillary site works to include pumping station for foul	Grant 06/06/2008

Planning Ref:	Description	Status
	drainage and internal parking and road layout. All proposals refer to previous grant of planning permission ref: P04/979 for residential group home	
LCC 08/227	Carry out development which will consist of 1. The material change of use of 2 no. dwelling houses to commercial units at ground floor level, consisting of 1 no. off licence (36.38m2) and 1 no. take away (100m2), each with new shop front and 2. The provision of 1 no. 3 bed apartment (107m2) at first floor level and 3. Carry out all ancillary site works	Refused 07/05/2008
LCC 08/230	Construct a 15 metre support pole to carry 3 no. radio aerials (3.9m) for use by the Emergency Services (Garda, Ambulance and Fire Brigade) together with associated equipment, fencing, cabling and a GPS timing antenna for a new National Digital Radio Service	Granted 22/07/2008
LCC 08/475	Erect one number dormer type dwelling, one domestic garage, proprietary sewerage treatment system, entrance piers, new site access and all associated ancillary works	Grant 14/08/2008
LCC 09/323	Retain modifications to existing house and garage previously granted under P.04/1048	Grant 06/11/2009
LCC 09/483	(a) Retain and complete residential group home (Revisions made to previous planning permissions P04/979 and P08/223) total floor area 1731.47sqm, (b) to retain the retaining wall altered from P08/223 and (c) planning permission to provide a door at level 1 to laundry room	Grant 22/03/2010
LCC 11/140	Erect an extension to side of existing dwelling and all associated works	Grant 08/09/2011
LCC 13/5	Extend duration of Planning Permission 07-170 for a period of five years	Refused 21/03/2013
LCC 13/100	Continued use of an existing 15 metre telecommunications monopole and antennae used by the Emergency Services (Garda, Ambulance and Fire Brigade) together with associated equipment, previously granted under Planning Ref. No P08-230	Granted 29/07/2013
LCC 18/45	The installation of approximately 0.46km of underground cable ducting, 1 no. joint bay and ancillary development laid primarily within the public road corridor, with a section of circa. 0.07km within private lands at Seltan.	Refused LCC 05/08/2018; Granted by ABP (Ref: 301812-18) 18/06/2018

Planning Ref:	Description	Status
LCC 19/246	Construct a new entrance lobby/seating area on the east elevation and to carry out all ancillary site works (Previous Plannings 09/483, 08/223 and 04/979 refer)	Grant 24/02/2020
LCC 20/2	Retention of extension to the rear of existing house,	Granted 09/03/2020
20/13	(a) demolish 1 number existing derelict dwelling and adjacent out-building; (b) to construct 9 number 3 storey type domestic dwellings, new site entrance, connection to the public services and all ancillary works	Ongoing

2.6 Scoping and Consultations

Scoping is the process of determining the content, depth and extent of topics to be covered in the environmental information to be submitted to a competent authority for projects that are subject to Environmental Impact Assessment (EIA). This process is conducted by contacting the relevant authorities and Non-Governmental Organisations (NGOs) with interest in the specific aspects of the environment with the potential to be affected by the proposal. These organisations are invited to submit comments on the scope of the EIAR and the specific standards of information they require. Comprehensive and timely scoping helps ensure that the EIAR refers to all relevant aspects of the proposed development and its potential effects on the environment and provides initial feedback in the early stages of the project, when alterations are still easily incorporated into the design. In this way scoping not only informs the content and scope of the EIAR, it also provides a feedback mechanism for the proposed design itself.

A scoping report, providing details of the application site and the proposed development, was prepared by MKO and circulated in December 2018. MKO requested the comments from relevant personnel/bodies in their respective capacities as consultees with regards to the EIAR process.

Furthermore the scoping consultee list was also circulated to near neighbours for their review of the consultees. This process resulted in two further local tourism organisations being included on the scoping list. The scoping report when complete was then issued to the near neighbours in February 2019.

2.6.1 Scoping Replies

Table 4-1 lists the responses received to the scoping document circulated. Telecommunications operators were scoped at an earlier stage for the purposes of constraints mapping. Copies of all scoping responses received as of June 2020 are included in Appendix 2-1 of this EIAR. The recommendations of the consultees have informed the scope of the assessments undertaken and the contents of the EIAR. Those bodies engaged with at scoping stage are set out below in Tables 2-4 and 2-5.

Table 2-4 Scoping Consultees and Scoping Replies

Ref	Consultee	Date of Response
1	An Taisce	05/04/19

Ref	Consultee	Date of Response
2	Bat Conservation Ireland	No response received as of June 2020
3	BirdWatch Ireland	14/12/18
4	Commission for Regulation of Utilities	No response received as of June 2020
5	Department of Agriculture, Food and the Marine	22/01/19
6	Department of Communications, Climate Action and the Environment	No response received as of June 2020
7	Department of Defence	06/02/19
8	Department of Culture, Heritage and the Gaeltacht	30/01/19
9	Department of Transport, Tourism & Sport	No response received as of June 2020
10	EirGrid	No response received as of June 2020
11	Failte Ireland	11/01/19
12	Forest Service	No response received as of June 2020
13	Geological Survey of Ireland	15/01/19
14	Health Service Executive	10/01/19
15	Inland Fisheries Ireland - Shannon Region & Western Region	12/02/19
16	Irish Aviation Authority	04/01/19
17	Irish Peatland Conservation Council	21/01/19
18	Irish Red Grouse Association	No response received as of June 2020
19	Irish Raptor Study Group	No response received as of June 2020

Ref	Consultee	Date of Response
20	Irish Water	No response received as of June 2020
21	Irish Wildlife Trust	No response received as of June 2020
22	Leitrim County Council – Planning	No response received as of June 2020
23	Leitrim County Council – Roads	No response received as of June 2020
24	Leitrim County Council - Env.	No response received as of June 2020
25	Leitrim County Council – Heritage	No response received as of June 2020
26	Leitrim Tourism	No response received as of June 2020
27	Leitrim Tourism Network	No response received as of June 2020
28	Office of Public Works	11/01/19
29	Roscommon County Council – Planning	28/02/19
30	Roscommon County Council – Roads	07/03/19
31	Roscommon County Council - Env.	28/02/19
32	Roscommon County Council – Heritage	No response received as of June 2020
33	Sligo County Council – Planning	07/01/19
34	Sligo County Council – Roads	No response received as of June 2020

Ref	Consultee	Date of Response
35	Sligo County Council – Environment	No response received as of June 2020
36	Sligo County Council – Heritage	No response received as of June 2020
37	The Heritage Council	No response received as of June 2020
38	Transport Infrastructure Ireland	25/01/19
39	Waterways Ireland	04/04/19

A separate scoping exercise was undertaken with telecoms operators in August 2018. Those engaged with as part of this scoping exercise are listed below in Table 2-5:

Table 2-5 Scoping Replies – Telecoms Operators

Ref	Consultee	Date of Response
1	Airspeed Communications	-
2	BT Communications Ireland	15/08/18
3	ESB Telecoms	20/09/18
4	Eir and Meteor (formerly Eircom)	09/11/18
5	Imagine Group	15/08/18
6	Ripplecom	16/08/18
7	2rn (RTE Transmission Network)	20/08/18
8	Tetra Ireland Communications Ltd.	22/08/18
9	Three Ireland Ltd. (Hutchison)	16/08/18
10	Towercom	22/08/18
11	Virgin Media	16/08/18
12	Vodafone Ireland Ltd.	16/08/18
13	ComReg	

Table 2-6 sets out the detail of consultation responses received from those bodies as relevant and notes where they have been addressed in this EIAR. The responses received were fully considered and issues

raised were followed up through contact with the respondent where clarification was necessary and addressed throughout the EIAR.

Table 2-6 Expanded Consultee Responses

No.	Consultee	Comment	EIAR Reference
1	An Taisce	Address cumulative effects, impacts on birds since construction of other wind farms in the area	Refer to Section 2.8 of this EIAR for details on cumulative assessment. Refer to Chapter 7: Ornithology for the assessment of the potential for impacts on birds.
2	Bat Conservation Ireland	N/A	N/A
3	BirdWatch Ireland	Acknowledgement email - has forwarded to Policy & Advocacy officer for comment	N/A
4	Commission for Regulation of Utilities	N/A	N/A
5	Department of Agriculture, Food and the Marine	Felling licence requirements, felling impacts to be assessed	Refer to Chapter 4: Description of the Proposed Development for details in relation to felling.
6	Department of Communications, Climate Action and the Environment	N/A	N/A
7	Department of Defence	Standard lighting requirements	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
8	Department of Culture, Heritage and the Gaeltacht	Nature conservation comments re EIAR and AA. Requirements re ecological surveys on biodiversity, flora, fauna (incl birds, bats), habitats (incl aquatic), Construction Management Plan, cumulative impacts, post-construction monitoring	Refer to Chapter 6: Biodiversity and Chapter 7: Ornithology Refer to Appendix 4.4: Construction and Environmental Management Plan
9	Department of Transport, Tourism & Sport	N/A	N/A

No.	Consultee	Comment	EIAR Reference
10	EirGrid	N/A	N/A
11	Fáilte Ireland	General response, sent copy of EIS & Tourism Guidelines	Refer to Chapter 5: Population and Human Health for an assessment of the potential impacts on tourism
12	Forest Service	No direct response - but see Dept of Agriculture response for Forest Service requirements	Refer to Chapter 4: Description of the Proposed Development for details in relation to felling.
13	Geological Survey of Ireland	List of GSI resources, EIAR to address County Geological Sites (no envisaged impact), address area landslides/peat stability	Refer to Chapter 8: Land, Soil & Geology
14	Health Service Executive	Items to be addressed incl. ground & surface water quality and protection at all stages, air pollution mitigation, noise and vibration surveys, cumulative noise impact, peat stability, staff facilities onsite	Refer to Chapter 9: Water for details in relation to ground and surface water quality Refer to Chapter 10: Air and Climate for details in relation to air quality Refer to Chapter 11: Noise and Vibration for details in relation noise surveys
15	Inland Fisheries Ireland - Shannon Region & Western Region	Requirements regarding items to be addressed in surveys & assessment, re protection of aquatic habitat. Refer to Section 2.6.1.1 below for further detail in relation to response.	Refer to Section 2.6.1.1 below for further detail in relation to response.
16	Irish Aviation Authority	Standard lighting & as-constructed turbine coordinates requirement	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
17	Irish Peatland Conservation Council	Concerns re loss of blanket bog, impacts on designated sites, birds (Curlew), water quality, peat stability, visual amenity/views.	Refer to Chapter 6: Biodiversity for assessment of potential impacts on blanket bog Refer to Chapter 7: Ornithology for details in relation to bird species assessed as part of this EIAR Refer to Chapter 8: Land, Soil & Geology for details in relation to peat stability

No.	Consultee	Comment	EIAR Reference
			Refer to Chapter 9: Water for details in relation to ground and surface water quality Refer to Chapter 11 for details in relation to the assessment of visual amenity and scenic views
18	Irish Red Grouse Association	N/A	N/A
19	Irish Raptor Study Group	N/A	N/A
20	Irish Water	N/A	N/A
21	Irish Wildlife Trust	N/A	N/A
22	Leitrim County Council – Planning	N/A Refer to Section 2.7.2 below for further detail on engagements with Leitrim County Council.	Refer to Section 2.7.2 below for further detail on engagements with Leitrim County Council.
23	Leitrim County Council – Roads	N/A	N/A
24	Leitrim County Council - Env.	N/A	N/A
25	Leitrim County Council – Heritage	N/A	N/A
26	Leitrim Tourism	N/A	N/A
27	Leitrim Tourism Network	N/A	N/A
28	Office of Public Works	WF boundary is outside boundary of Bonet Catchment Drainage Scheme, does not interfere with scheme channels. No records of flooding. Section 50 consent will be required for any new bridge or alterations to existing bridges	Refer to Chapter 4: Description of the Proposed Development for details in relation to watercourse crossings.
29	Roscommon County Council - Planning	Refer to Roscommon Renewable Energy Strategy in relation to assessing potential environmental impacts	N/A
30	Roscommon County Council - Roads	Heavy loads/abnormal plant not to adversely impact public roads, bridges,	Refer to Chapter 14, Section 14.1: Roads and Traffic

No.	Consultee	Comment	EIAR Reference
		culverts. Assess drainage works & potential for flooding issues	Refer to Chapter 9: Water for assessment of drainage works and potential for flooding issues
31	Roscommon County Council - Env.	N/A	N/A
32	Roscommon County Council – Heritage	N/A	N/A
33	Sligo County Council – Planning	Comments re NIS and list of items to be included in EIAR; site selection & cumulative, grid connection, ECoW, Flora & Fauna and Cultural Heritage studies.	Refer to Section 2.7.2 for further detail on engagements with Sligo County Council
34	Sligo County Council – Roads	N/A	N/A
35	Sligo County Council - Env.	N/A	N/A
36	Sligo County Council – Heritage	N/A	N/A
37	The Heritage Council	N/A	N/A
38	Transport Infrastructure Ireland	General response referring to TII guidelines. Identify haul routes, grid connection routes, consult with Local Authority roads office	Refer to Chapter 14, Section 14.1: Roads and Traffic
39	Waterways Ireland	Area is outside WWI jurisdiction, no comments to make	N/A
40	Airspeed Communications	N/A	N/A
41	BT Communications Ireland	No impact	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
42	ESB Telecoms	No impact on telecoms network	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation

No.	Consultee	Comment	EIAR Reference
43	Eir and Meteor (formerly Eircom)	Eir Link on western side of site. Apply 100m buffer. Link is 270m west of current T1.	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
44	Imagine Group	No links in area	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
45	Ripplecom	No links in area	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
46	2rn (RTE Transmission Network)	Telcoms link unaffected.	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
47	Tetra Ireland Communications Ltd.	Risk of disruption to viewers south of the area; recommend protocol document to be in place"	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
48	Three Ireland Ltd. (Hutchison)	No network/coverage concerns	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
49	Towercom	Link on western side of site. Applied 100m buffer. Link is 270m west of current T1.	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
50	Virgin Media	Review of turbine layout when available	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
51	Vodafone Ireland Ltd.	Doesn't appear to have significant impact, but send on turbine layout when available	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation
52	ComReg	No links in area. Let him know if site area changes	Refer to Chapter 14, Section 14.2 Telecommunication and Aviation

2.6.1.1 Inland Fisheries Ireland

MKO received a detailed, formal scoping response letter from Inland Fisheries Ireland – Shannon Region and Western Region (IFI) on the 12th February 2019. In the letter, the IFI outlined the hydrological setting of the area of the proposed Croagh Wind Farm and also provided information on the aquatic species of the waterbodies with which the site of the proposed development would potentially be hydrologically linked.

The letter also provided details in relation to the severe pollution, in September 2008, of the Owengar River that occurred as a result of a landslide event, caused by construction activities at an existing, neighbouring wind farm. The volume of peat material that entered the watercourse caused the destruction of fisheries habitat within the Owengar River. Thus, the IFI have serious concerns regarding

the potential for landslides within the site of the proposed development and given numerous landslide events recorded within the local area, two of which occurred during the construction of the neighbouring Garvagh Glebe Wind Farm.

The IFI requested that the EIAR consider and include the following:

- Description and assessment of the aquatic biodiversity of watercourses that would potentially have a direct hydrological link to the drainage network of the proposed wind farm development and also local watercourses that would not have a direct hydrological link. (Refer to Appendix 6-3: Aquatic and fisheries assessment of Croagh Wind Farm)
- Electrofishing of all watercourses with the potential to be impacted by the proposed development. (Refer to Appendix 6-5: Aquatic and fisheries assessment of Croagh Wind Farm)
- A detailed geotechnical survey to assess the potential impact of the construction of the wind farm infrastructure on the stability of peat on the site, especially areas with steep slopes. (Refer to Chapter 8: Land, Soils and Geology and Appendix 8.1: Geotechnical and Peat Stability Assessment Report)
- Avoidance of alternation of the natural flowpaths of watercourses during the construction of the development, which could lead to erosion of instability of peat. (Refer to Chapter 9: Water)
- Development of a drainage plan for the proposed development and ensuring that the collected waters from works areas are returned to their original catchment. Maintenance of drainage controls during the operational phase and careful siting of silt traps to allow for easy access for monitoring, sampling and maintenance. (Refer to Chapter 4: Description of the Proposed Development and Appendix 4.5: Drainage Layout Drawings)
- Ensuring the careful placement of excavated peat and spoil in designated areas that have been subject of a detailed risk assessment and careful drainage design. (Refer to Appendix 4.2: Peat and Spoil Management Plan)
- Details of the location of site offices and associated services to be included in addition to details relating to the management of potential pollutants such as fuels, oils and cement. (Refer to Chapter 4: Description of the Proposed Development)
- Fully detailed assessment of the cabling works required for the connection of the proposed wind farm to the national electricity grid. (Refer to Chapter 4: Description of the Proposed Development)
- Use of specialist expertise to inform the type of material to be used for the construction of roads and ensuring the avoidance of pollution of watercourses from sediment being washed from the road structures into the drainage network. (Refer to Chapter 4: Description of the Proposed Development and Chapter 9: Water)
- Minimising the number of proposed new watercourse crossing to be required and the use of clear span crossings here necessary. (Refer to Chapter 4: Description of the Proposed Development)
- Proposals for the monitoring of all watercourses within the site and provision of a response plan in the event that environmental damage is caused to the aquatic habitat and associated riparian zone. (Refer to Chapter 4: Description of the Proposed Development)
- Provision of a Construction and Environmental Monitoring Plan that includes strict control measures for the prevention of pollution of aquatic environment during the construction phase. (Refer to Appendix 4.4: Construction and Enviornmental Management Plan)

In February 2019, MKO offered to meet the IFI on site to provide an overview of the proposed infrastructure locations and to discuss how it was intended to address the concerns of the IFI as part of the EIAR. In response to the offer, the IFI requested further details in relation to surveys to be carried

out as part of the EIAR ahead of any meeting. On the 17th May 2019, MKO issued a letter to the IFI that provided detailed further information on the following:

- Site Location and Context
  - Catchments and Water Quality
  - Site Overview
- Site Design Principles and Methodology
- Aquatic Biodiversity
  - Aquatic Surveys
  - Electrofishing and Crayfishing
  - Invasive Species
- Site Investigations
  - Geotechnical Survey and Peat Stability Assessment
  - Geotechnical Walkover Survey
  - Peat Stability Report
  - Land, Soils & Geology and Hydrology and Hydrogeology Assessments
- Peat and Spoil Management
- Drainage Design
- Road Construction
- Watercourse Crossings
- Grid Connection
- Environmental Management of Site Activities

The IFI indicated that a site visit could be facilitated in July and on the 9th July 2019 MKO also issued a summary of the findings of the geotechnical site investigations carried out on site in lieu of the detailed peat stability assessment report which was being finalised at the time. However, a date for a site visit was not agreed.

MKO sent numerous follow up requests to the IFI, between August 2019 and March 2020, in relation to an on site meeting, however, no such meeting could be arranged. Details in relation to the final development layout arrangement were issued to IFI on 25th June 2020.

2.7 Other Consultation

2.7.1 Community Engagement

Coillte has undertaken a comprehensive community engagement programme over the 2018/2019 period, liaising with near neighbours and those in the wider area with regard to the proposed wind farm. Coillte has a long history of working with communities and their experience around the country has generated an inherent understanding of the communities in which they operate.

Community engagement commenced in June 2018 with the appointment of a community liaison officer (CLO) for the proposed project. Coillte placed a focus on the residents within 2 km of the proposed site, in this regard residential dwellings within the 2km were identified.

The applicant's team carried out individual house to house engagements to gather the views of those within the area. As part of this process, a low-call number and project email address were created to aid communication. All those who expressed an interest agreed to their inclusion in an email group for two way traffic such as raising queries and receipt of answers in addition to facilitating updates and circulation of information to all parties.

As the engagement continued, the list extended as other interested near neighbours, some from outside the 2 km area who agreed to be added. To those who were not on the email list all information was circulated in a print form from the CLO.

Through the dual email and delivery approach, Coillte were able to engage with all neighbours within the immediate zone and were very available for any queries.

Furthermore, the following were also carried out to engage with the community:

- Small group meetings commenced in September 2018.
- A site visit for near neighbours
- Larger group meetings (January 2019 - August 2019) throughout the investigative and design phase of the project
- Circulation of newsletters which included updates on the overall project,
- A number of workshops were carried out (discussions surrounding noise, archaeology, cultural heritage and property value)
- Discussions surrounding visual impact and impact on the landscape including the preparation of a number of photomontages and visibility maps were presented.

In early 2020 a list of all community groups within 10km of the proposed site was compiled, once identified an invitation to engage was issued along with a booklet containing information surrounding the proposed development.

Following the community engagement effort to date, it is considered that many of the near neighbours are supportive of the project. Much has been achieved in terms of making the proposed project a better project for all through the community engagement process. Further engagement is required in order to get to a point where a full stakeholder group is formed and working on the Community Benefit Fund and Community Investment work-streams. Coillte recognise that development of a proposed wind farm is a long and complex process and that there is ample time to jointly develop our community offerings with our near neighbours and other stakeholders, and they will be progressing these throughout the planning adjudication and decision phases as well as in the pre-construction phase should the project receive planning consent.

It is the intention of the applicant to adhere to this community report for the lifetime of the development, in compliance with the Code of Practice for Wind Energy Development in Ireland Guidelines for Community Engagement issued by the Department of Communications, Climate Action and Environment (December 2016) or updated revision.

The associated Community Engagement Report has been included under Appendix 2-2 of this EIAR.

2.7.2 Pre-Planning Meetings

2.7.2.1 Leitrim County Council Meeting 1

The project team (Coillte and MKO) met with representatives of Leitrim County Council on the 10th of June 2019. During the meeting the overall project was introduced to Leitrim County Council and detailed discussions were held. As per the meeting agenda prepared by the project team discussions were held surrounding the following topics:

- Introductions
- Project Background & History
- Constraints Mapping Process, Proposed Layout Design, Turbine Dimensions
- Potential Turbine Delivery and Grid Connection Routes
- Peat Stability
- Noise
- Landscape & Visual: Zone of Theoretical Visibility (ZTV) & Photomontages
- Community Engagement
- Scoping and Consultation
- Environmental Impact Assessment Report (EIAR):

- Other Surveys / Studies completed and underway
- Development Plan Provisions and Wind Energy Guidelines
- Next Steps & Proposed Planning Application Process
- AOB

At the meeting MKO presented information and mapping in relation to the proposed wind farm layout, the design methodology, and an overview of the EIAR surveys carried out to date. The team also updated the Council on consultations underway, such as with Inland Fisheries Ireland and the National Parks & Wildlife Service.

2.7.2.2 Leitrim County Council Meeting 2

A second pre-application meeting was held with Leitrim County Council on the 15th of May 2020. The meeting was attended by representatives of Coillte, MKO and Leitrim County Council. Discussions were held surrounding the following topics:

- Introductions
- Site Location & Site Context
- Site Selection & Site Constraints
- Wind Farm Design Process and Emergence of Optimal Layout
- EIAR Update
- Landscape and Visual Impact Assessment
- Public and Community Consultation
- Policy Context (Potential Plan Updates), Planning Context.
- Drawing Scales, Validation Process, Application Procedures

2.7.2.3 Sligo County Council Meeting 1

The project team (Coillte and MKO) met with representatives of Sligo County Council on the 21st of June 2019. In the first meeting the overall project was introduced to the Sligo County Council and discussions were facilitated. As per the meeting agenda circulated discussions were held surrounding the following topics:

- Introductions
- Proposed Layouts and Alternatives
- Cumulative Assessments
- Site Design and Consultation
- Proposed Grid Connection and Turbine Delivery Routes
- Planning Application and EIA/AA Procedures
- Community Engagement
- Landscape and Visual
- AOB

MKO at the meeting presented information with regards to the proposed wind farm layout, the design methodology, and an overview of the EIAR surveys carried out to date. The team also updated Sligo County Council on consultations underway.

2.7.2.4 Sligo County Council Meeting 2

A second pre-application meeting was held with Sligo County Council on the 21st of May 2020. The meeting as attended by representatives of Coillte, MKO and Sligo County Council. MKO and Coillte reintroduced the project and the various updates that have occurred following the initial meeting with SCC. The various elements discussed included the following:

- Updates on the design process and the emergence of the optimal layout,

- Updates on the EIAR (including on site assessments, high level findings and scoping)
- Various consultations,
- Policy,
- Discussions surrounding planning drawings (scales and validation) and the application.
- Detailed discussions were also had surrounding landscape and any potential impacts it might have. Further discussions were also held surrounding any potential visual impacts.

2.8 Cumulative Impact Assessment

The EIAR Directive and associated guidance documents state that as well as considering any indirect, secondary, transboundary, short-, medium-, and long-term, permanent and temporary, positive and negative effects of the project (all of which are considered in the various chapters of this EIAR), the description of likely significant effects should include an assessment of cumulative impacts that may arise. The factors to be considered in relation to cumulative effects include population and human health, biodiversity, land, soil, water, air, climate, material assets, landscape, and cultural heritage as well as the interactions between these factors. To gather a comprehensive view of cumulative impacts on these environmental considerations and to inform the EIAR process being undertaken by the consenting authority, each relevant chapter within this EIAR includes a cumulative impact assessment where appropriate.

The potential for cumulative impacts arising from other projects has therefore been fully considered within this EIAR.

2.8.1 Methodology for Cumulative Assessment of Projects

The potential cumulative impact of the proposed wind farm development combined with the potential impact of other projects has been carried out with the purpose of identifying what influence the proposed development will have on the surrounding environment when considered collectively with approved and existing projects in the vicinity of the proposed site location.

The Cumulative Impact Assessments (CIA) of projects has three principle aims:

1. To establish the range and nature of existing and/or approved projects within the cumulative impact study area of the proposed development.
2. To summarise the relevant projects which have a potential to create cumulative impacts.
3. To identify the projects that hold the potential for cumulative interaction within the context of the proposed development and discard projects that will neither directly or indirectly contribute to cumulative impacts.

Assessment material for the Cumulative Impact Assessments carried out within this EIAR was compiled in relation to the relevant infrastructure developments within the vicinity of the proposed development from which there may be potential for cumulative impacts to arise. The material gathered comprised EIAR's (/EIS's), planning application details and planning drawings and served to identify past and future projects, their activities and their environmental impacts.

2.8.1.1 Projects Considered in Cumulative Assessment

The projects considered in relation to the potential for cumulative impacts and for which all relevant data was reviewed (e.g. individual EIS/EIAR's, layouts, drawings etc) include those listed previously above in Section 2.5 (i.e. wind farms and renewable energy infrastructure within 20 kilometres of the site, smaller scale projects (i.e. agricultural, residential and other developments within approximately 2 kilometres of the site) and all relevant associated works. Other developments considered within the cumulative assessment include land uses and the categories of works listed below. This EIAR therefore

considers the full range of projects that could potentially have a cumulative effect with the current proposed development.

2.8.1.1.1 Forestry and Replanting

The proposed development site is used for commercial forestry. This land-use will continue in conjunction with the proposed wind farm. The potential for cumulative effects during the construction, operational and decommissioning phases of the proposed wind farm have therefore been assessed.

The Forest Service is responsible for ensuring the development of Forestry within Ireland occurs in a manner and to a scale that maximises its contribution to national socio-economic well-being on a sustainable basis that is compatible with the protection of the environment. The forestry works (felling/planting) associated with the proposed development will be carried out under the relevant guidance and under licence from the Forest Service and full details are set out in Section 4.3.10 of this EIAR in conjunction with the replanting assessment included as Appendix 4-3. Forestry replacement lands are located in the following areas:

- Stranamart, Co. Cavan
- Ballard, Co. Wicklow
- Brackloon, Co. Roscommon

2.8.1.1.2 Other Wind Turbines

There are a number of wind farms located within a 20-kilometre radius of the proposed development site, as identified previously above in this Chapter. Any cumulative affects arising are considered in the relevant chapters of this EIAR.

2.8.1.1.3 Other Developments/Land uses

In preparing this EIAR the planning register has been reviewed and all relevant general development planning applications/permissions and projects in the vicinity of the proposed development have been noted and considered as well as other existing projects/development. As discussed previously the majority of applications in the vicinity relate to the provision of wind farm infrastructure and/or alteration of one-off rural housing and agriculture-related structures, as described previously above. These applications and land uses (which include those listed previously above in Section 2.5) have also been taken into account in describing the baseline environment and in the relevant assessments.

Furthermore, the cumulative impact assessments carried out in each of the subsequent chapters of this EIAR consider all potential significant cumulative effects arising from all land uses in the vicinity of the proposed development. These include ongoing agricultural practices.

Overall the proposed development has been designed to mitigate impacts on the environment, and a suite of mitigation measures is set out within the EIAR. The mitigation measures set out in this EIAR have been developed to ensure that significant cumulative affects do not arise during construction, operational or decommissioning phases of the proposed development.

Additional detail in relation to the potential significant cumulative effects arising and, where appropriate, the specific suite of relevant mitigation measures proposed are set out within each of the relevant chapters of this EIAR.

3. CONSIDERATION OF REASONABLE ALTERNATIVES

3.1 Introduction

Article 5(1)(d) of Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment (codification) as amended by Directive 2014/52/EU (the EIA Directive) requires that the EIAR prepared by the developer contains *"a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment."*

Article 5(1)(f) of the EIA Directive requires that the EIAR contains *"any additional information specified in Annex IV relevant to the specific characteristics of a particular project or type of project and to the environmental features likely to be affected."*

Annex IV of the EIA Directive states that the information provided in an Environmental Impact Assessment Report (EIAR) should include a *"description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects."*

This section of the EIAR contains a description of the reasonable alternatives that were studied by the developer, which are relevant to the proposed project and its specific characteristics, in terms of site location and other renewable energy technologies as well as site layout incorporating size and scale of the project, connection to the national grid and transport route options to the site. This section also outlines the design considerations in relation to the wind farm, including the associated substation, construction compound and borrow pits. It provides an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.

The consideration of alternatives is an effective means of avoiding environmental impacts. As set out in the '*Draft Guidelines on The Information to be Contained in Environmental Impact Assessment Reports' (Environmental Protection Agency, 2017),* the presentation and consideration of reasonable alternatives investigated is an important part of the overall EIA process.

Hierarchy

EIA is concerned with projects. The Environmental Protection Agency's draft guidelines (EPA, 2017) state that in some instances neither the applicant nor the competent authority can be realistically expected to examine options that have already been previously determined by a higher authority, such as a national plan or regional programme for infrastructure which are examined by means of a Strategic Environmental Assessment, the higher tier form of environmental assessment.

Non-environmental Factors

EIA is confined to the potential significant environmental effects that influence consideration of alternatives. However, other non-environmental factors may have equal or overriding importance to the developer of a project, for example project economics, land availability, engineering feasibility or planning considerations.

Site-specific Issues

The EPA guidelines state that the consideration of alternatives also needs to be set within the parameters of the availability of the land, i.e. the site may be the only suitable land available to the developer, or the need for the project to accommodate demands or opportunities that are site-specific. Such considerations should be on the basis of alternatives within a site, for example design and layout.

3.1.2 Methodology

The EU Guidance Document (EU, 2017) on the preparation of EIAR outlines the requirements of the EIA Directive and states that, in order to address the assessment of reasonable alternatives, the Developer needs to provide the following:

- A description of the reasonable alternatives studied; and
- An indication of the main reasons for selecting the chosen option with regards to their environmental impacts.

There is limited European and National guidance on what constitutes a 'reasonable alternative' however the EU Guidance Document (EU, 2017) states that reasonable alternatives "*must be relevant to the proposed project and its specific characteristics, and resources should only be spent assessing these alternatives*".

The guidance also acknowledges that "*the selection of alternatives is limited in terms of feasibility. On the one hand, an alternative should not be ruled out simply because it would cause inconvenience or cost to the Developer. At the same time, if an alternative is very expensive or technically or legally difficult, it would be unreasonable to consider it to be a feasible alternative*".

The current Draft EPA Guidelines (EPA, 2017) state that "*It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account is deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required.*"

Consequently, taking consideration of the legislation and guidance requirements into account, this chapter addresses alternatives under the following headings:

- 'Do Nothing' Alternative;
- Alternative Locations;
- Alternative Technologies;
- Alternative Turbine Layouts and Development Design; and,
- Alternative Mitigation Measures.

Each of these is addressed in the following sections.

When considering a wind farm development, given the intrinsic link between layout and design, the two will be considered together in this chapter.

While environmental considerations have been at the core of the decision-making process for all of the project processes and infrastructure components, it should be noted that the majority of alternative options considered under the headings listed above are unlikely to have had significantly, greater environmental effects than the chosen option.

3.2 'Do-Nothing' Alternative

Article IV, Part 3 of the EIA Directive states that the EIAR should include "*an outline of the likely evolution thereof without implementation of the project as far as natural changes from the baseline*

scenario can be assessed with reasonable effort on the basis of the availability of environmental information and scientific knowledge." This is referred to as the "do nothing" alternative. EU guidance (EU, 2017) states that this should involve the assessment of "an outline of what is likely to happen to the environment should the Project not be implemented – the so-called 'do-nothing' scenario."

An alternative land-use option to the development of a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to existing land-use practices. Commercial forestry operations would continue at the site.

In implementing the 'Do-Nothing' alternative, however, the opportunity to capture a significant part of the countries renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, development contributions, rates and investment in the local area would also be lost. Also, the proposed amenity walkways and associated carpark would not be constructed and therefore this recreational opportunity would be lost. On the basis of the positive environmental effects arising from the project, when compared to the do-nothing scenario, therefore the do–nothing scenario was not the chosen option.

The existing commercial forestry operations can and will continue in conjunction with this proposed use of the site.

A comparison of the potential environmental effects of the 'Do-Nothing' Alternative when compared against the chosen option of developing a renewable energy project at this site are presented in Table 3-1 below.

Table 3-1 Comparison of environmental effects when compared against the chosen option (developing the proposed wind farm at this site)

Environmental Consideration	Do Nothing Alternative
Population & Human Health (incl. Shadow Flicker)	No increase in local employment and no long-term financial contributions towards the local community. No potential for shadow flicker to affect sensitive receptors.
Biodiversity & Ornithology	No habitat loss
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	Neutral
Air & Climate	Will not provide the opportunity for an overall increase in air quality or reduction of greenhouse gasses. Will not assist in achieving the renewable energy targets set out in the Climate Action Plan.
Noise & Vibration	No potential for noise impacts on nearby sensitive receptors
Landscape & Visual	Neutral
Cultural Heritage & Archaeology	No potential for impacts on unrecorded, subsurface archaeology.

Material Assets	Neutral

3.3 Alternative Locations

3.3.1 Strategic Site Screening

In 2014, Coillte's Renewable Energy Development Team undertook a detailed screening process, through Geographical Information Spatial software (GIS), using a number of criteria and stages to assess the potential of a large number of possible sites, on lands within its stewardship (c. 441,000 hectares), suitable to accommodate a wind energy development. The GIS database drew upon a wide array of key spatial datasets such as forestry data, ordnance survey land data, house location data, transport, existing wind energy and grid infrastructure data and environmental data such as ecological designations, landscape designations and wind energy strategy designations available at the time.

The following is a summary of the methodology used in the screening process.

3.3.1.1 Phase 1 – Initial Screening

This stage in the selection process discounted lands that were not available for development under a number of criteria, as follows:

- Committed Lands for other developments
- Millennium Sites (This is a Coillte environmental designation – these sites were planted and managed for provision of a tree for every household in the country as part of the Millieneum tree planting project)
- Life Site (This is a Coillte environmental designation – these former forested sites were cleared and are managed for biodiversity)
- Wild Nephin Properties (This is a Coillte designation. Since 2014 these properties have been incorporated into National parks)
- Farm Partnerships and Leased Lands
- National Parks
- Natura 2000 and Nationally Designated Sites (SAC, SPA, NHA, pNHA)

Coillte also reviewed the relevant local authority's County Development Plan (CDP) and/or Renewable Energy Strategy (RES) provisions and did not proceed with further analysis where the policy context was not supportive of wind farm development. In this regard, areas were not brought forward for further analysis if they were not identified as being at least "open for consideration" for wind farm development.

Lands where the average wind speed at 80 metres above ground level is less than 7 m/s and, therefore, potentially not suitable for a commercially viable wind energy development were also discounted at this stage. In addition, sites with a contiguous area of less than 300 hectares were discounted.

3.3.1.2 Phase 2 – Grid Constraints

As part of the site selection process, it was necessary to consider the potential for grid connection, including in terms of distance to potential connection nodes and the grid capacity at the nodes, in the local area, to accommodate the connection.

3.3.1.3 Phase 3 – Screening

The next stage of screening out lands from further analysis was due to the presence of the following:

- Sensitive Amenity or Scenic Areas designation in CDPs (at the time of the screening process)
- Tourist areas/sites/trails
- Lands utilised for other wind farm developments
- Telecommunications masts and links
- Sensitive habitat/species of bird
- Land Ownership title Issues,
- Relatively high residential density in vicinity
- Unfavourable slopes and ground conditions

This stage of screening was generally applied using Coillte's in-house expertise and local knowledge, and was subsequently validated by MKO in terms of the engineering considerations and the likelihood of obtaining a successful grant of planning permission based on industry trends in 2014.

3.3.2 Results of the Screening Process

The application of the above criteria to identify a site relevant to the project and its specific characteristics, resulted in the selection of a site known as Croagh, located on the northwestern slopes of Carran Hill as a candidate site to be brought forward for more detailed analysis. Figure 3-1 shows the initial boundary of the Croagh site.

Sites that also emerged from the site selection process, outlined above, for which Coillte are in the process of preparing separate planning applications are::

- Carrownagowan, Co. Clare
- Glenard, Co. Donegal
- Bottlehill, Co. Cork
- Castlebanny, Co. Kilkenny

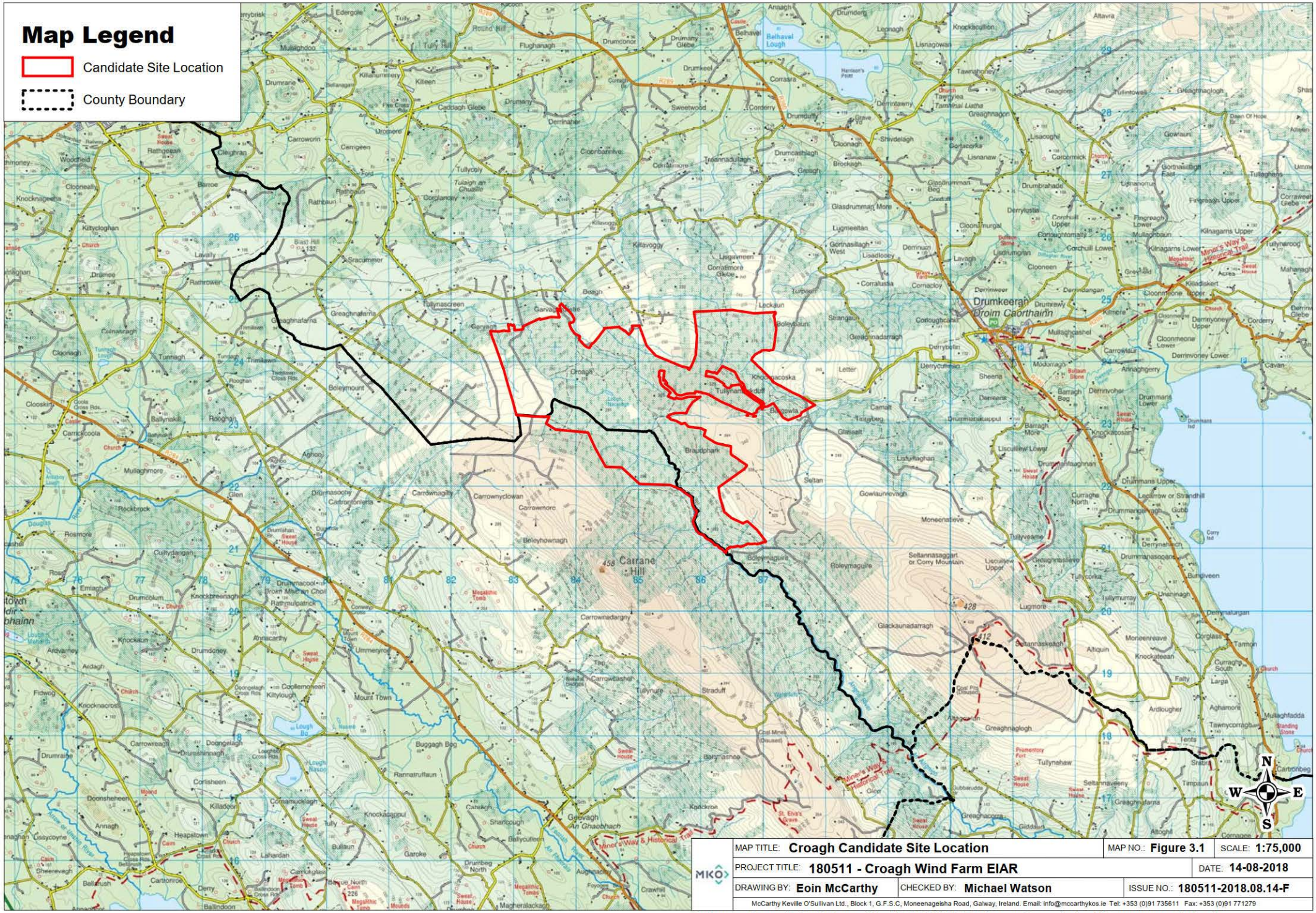
Coillte intend to bring forward all of these landholdings for wind energy development as all were considered by Coillte to be viable sites for a wind energy project. Each are projects in their own right which will be subject to EIA. As such a description of the reasonable alternatives studied which are relevant to each project and its specific characteristics, together with an indication of the main reasons for selecting the chosen option with regards to their environmental impacts will be provided in the EIAR accompanying the applications for same.

The alternative would be to bring forward a site that did not pass one or all of the above phases of the screening process. In that instance, there would be the potential for the construction and operation of a wind energy development to have an adverse effect on ecologically designated or sensitive areas and visually sensitive (scenic) or amenity areas. There would also be the potential for greater shadow flicker, noise and traffic impacts if the candidate site was located in an area with a higher number of residential dwellings. Numerous third party land agreements would also be required to ensure a site of adequate size, (ie. a 300ha contiguous site area). In addition, a site with an average wind speed less than 7m/s (at 80m above ground level) and/or not located within practical proximity of existing grid infrastructure may not be economically viable.

3.3.3 Suitability of the Candidate Site

Croagh, as a candidate site, was further examined under the following headings in order to confirm its suitability for wind energy development.

- Planning Policy
- Proximity of Existing Grid Infrastructure
- Designated Sites
- Average Wind Speeds



MAP TITLE: **Croagh Candidate Site Location**		MAP NO.: **Figure 3.1**	SCALE: **1:75,000**
PROJECT TITLE: **180511 - Croagh Wind Farm EIAR**			DATE: **14-08-2018**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**		ISSUE NO.: **180511-2018.08.14-F**

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- Population Density

3.3.3.1 Planning Policy

The Croagh site straddles the boundary separating two planning authorities – Leitrim and Sligo County Councils.

County Leitrim

Leitrim County Council does not have a Wind Energy Strategy; however, Section 4.11.5 of Chapter 4: Policies and Objectives of the Leitrim County Development Plan (CDP) 2015-2021 sets out the sole objective of the CDP in relation to wind energy.

> **Policy 128** "*It is the policy of the Council that all wind farm applications will be assessed on the full range of criteria including those identified in the Wind Farm Development Guidelines 2006 (or any subsequent update) published by the Department of Environment, Heritage and Local Government.*"

Section 4.11.5 of the CDP states that,

> *"...development that can clearly demonstrate, to the satisfaction of the Planning Authority, that [it] would not have a significant adverse impact on the amenities of a dwelling or a building occupied, or capable of being occupied, by people, or would not compromise the integrity of an environmentally sensitive area will be 'open to consideration'."*

Section 4.11.5 also states,

> *"The location of the development within easy access of the electrical grid and having suitable windspeeds, will be important factors in determining the suitability of a site to accommodate a Windfarm."*

The environmentally sensitive areas that have been identified by the CDP include:

- Natura 2000 sites i.e. Special Areas of Conservation (SAC) and Special Protection Areas (SPA)
- Natural Heritage Areas (NHA)
- Areas of Outstanding Natural Beauty (AONB)
- Areas of High Visual Amenity
- Outstanding Views and Prospects
- Areas of Archaeological Importance
- Areas of Geological Importance.

The Croagh site is capable of accommodating a wind farm development that is compliant with the requirements of the Wind Energy Development Guidelines 2006. Furthermore, this area is also capable of accommodating a wind farm development that can be brought in line with the requirements of the Draft Wind Energy Development Guidelines, prepared by the Department of Housing, Planning and Local Government in December 2019, should these guidelines be adopted while the proposed wind farm development is in the planning system.

The Croagh site is not located within any SACs, SPAs, NHAs, proposed NHAs, or Areas of Archaeological or Geological Importance as listed in the Leitrim CDP.

County Sligo

The current Sligo County Development Plan 2017-2023, similar to the Leitrim CDP, does not contain a wind energy strategy.

Sligo County Council fully supports the move from fossil fuels to cleaner renewable energy and technologies in order to achieve local and national emissions targets. Sligo County Council recognise the county's ideal geographical and topographical compatibility with wind energy generation and aim to balance the county's favourability for this type of development with careful site selection to minimise visual impact. Policies which relate to Renewable Energy include:

> **Policy SP-EN-1:** "*Support the sustainable development, upgrading and maintenance of energy generation, transmission, storage and distribution infrastructure, to ensure the security of energy supply and provide for future needs, as well as protection of the landscape, natural, archaeological and built heritage, and residential amenity and subject to compliance with the Habitats Directive.*"
>
> **Policy SP-EN-2**: "*Facilitate the sustainable production of energy from renewable sources, energy conversion and capture in forms such as wind power, hydro-power, wave-generated energy, bioenergy, solar technology and the development of Waste to Energy/Combined Heat and Power schemes at appropriate locations and subject to compliance with the Habitats Directive. All such development proposals will be assessed for their potential impact on urban and rural communities, Natura 2000 sites, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes and scenic views, as well as in accordance with strict location, siting and design criteria.*"
>
> **Policy SP-EN-7**: "*Protect significant landscapes from the visual intrusion of large-scale energy infrastructure."*

All renewable energy applications submitted to Sligo County Council will be assessed against the following:

- visual impact on surrounding landscape;
- impact on designated sites, natural and built heritage, water bodies, groundwater, soils and air;
- impact on settlements or individual rural dwellings;
- impact on existing walking routes / rights-of-way / public access to the countryside.

Wind energy developments in particular are assessed following the recommendations set out in the DOEHLG's Wind Energy Development Guidelines 2006 (and any future adopted guidelines). Particular guidelines such as the following will be reviewed:

- environmental impact – effects on landscape (including the scarring effect of access roads), natural and archaeological heritage;
- seeking visual harmony and balance – choice of turbines, towers, colour and siting;
- keeping secondary structures to a minimum – buried on-site cabling, minimal fencing, transformers placed inside towers where possible;
- keeping access roads to a minimum – using established roads where possible and following natural contours if roads are necessary;
- managing the building site – removing waste, avoiding erosion, replanting the land
- noise, electro-magnetic interference, ecological impact, safety (including aircraft safety and navigation) and land use implications.

As discussed above, the Croagh site complies with the DOEHLG guidelines 2006 as outlined above. It is not located within any SACs, SPAs, NHAs or pNHAs, nor is it sited within archaeological heritage areas. The portion of the candidate site within the Sligo county border falls within the 'Normal Rural

Landscape', avoiding 'Sensitive Rural Landscape Areas', 'Scenic Routes' and Visually Vulnerable Areas' as illustrated on the Landscape Character Map of the Sligo CDP 2017-2023.

3.3.3.2 Existing Grid Infrastructure

The Croagh site is located within close proximity of 3 no. existing electricity substations and therefore a wind energy development at this location has multiple options for connection to the national electricity grid. The 110kV Garvagh substation is located 670m south of the candidate site boundary at its closest point. The 110kV Shranangh is located 7.7km northwest of the Croagh candidate site and the 110kV Corderry substation is located 2.7km to the northeast.

3.3.3.3 Designated Sites

The proposed development site is not located within any area designated for ecological protection. The nearest Natura 2000 site, i.e. Special Area of Conservation (SAC) or Special Protection Area (SPA) is the Lough Gill SAC located approximately 4.4km north of the site at its nearest point.

The nearest national designated site, i.e. Natural Heritage Area (NHA) or proposed Natural Heritage Area (pNHA) is the Corry Mountain Bog NHA [002321], which adjoins the eastern boundary of the site.

3.3.3.4 Average Wind Speeds

The Irish Wind Atlas produced by Sustainable Energy Authority of Ireland (SEAI) shows average wind speeds for the country. With the upland nature of the landscape, the Wind Atlas shows that wind speeds on the proposed development site range from 8.8m/s to 9.1m/s at a 100m elevation. Such wind speeds indicate that this site is viable for commercial wind energy development. On-site monitoring of the wind resource, which is ongoing, will further verify that with a sufficient turbine height and blade diameter, the wind resource of the site is commercially viable.

3.3.3.5 Population Density

The Applicant sought to identify an area with a relatively low population density. Having reviewed the settlement patterns in the vicinity, the study area has emerged as suitable to accommodate the proposal. The population density of the *Population Study Area* as described in Chapter 5 of this EIAR is 8.9 persons per square kilometre. This is significantly lower than the average national population density of 68.1 persons per square kilometre.

3.3.3.6 Summary

The Croagh site is located within an existing commercial forestry property which allows the site to take advantage of existing access roads. This, when combined with the proximity to three existing substations, further highlights the suitability of the site as it can make further sustainable use of these established items of infrastructure.

The Croagh site does not overlap with any environmental designations and is also located in an area with a very low population density, relative to the national average, with appropriate annual wind speeds.

The purpose of the site screening exercise in 2014 outlined in Section 3.4, above, was to identify areas within Coillte's nationwide portfolio, that would be capable of accommodating a wind farm development while minimising the potential for adverse impact on the environment. In order to satisfy this requirement, significant landholdings that would yield a sufficient viable area for the siting of each

element of the proposed development was required (ie. sites with a contiguous area of less than 300 hectares as described in Stage 1 of the screening process).

While the outcome of the site screening process has identified the site of the current proposal as a suitable location for a wind farm development of the nature proposed, it does not preclude other sites within Coillte's portfolio being brought forward for consideration in the future. Coillte continuously examines the lands under its stewardship for further candidate sites for wind energy development.

3.4 Alternative Renewable Energy Technologies

Although the 2014 screening exercise was based on identifying lands for wind development; a reasonable alternative source of renewable electricity generation namely solar was considered based on the scale and current land-use of the Croagh site that emerged.

Commercial solar energy production is the harnessing and conversion of sunlight into electricity using photovoltaic arrays (panels). To achieve the same electricity output, as is expected from the proposed wind energy development (c.48MW), from solar energy would require a significantly larger development footprint. In this instance, the proposed wind energy development requires 54.2 hectares of commercial forestry to be permanently felled. A solar PV array of the scale necessary to provide the same electricity output would require the permanent felling of approximately 96 hectares of commercial forestry. In addition, a solar development would have a higher potential environmental effect on Hydrology and Hydrogeology, Traffic and Transport (construction phase) and Biodiversity and Birds (habitat loss, glint and glare) at the site.

For the reasons set out above, the proposal for a wind energy development at this site is considered to be the most efficient method of electricity production with the lesser potential for significant, adverse environmental effects.

A comparison of the potential environmental effects of the development of a solar PV array when compared against the chosen option of developing the proposed wind farm at this site are presented in Table 3-2 below.

Table 3-2 Comparison of environmental effects when compared against the chosen option (wind turbines)

Environmental Consideration	Solar PV Array (with a 48MW output)
Population & Human Health (incl. Shadow Flicker)	No long-term financial contributions towards the local community (i.e. community benefit fund). No potential for shadow flicker to affect sensitive receptors. Potential for glint and glare impacts on local road users
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss. Potential for glint and glare impacts on birds.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated.
Geotechnical	Shallower excavations involved in solar PV array developments would decrease the potential for peat instability.

Water	A solar PV array development would require a significantly larger area of forestry to be felled therefore increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Reduced capacity factor of solar PV array technology would result in a longer carbon payback period.
Noise & Vibration	No potential for noise impacts on nearby sensitive receptors.
Landscape & Visual	Potentially less visible from surrounding area due to screening from forestry and topography.
Cultural Heritage & Archaeology	Neutral
Material Assets	Potential for greater traffic volumes during construction phase due to the number of solar panels required to achieve the same output.

3.4.1 Alternative Turbine Numbers and Turbine Models

The proposed wind turbines will have a potential power output in the 3-5 megawatt (MW) range. It is proposed to install 10 turbines at the site which could achieve an approximate 48MW output. Such a wind farm could also be achieved on the proposed site by using smaller turbine technology (for example 2.5 MW machines). However, this would necessitate the installation of 19 turbines to achieve a similar output. Furthermore, the use of smaller turbines would not make efficient use of the wind resource available having regard to the nature of the site.

A larger number of smaller turbines would result in the wind farm occupying a greater footprint within the site, with a larger amount of supporting infrastructure being required (i.e. roads etc.) and increasing the potential for negative environmental impacts to occur on biodiversity, hydrology and traffic and transportation.

The use of alternative smaller turbines at this site would not be appropriate as they would fail to make the most efficient use of the wind resource passing over the site. Furthermore, the increased use of materials, excavation and movement of peat and increase in visual impact associated with a larger number of smaller turbines would result in a higher level of negative environmental effects than the chosen option.

It should be noted that the turbine model to be installed on the site will be the subject of a competitive tendering process. The maximum height of the turbines that will be selected for construction on the site will not exceed 170 metres when measured from ground level to blade tip. For the purposes of this EIAR a range of turbines within this size envelope has been assessed (e.g. tallest turbine within defined range has been assessed for visual impact, widest rotor diameter within the defined range has been assessed for shadow flicker etc.). The EIAR therefore provides a robust assessment of the turbines that could be considered within the overall development description.

A comparison of the potential environmental effects of the installation of a larger number of smaller wind turbines when compared against the chosen option of installing a smaller number of larger wind turbines are presented in Table 3-3 below.

Table 3-3 Comparison of environmental effects when compared against the chosen option (larger wind turbines)

Environmental Consideration	Larger number of smaller turbine models
Population & Human Health (incl. Shadow Flicker)	Greater potential for shadow flicker impacts on nearby sensitive receptors due to the increased number of turbines.
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss. Greater potential collision risk for birds due to the presence of more turbines
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated and stored.
Geotechnical	Neutral
Water	Larger development footprint, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Increased potential for vehicle emissions and dust emissions due to an increased volume of construction material and turbine component deliveries to the site.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors.
Landscape & Visual	A larger number of turbines would have a greater visual impact.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials and turbine components.

3.5 Alternative Turbine Layout and Development Design

The design of the proposed development has been an informed and collaborative process from the outset, involving the designers, developers, engineers, environmental, hydrological and geotechnical, archaeological specialists and traffic consultants. The aim of the process being to reduce the potential for environmental effects while designing a project capable of being constructed and viable.

Throughout the preparation of the EIAR, the layout of the proposed development has been revised and refined to take account of the findings of all site investigations and baseline assessments, which have brought the design from its first initial layout to the current proposed layout. The design process has also taken account of the recommendations and comments of the relevant statutory and non-statutory organisations, near neighbours / the local community and local authorities as detailed in Section 2.7 of Chapter 2.

3.5.1 Detailed Constraints Mapping

The design and layout of the proposed wind energy development follows the recommendations and guidelines set out in the 'Wind Energy Development Guidelines' (Department of the Environment, Heritage and Local Government, 2006) and the 'Best Practice Guidelines for the Irish Wind Energy Industry' (Irish Wind Energy Association, 2008).

The 'Wind Energy Development Guidelines for Planning Authorities' (DoEHLG, 2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the Draft Revised Wind Energy Development Guidelines, December 2019.

The constraints mapping process involves the placing of buffers around different types of constraints so as to identify clearly the areas within which no development works will take place if possible. The size of the buffer zone for each constraint has been assigned using guidance presented in the wind energy guidance documents listed above. The constraints maps for the site encompasses the following constraints and associated buffers:

- Residential dwellings plus a minimum 800 metre buffer (exceeding the requirement of 4 x tip height separation distance);
- Designated sites plus 100 metre buffer;
- Rivers plus 100 metre buffer, streams plus 50 metre buffer and lakes plus 50m buffer;
- Recorded Archaeological Sites and Monuments plus 50 metres buffer.
- Telecommunications buffer plus operator-specific buffer;
- Overhead Electricity Transmission Line plus 420 metre buffer (Eirgrid requirement of 3.5 x rotor diameter setback from overhead transmission lines);
- Existing wind turbines plus 4 x rotor diameter buffer.

For clarity, the constraints map is presented in two parts. Residential and environmental constraints are presented in Figure 3-2a and telecommunications and infrastructure constraints are presented in Figure 3-2b.

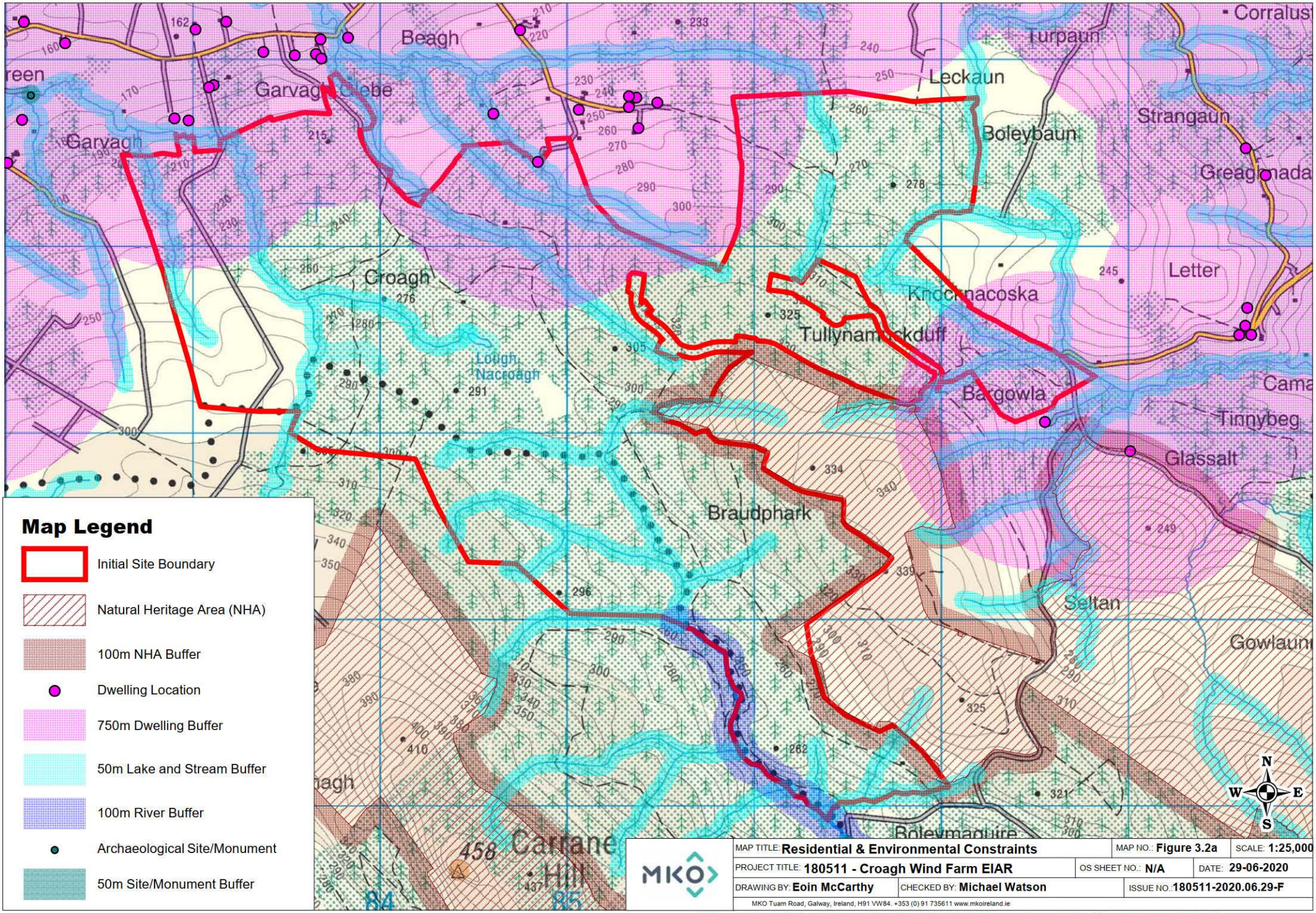
Facilitators at the site build on the existing advantages and include the following:

- Available lands for development;
- Separation distance from neighbouring landowners;
- Good wind resource;
- Existing access points and general accessibility of all areas of the site due to existing road infrastructure; and
- Limited extent of constraints.

The inclusion of the detailed, combined constraints on a map of the EIAR Site Boundary allows for a viable area to be identified as shown in Figure 3-3.

An initial turbine layout was then developed to take account of all the constraints mentioned above including their associated buffer zones and the separation distance required between them.

Following the mapping of all known constraints described above, detailed site investigations were carried out by the project team. The ecological assessment of the site encompassed habitat mapping and extensive surveying of birds and other fauna. These assessments, as described in Chapters 6 and 7 of this EIAR, informed the decision on the siting of turbines and the carrying out of any development works, such as the construction of roads. The hydrological and geotechnical investigations of the site examined the proposed locations for turbines, roads and other components of the proposed development, such as the substation and the construction compound. Where specific areas were deemed as being unsuitable for the siting of turbines or roads, etc., alternative infrastructure locations within the Croagh site were proposed and assessed, taking into account the areas that were already



MAP TITLE: **Residential & Environmental Constraints** | MAP NO.: **Figure 3.2a** | SCALE: **1:25,000**

PROJECT TITLE: **180511 - Croagh Wind Farm EIAR** | OS SHEET NO.: **N/A** | DATE: **29-06-2020**

DRAWING BY: **Eoin McCarthy** | CHECKED BY: **Michael Watson** | ISSUE NO.: **180511-2020.06.29-F**

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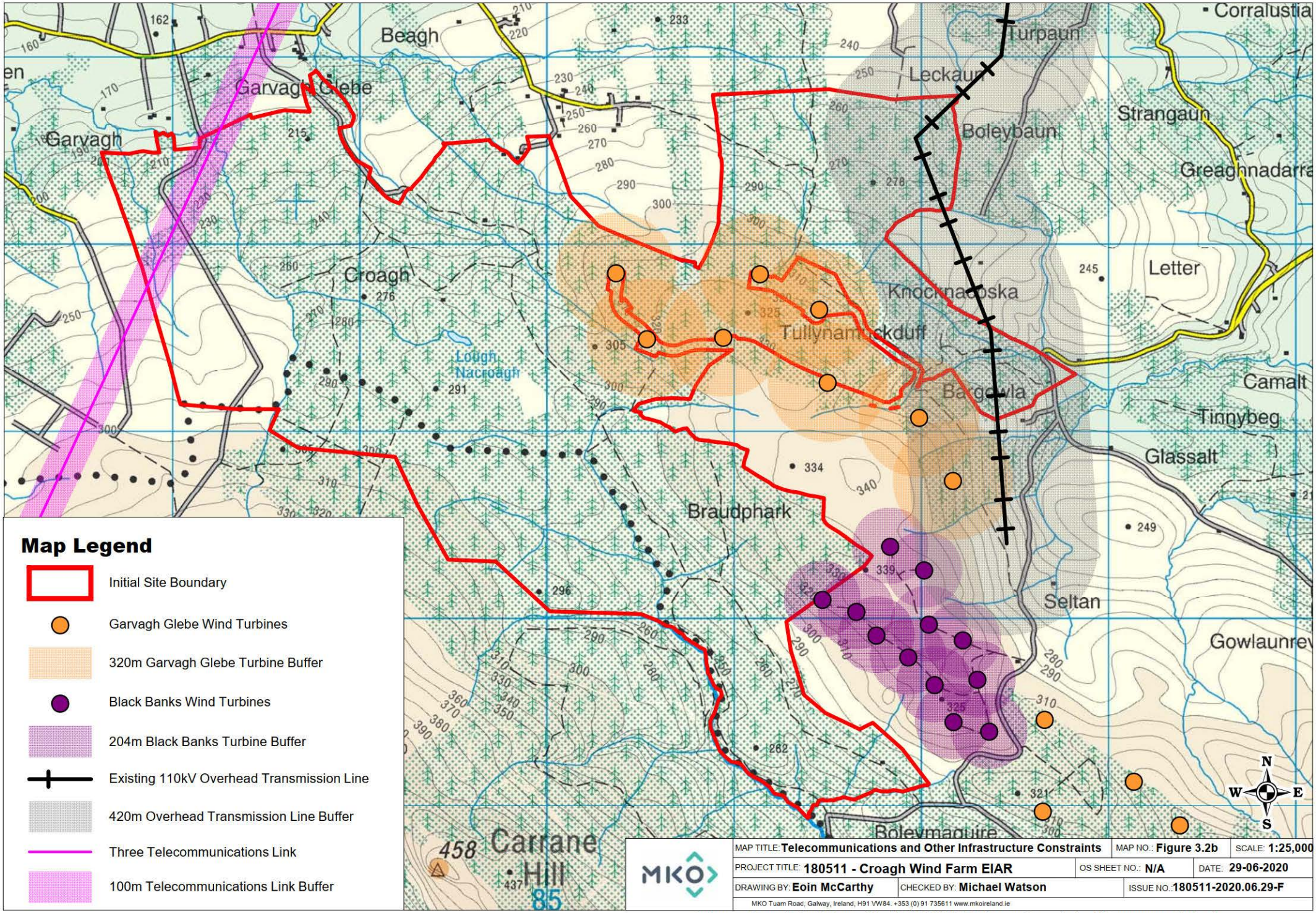

Map Legend

- Initial Site Boundary
- Garvagh Glebe Wind Turbines
- 320m Garvagh Glebe Turbine Buffer
- Black Banks Wind Turbines
- 204m Black Banks Turbine Buffer
- Existing 110kV Overhead Transmission Line
- 420m Overhead Transmission Line Buffer
- Three Telecommunications Link
- 100m Telecommunications Link Buffer

MAP TITLE: **Telecommunications and Other Infrastructure Constraints**		MAP NO.: **Figure 3.2b**	SCALE: **1:25,000**
PROJECT TITLE: **180511 - Croagh Wind Farm EIAR**		OS SHEET NO.: **N/A**	DATE: **29-06-2020**
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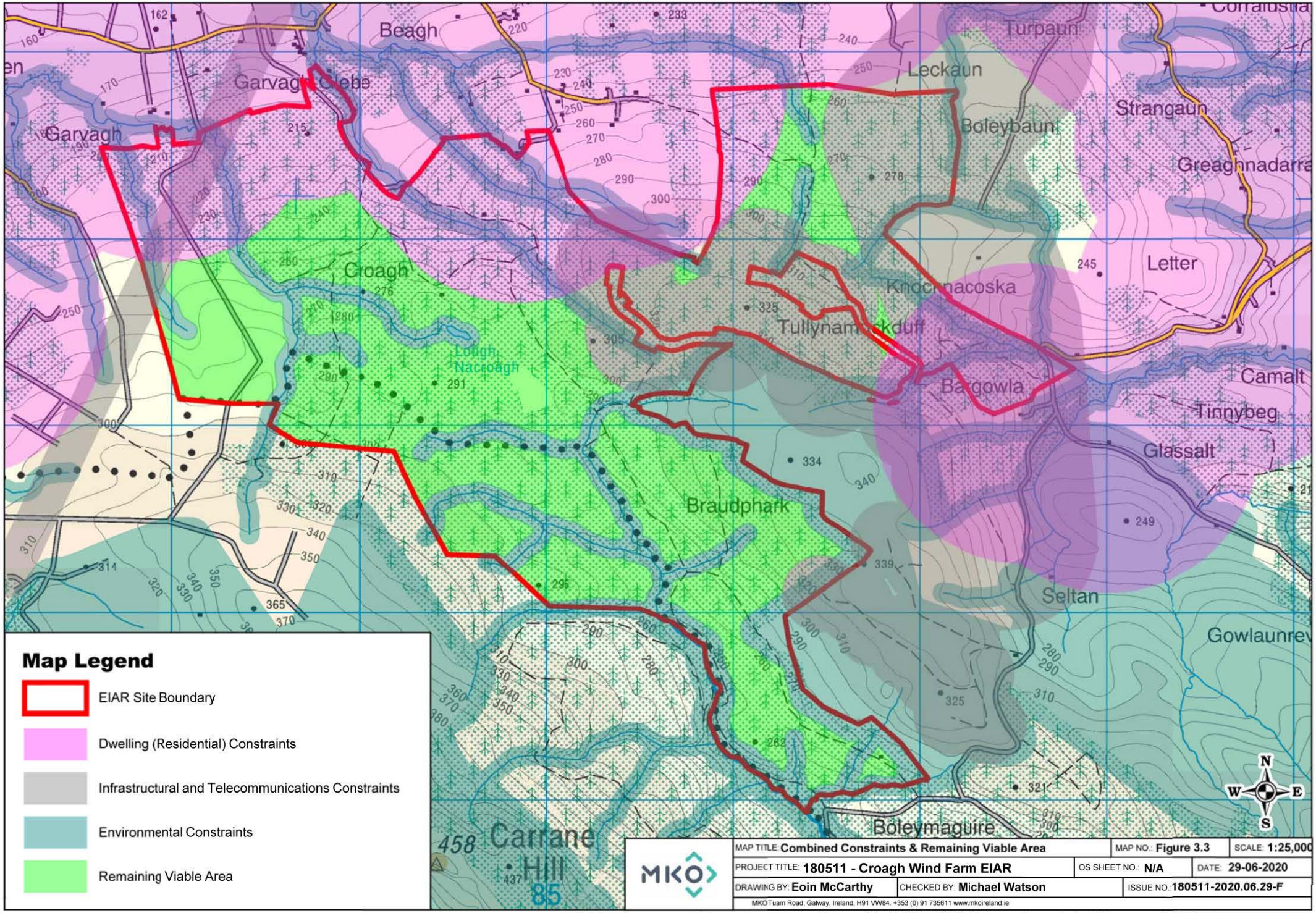

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ruled out of consideration. The turbine layout for the proposed wind farm was also informed by wind data and the results of noise assessments as they became available.

3.5.2 Turbine Layout

The final proposed turbine layout takes account of all site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on a combination of the results of all site investigations that have been carried out during the EIAR process and the community engagement process that began in June 2018. As information regarding the site of the proposed development was compiled and assessed, the proposed layout has been revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas in which no turbines could be located, as well as cumulative impacts.

The selection of turbine number and layout has also had regard to wind-take, noise and shadow flicker impacts and the separation distance to be maintained between turbines. The EIAR and wind farm design process was an iterative process, where findings at each stage of the assessment were used to further refine the turbine layout, always with the intention of minimising the potential for environmental impacts.

There were a number of reviews of the specific locations of the various turbines during the optimisation of the site layout. The initial constraints study identified a significant viable area within the overall study area, suitable for approximately 10 no. turbines. The initial turbine layout, shown in Figure 3-4, occupied the viable area within the wider study area, however the proposed turbine layout was refined following feedback from the project team, applicant and local residents. The chosen turbine layout is considered optimal as the alternative, earlier iterations of the layout had the potential for greater environmental effects in relation to shadow flicker, noise, habitat loss and visual amenity.

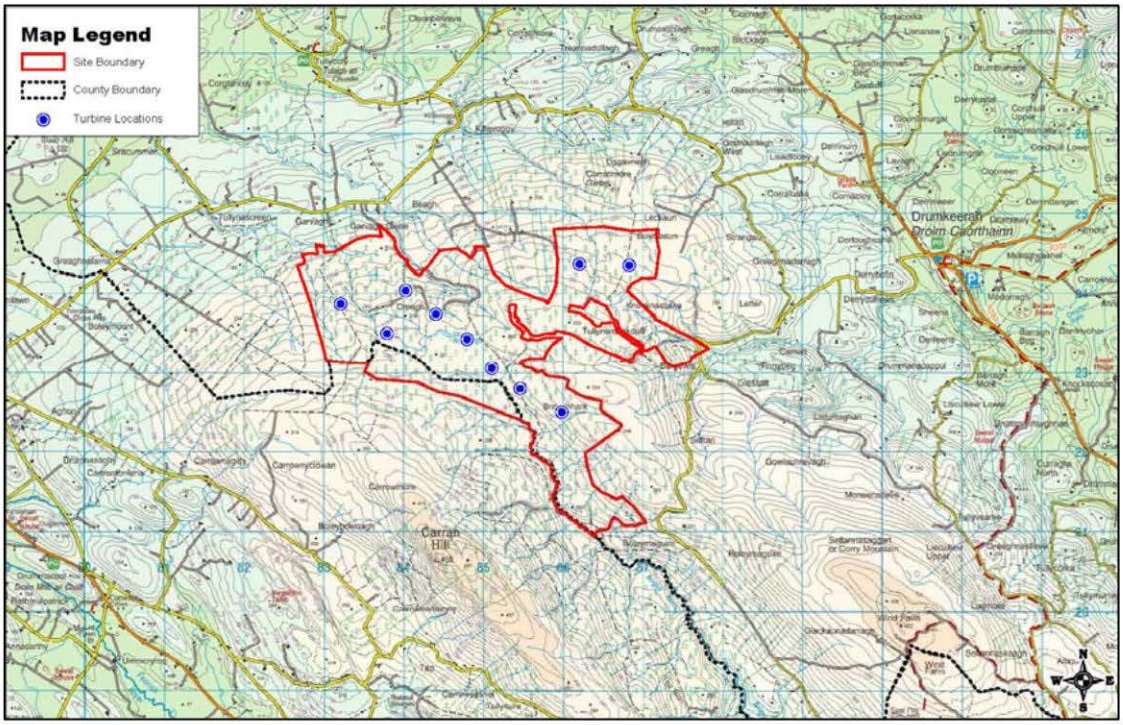


Figure 3-4 Initial Turbine Layout

The first iteration of the turbine layout, shown in Figure 3-5, involved rotating the axis of the two turbines to the northeast from an east-west to a north-south orientation. This achieved a greater separation distance from the nearest residential dwellings. However, this iteration of the proposed turbine layout, in combination with the existing Garvagh Glebe Wind Farm would have left the nearest

residential dwellings with turbines to their east, west and south. This version of the layout had the potential for significant adverse effects in relation to noise, shadow flicker and visual amenity.

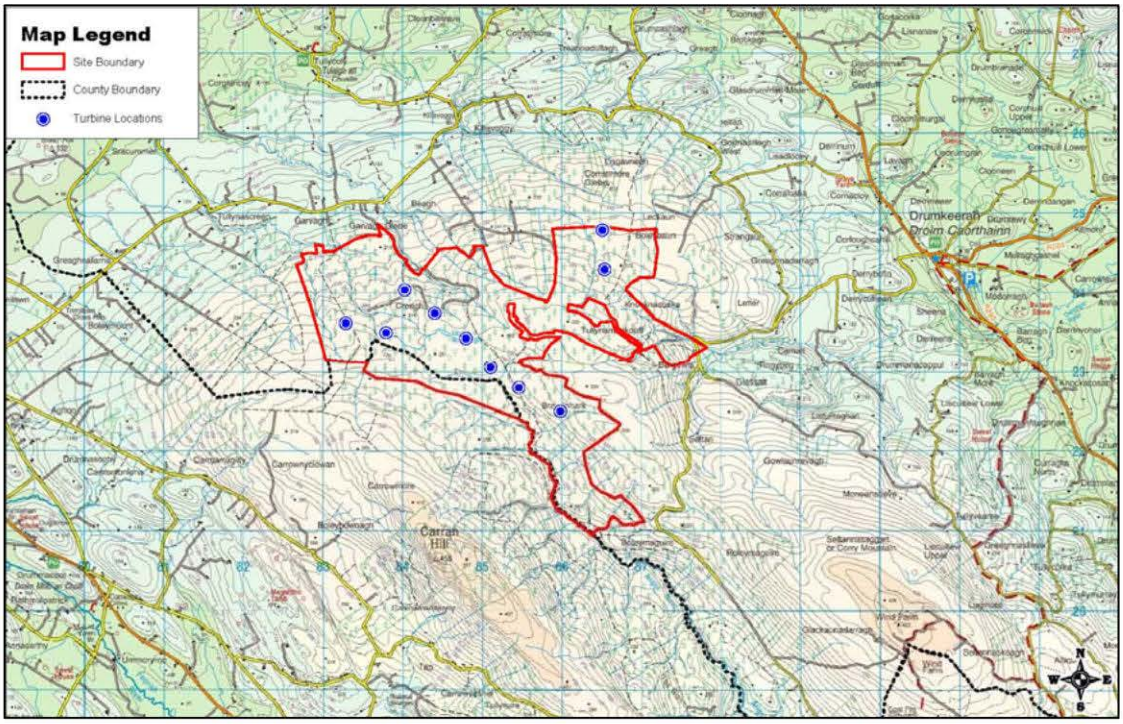


Figure 3-5 First Iteration of the Turbine Layout

The second and final iteration of the proposed turbine layout, illustrated in Figure 3-6 below, saw the relocation of the two north-eastern turbines to subsequently identified, suitable locations to the southwest of the other 8 no. turbine locations. The relocation of these turbines further increased the separation distance between the proposed turbine locations and the nearest residential dwelling, thereby reducing the potential for noise and shadow flicker effects and gave rise to a more visually coherent turbine layout (visual amenity) amalgamating the two turbine clusters in to a single cluster. The relocation of these turbines also reduced the potential for increased habitat loss by decreasing the size of the overall development footprint . For these reasons, this iteration of the turbine layout was the preferred option. The second and final iteration of the turbine layout involved some very minor micrositing of turbine locations based on the rigorous assessment of local ground conditions until the final turbine locations were adopted for the planning application.

It was also at this point that the site boundary for the purposes of the EIAR was defined. The initial site boundary was amended to focus on the final iteration of the turbine layout, the chosen grid connection route (refer to Section 3.5.4.3 below) and the construction access route for the proposed development (refer to Section 3.6.2 below).

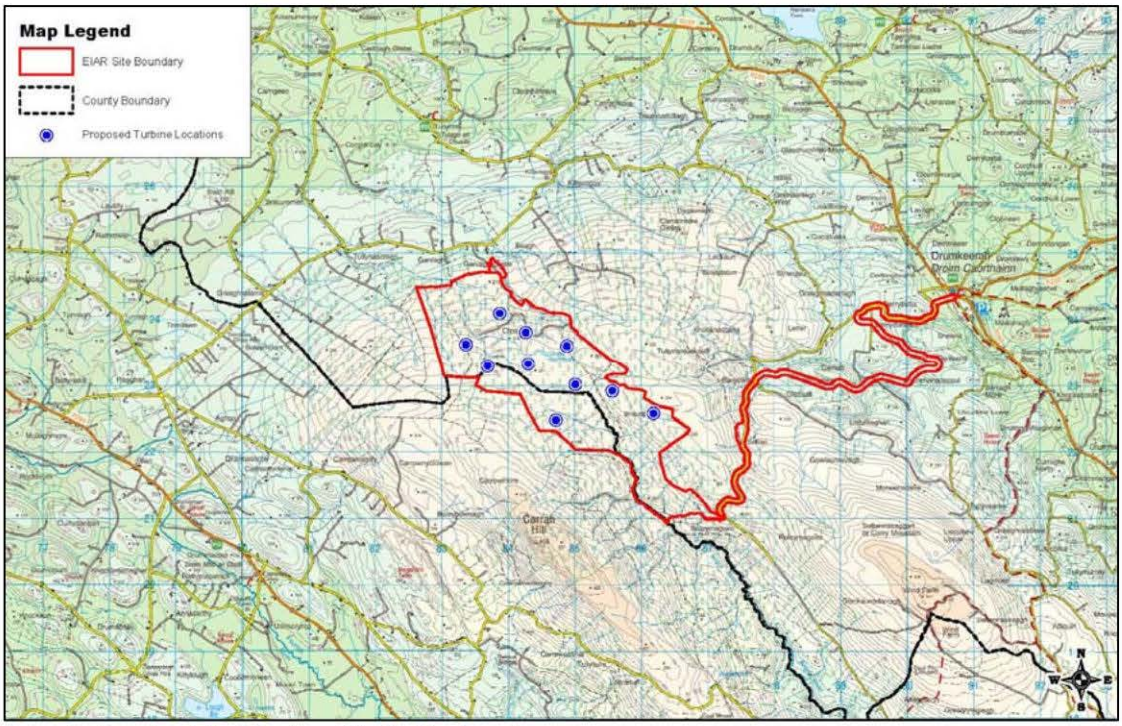


Figure 3-6 Second and Final Iteration of the Turbine Layout

A comparison of the potential environmental effects of initial and first iterations of the turbine layout when compared against the second and final turbine layout are presented in Table 3-4 below.

Table 3-4 Comparison of environmental effects when compared against the chosen option (final turbine layout)

Environmental Consideration	Initial Layout	First Iteration
Population & Human Health (incl. Shadow Flicker)	No material environmental difference for population or human health. Potential for increased shadow flicker duration at nearby sensitive receptors.	No material environmental difference for population or human health. Potential for increased shadow flicker duration at nearby sensitive receptors.
Biodiversity & Ornithology	No significant environmental difference for either biodiversity or birds. Larger development footprint linked to additional road infrastructure being required,would lead to an increase in habitat loss however this would have occurred within the constrained out area i.e. viable area.	No significant environmental difference for either biodiversity or birds. Larger development footprint would lead to an increase in habitat loss however this would have occurred within the constrained out area i.e. viable area.
Land, Soils & Geology	Larger development footprint would lead to an increase in peat and spoil volumes to be	Larger development footprint would lead to an increase in peat and spoil volumes to be

	excavated and would require more crushed stone to be extracted for construction. Overall, no significant environmental difference.	excavated and would require more crushed stone to be extracted for construction. Overall, no significant environmental difference.
Geotechnical	This layout was amended following more detailed geotechnical investigations to reduce risk of peat instability and reduce the volume of peat and spoil to be managed.	This layout was amended following more detailed geotechnical investigations to reduce risk of peat instability and reduce the volume of peat and spoil to be managed.
Water	The amendment of this layout resulted in reduce risk of peat instability and reduce the volume of peat and spoil to be managed which in turn reduces potential for water quality effects	The amendment of this layout resulted in reduce risk of peat instability and reduce the volume of peat and spoil to be managed which in turn reduces potential for water quality effects
Air & Climate	Neutral	Neutral
Noise & Vibration	Potential for greater noise impacts due to reduced separation distance between turbines and closest sensitive receptors.	Potential for greater noise impacts due to reduced separation distance between turbines and closest sensitive receptors.
Landscape & Visual	Potential for greater visual impacts due to the wider visual extent of the proposed turbines.	Potential for greater visual impacts due to the wider visual extent of the proposed turbines.
Cultural Heritage & Archaeology	No material environmental difference for cultural heritage	No material environmental difference for cultural heritage
Material Assets	Larger development footprint would lead to an increase in construction traffic volumes and traffic impacts across a greater extent of the public road network.	Larger development footprint would lead to an increase in construction traffic volumes and traffic impacts across a greater extent of the public road network.

3.5.3 Road Layout

Access tracks are required onsite in order to enable transport of infrastructure and construction materials within the proposed development. Such tracks must be of a gradient and width sufficient to allow safe movement of equipment and vehicles. It was decided at an early stage during the design of the proposed development that maximum possible use would be made of existing roadways and tracks where available to minimise the potential for impacts by using new roads as an alternative.

As the overall site layout was finalised, the most suitable routes between each component of the development were identified, taking into account the extensive network of existing roads and the

physical constraints of the site. Locations were identified where upgrading of the existing road would be required and where new roads are to be constructed, in order to ensure suitable access to and linkages between the various project elements, and efficient movement around the site.

An alternative option to making maximum use of the existing road network within the site would be to construct a new road network, having no regard to existing roads or tracks. This approach was not favourable, as it would create the potential for additional significant environmental effects to occur in relation to land, soils and geology (increased excavation and aggregate requirements), hydrology (increased number of new watercourse crossings) and biodiversity (increased habitat loss).

A comparison of the potential environmental effects of constructing an entirely new road network when compared against maximising the use of the existing road network is presented in Table 3-5 below.

Table 3-5 Comparison of environmental effects when compared against the chosen option (maximising the use if the existing road network))

Environmental Consideration	New Road Network
Population & Human Health (incl. Shadow Flicker)	Neutral
Biodiversity & Ornithology	Larger development footprint would result in greater habitat loss.
Land, Soils & Geology	Larger development footprint would result in greater volumes of peat and spoil to be excavated and stored. Larger volume of stone required from on-site borrow pit and off-site quarries for road construction.
Geotechnical	Neutral
Water	Larger development footprint and increased number of new watercourse crossings, therefore, increasing the potential for silt laden runoff to enter receiving watercourses.
Air & Climate	Potential for greater dust emissions due to the requirement of an increased volume of stone from the on-site borrow pit and off-site quarries. Potential for greater vehicular emissions due to and increased volume of construction traffic.
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors during the construction of the new roads.
Landscape & Visual	Potential for greater visual and landscape impacts due to the construction of new roads.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials.

3.5.4 Location of Ancillary Structures

The ancillary infrastructure required for the construction and operation of the proposed development include temporary construction compounds, an electricity substation and associated grid connection and borrow pit.

3.5.4.1 Construction Compounds

The two proposed construction compounds will be used for the storage of all construction materials and turbine components. The use of multiple temporary construction was deemed preferable to the alternative of a single large compound at the southern end of the site for a number of reasons. Principally, it will facilitate more efficient construction practices and will result in shorter distances for traffic movements within the site during construction. As a result, vehicle emissions and the potential for dust arising will be reduced.

A comparison of the potential environmental effects of constructing a single, large construction compound when compared against constructing multiple, smaller compounds is presented in Table 3-6 below.

Table 3-6 Comparison of environmental effects when compared against the chosen option (multiple construction compounds)

Environmental Consideration	Single Large Construction Compound
Population & Human Health (incl. Shadow Flicker)	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site which could have adverse health effects.
Biodiversity & Ornithology	Neutral
Land, Soils & Geology	Neutral
Geotechnical	Neutral
Water	Neutral
Air & Climate	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site
Noise & Vibration	Potential for increased noise impacts on nearby sensitive receptors due to longer distance of traffic movements within the site.
Landscape & Visual	Neutral
Cultural Heritage & Archaeology	Neutral
Material Assets	Less efficient construction practices due to longer movements of construction vehicles, plant and materials within the site.

3.5.4.2 Electricity Substation

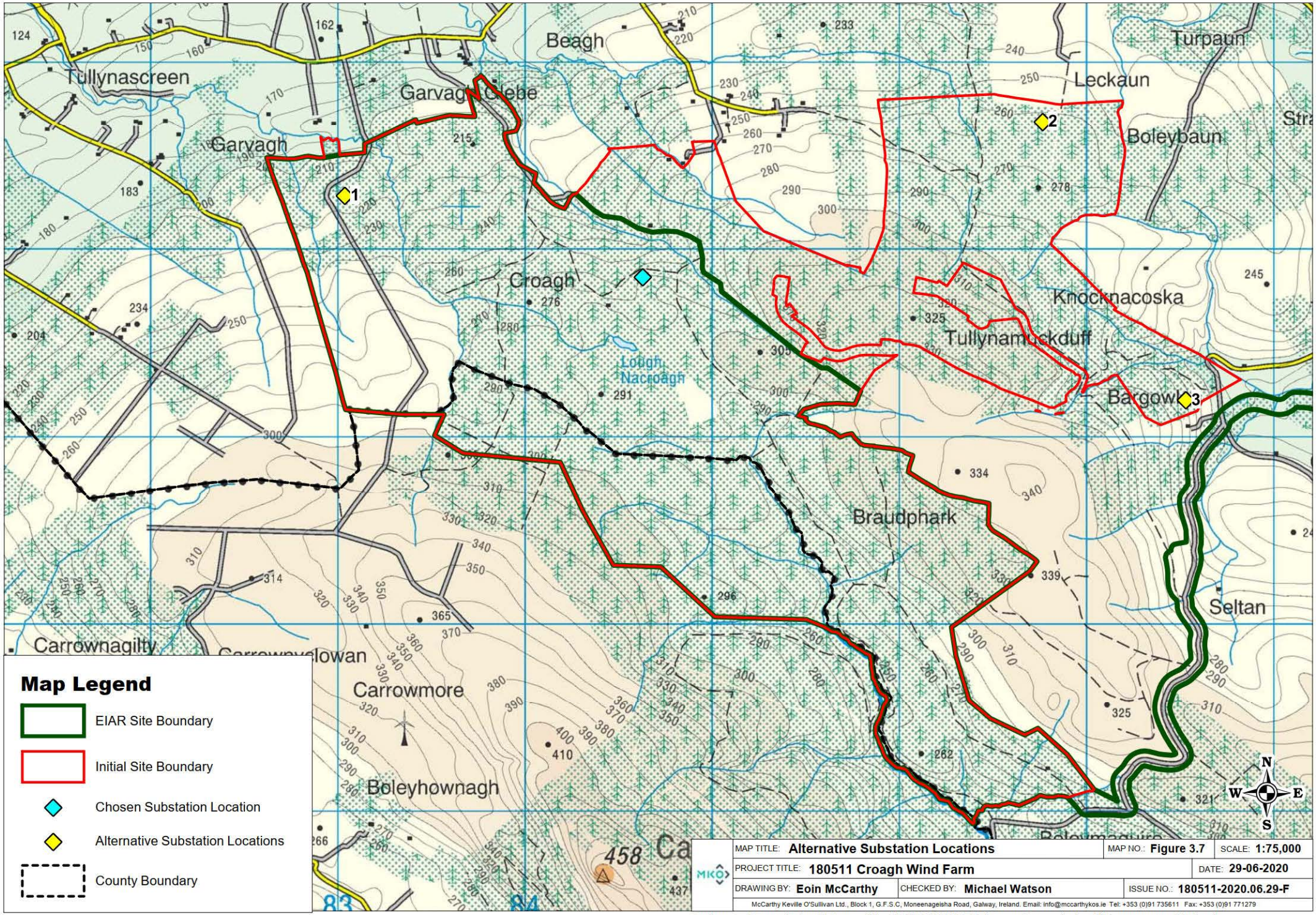
The selection of the location of the on-site substation has had regard to the constraints of the site, outlined in Section 3.6.1 above. Ease of access and minimising distance from turbines were also taken into consideration. It should also be noted that while the operational lifespan of the proposed turbines is expected to be 30 years (following which they may be replaced or decommissioned) the electricity substation and associated infrastructure will become an ESB asset and will be a permanent feature of the proposal as it will be required to continue to form part of the electrical infrastructure of the area in the event of the remainder of the site being decommissioned.

Three alternative substation locations were considered at a very early stage of the design of the proposed development, these locations are shown in Figure 3-7. While these locations would have decreased the required length of the grid connection cabling to the nearest existing substations, the footprint of the proposed development would have increased as existing roads to any of these locations would have required widening and Alternative Locations 2 and 3 would have also required the construction of new roads, thereby resulting in greater habitat loss, increased traffic movements and an increased requirement for construction materials. The length of internal cabling between the turbines and any of these alternative substations would have also increased significantly. The selection of Alternative Locations 1 and 3 would have brought the footprint of the proposed development much closer to residential dwellings (these locations are 392m and 133m from the nearest dwelling respectively whereas the chosen location is over 600m from the closest dwelling), resulting in a potential increase in noise and dust nuisances at these dwellings during construction and a potential increase in noise impacts during operation. All three alternative locations would be more visually exposed to the nearest residential dwellings when compared to the chosen location which is screened by a combination of forestry and topography.

A comparison of the potential environmental effects of the alternative locations when compared against chosen location is presented in Table 3-7 below.

Table 3-7 Comparison of environmental effects when compared against the chosen option

Environmental Consideration	Location 1	Location 2	Location 3
Population & Human Health (incl. Shadow Flicker)	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site which could have adverse health effects.	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site which could have adverse health effects.	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site which could have adverse health effects.
Biodiversity & Ornithology	Increased habitat loss due to the requirement to widen more existing roads.	Increased habitat loss due to the requirement to widen more existing roads and construction of additional new roads.	Increased habitat loss due to the requirement to widen more existing roads and construction of additional new roads.
Land, Soils & Geology	Increased volume of peat and spoil to be excavated due to larger development footprint.	Increased volume of peat and spoil to be excavated due to larger development footprint.	Increased volume of peat and spoil to be excavated due to larger development footprint.



Map Legend

- EIAR Site Boundary
- Initial Site Boundary
- Chosen Substation Location
- Alternative Substation Locations
- County Boundary

MAP TITLE: **Alternative Substation Locations**		MAP NO.: **Figure 3.7**	SCALE: **1:75,000**
PROJECT TITLE: **180511 Croagh Wind Farm**			DATE: **29-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**		ISSUE NO.: **180511-2020.06.29-F**

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Geotechnical	Neutral	Neutral	Neutral
Water	Requirement for the upgrade of additional watercourse crossings.	Requirement for the upgrade of additional watercourse crossings and the construction of additional new watercourse crossings.	Requirement for the upgrade of additional watercourse crossings and the construction of additional new watercourse crossings.
Air & Climate	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site	Potential for increased vehicular and dust emissions from longer distance of traffic movements within the site
Noise & Vibration	Potential for increased noise impacts during construction and operational phases on nearby sensitive receptors due to location being closer to nearby sensitive receptors.	Neutral	Potential for increased noise impacts during construction and operational phases on nearby sensitive receptors due to location being closer to nearby sensitive receptors.
Landscape & Visual	Location is potentially more visually exposed to the nearest residential dwellings.	Location is potentially more visually exposed to the nearest residential dwellings.	Location is potentially more visually exposed to the nearest residential dwellings.
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials.	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials.	Potential for greater traffic volumes during construction phase due to larger development footprint and requirement for more construction materials.

3.5.4.3 Grid Connection

A key consideration in determining the grid connection method for a proposed wind energy development is whether the cabling is undergrounded or run as an overhead line. While overhead lines are less expensive and allow for easier repairs when required, underground lines will have no visual impact. For this reason, it was considered that underground lines would be a preferable alternative to overhead lines. The draft Wind Energy Guidelines 2019 also indicate that underground cables are the preferred option for connection of a wind energy development to the national grid.

The output of the windfarm is such that it needs to connect to a 110kV substation. There are 3 no. existing 110kV electricity substations located within 10km of the proposed development site, namely:

- Garvagh 110kV Electricity Substation
- Shrananagh 110kV Electricity Substation
- Corderry 110kV Electricity Substation

Therefore, an underground grid connection cabling route to each of these existing substations was considered and assessed in order to determine which route would be brought forward as part of the planning application. The three routes are shown in Figure 3-8 and are detailed below.

Option A is an underground grid connection cabling route, connecting the proposed onsite electricity substation to the existing Garvagh substation. The Garvagh substation is located approximately 3km southeast of the proposed onsite substation. The grid connection cabling route runs entirely along a combination of forestry and public roads. The cabling route measures approximately 6.2km in length.

Option B is an underground cabling route connecting the proposed onsite substation to the existing Shranangh substation. The Shrananagh substation is located 9.9km northwest of the proposed onsite substation. This grid connection cabling route runs approximately 2.1km of forestry roads, 10.2km of public roads and includes 1.7km off road section over which a new access road would need to be constructed. The cabling route measures approximately 14km in length.

Option C is an underground cabling route connecting the proposed onsite substation to the existing Corderry substation which is located approximately 4.6km northeast of the proposed onsite substation. This cabling route runs along approximately 3km of forestry roads, 1.6km of private access tracks, 2.1km of public road and includes a 800m off road section over which a new access track would need to be constructed. The cabling route measures approximately 7.5km in length.

Grid Connection Option A is shorter than Options B and C and is also located within or alongside existing roads for its entire length. Options B and C have approximately 1km and 450m of off road sections, respectively, along which new roads would be required to be constructed, resulting in a larger development footprint and therefore increased volumes of peat and spoil to be excavated and managed and increased habitat loss.

Unlike Options B and C, there are no residential dwellings located along Grid Connection Route A. Therefore, Option A has the least potential to cause adverse impacts to local traffic or environmental nuisances to local residents in relation to noise, dust or vehicular emissions.

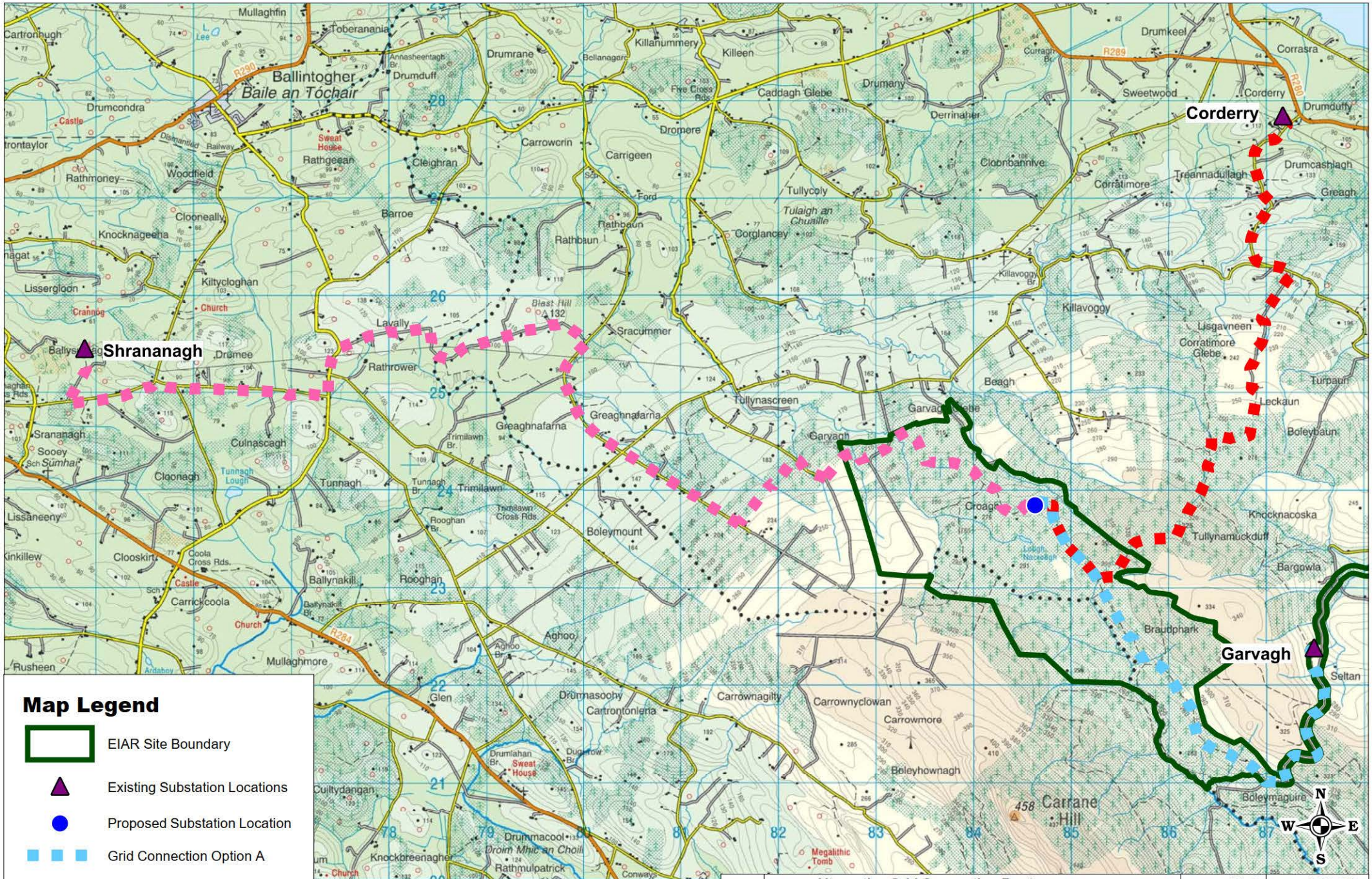
Option A is located entirely within lands under the control of the applicant whereas sections of Options B and C are located within third-party landholdings for which consent would be required if either of these options were to be included in the planning application for the proposed development.

Based on the environmental and land availability considerations outlined above, Grid Connection Option A was the most favoured option of those considered.

A comparison of the potential environmental effects of the alternative grid connection cabling routes when compared against the chosen option (option A) is presented in Table 3-8 below.

Table 3-8 Comparison of environmental effects when compared against the chosen option (Option A)

Environmental Consideration	Option B	Option C
Population & Human Health (incl. Shadow Flicker)	Potential for increased dust emissions from excavations and traffic movements along sections	Potential for increased dust emissions from excavations and traffic movements along sections



MAP TITLE: **Alternative Grid Connection Routes**		MAP NO.: **Fig 2**	SCALE: **1:60,000**
PROJECT TITLE: **180511 Croagh Wind Farm**			DATE: **29-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**		ISSUE NO.: **180511-2020.06.29-F**

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	of public road with residential dwellings either side, during the construction phase which could have adverse health effects.	of public road with residential dwellings either side, during the construction phase which could have adverse health effects.
Biodiversity & Ornithology	Increased habitat loss due to the requirement to construct new lengths of roads where the cable route is currently 'off-road',	Increased habitat loss due to the requirement to construct new lengths of roads where the cable route is currently 'off-road',
Land, Soils & Geology	Increased volume of peat, spoil and tar to be excavated due to longer route and the requirement for new roads along certain sections of the route.	Increased volume of peat, spoil and tar to be excavated due to longer route and the requirement for new roads along certain sections of the route.
Geotechnical	Neutral	Neutral
Water	Longer route would require more watercourse crossings which would increase the potential for silt-laden runoff and hydrocarbons to enter receiving watercourses.	Longer route would require more watercourse crossings which would increase the potential for silt-laden runoff to enter receiving watercourses. An off-road section of the route runs parallel and adjacent to the bank of a stream. The construction of a cable trench with in a new road along this section would also increase the potential for silt-laden runoff and hydrocarbons to enter the receiving watercourse.
Air & Climate	Potential for increased vehicular and dust emissions traffic movements along the cable route.	Potential for increased vehicular and dust emissions traffic movements along the cable route.
Noise & Vibration	Potential for increased noise and vibration nuisances during construction phase on sensitive receptors (residential dwellings) located along the public road sections of the cable route.	Potential for increased noise and vibration nuisances during construction phase on sensitive receptors (residential dwellings) located along the public road sections of the cable route.
Landscape & Visual	Neutral	Neutral
Cultural Heritage & Archaeology	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.	Larger development footprint would increase the potential for impacts on unrecorded, subsurface archaeology.
Material Assets	Potential for greater traffic volumes during construction phase due to larger development	Potential for greater traffic volumes during construction phase due to larger development

	footprint and requirement for more construction materials. As part of the cable route has residential dwellings located along it, there would be an increased potential for impacts on existing underground services and utilities.	footprint and requirement for more construction materials. As part of the cable route has residential dwellings located along it, there would be an increased potential for impacts on existing underground services and utilities.

3.5.4.4 Borrow Pit

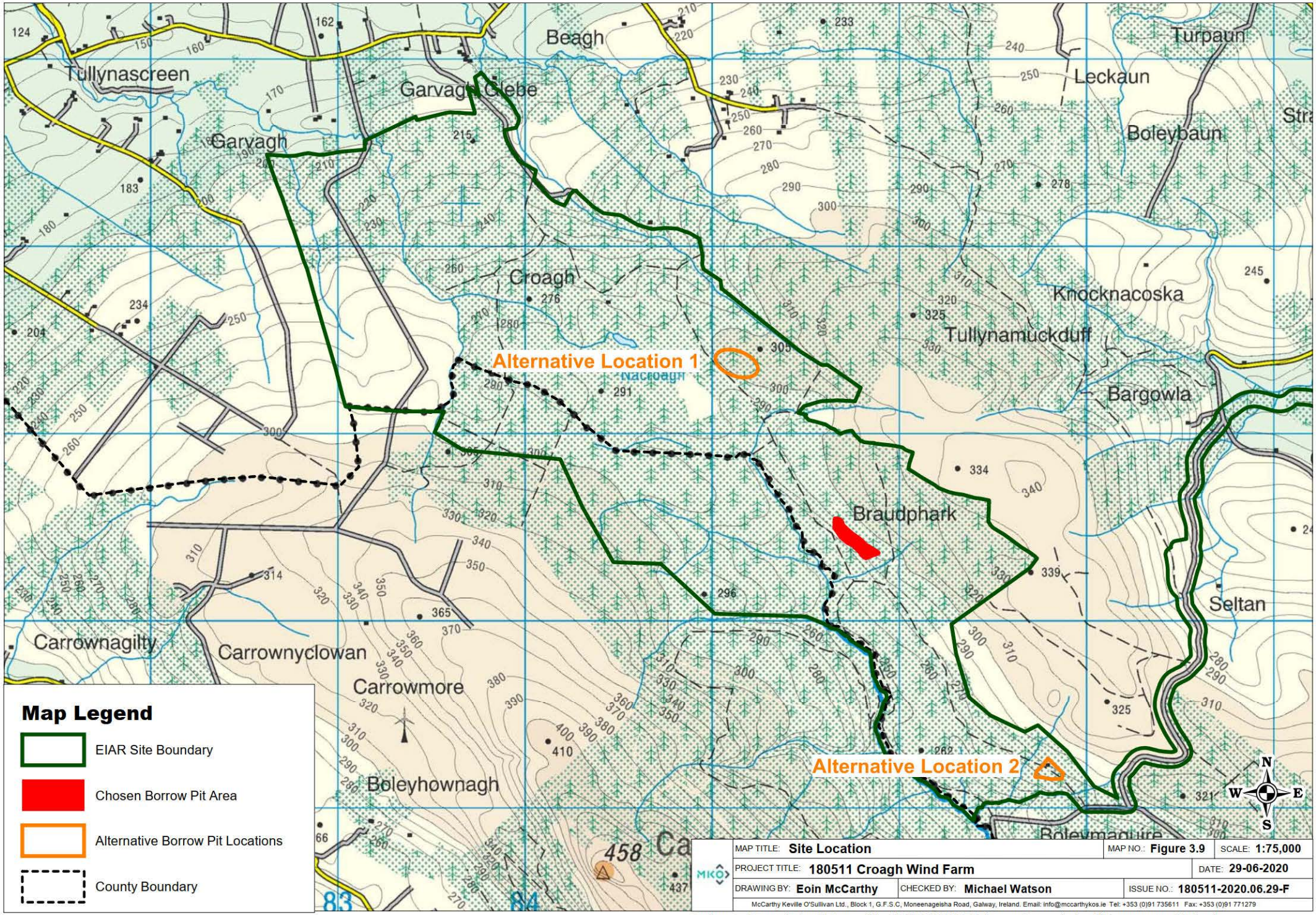
The majority of material required for the construction of access roads and turbine bases will be obtained from one borrow pit onsite which will be located approximately 430m to the west of Turbine No. 9. The use of an onsite borrow pit represents an efficient use of existing onsite resources and eliminates the need to transport large volumes of construction materials along the local public road network to the site. The location for the borrow pit was identified taking into account the site characteristics, including topography, ground conditions, habitat type and surface water features.

Two alternative potential borrow pit locations were considered during the design phase of the proposed development. These alternative locations are shown in Figure 3-9. Each potential location had regard to the constraints of the site, outlined in Section 3.6.1 above and was subject to detailed geotechnical site investigations that are outlined in Appendix 8.1 of this EIAR. The proposed borrow pit location was selected due to the presence of competent or usable rock at an acceptable level below existing surface level. Developing borrow pits at the other locations would result in a significant increase in the volumes of peat and spoil to be excavated in order to access the usable rock underneath and therefore much higher volumes of excavated material that would need to be managed onsite. The excavation of such increased volumes of peat and spoil has the potential to lead to adverse environmental effects in relation to peat instability and dust emissions.

A comparison of the potential environmental effects of the alternative borrow pit locations when compared against chosen location is presented in Table 3-9 below.

Table 3-9 Comparison of environmental effects when compared against the chosen option (chosen borrow pit area)

Environmental Consideration	Location 1	Location 2
Population & Human Health (incl. Shadow Flicker)	Neutral	Neutral
Biodiversity & Ornithology	Neutral	Neutral
Land, Soils & Geology	Increased volume of peat and spoil to be excavated and managed in order to get to usable rock.	Increased volume of peat and spoil to be excavated and managed in order to get to usable rock.
Geotechnical	The increased volume of peat and spoil that would be required to be excavated and managed could lead to peat instability.	The increased volume of peat and spoil that would be required to be excavated and managed could lead to peat instability.
Water	Neutral	Neutral



MAP TITLE: **Site Location**		MAP NO.: **Figure 3.9**	SCALE: **1:75,000**
PROJECT TITLE: **180511 Croagh Wind Farm**			DATE: **29-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**		ISSUE NO.: **180511-2020.06.29-F**

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Air & Climate	Potential increase in dust emissions due to increased volumes of peat and spoil to be excavated.	Potential increase in dust emissions due to increased volumes of peat and spoil to be excavated.
Noise & Vibration	Neutral	Neutral
Landscape & Visual	Neutral	Neutral
Cultural Heritage & Archaeology	Neutral	The development of a borrow pit at this location would have required the demolition of a derelict house which could potentially have an adverse impact on cultural heritage.
Material Assets	Neutral	Neutral

While a certain volume of more durable, crushed stone for the finished surface layer of site roads and hardstanding areas will be sourced from fully authorised, local quarries, an alternative to using an on-site borrow pit was the option of sourcing of all stone and hardcore materials from a licensed quarry or quarries in the vicinity of the site. The movement of the volume of material required for the construction of 10 no. turbine wind farm would result in a significant increase in construction traffic and heavy loads, in combination with a potential for an increase in noise and dust emissions along the haul routes, and was therefore considered a less preferable option.

3.6 Alternative Transport Route

Wind turbine components (blades, nacelles and towers) are not manufactured in Ireland and therefore must be imported from overseas and transported overland to the site of a proposed development. With regard to the selection of a transport route to the proposed development site, alternatives were considered in relation to turbine components, general construction-related traffic, and site access locations.

3.6.1 Port of Entry

The alternatives considered for the port of entry of wind turbines into Ireland for the proposed development include Dublin Port and the Port of Galway. Dublin Port is the county's principal seaport catering for approximately two-thirds of Ireland's port traffic. The Port of Galway also offers a roll-on roll-off procedure to facilitate import of wind turbines. Both ports and indeed others in the State (including Cork and Shannon-Foynes), offer potential for the importing of turbine components and therefore are equally viable alternatives.

3.6.2 Site Access and Turbine Delivery Route

For turbine components and construction material transport, cognisance was taken of the haul routes used for other wind farm developments in local area in addition to the general preference to minimise the requirement for significant accommodation or widening works along the public road network and associated environmental effects.

It was determined that any proposed turbine delivery route would comprise use of the N4 National Primary Road, given that the ports of entry outlined above are well connected to the motorway network, particularly the M4, from which the N4 originates. From the N4, delivery vehicles would turn

on to the R299 at Drumsna, Co. Leitrim before then turning north onto the R280 and continuing towards Drumkeeran. From the R280, three potential routes were identified and considered for turbine component and abnormal load delivery to the site, as follows:

- Option A: The delivery vehicles would turn left off the R280 at the existing crossroads in the village of Drumkeeran and continue along the L4282 Local Road until they reach the main site entrance in the townland of Boleymaguire.
- Option B: The delivery vehicles would turn left off the R280 in the townland of Barragh More, approximately 1.3km south of Drumkeeran, using a new entrance into a third-party landholding. From here the delivery vehicles would follow a combination of new and existing roads in a generally westerly direction before emerging onto the L4282 in the townland of Bargowla. The delivery vehicles would then continue in a southerly direction (as per Option A) on the L4282 towards the site entrance in Boleymaguire.
- Option C: The delivery vehicles would enter an existing farmyard directly off the R280 in the village of Drumkeeran. The delivery vehicles would continue through the farmyard (minor alternations to two agricultural buildings would be required) and on to a new road through agricultural land west of the farmyard and turn left again on to the L4282. From here, the delivery vehicles would travel in a westerly direction on the L4282 (as per Option A) before turning south at new construction access junction in the townland of Derrycullinan The vehicles will travel in a south-easterly direction along existing forestry and new roads before turning to head in a westerly direction in the townland of Derreens and following the route, described in Option B, to the L4282 and then turning south and continuing towards the main site entrance in the townland of Boleymaguire.

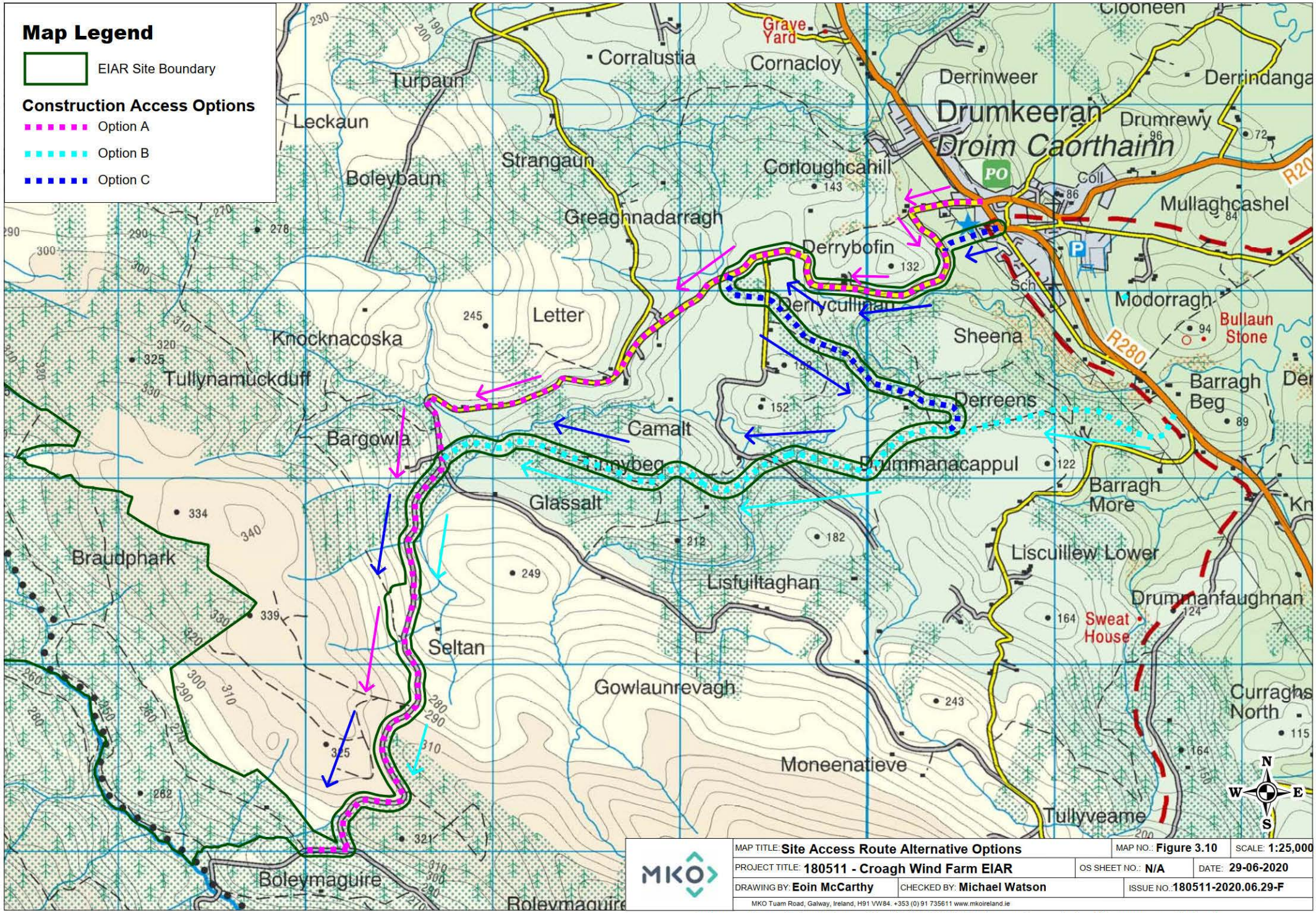
The three access route options are illustrated in Figure 3-10.

An assessment of all three options was carried out, taking account of criteria such as third-party land requirements, existing road upgrade and new road construction requirements and associated environmental effects. Option C was the chosen option given the availability of land under the control of the applicant and other participating third-party landowners between the village of Drumkeeran and the main site entrance in the townland of Boleymaguire.

Whilst the potential environmental effects of Option A could be less than Option C as it does not require the construction of new roads, the number of locations where third-party party land was required (5 locations) to facilitate the delivery of large turbine components, including major widening works at a hairpin bend with an existing watercourse crossing on the L4282, rendered this option unviable.

Option B is considered to have a similar potential for environmental effects as Option C, however, the construction of a new junction off the R280 instead of using an existing access point off the same road (the farmyard in the Village of Drumkeeran) was considered less preferable.

A comparison of the potential environmental effects of the alternative access route options when compared against chosen option is presented in Table 3-10 below.



MAP TITLE: **Site Access Route Alternative Options**		MAP NO.: **Figure 3.10**	SCALE: **1:25,000**
PROJECT TITLE: **180511 - Croagh Wind Farm EIAR**		OS SHEET NO.: **N/A**	DATE: **29-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**	ISSUE NO.: **180511-2020.06.29-F**	

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Table 3-10 Comparison of environmental effects when compared against the chosen option (chosen site access route)

Environmental Consideration	Option A	Option B
Population & Human Health (incl. Shadow Flicker)	Neutral	Neutral
Biodiversity & Ornithology	Decreased habitat loss due to use of existing roads for entire route.	Neutral
Land, Soils & Geology	Decrease in volume of overburden to be excavated and managed as no new roads required.	Neutral
Geotechnical	Decreased risk of peat instability due to use existing roads along entire route.	Neutral
Water	No new watercourse crossings required so decreased potential for silt-laden water entering watercourses.	Neutral
Air & Climate	The potential for dust emissions is reduced as no new roads required.	Neutral
Noise & Vibration	Increased potential for noise and vibration nuisances at residential dwellings along the route.	Reduced potential for noise and vibration nuisances at residential dwellings as none located along this route.
Landscape & Visual	Neutral	Neutral
Cultural Heritage & Archaeology	Decreased potential for impact on unrecorded, sub-surface archaeology as no new roads require along this route.	Neutral
Material Assets	Increased potential for adverse traffic impacts on local road users as entirety of route is located on the public road network.	The construction of a new junction off the R280 instead of using an existing access point off the same road (the farmyard in the Village of Drumkeeran) was considered to have a greater effect on local road users.

It should be note that while large turbine components and other abnormal loads deliveries will be via the Option C access route exclusively, other general construction material deliveries will be via the existing junction between the R280 and the L4282 in the village of Drumkeeran and continue on the local road before reaching the construction access junction in Derrycullinan. It is intended that passenger vehicles carrying construction staff and some regular HGVs delivering construction materials will turn onto the L4282 at the crossroads in Drumkeeran and continue to the main site entrance in Boleymaguire via the local road without using the construction access road.

The geometric assessment of large turbine components and other abnormal load deliveries during the construction of the proposed wind energy development is based on the use extended articulated trucks which is the standard and most common delivery vehicle technology for turbine blades. This assessment is included in Section 14.1 of this EIAR. However, alternative delivery vehicle technologies such as blade adapters or lifters may be considered, should they be deemed economically viable and readily available at the time of construction of the wind farm and to fall within all assessment envelopes identified in this EIAR.

3.6.3 Alternative Mitigation Measures

Mitigation by avoidance has been a key aspect of the proposed project's evolution through the selection and design process. Avoidance of the most ecologically sensitive areas of the site limits the potential for environmental effects. As noted above, the site layout aims to avoid environmentally sensitive areas. Where loss of habitat occur within the site, this has been mitigated by proposing enhancement lands as described in Chapter 6 of this EIAR. The alternative to this approach is to encroach on the environmentally sensitive areas of the site and accept the potential adverse environmental effects associated with this.

The best practice design and mitigation measures set out in this EIAR will contribute to reducing any risks and have been designed to break the pathway between the site and any identified environmental receptors. The alternative is to either not propose these measures or propose measures which are not best practice and /or effective and neither of these options is acceptable or sustainable.

4. DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) describes the development and its component parts which is the subject of a proposed application for planning permission to Leitrim County Council and Sligo County Council, ('the Proposed Development'). The Proposed Development comprises:

i. *Construction of 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
ii. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
iii. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
iv. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
v. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
vi. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
vii. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;*
viii. *1 no. borrow pit;*
ix. *2 no. peat and spoil repository areas*
x. *2 no. temporary construction compounds;*
xi. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
xii. *Site Drainage;*
xiii. *Permanent Signage;*
xiv. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
xv. *All associated site development works*

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

The development of the proposed wind farm development will require the felling of approximately 55.1 hectares of commercial forestry which will require replanting elsewhere in the state. Details regarding the area to be felled are outlined in Section 4.3.10 below. The Forest Service policy on the granting of felling licences requires replanting of forestry on a hectare by hectare basis. Three potential forestry replacement lands have been identified for assessment purposes. These lands, located in Counties Cavan, Roscommon and Wicklow, have all been granted Forest Service Technical Approval for afforestation and these or similarly approved lands will be used for replanting should the Proposed Development receive planning permission.

All elements of the Proposed Development described in the list above and the forestry replacement lands have been assessed as part of this EIAR.

4.2 Development Layout

The layout of the Proposed Development has been designed to minimise the potential environmental effects of the wind farm, while at the same time maximising the energy yield of the wind resource passing over the site. A constraints study, as described in Section 3.6.1 of this EIAR, has been carried out to ensure that turbines and ancillary infrastructure are located in the most appropriate areas of the site. The Proposed Development layout makes maximum use of the existing access roads and tracks within the site.

The overall layout of the Proposed Development is shown on Figure 4-1. This drawing shows the proposed locations of the wind turbines, electricity substation, grid connection route, borrow pit, peat and spoil repositories, construction compounds, internal roads layout, the construction access road and the main site entrance. Detailed site layout drawings of the Proposed Development are included in Appendix 4-1 to this EIAR.

4.3 Development Components

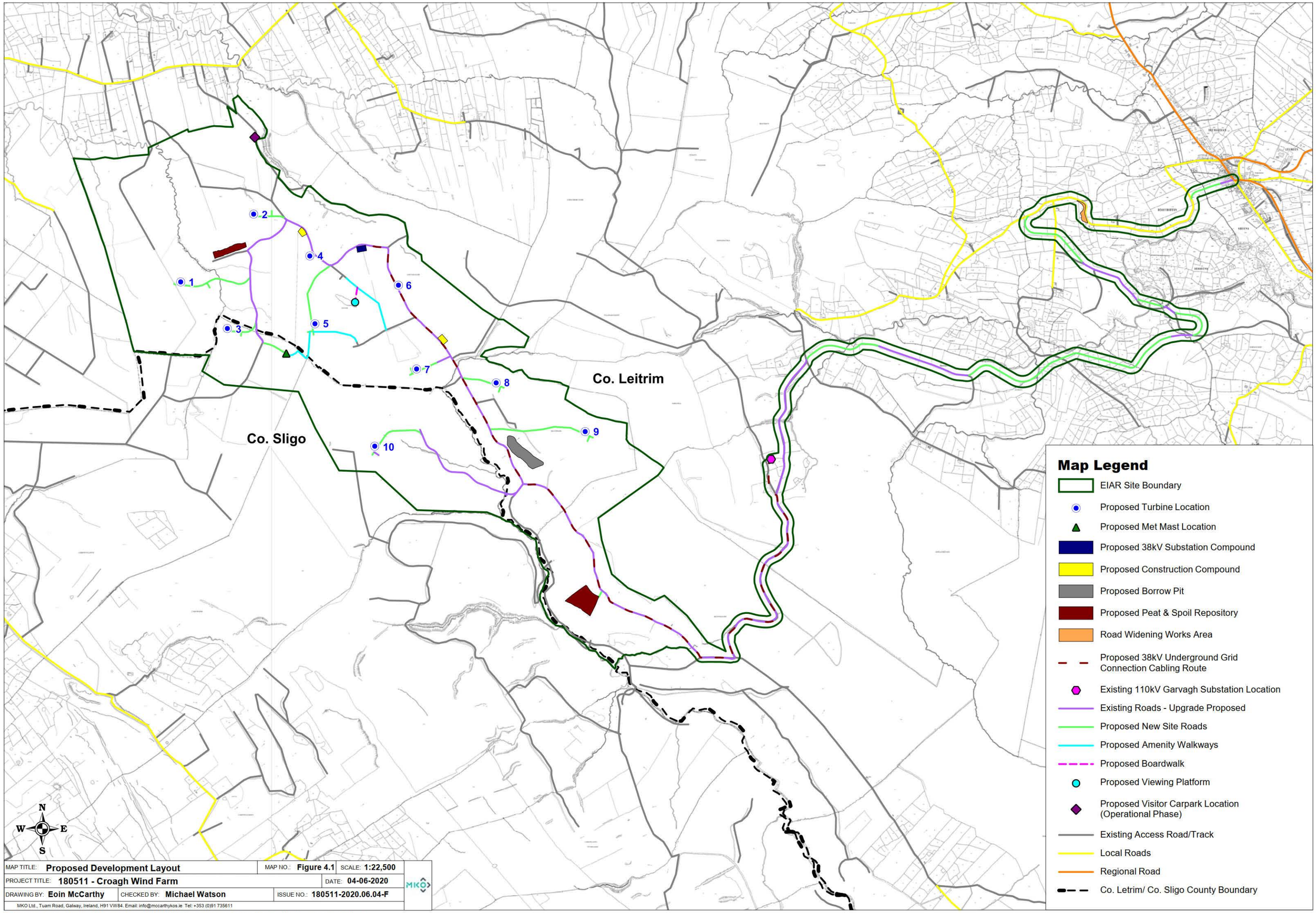
4.3.1 Wind Turbines

4.3.1.1 Turbine Locations

The proposed wind turbine layout has been optimised using industry standard wind farm design software to maximise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance. The Grid Reference coordinates of the proposed turbine locations are listed in Table 4-1 below.

Table 4-1 Propose Wind Turbine Locations and Elevations

Turbine No.	Irish Transverse Mercator Co-ordinates		Elevation (m OD)
	Easting (m)	Northing (m)	
1	583322	823639	271
2	583831	824112	241
3	583648	823314	287
4	584,223	823,820	277
5	584259	823347	294
6	584841	823616	294
7	584968	823032	291
8	585523	822935	300
9	586144	822595	323
10	584676	822493	298



MAP TITLE: **Proposed Development Layout**		MAP NO.: **Figure 4.1**	SCALE: **1:22,500**
PROJECT TITLE: **180511 - Croagh Wind Farm**			DATE: **04-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**	ISSUE NO.: **180511-2020.06.04-F**	

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4.3.1.2 Turbine Type

Wind turbines use the energy from the wind to generate electricity. A wind turbine, as shown in Plate 4-1 below, consists of four main components:

- Foundation unit
- Tower
- Nacelle (turbine housing)
- Rotor

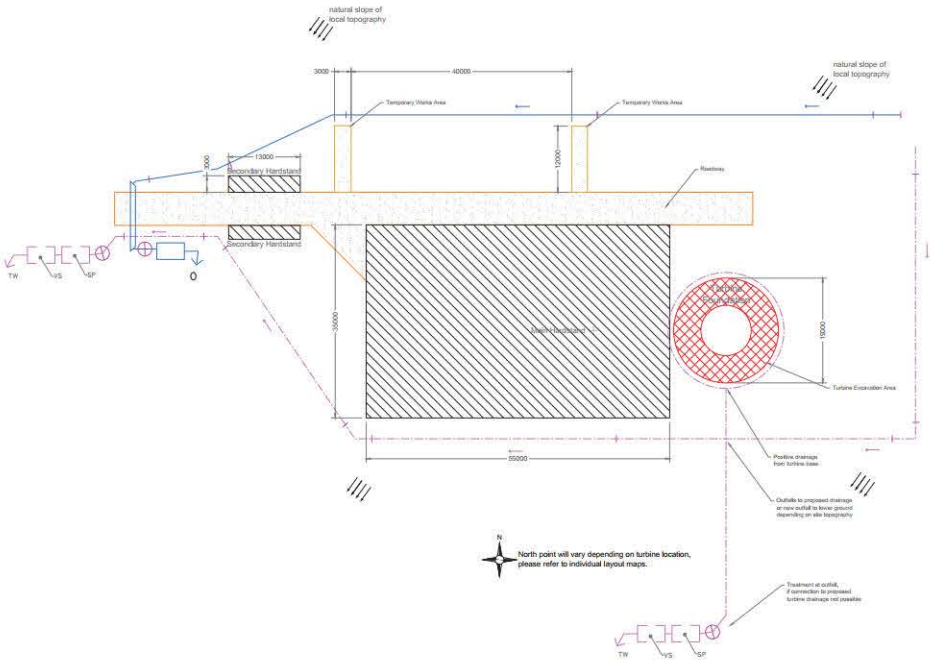


Plate 4-1 Wind turbine components

The proposed wind turbines will have a tip height of up to 170 metres. Within this size envelope, various configurations of hub height, rotor diameter and ground to blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of up to 170 metres. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics, with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be grey matt in colour.

For the purposes of this EIAR, various types and sizes of wind turbines within the 170-metre tip height envelope have been selected and considered in the relevant sections of the EIAR to assess the worst-case scenario. Turbine design parameters have a bearing on the assessment of shadow flicker, noise, visual impact, traffic and transport and ecology (specifically birds), as addressed elsewhere in this EIAR. In each EIAR section that requires the consideration of turbine parameters as part of the impact assessment, the worst-case turbine design parameters that have been used in the impact assessment are specified.

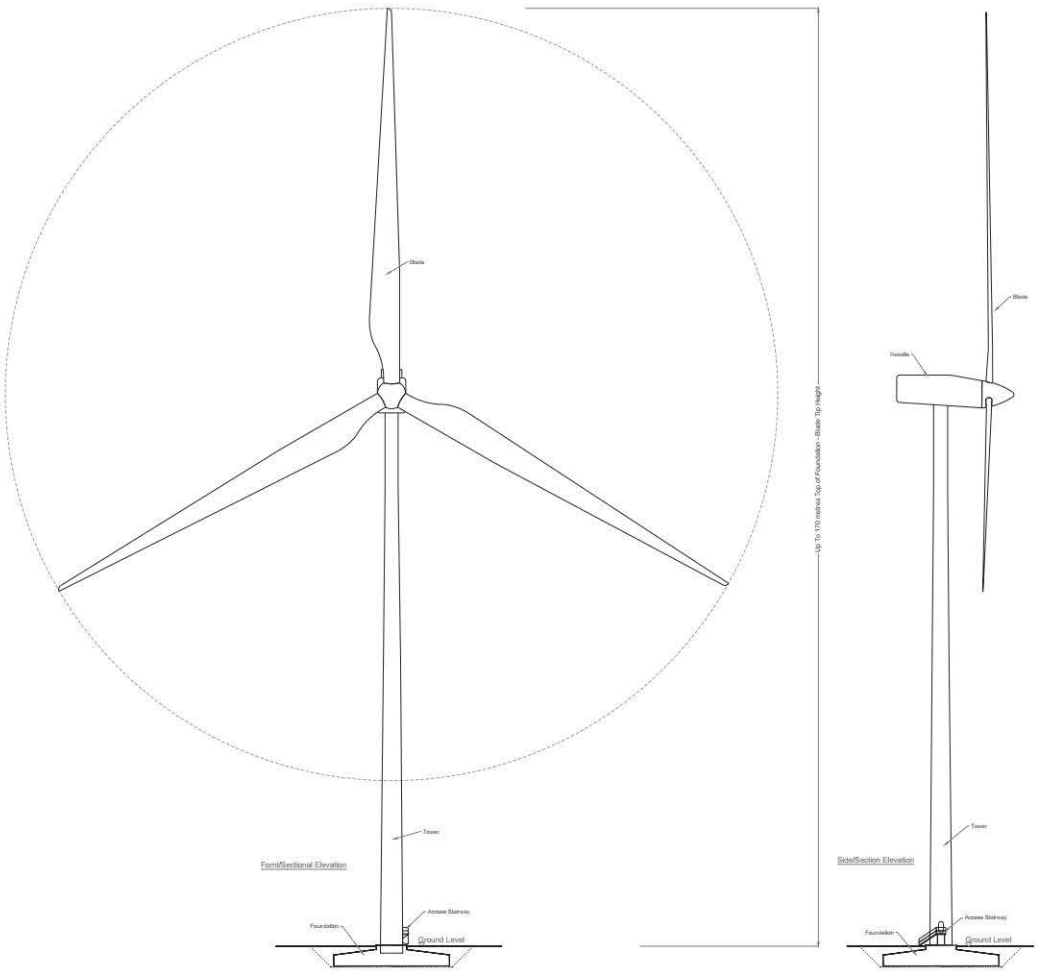
A drawing of the proposed wind turbine is shown in Figure 4-2. The individual components of a typical geared wind turbine nacelle and hub are shown in Figure 4-3 below.

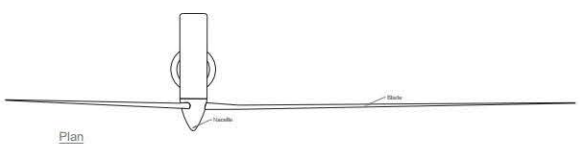


DRAWING LEGEND

PROPOSED DRAINAGE

- UPSTREAM INTERCEPTOR DRAIN
- SWALES/DOWNSTREAM COLLECTOR DRAIN
- DIRECTION OF FLOW
- SETTLEMENT POND - VEGETATION FILTER - LEVEL SPREADER
- CHECK DAM 'TYPE A'
- CHECK DAM 'TYPE B'
- INTERCEPTOR DITCH CULVERT
- COLLECTOR DITCH CULVERT
- O — OVERLAND FLOW DISCHARGE
- TW — TREATED WATER DISCHARGE
- SP — SETTLEMENT POND
- VS — SEMI-NATURAL VEGETATION SWALE / FILTER BED /SECONDARY SP





Plan

Drawing Notes

1. Proposed wind turbines to have a maximum ground to blade tip height of up to 170m.
2. Exact make and model of the turbine to be dictated by a competitive tender process.
3. Installed wind turbine not to exceed maximum size envelope set out above in any blade length and hub-height configuration.
4. Turbine foundation diameter may vary.
5. Ground level represents the top of turbine foundation.

Figure 4-2

DRAWING TITLE:
Typical Wind Turbine Hardstanding & Elevations

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin McCarthy
PROJECT NO.: 180511	DRAWING NO.: 180511 - 45
SCALE: 1:500 @ A1	DATE: 03.07.2020

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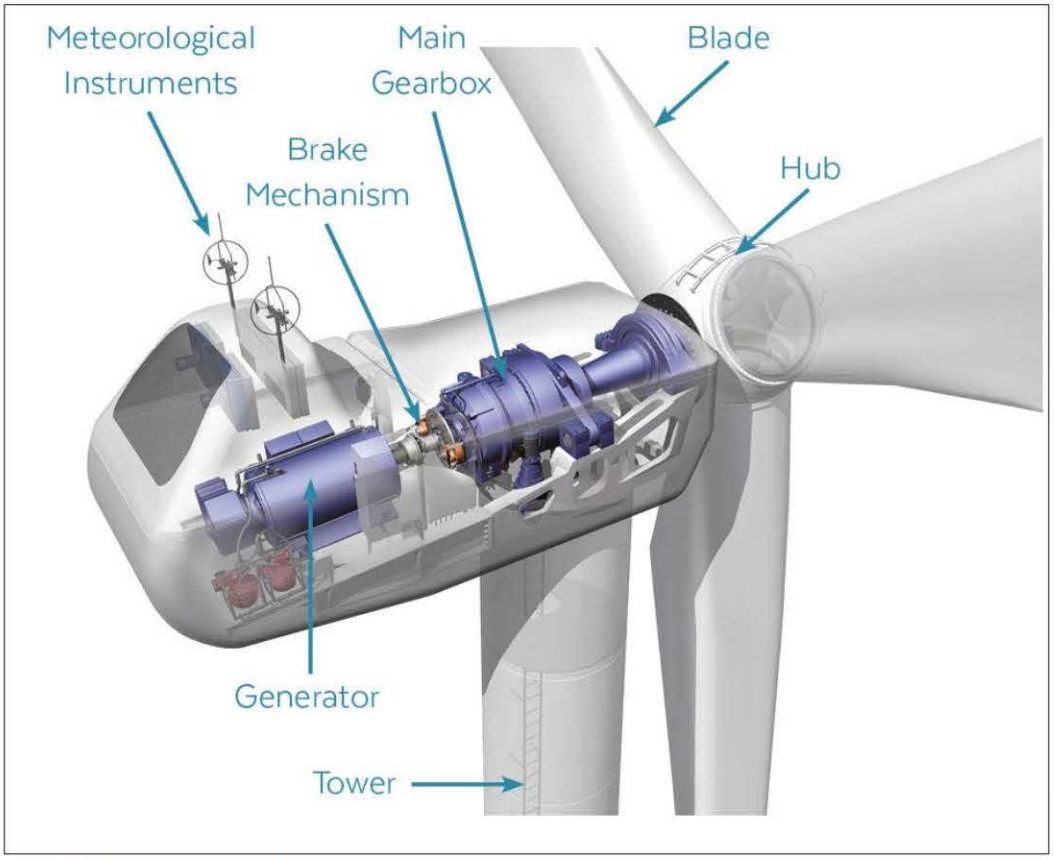


Figure 4-3 Turbine nacelle and hub components

Figure 4-2 shows a typical turbine base layout, including turbine foundation, hard standing area, assembly area, access road and surrounding works area.

4.3.1.3 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground level. The size of the foundation will be dictated by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbine foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier and a foundation area large enough to accommodate modern turbine models has been assessed in this EIAR. The turbine foundation transmits any load on the wind turbine into the ground. The typical horizontal and vertical extent of a turbine's foundation is shown in Figure 4-2.

After the foundation level of each turbine has been formed on competent strata or using piling methods, the bottom section of the turbine tower "Anchor Cage" is levelled and reinforcing steel is then built up around and through the anchor cage. The outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete and is backfilled accordingly with appropriate granular fill to finished surface level (Plate 4-2 below).



Plate 4-2 Turbine 'Anchor Cage' and finished turbine base

4.3.1.4 Hard Standing Areas

Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard-standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage of turbine components, and generally provide a safe, level working area around each turbine position. The hard-standing areas are extended to cover the turbine foundations once the turbine foundation is in place. The sizes, arrangement and positioning of hard standing areas are dictated by turbine suppliers. The hard-standing area is intended to accommodate a crane during turbine assembly and erection. The proposed hard standing areas shown on the detailed layout drawings included in Appendix 4-1 to this report are indicative of the sizes required, but the extent of the required areas at each turbine location may be optimised on-site depending on topography, position of the site access road, the proposed turbine position and the turbine supplier's exact requirements.

4.3.1.5 Assembly Area

Levelled assembly areas will be located on either side of the hard-standing area as shown on Figure 4-2. These assembly areas are required for offloading turbine blades, tower sections and hub from trucks until such time as they are ready to be lifted into position by cranes and to assist the main crane during turbine assembly. The exact location and number of assembly areas will be determined in consultation with the selected turbine manufacturer.

4.3.1.6 Power Output

It is anticipated the proposed wind turbines will have a rated electrical power output in the 3 to 5-megawatt (MW) range depending on further wind data analysis and power output modelling. Turbines of the exact same make, model and dimensions can also have different power outputs depending on the capacity of the electrical generator installed in the turbine nacelle. For the purposes of this EIAR, a rated output of 4.8MW has been chosen to calculate the power output of the proposed 10-turbine wind farm, which would result in an estimated installed capacity of 48MW.

Assuming an installed capacity of 48 MW, the Proposed Development therefore has the potential to produce up to 147,168 MWh (megawatt hours) of electricity per year, based on the following calculation:

A x B x C = Megawatt Hours of electricity produced per year

where: A = ... The number of hours in a year: 8,760 hours

B = ... The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc. A standard capacity factor of 35% is applied here

C = ... Rated output of the wind farm: 48 MW

The 147,168 MWh of electricity produced by the Proposed Development would be sufficient to supply 35,040 Irish households with electricity per year, based on the average Irish household using 4.2 MWh[1] of electricity.

The 2016 Census of Ireland recorded a total of 50,815 households in Co. Leitrim and Co. Sligo combined. Per annum, based on a capacity factor of 35%, the Proposed Development would therefore produce sufficient electricity for the equivalent of approximately 69% of all households in Co. Leitrim and Co. Sligo.

4.3.2 Site Roads

4.3.2.1 Road Construction Types

To provide access within the site of the Proposed Development and to connect the wind turbines and associated infrastructure approximately 10.9 kilometres of existing roads and tracks will need to be upgraded and approximately 6.9 kilometres of new access roads will need to be constructed. The road construction preliminary design has taken into account the following key factors as stated in the Fehily Timoney & Company's (FTC) Peat & Spoil Management Plan in Appendix 4-2:

1. *Buildability considerations*
2. *Serviceability requirements for construction and wind turbine delivery and maintenance vehicles*
3. *Minimise excavation arising*
4. *Requirement to minimise disruption to peat hydrology*

Whilst the above key factors are used to determine the road design the actual construction technique employed for a particular length of road will be determined on the prevailing ground conditions encountered along that length of road.

The proposed upgrade to existing roadways and construction of new roadways will incorporate passing bays to allow traffic to pass easily while traveling around the site.

4.3.2.1.1 *Upgrade to Existing Roads or Tracks*

The general construction methodology for upgrading of existing sections of excavated and floating roads or tracks, as presented in FTC's Peat & Spoil Management Plan in Appendix 4-2, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *For upgrading of existing excavated access tracks the following guidelines apply:*
    a. *Excavation will be required on one or both sides of the existing access track to a competent stratum.*
    b. *Granular fill to be placed and compacted in layers in accordance with the designer's specification.*
    c. *The surface of the existing access track should be overlaid with up to 500mm of selected granular fill.*
    d. *Access roads to be finished with a layer of capping across the full width of the road.*
    e. *A layer of geogrid/geotextile may be required at the surface of the existing access road in areas where the existing track shows signs of excessive rutting, etc.*

1 March 2017 CER (CRU) Review of Typical Consumption Figures Decision https://www.cru.ie/document_group/review-of-typical-consumption-figures-decision-paper/

f. *For excavations in peat and spoil, side slopes shall be not greater than 1 (v):3 (h). Where areas of weaker peat are encountered then shallower slopes will be required to ensure stability.*

2. *For upgrading of existing floated access tracks the following guidelines apply:*
   a. *The make-up of the existing floating access roads on site is generally locally tree brash/trunks laid directly onto the peat surface and/or geotextile overlain by up to 500mm of coarse granular fill/till type (fine granular/cohesive) site won material. It should be noted that there are localised variations in the make-up of the existing floated access tracks on site, frequently no tree brash/trunks were used in the make-up and the presence of a geogrid was also noted in localised sections of the existing track.*
   b. *The surface of the existing access track will be levelled prior the placement of any geogrid/geotextile, where necessary (to prevent damaging the geogrid/geotextile).*
   c. *Where coarse granular fill has been used in the existing floated access road make-up, a layer of geogrid will be placed on top of the existing floated access track.*
   d. *Where fine granular/cohesive type material has been used in the existing floated access road make-up (as is the case on some of the existing access roads in the southeast of the site), a layer of geotextile will be required as a separator layer with a layer of geogrid.*
   e. *The geogrid will be overlaid with up to 500mm of selected granular fill. Granular fill to be placed and compacted in layers.*
3. *The finished road width will have a running width of 5m, with wider sections on bends and corners.*
4. *On side long sloping ground any road widening works required will be done on the upslope side of the existing road where possible.*
5. *At transitions between new floating and existing excavated roads a length of road of about 10 to20m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated road.*
6. *A final surface layer shall be placed over the existing access track, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.*

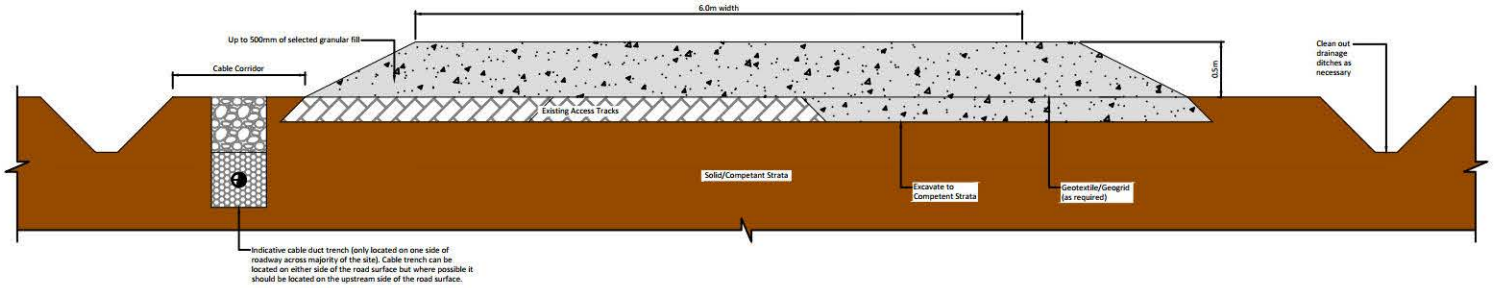
A typical section of existing excavated road for upgrade is shown in Figure 4-4. A typical section through an existing floating road to be upgraded is shown in Figure 4-5.

4.3.2.1.2 Construction of New Excavated Roads

Excavate and replace type access roads are the conventional method for construction of access roads on peatland sites and the preferred construction technique on this site.

The general methodology for the construction of excavated roads, as presented in FTC's Peat & Spoil Management Plan in Appendix 4-2, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *Prior to commencing road construction movement monitoring posts will be installed in areas where the peat depth is greater than 2m.*
2. *Interceptor drains will be installed upslope of the access road alignment to divert any surface water away from the construction area.*
3. *Excavation will take place to a competent stratum beneath the peat.*
4. *Road construction will be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without replacement with stone fill.*
5. *Excavation of materials with respect to control of peat stability.*



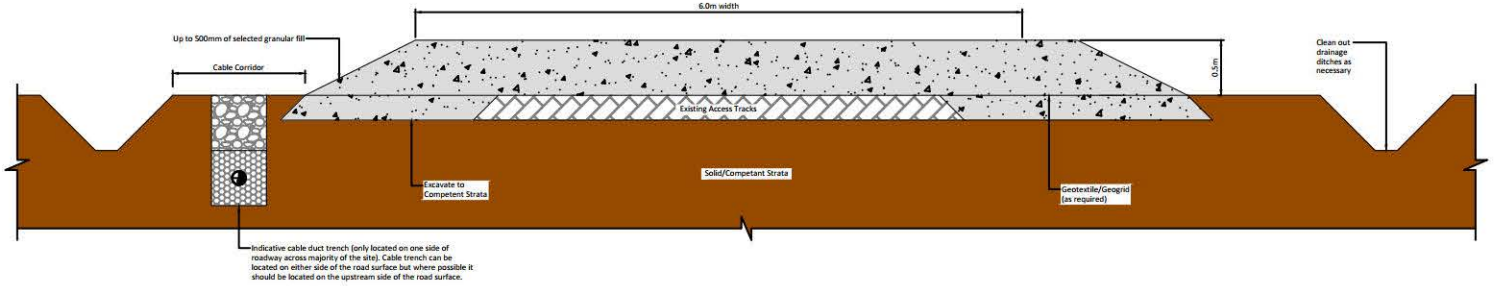


Figure 4-4

DRAWING TITLE:
Upgrade of Existing Excavated Access Roads

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
POR	IH
PROJECT No.: 180511	DRAWING No.: 180511 - 46
SCALE: 1:50 @ A3	DATE: 03.07.2020

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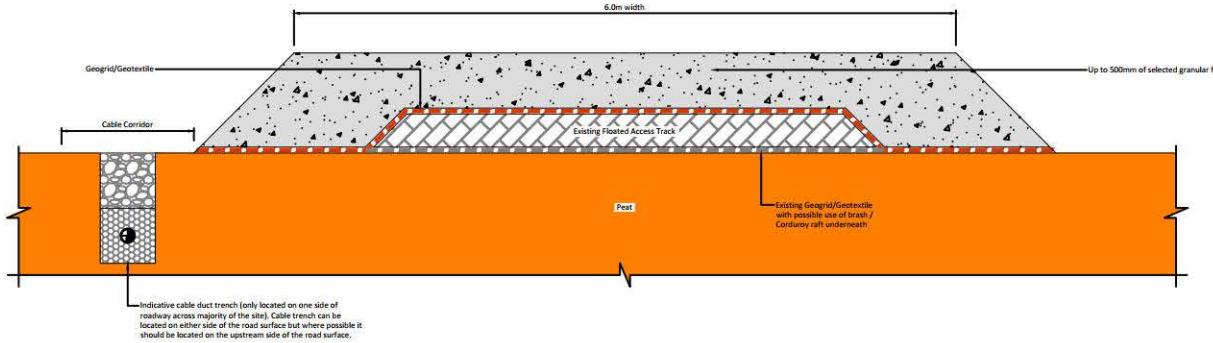

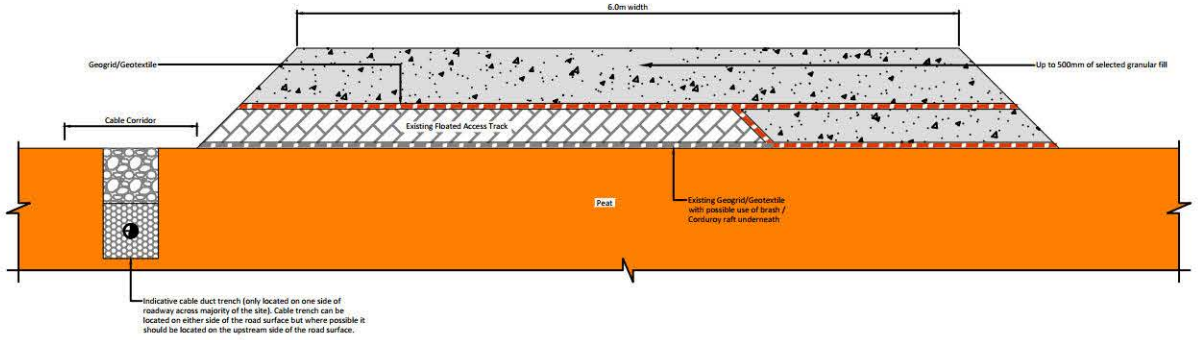

Figure 4-5

DRAWING TITLE:
Upgrade of Existing Floated Access Roads

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 180511	DRAWING No.: 180511 - 47
SCALE: 1:50 @ A3	DATE: 03.07.2020
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a. *Acrotelm (top about 0.3 to 0.4m of peat) is generally required for landscaping and shall be stripped and temporarily stockpiled for re-use as required. Acrotelm stripping shall be undertaken prior to main excavations.*
b. *Where possible, the acrotelm shall be placed with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation.*
c. *All catotelm peat (peat below about 0.3 to 0.4m depth) shall be transported immediately on excavation to the borrow pit or peat repositories.*

6. *Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then shallower slopes will be required. Battering of the side slopes of the excavations will be carried out as the excavation progresses.*
7. *The excavated access road will be constructed of up to 1000mm of selected granular fill.*
8. *Access roads to be finished with a layer of capping across the full width of the road.*
9. *A layer of geogrid/geotextile may be required at the surface of the competent stratum.*
10. *At transitions between floating and excavated roads a length of road of about 10 to 20m shall have all peat excavated and replaced with suitable fill. The surface of this fill shall be graded so that the road surface transitions smoothly from floating to excavated road.*
11. *Where steeper slopes are encountered along with relatively deep peat (i.e. typically greater than 1m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability.*
12. *A final surface layer shall be placed over the excavated road and graded to accommodate wind turbine construction and delivery traffic.*

A typical section of a new excavated road is shown in Figure 4-6.

4.3.2.1.3 Construction of New Floating Roads

In a number of areas across the site of the Proposed Development it will be necessary to construct floating roads over peat.

A confirmatory stability analysis to affirm the conditions predicted in this EIAR will be carried out by the designer where it is proposed to install floating access roads over the peat prior to any construction work commencing on site.

Floating roads minimise impact on the peat, particularly peat hydrology. As there is no excavation required no peat arisings are generated. However, where the underlying peat has insufficient bearing capacity or due to topographic restrictions an excavated type access road is more suitable.

The general construction methodology for the construction of floating, as presented in FTC's Peat and Spoil Management Plan in Appendix 4-2, is summarised below. This methodology includes procedures that are to be included in the construction to minimise any adverse impact on peat stability.

1. *Prior to commencing floating road construction movement monitoring posts will be installed in areas where the peat depth is greater than 3m.*
2. *Base geogrid to be laid directly onto the existing peat surface along the line of the road in accordance with geogrid provider's requirements.*
3. *The typical make-up of the new floated access road is a minimum of 1000mm of selected granular fill with 2 no. layers of geogrid with possibly the inclusion of a basal layer of tree trunks/brash.*
4. *Granular fill to be placed in layers and compacted in accordance with the TII Specification for Road Works.*

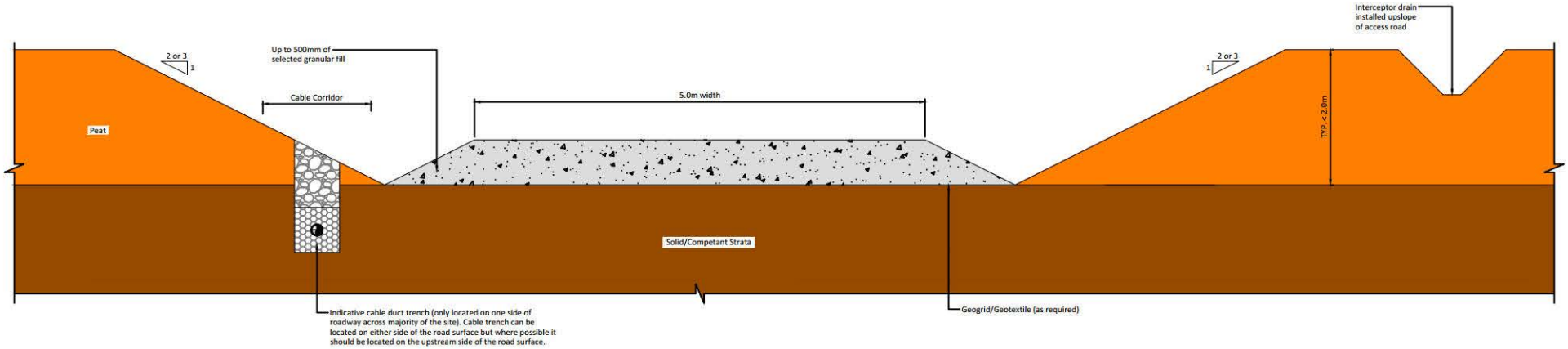

Figure 4-6

DRAWING TITLE:
New Excavate and Replace Access Road

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

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PROJECT No.: 180511	DRAWING No.: 180511 - 48
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5. *During construction of the floated access roads it may be necessary to include pressure berms either side of the access road in some of the deeper/weaker peat areas. The inclusion of a 2 to 5m wide pressure berm (typically 0.5m in height) either side of the access road at such locations will reduce the likelihood of potential bearing failures beneath the access road.*
6. *The finished running width of the road will be 5m, with wider sections on bends and corners.*
7. *Stone delivered to the floating road construction shall be end-tipped onto the constructed floating road. Direct tipping of stone onto the peat shall not be carried out.*
8. *To avoid excessive impact loading on the peat due to concentrated end-tipping all stone delivered to the floating road shall be tipped over at least a 10m length of constructed floating road.*
9. *Where it is not possible to end-tip over a 10m length of constructed floating road due to the presence of weak deep peat then dumpers delivering stone to the floating road shall carry a reduced stone load (not greater than half full) until such time as end-tipping can be carried out over a 10m length of constructed floating road.*
10. *Following end-tipping a suitable bulldozer shall be employed to spread and place the tipped stone over the base geogrid along the line of the road.*
11. *A final surface capping layer shall be placed over the full width of the floating road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and turbine delivery traffic.*

A typical section of a new floating road is shown in Figure 4-7.

4.3.3 Borrow Pits

4.3.3.1 Description

It is proposed to develop an on-site borrow pit as part of the Proposed Development. It is proposed to obtain the majority of all rock and hardcore material that will be required during the construction of the proposed development from the on-site borrow pit. The borrow pit is located adjacent to an existing site road. Usable rock may also be won from other infrastructure construction including the substation and the turbine base excavations.

The proposed borrow pit is located approximately 430 metres west of Turbine No. 9, measures approximately 20,930m^2 in area and is shown on Figure 4-1 and on the detailed site layout drawings included as Appendix 4-1 to this EIAR. Figure 4-8 below shows detailed sections through the proposed borrow pits. The borrow pits will, on removal of all necessary and useful rock, be reinstated with excavated peat and subsoils as described in Section 4.3.4 below.

Post-construction, the borrow pit area will be permanently secured and a stock-proof fence will be erected around the borrow pit areas to prevent access to these areas. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.

At certain turbine foundation and hardstand locations, depending on local ground conditions, the extraction of rock may be required in order to obtain a level construction area. Any rock obtained from a turbine location will be used to supply the hardcore materials requirement for that turbine's hardstand and access road.

Hardcore materials will be extracted from the borrow pit (and some turbine locations, if necessary), principally by means of rock breaking. Depending on the hardcore volume requirements, blasting may also be used as a more effective rock extraction method, capable of producing significant volumes of rock in a matter of milliseconds. Blasting will only be carried out after notifying any potentially sensitive local residents. The potential noise and vibration impact on sensitive receptors associated with the rock extraction measures, detailed below, are assessed in Chapter 11 of this EIAR.

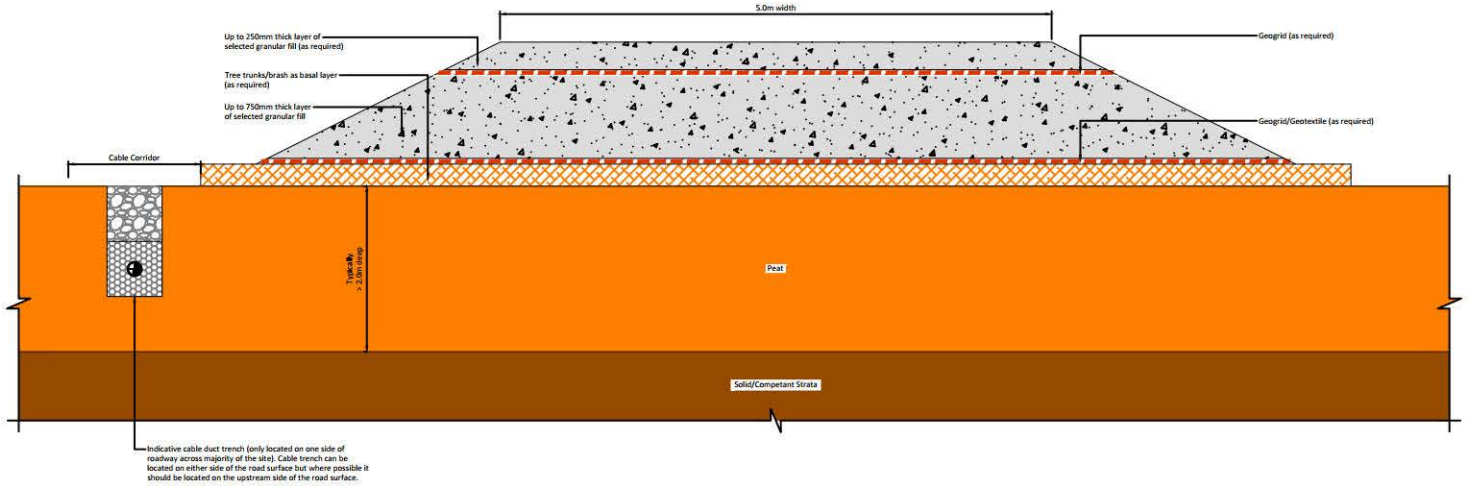

Figure 4-7

DRAWING TITLE:
New Floating Access Road

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
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PROJECT No.: 180511	DRAWING No.: 180511 - 49
SCALE: 1:50 @ A3	DATE: 03.07.2020
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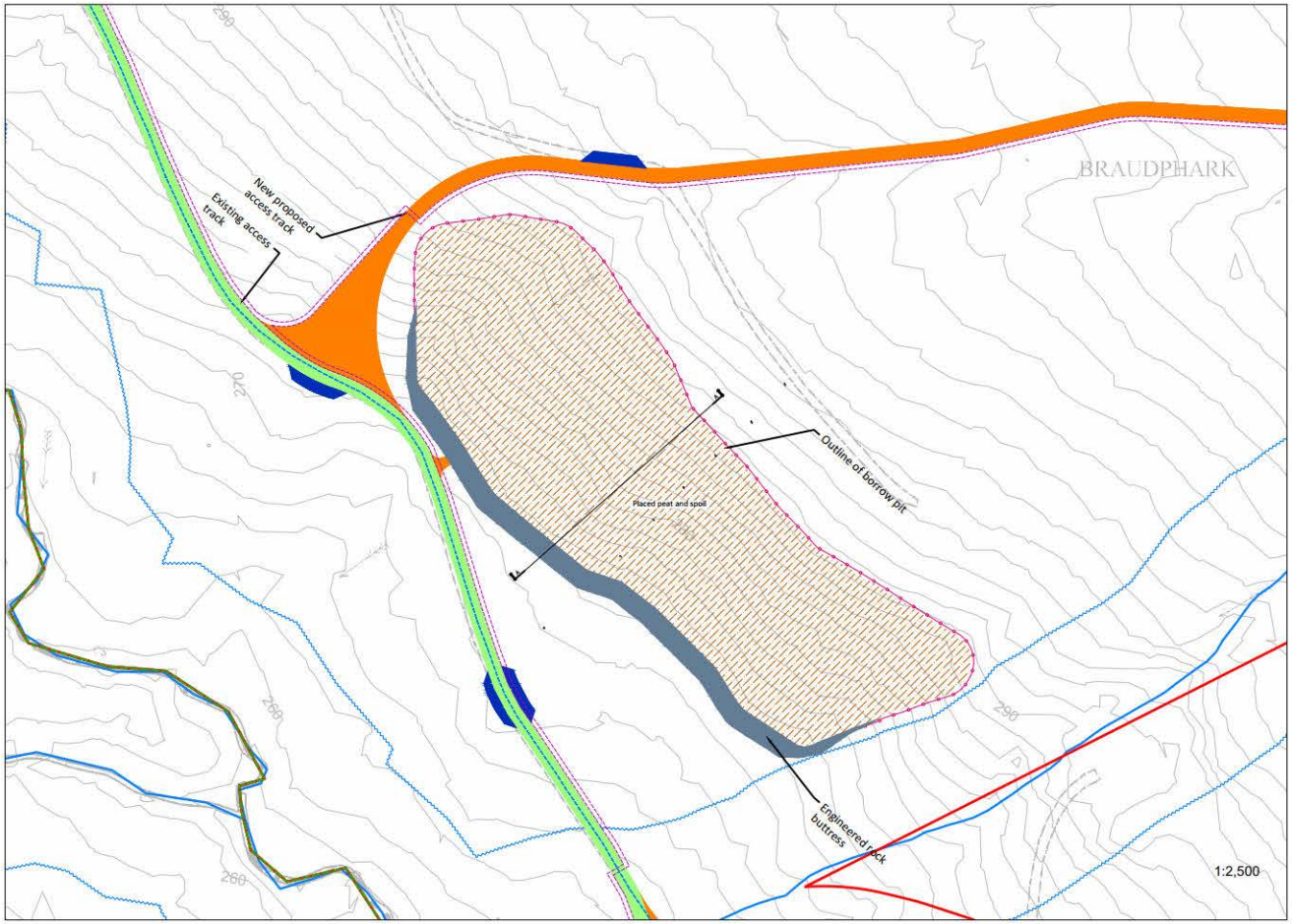

Construction Notes Borrow pit

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Depending on the type and condition of rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit should be formed at stable inclinations to suit local in-situ rock conditions.

(3) Infilling of the peat & spoil should commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Excavation and infilling of the borrow pit will need to be sequenced and programmed. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(4) The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat & spoil to be reinstated safely.

(5) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.

(6) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by a competent person.

(7) In order to prevent water retention occurring behind the buttresses, the buttresses should be constructed of coarse boulder fill with a high permeability.

(8) Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from the placed arising's.

(9) Control of groundwater within the borrow pit may be required and measures will be determined as part of the ground investigation programme.

(10) All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

(11) Further guidelines on the construction of the borrow pit is included within Section 7.4 of the Peat & Spoil Management Plan

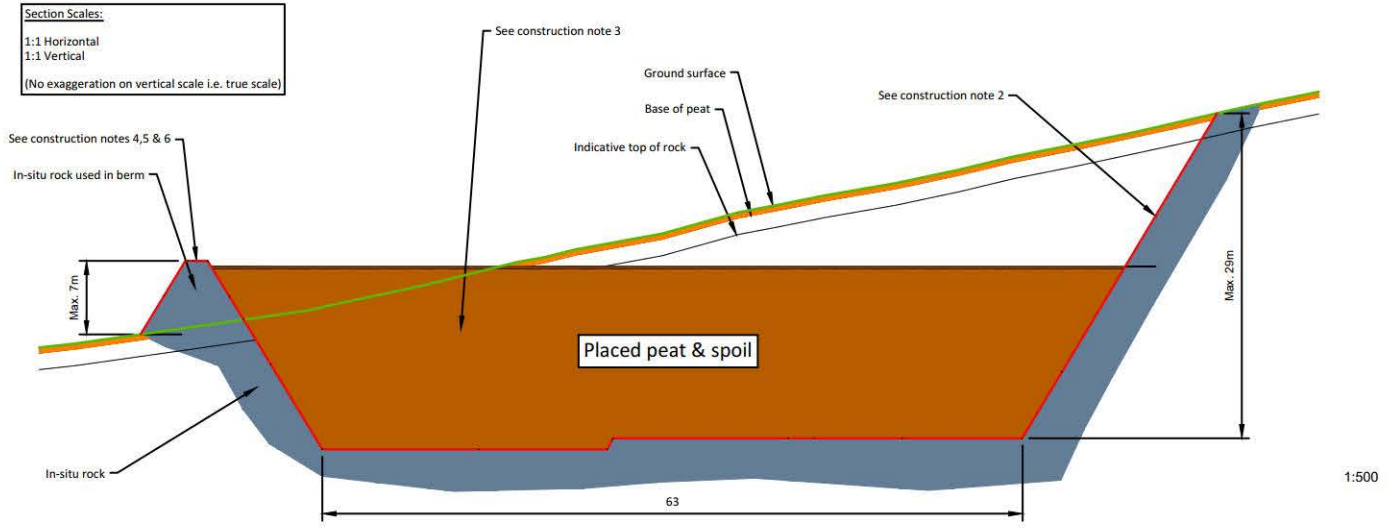

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Figure 4-8

DRAWING TITLE:
Borrow Pit Layout and Sections

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 180511	DRAWING No.: 180511 - 41
SCALE: As Shown @ A3	DATE: 03.07.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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It is anticipated that a certain volume of finer, crushed stone, used to provide the final surface layer for site roads and hardstanding areas will be brought to the site from local, appropriately authorised quarries. Five quarries located within 20 km of the proposed development have been selected for the purposes of assessment throughout this EIAR. The locations of these quarries are shown in Figure 4-9.

The two proposed extraction methods are detailed below.

4.3.3.2 Rock Extraction Methods

The extraction of rock from the borrow pit is a workstage of the Proposed Development which will be a temporary operation run over a short period of time relative to the duration of the entire project. As described above, there is a layer of overburden present at the borrow pit location, which will be stripped back and stockpiled using standard tracked excavators. Two extraction methods have been assessed for breaking out the useful rock below; rock breaking and blasting.

4.3.3.2.1 *Rock Breaking*

Weathered or brittle rock can be extracted by means of a hydraulic excavator and a ripper attachment. This is a common extraction methodology where fragmented rock is encountered as it can be carefully excavated in layers by a competent operator. In areas where rock of a much higher strength is encountered and cannot be removed by means of excavating then a rock breaking methodology may be used. Where rock breaking is required, a large hydraulic 360-degree excavator with a rock breaker attachment is typically used. Given the power required to break out tight and compact stone at depth, the machines are generally large and in the 40-60 tonne size range. Even where rock might appear weathered or brittle at the surface, the extent of weathering can quickly diminish with depth resulting in strong rock requiring significant force to extract it at depths of only a few metres.

A large rock breaking excavator progressively breaks out the solid rock from the ground in the borrow pit area. The large rock breaker is typically supported by a smaller rock breaker which can often be in the 30-40 tonne size range and works to break the rocks down to a size that they can be fed into a crusher.

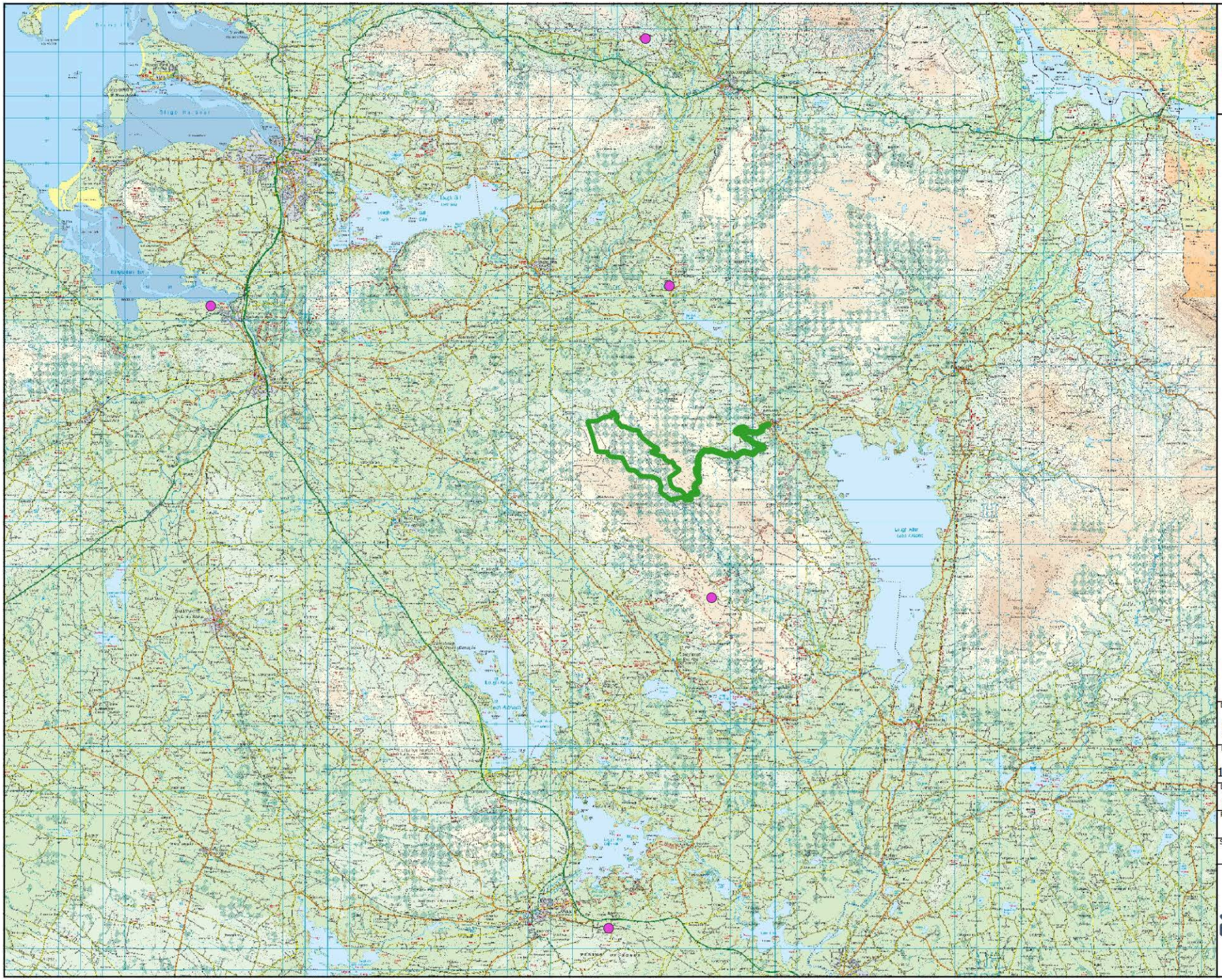
The extracted broken rock is typically loaded into a mobile crusher using a wheeled loading shovel and crushed down to the necessary size of graded stone required for the on-site civil works. The same wheeled loader takes the stone from the crusher conveyor stockpile and stockpiles it elsewhere away from the immediate area of the crusher until it is required elsewhere on the site of the Proposed Development.

4.3.3.2.2 *Rock Blasting*

Where blasting is used as an extraction method, a mobile drilling rig is used to drill vertical boreholes into the area of rock that is to be blasted. The drilling rigs used are normally purpose built, self-propelled machines, designed specifically for drilling blast boreholes. A drilling rig working for 3-4 days would typically drill the necessary number of boreholes required for a single blast. The locations, depth and number of boreholes are determined by the blast engineer, a specialist role fulfilled by the blasting contractor that would be employed to undertake the duties.

The blast engineer would then arrange for the necessary quantity of explosive to be brought to site to undertake a single blast. The management of explosives onsite and the actual blasting operation would be agreed in advance with and supervised by An Gardaí Siochána. The blast engineer sets the explosives in place in the boreholes, sets the charges, and fires the blast. The blast takes only a matter of milliseconds but may be perceived to take longer as blast noise echoes around the area.

A properly designed blast should generate rock of a size that can be loaded directly into a mobile crusher, using the same wheeled loader description outlined above. From that point on, the same



Map Legend

- EIAR Site Boundary
- Quarry Locations

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Drawing Title

Existing Quarry Locations

Project Title	180511 - Croagh Wind Farm EIAR
Drawn By: Daire O'Shaughnessy	Checked By: Eoin McCarthy
Project No.: 180511	Drawing No.: Fig 4-9
Scale: 1:220,000	Date: 29.06.20

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method is used for processing the rock generated from a blast, as would be used to process rock generated by rock breaking. It would be likely that a drilling rig would recommence drilling blast holes for the next blast as soon one blast finished. The potential impacts associated with noise and vibration are assessed in Chapter 11: Noise and Vibration.

4.3.4 Peat and Spoil Management Plan

4.3.4.1 Quantities

The quantity of peat and non-peat material (spoil), requiring management on the site of the Proposed Development has been calculated, as presented in Table 4-2 below. These quantities were calculated by FTC as part of the *Peat and Spoil Management Plan* in Appendix 4-2 of this EIAR.

Table 4-2 Peat and Spoil Volumes requiring management

Development Component	Area (m2) (approx.)	Peat Volume (m3) (approx.)	Spoil Volume(m3) (approx.)
10 no. Turbines and Hardstanding Areas	22,800	65,925	48,635
2 no. Construction Compound Platform	4,800	7,940	17,095
1 no. Substation Platform & Building	2,600	2,810	
Anemometry Mast Platform	280	425	
Access Roads	67,200	103,500	93,550
1 no. Borrow Pit	20,930	14,820	34,580
2 no. Repository Areas	34,530	15,000	3,000
Total		**209,970**	**196,860**
Total Peat & Spoil to be managed (m^3)		406,830	

4.3.4.2 Peat and Spoil Usage in Restoration of Borrow Pits

Once the required volume of rock has been extracted from the borrow pit areas, it is intended to reinstate these areas with peat and overburden excavated from the works areas of the Proposed Development and the alternative construction access road.

As rock is being extracted from the borrow pit, upstands of rock will be left in place, depending on the type of rock, to act as intermediate retaining buttresses. Where this is not achievable, stone buttresses will be constructed within the borrow pit. The upstands or buttresses will form individual restoration areas within the borrow pit which will be filled once the required volume of rock has been extracted from each individual area. The buttresses will be wide enough to allow construction traffic access for the tipping of peat into the individual cells.

A temporary access track, will be placed around the perimeter of the borrow pit area to allow for the tipping of peat over the edge of the borrow pit area.

Where possible, the acrotelm peat that has been excavated and not retained for reinstatement and landscaping works will be stored with the vegetated side facing up so as to promote the growth of vegetation across the surface of the stored peat within the borrow pit area.

4.3.4.2.1 Placement of Peat and Spoil in Repository Areas

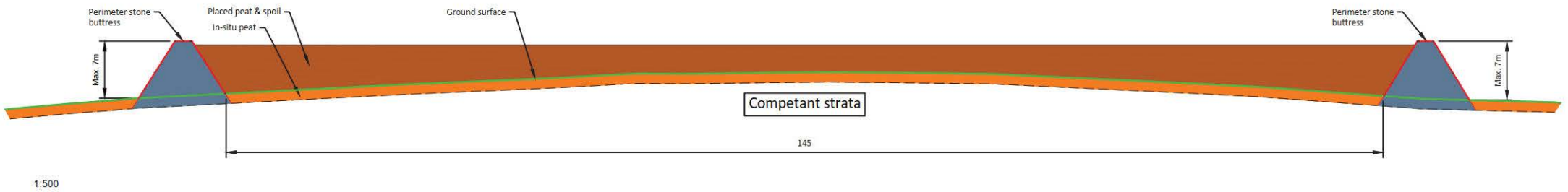
Two locations have been identified as suitable peat and spoil repository areas and are shown in Figure 4-1. The peat depth within the footprint of the repositories is generally less than 1.5m. Repository No. 1 is located approximately 1,080m south of Turbine No. 9 and measures approximately 24,770 square metres. Repository No. 2 is located approximately 210m southwest of Turbine No. 2 and measures approximately 9,760 square metres. Both repository areas are located adjacent to existing roads.

Both repository areas have a perimeter buttress which will contain and ensure the placed peat and spoil remains stable in the long-term. Prior to the placement of any excavated peat and spoil, the permanent stone buttresses shall be constructed around the perimeter of the repository areas. Construction details for each of the repository areas are shown on Figures 4-10 and 4-11.

The presence of perimeter buttresses will help prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

The repository areas in particular the stone buttresses shall be constructed as follows:

1. *All stone buttresses required within the repository areas will be founded on mineral soil or bedrock i.e. competent strata. The founding stratum for each stone buttress will be inspected and approved by a geotechnical engineer or competent person.*
2. *In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. Alternatively, drains will be placed through the buttresses to allow excess water to drain.*
3. *The height of the stone buttresses constructed will be greater than the height of the stored peat and spoil to prevent any surface run-off. The height of the stone buttresses will be a minimum of 0.5m above the height of the placed peat and spoil to prevent any potential for saturated peat to flow out of the repository area.*
4. *The side slopes of the stone buttresses shall be constructed at 45 degrees. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.*
5. *An interceptor drain will also be installed upslope of the repository areas. The drain will divert any surface water away from the repository area and hence prevent water from ponding in the area.*
6. *A settlement pond will be required at the lower side of the repository areas.*
7. *A granular layer of material will be required at the base of the stored spoil immediately upslope of the stone buttresses to act as a drainage layer. This drainage layer will aid in preventing a build-up of pore water pressure behind the stone buttress.*
8. *The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope against the stone buttress and placement will then continue upslope.*
9. *It is important that the surface of the stored spoil be shaped to allow efficient run-off of water from the stored spoil.*
10. *Supervision by a geotechnical engineer or appropriately competent person is required for the construction of the repository area.*



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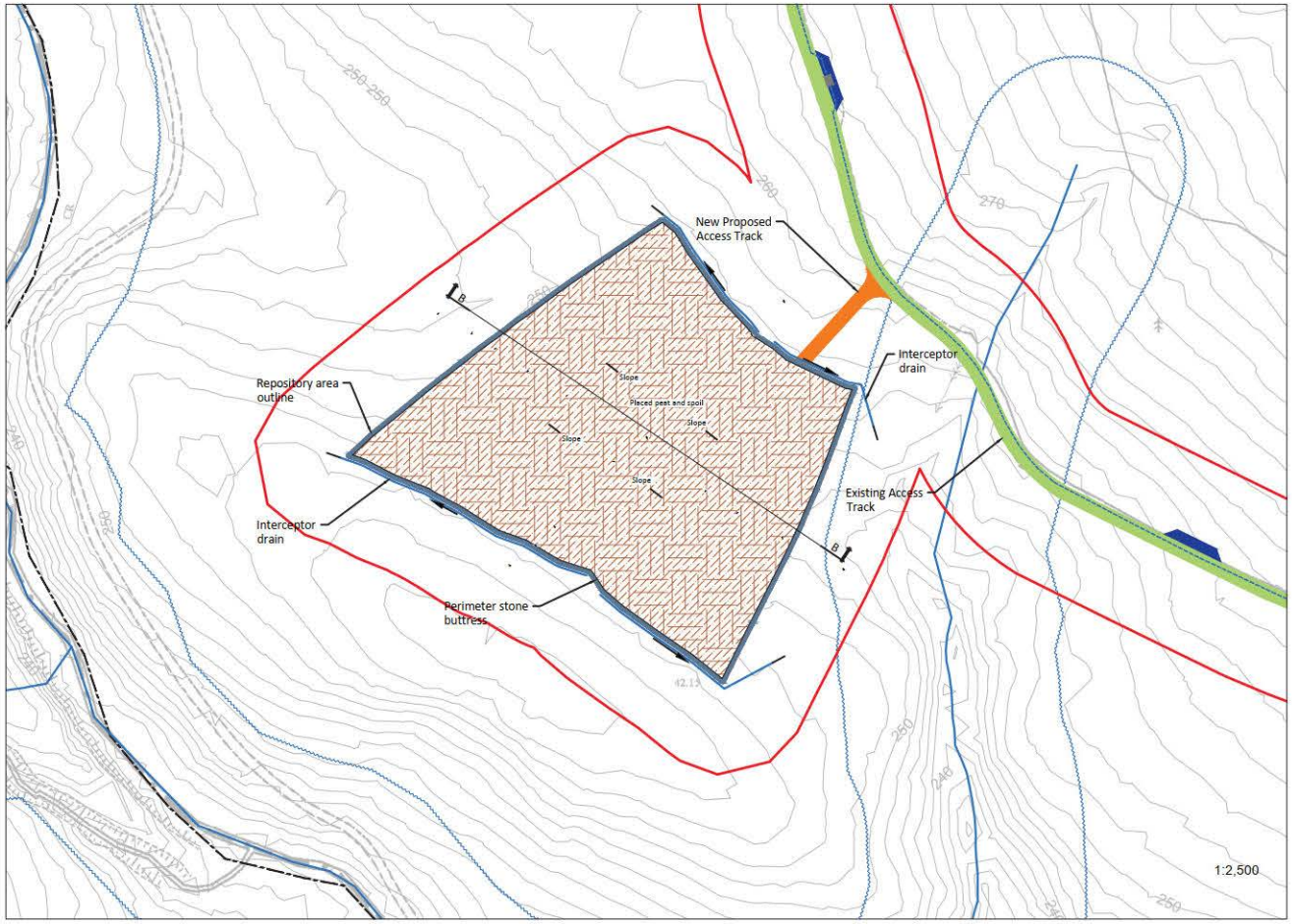

1:2,500

Construction Notes Borrow pit

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Depending on the type and condition of rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit should be formed at stable inclinations to suit local in-situ rock conditions.

(3) Infilling of the peat & spoil should commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress. Excavation and infilling of the borrow pit will need to be sequenced and programmed. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(4) The contractor excavating the rock will be required to develop the borrow pit in a way which will allow the excavated peat & spoil to be reinstated safely.

(5) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed should be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is likely to be required.

(6) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by a competent person.

(7) In order to prevent water retention occurring behind the buttresses, the buttresses should be constructed of coarse boulder fill with a high permeability.

(8) Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from the placed arising's.

(9) Control of groundwater within the borrow pit may be required and measures will be determined as part of the ground investigation programme.

(10) All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

(11) Further guidelines on the construction of the borrow pit is included within Section 7.4 of the Peat & Spoil Management Plan

N

Figure 4-10

DRAWING TITLE:
Peat and Spoil Repository 1 Layout and Sections

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
POR	IH
PROJECT No.: 180511	DRAWING No.: 180511 - 42
SCALE: As Shown @ A3	DATE: 03.07.2020

OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493

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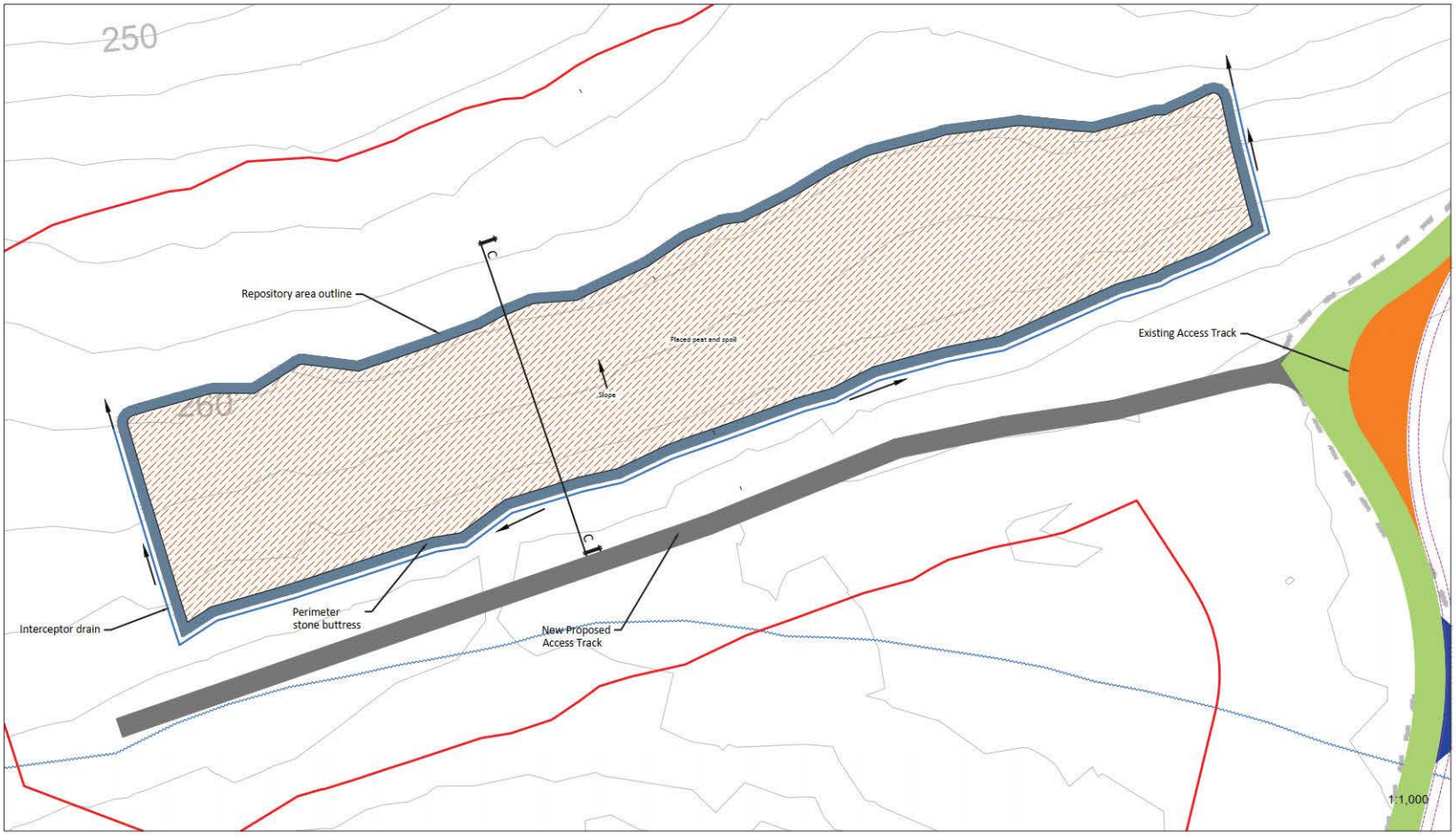

Construction Notes Borrow pit

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Depending on the type and condition of rock present in the borrow pit it may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit.

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(6) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress should be inspected and approved by a competent person.

(7) In order to prevent water retention occurring behind the buttresses, the buttresses should be constructed of coarse boulder fill with a high permeability.

(8) Where possible, the surface of the placed peat & spoil should be shaped to allow efficient run-off of surface water from the placed arising's.

(9) Control of groundwater within the borrow pit may be required and measures will be determined as part of the ground investigation programme.

(10) All the above-mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

(11) Further guidelines on the construction of the borrow pit is included within Section 7.4 of the Peat & Spoil Management Plan

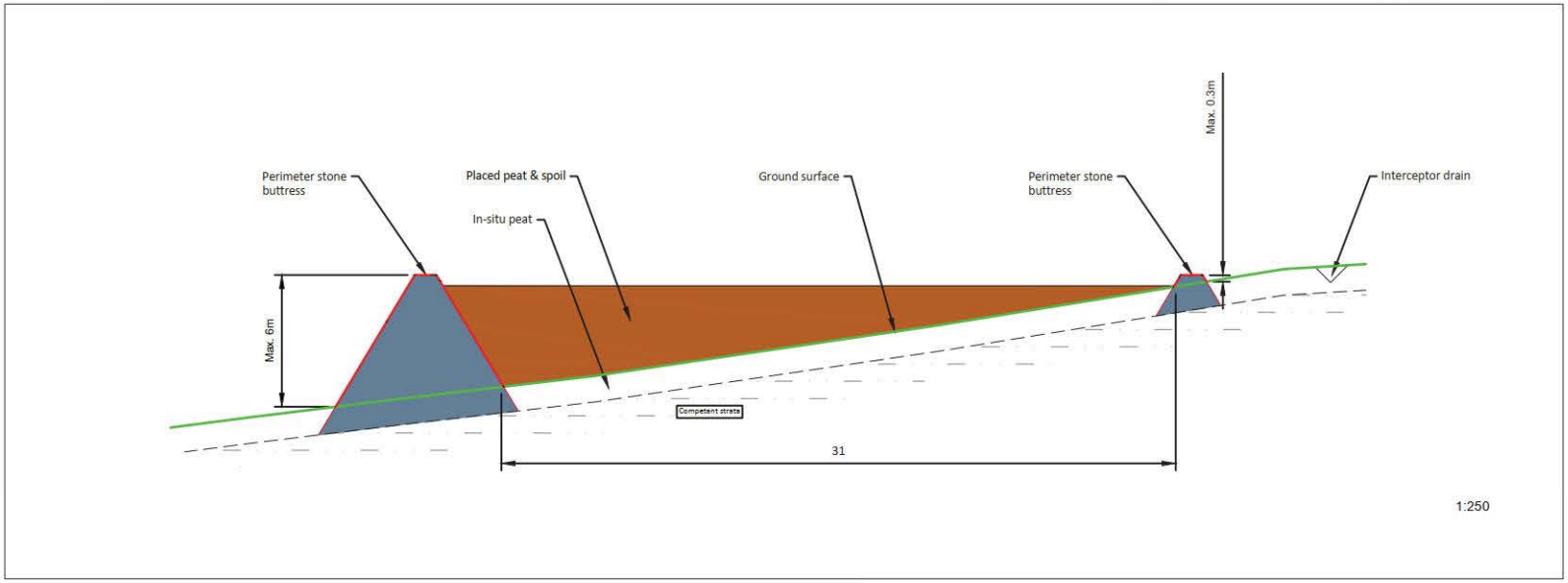



Figure 4-11

DRAWING TITLE:
Peat and Spoil Repository 2 Layout and Sections

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: POR	CHECKED BY: IH
PROJECT No.: 180511	DRAWING No.: 180511 - 43
SCALE: As Shown @ A3	DATE: 03.07.2020
OS SHEET No.: 4315, 4316, 4317, 4318, 4373, 4374, 4375, 4376, 4431, 4432, 4333, 4334, 4490, 4491, 4492, 4493	

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The management of excavated peat and overburden and the methods of placement and/or reinstatement are described in detail in FTC's Peat and Spoil Management Plan in Appendix 4-2 of this EIAR.

4.3.5 Electricity Substation

It is proposed to construct a 38kV electricity substation within the site of the Proposed Development as shown in Figure 4-1. The proposed substation site is located within an area of forestry adjacent to an existing access road.

The footprint of the proposed onsite electricity substation compound measures approximately 1,058 square metres, and will include a wind farm control building and the electrical components necessary to consolidate the electrical energy generated by each wind turbine and export that electricity from the wind farm to the national grid. Further details regarding the connection of the onsite substation to the national electricity grid are provided in Section 4.3.7 below.

The layout and cross-section of the proposed onsite substation is shown on Figure 4-12. The substation compound will be surrounded by an approximately 2.6-metre-high steel palisade fence (or as otherwise required by ESB), and internal fences will also segregate different areas within the main substation. The construction and exact layout of electrical equipment in the onsite electricity substation will be to ESB Networks specifications.

4.3.5.1 Wind Farm Control Building

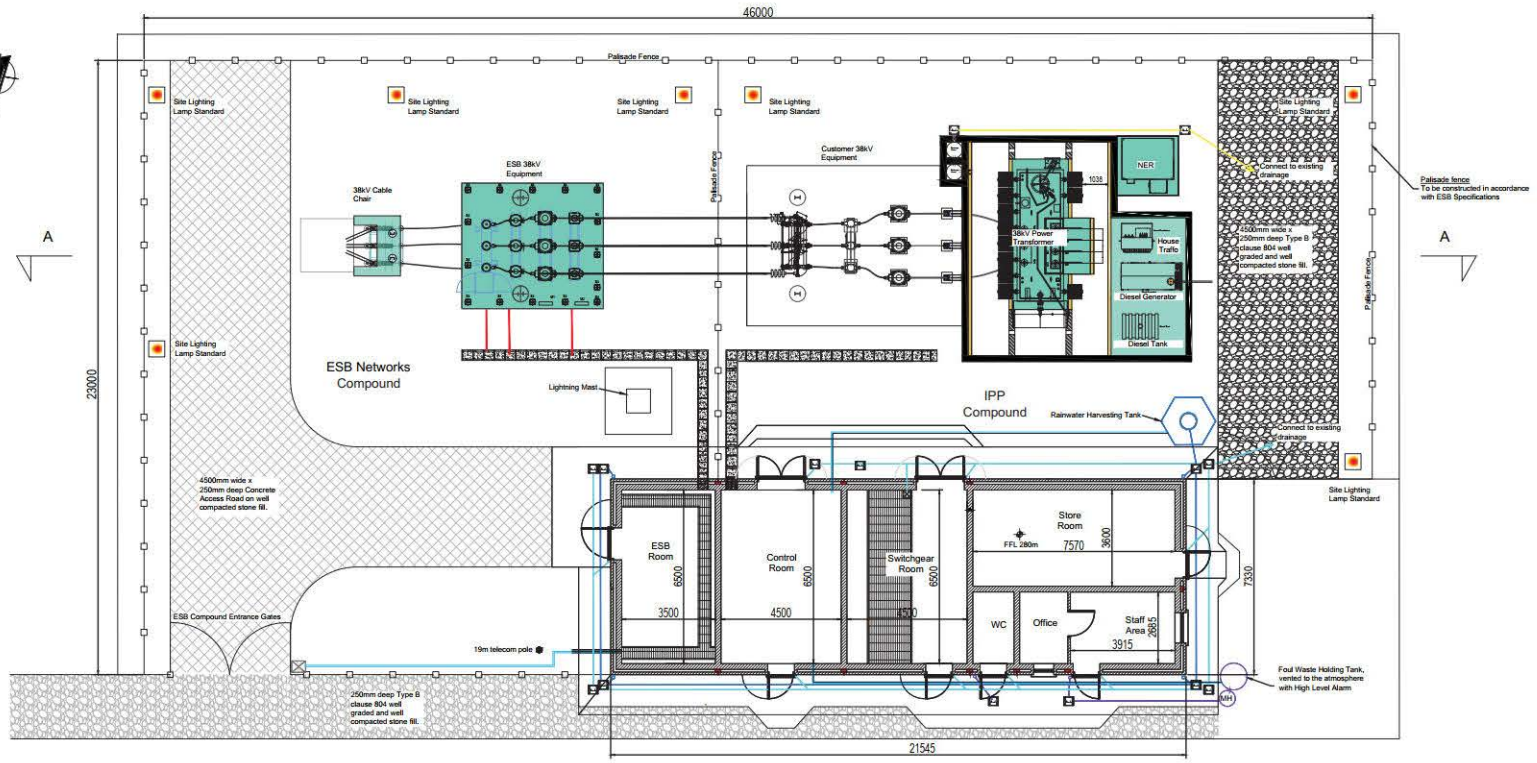
The wind farm control building will be located within the substation compound and will measure 21.8 metres by 7.3 metres and six metres in height. Layout and elevation drawings of the control building are included in Figure 4-13.

The wind farm control building will include staff welfare facilities for the staff that will work on the Proposed Development during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the proposed development there will be a very small water requirement for occasional toilet flushing and hand washing and therefore the water requirement of the proposed development does not necessitate a potable source. It is proposed to harvest rainwater from the roofs of the building, and if necessary, bottled water will be supplied for drinking.

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater tankered off site by permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site, and therefore the EPA's 2009 'Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. 10)' does not apply. Similarly, the EPA's 1999 manual on 'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels' also does not apply, as it too deals with scenarios where it is proposed to treat wastewater on-site.

Such a proposal for managing the wastewater has become almost standard practice on wind farm sites, which are often in areas where percolation requirements for on-site treatment are challenging. This type of wastewater management proposal has been accepted by numerous planning authorities and An Bord Pleanála as an acceptable proposal.

The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. Full details of the proposed tank alarm system can be submitted to the Planning Authority in advance of any works commencing on-site. The wastewater storage tank alarm will be part of a continuous stream of data from the site's turbines, wind measurement devices and electricity substation that will be monitored remotely 24 hours a day, 7 days per week. Only waste collectors holding valid waste collection permits under the Waste Management

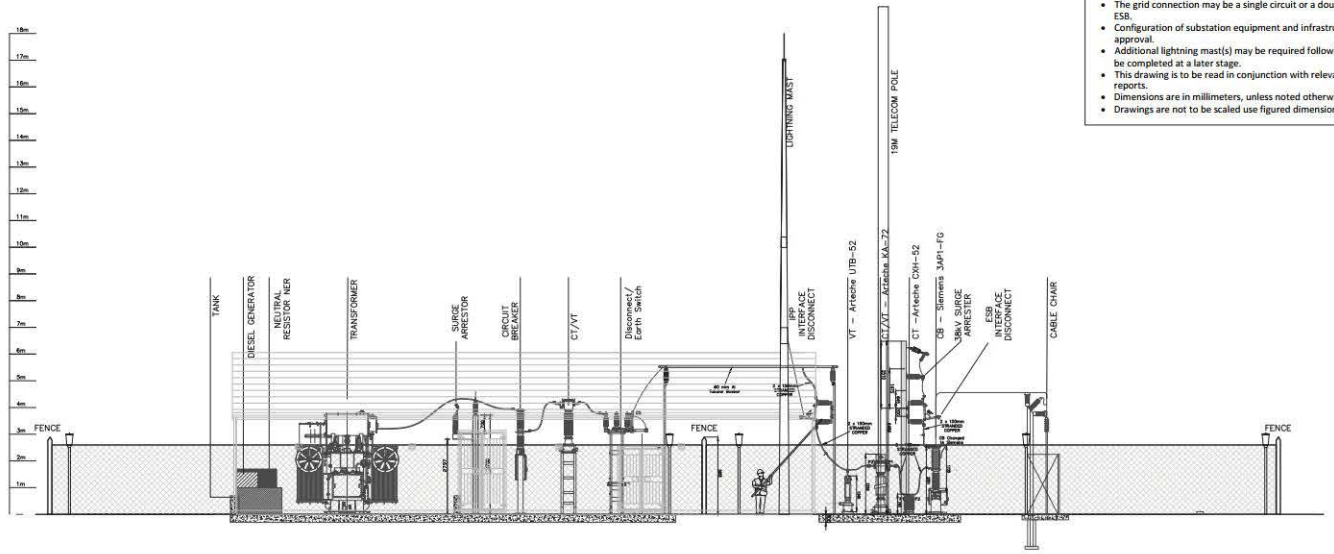


Windfarm-Substation Compound Layout

SCALE 1:100

PLEASE NOTE THAT THE SUBSTATION LAYOUT AND SUBSTATION COMPONENTS ILLUSTRATED ON THIS DRAWING ARE INDICATIVE ONLY. THE FULL SPECIFICATION AND DETAIL WILL BE DETERMINED FROM THE ELECTRICAL EQUIPMENT SUPPLIER, ESB FUNCTIONAL SPECIFICATION AND EIRGRID FUNCTIONAL SPECIFICATION

NOTES:
- This design is subject to ESB approval and should be used for planning purposes only.
- The grid connection may be a single circuit or a double circuit as to be agreed with ESB.
- Configuration of substation equipment and infrastructure is subject to ESB design approval.
- Additional lightning mast(s) may be required following a lightning protection study to be completed at a later stage.
- This drawing is to be read in conjunction with relevant drawings, specifications and reports.
- Dimensions are in millimeters, unless noted otherwise.
- Drawings are not to be scaled use figured dimensions only.



Section A-A

SCALE 1:100

Project Management Initials: Designer: CH Checked: SK Approved: RG

ISO A1 594mm x 841mm

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PROJECT

Croagh Wind Farm

38kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

MKO

NOTES: -

- See notes in main drawing window

LEGEND: -

Figure 4-12

ISSUE/REVISION

I/R	DATE	DESCRIPTION
04	01.07.20	Issued for Planning
03	12.06.20	Issued for Planning
02	15.01.20	Issued for Planning
01	19.11.19	Issued for Planning
00	29.08.19	Issued for Information

PROJECT NUMBER

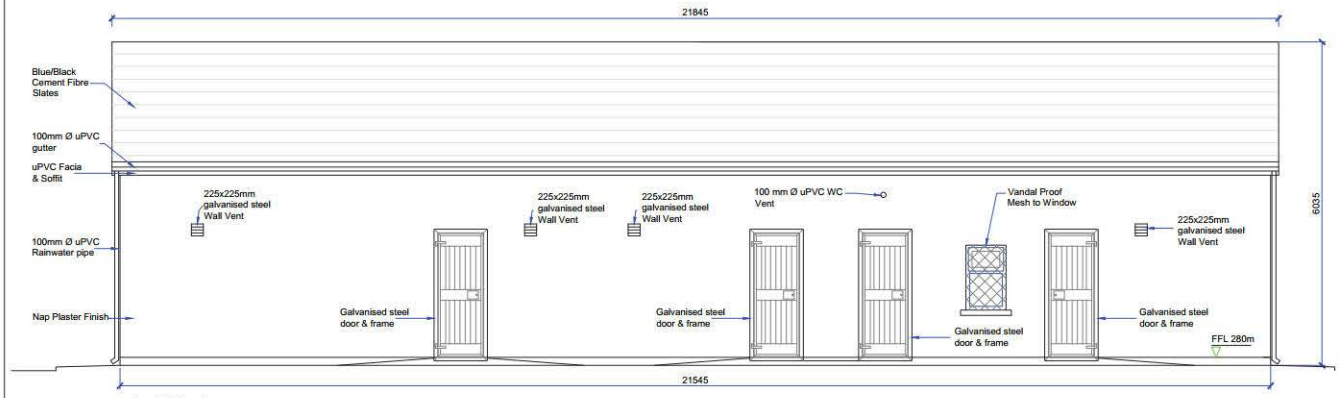
05-649

SHEET TITLE

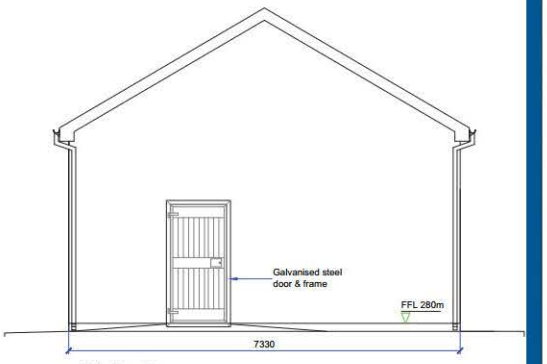
Windfarm-Substation Compound Layout & Section

SHEET NUMBER

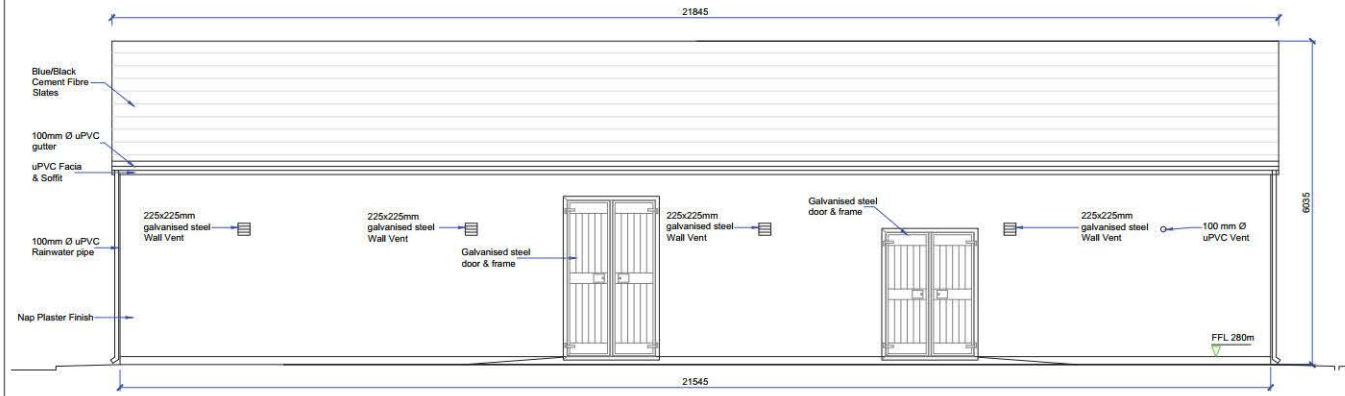
05649-230 (0511-67)



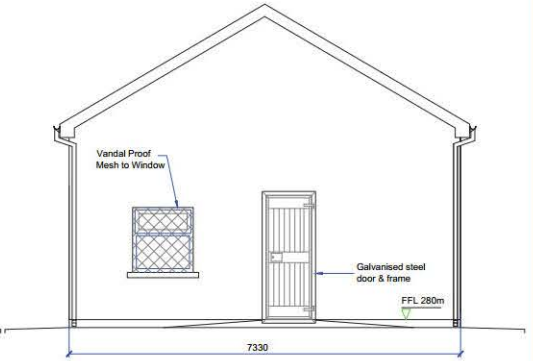
Front Elevation
SCALE 1:50



Side Elevation
SCALE 1:50



Rear Elevation
SCALE 1:50



Side Elevation
SCALE 1:50

PLEASE NOTE THAT THE SUBSTATION LAYOUT AND SUBSTATION COMPONENTS ILLUSTRATED ON THIS DRAWING ARE INDICATIVE ONLY. THE FULL SPECIFICATION AND DEATIL WILL BE DETERMINED FROM THE ELECTRICAL EQUIPMENT SUPPLIER, ESB FUNCTIONAL SPECIFICATION AND EIRGRID FUNCTIONAL SPECIFICATION

ISO A1 594mm x 841mm

Project Management Initials: Designer: CH Checked: SK Approved: RG

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PROJECT

Croagh Wind Farm
38kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

MKO

NOTES: -

- This design is subject to ESB approval and should be used for planning purposes only.
- This drawing is to be read in conjunction with relevant drawings, specifications and reports
- Dimensions are in millimeters, unless noted otherwise
- Drawings are not to be scaled use figured dimensions only

LEGEND: -

Figure 4-13

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	12.06.20	Issued for Planning
00	29.08.19	Issued for Information

PROJECT NUMBER

05-649

SHEET TITLE

Windfarm-Substation Building Elevations

SHEET NUMBER

05649-231 (0511-68)

(Collection Permit) Regulations, 2007 (as amended), will be employed to transport wastewater away from the site to an appropriately licensed facility.

4.3.6 Site Cabling

Each turbine will be connected to the on-site electricity substation via an underground 20 or 33kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building at the onsite substation compound. The electricity and fibre-optic cables running from the turbines to the onsite substation compound will be run in trenches that will be approximately 1.3 metres in depth and 0.6m in width, along the sides of roadways. The route of the cable ducts will follow the access track to each turbine location and are visible on the site layout drawings included as Appendix 4-1 to this report. The position of the internal site cable trench relative to the roadways is shown in section in Figure 4-4 to Figure 4-7 above. Figure 4-14 below shows two variations of a typical cable trench, one for off-road trenches (to be installed on areas of soft ground that will not be trafficked) and one for on-road trenches (to be used where trenches run along or under a roadway).

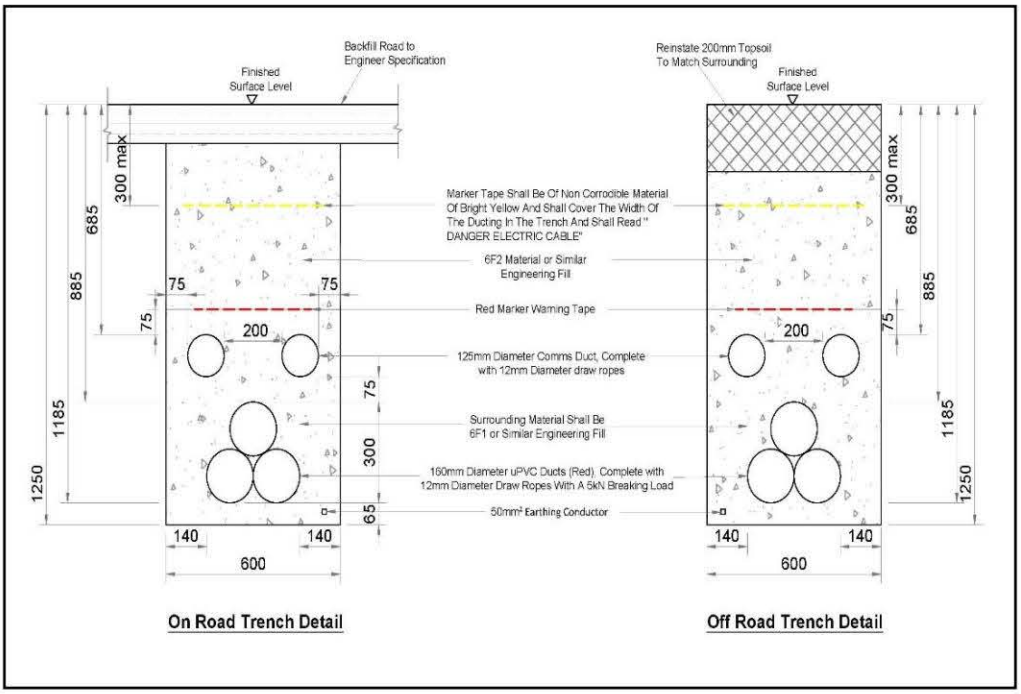


Figure 4-14 Typical Onsite Cable trench cross-section detail

Clay plugs will be installed at regular intervals of not greater than 50 metres along the length of the trenches to prevent the trenches becoming conduits for runoff water. While the majority of the cable trenches will be backfilled with native material, clay subsoils of low permeability will be used to prevent conduit flow in the backfilled trenches. This material will be imported onto the site should sufficient volumes not be encountered during the excavation phase of roadway and turbine foundation construction.

4.3.7 Grid Connection Cabling

A 38kV connection between the Proposed Development and the national electricity grid will be necessary to export electricity from the proposed wind farm. This connection will originate at the proposed onsite substation and will run southeast along the existing site roads before tuning northeast and running along the local public road and substation access road, within Coillte property, to the existing Garvagh 110kV Electricity Substation, located within the site in the townland of Seltan. The grid connection cabling route is approximately 6.2 kilometres in length. This connection route is

illustrated in Figure 4-1. All works required to connect the proposed wind farm to the national grid can be undertaken within the site boundary.

For the purposes of the grid connection design for this planning application, it is assumed that the export capacity of the of the proposed wind farm will be 48MW as per Section 4.3.1.6. Whether this export capacity will require a single circuit or double circuit 38kV connection to Garvagh Substation will be determined by ESB/EirGrid following more detailed analysis as part of the grid connection offer process. For the purposes of the planning application a double circuit connection has been designed, however, design details for a single circuit connection have also been provided. The difference between the two connection types is the number of ducts, the number of cables and the width of the trench and associated joint bay chambers.

Typical 38kV single and double circuit trench cross sections are shown in Figures 4-15 and 4-16. Further details in relation to the grid connection for the proposed development is outlined in Section 4.9.6.

4.3.8 Meteorological Mast

One permanent meteorological mast is proposed as part of the Proposed Development. The anemometry masts will be equipped with wind monitoring equipment at various heights. The mast will be located at E584,049 N823,136 as shown on the site layout drawing in Figure 4-1. The mast will be a slender structure up to 100 metres in height. The mast will be a free-standing structure. The mast will be constructed on a hard-standing area sufficiently large to accommodate the crane that will be used to erect the mast, adjacent to an existing track. The typical design of the proposed anemometry mast is shown in Figure 4-17.

4.3.9 Temporary Construction Compounds

A temporary construction compound measuring approximately 60 metres by 40 metres and 2,370 square metres in area is proposed for the centre of the site, adjacent to the existing access road approximately 270 metres northeast of Turbine No. 7. The location of the proposed construction compound is shown on the site layout drawing in Figure 4-1.

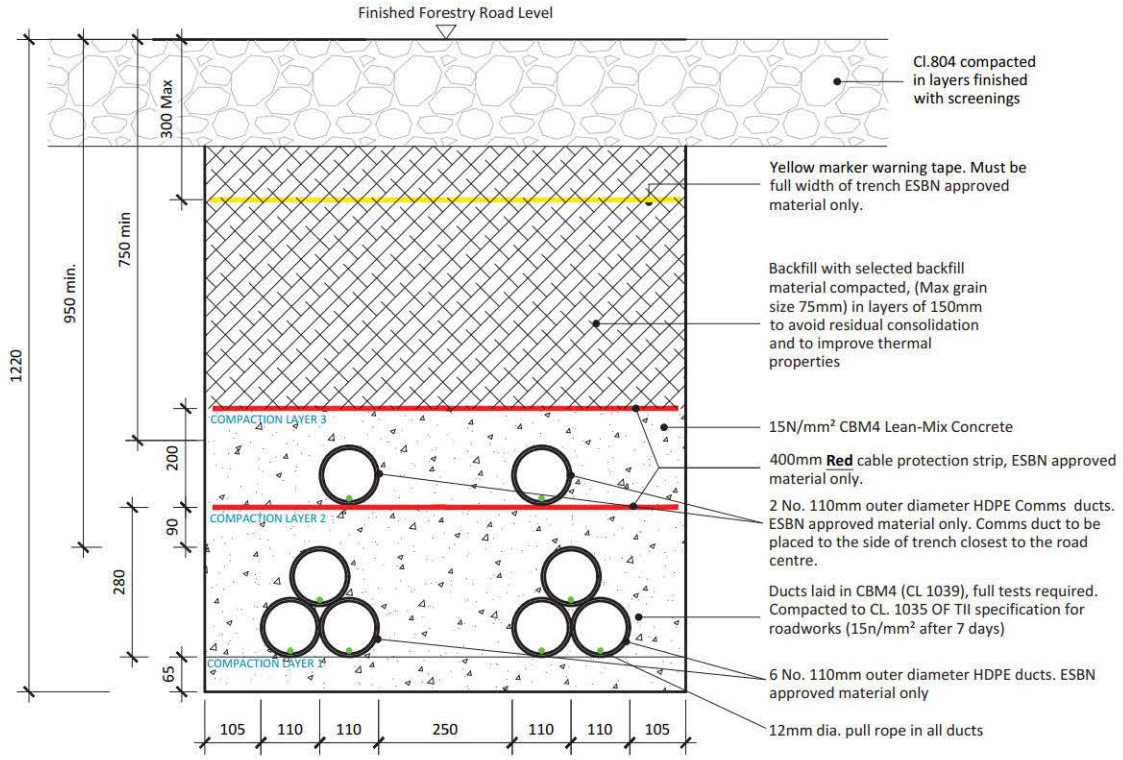
The construction compound will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors. The layout of this construction compound is shown on Figure 4-18. Construction materials and turbine components will be brought directly to the proposed turbine locations following their delivery to the site.

Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by a permitted waste collector to wastewater treatment plants.

There will be a second temporary construction compound located adjacent to an existing road approximately 140 metres north of Turbine No. 4 in the southwest of the proposed site. This temporary compound will measure approximately 2,110 square metres in area. This temporary construction compound will include staff facilities and a temporary port-a-loo and is also shown in Figure 4-1. The layout of this construction compound is shown in Figure 4-19

Upon commissioning of the proposed wind farm, all temporary structures will be removed from the construction compounds and the areas will be covered with previously excavated peat and spoil and reseeded.

38kV DOUBLE CIRCUIT DETAILS



Typical Section Through Forestry Road

SCALE 1:10

Note:
- The proposed design is subject to ESB approval and should be used for planning purposes only.
- This drawing is to be read in conjunction with relevant drawings, specifications and reports.
- Dimensions are in millimeters, unless noted otherwise.
- Drawings are not to be scaled use figured dimensions only.

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LANDOWNERS REQUIREMENTS

Figure 4-15

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CLIENT: COILLTE / MKO

PROJECT: Croagh Wind Farm
38 kV Grid Connection

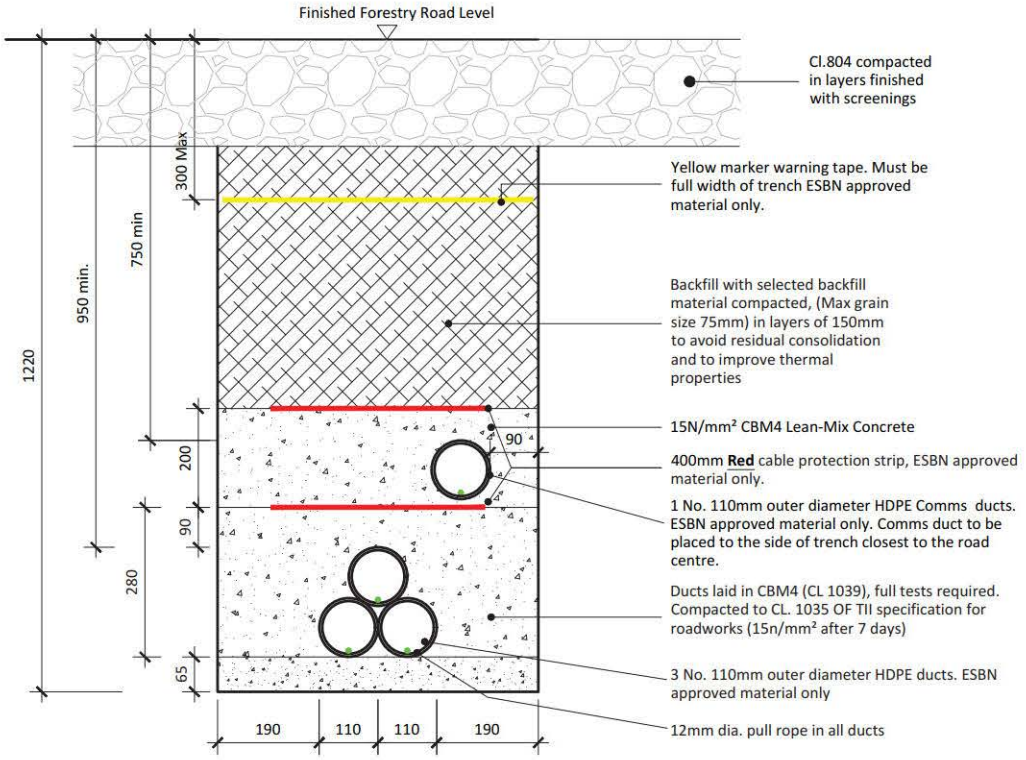
PROJECT NUMBER: 05-649

SHEET NUMBER: 05649-219(0511-75)

SHEET TITLE: 38kV Double Circuit - Typical Ducting Details through Forestry Road

DRAWING STATUS: For Planning

ISSUE/REVISION		
03	01.07.20	Issued for Planning
02	12.06.20	Issued for Planning
01	19.11.19	Issued for Planning
00	29.08.19	Issued for Information
I/R	DATE	DESCRIPTION



Typical Section Through Forestry Road

SCALE 1:10

Note:
- The proposed design is subject to ESB design approval and should be used for planning purposes only.
- This drawing is to be read in conjunction with relevant drawings, specifications and reports.
- Dimensions are in millimeters, unless noted otherwise.
- Drawings are not to be scaled use figured dimensions only.

ALL REINSTATEMENT WORKS ARE TO BE IN ACCORDANCE WITH LANDOWNERS REQUIREMENTS

Figure 4-16

tli GROUP
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Tel: 00353 66 7135710

CLIENT: COILLTE

PROJECT: Croagh Wind Farm
38 kV Grid Connection

SHEET TITLE: 38kV Single Circuit - Ducting through Forestry Road Section

PROJECT NUMBER: 05-649

SHEET NUMBER: 05649-241(0511-85)

DRAWING STATUS: For Planning

ISSUE/REVISION		
02	01.07.20	Issued for Planning
01	12.06.20	Issued for Planning
00	29.08.19	Issued for Information
I/R	DATE	DESCRIPTION

4.3.10 Tree Felling and Replanting

4.3.10.1 Tree Felling

The majority of the site (86%) currently comprises commercial coniferous forestry plantation. As part of the Proposed Development, tree felling will be required within and around the development footprint to allow the construction of turbine bases, access roads and the other ancillary infrastructure.

A total of 55.1 hectares of forestry will be permanently felled within and around the footprint of the Proposed Development in order to facilitate infrastructure construction and turbine erection. Figure 4-20 shows the extent of the areas to be permanently felled as part of the Proposed Development.

The tree felling activities required as part of the Proposed Development will be the subject of a Limited Felling Licence (LFL) application to the Forest Service in accordance with the Forestry Act 2014 and the Forestry Regulations 2017 (SI 191/2017) and as per the Forest Service's policy on granting felling licenses for wind farm developments. The policy requires that a copy of the planning permission for the Proposed Development be submitted with the felling licence application; therefore, the felling license cannot be applied for until such time as planning permission is obtained for the Proposed Development.

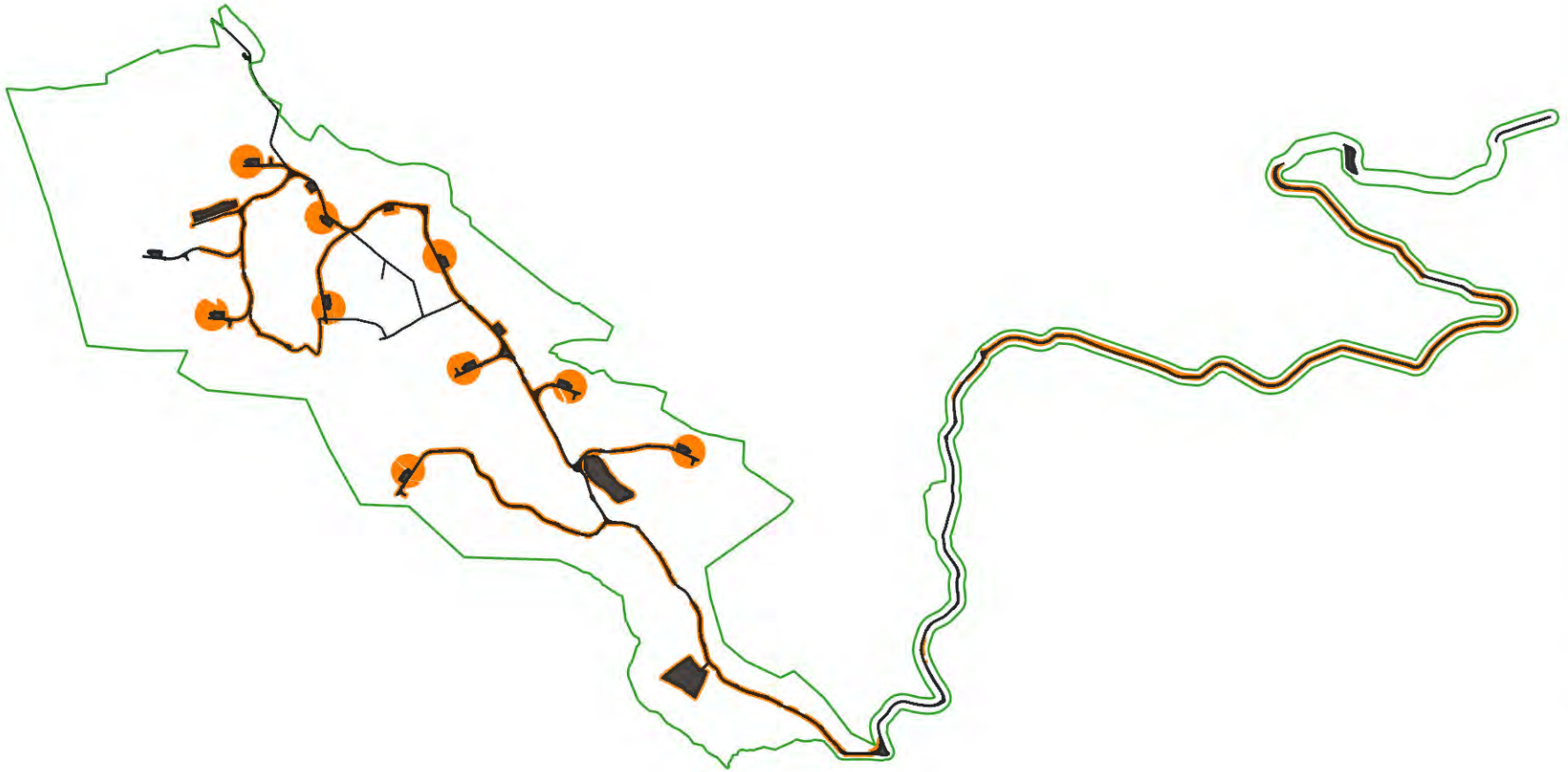
4.3.10.2 Forestry Replacement

In line with the Forest Service's published policy on granting felling licences for wind farm developments, areas cleared of forestry for turbine bases, access roads, and any other wind farm-related uses will have to be replaced by replanting at an alternative site.

The Forest Service policy requires replacement or replanting on a hectare for hectare basis for the footprint of the turbines and the other infrastructure developments.

The estimated 55.1 hectares that will be permanently felled for the footprint of the turbines and the other infrastructure and turbine erection will be replaced or replanted on a hectare for hectare basis as a condition of any felling licence that might be issued in respect of the proposed wind farm development. Replanting is a requirement of the Forestry Act and is primarily a matter for the statutory licensing processes that are under the control of the Forest service.

The replacement of the 55.1 hectares of forestry can occur anywhere in the State subject to licence. Three potential forestry replacement areas, listed in Table 4-3 below have been identified for assessment purposes, with a combined availability of 59.33 hectares. These lands have been granted Forest Service Technical Approval for afforestation, and these or similarly approved lands will be used for replanting should the proposed wind farm receive planning permission. A description of the proposed replanting lands and an assessment of the potential impacts including cumulative impacts associated with afforestation at this location are provided in Appendix 4-3 of this EIAR.



Map Legend

- EIAR Site Boundary
- Development Footprint
- Felling Area (55.1ha)

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N

Drawing Title

Proposed Felling Area

Project Title

180511 - Croagh Wind Farm EIAR

Drawn By	Checked By
Daire O'Shaughnessy	Eoin McCarthy
Project No.	Drawing No.
180511	Fig 4-20
Scale	Date
1:35,000	29.06.20

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Table 4-3 Proposed Replanting Lands

Location No.	Property Name	Location	Technically Approved Area (hectares)
1	Stranamart	Co. Cavan	12.57
2	Brackloon	Co. Roscommon	7.2
3	Ballard	Co. Wicklow	39.56
Total Area Available			59.33

4.3.11 Site Activities

4.3.11.1 Environmental Management

All proposed activities on the site of the Proposed Development will be provided for in an environmental management plan. A Construction and Environmental Management Plan (CEMP) has been prepared for the Proposed Development and is included in Appendix 4-4 of this EIAR. The CEMP sets out the key environmental considerations to be taken into account by the contractor during construction of the proposed development. The CEMP also details the mitigation measures to be implemented in order to comply with the environmental commitments outlined in the EIAR. The contractor will be contractually obliged to comply with all such measures. In the event planning permission is granted for the Proposed Development, the CEMP will be updated prior to the commencement of the development, to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned and will be submitted to the Planning Authority for written approval.

4.3.11.2 Refuelling

Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles. However, for construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site in bunded areas.

On-site refuelling of machinery will be carried out at dedicated refuelling locations using a mobile double skinned fuel bowser. The fuel bowser, a double-axle custom-built refuelling trailer will be re-filled off site and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the proposed wind farm. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays, spill kits and fuel absorbent mats will be used during all refuelling operations.

4.3.11.3 Concrete Deliveries

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching. When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of

water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a temporary lined impermeable containment area, or a Siltbuster-type concrete wash unit (https://www.siltbuster.co.uk/sb_prod/siltbuster-roadside-concrete-washout-rcw/) or equivalent. This type of Siltbuster unit catches the solid concrete and filters and holds wash liquid for pH adjustment and further solids separation. The residual liquids and solids can be disposed of off-site at an appropriate waste facility. Where temporary lined impermeable containment areas are used, such containment areas are typically built using straw bales and lined with an impermeable membrane. Two examples are shown in Plates 4-3 and 4-4 below.



Plate 4-3 Concrete washout area



Plate 4-4 Concrete washout area

The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents will be tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

Due to the volume of concrete required for each turbine foundation, and the requirement for the concrete pours to be continuous, deliveries are often carried out outside normal working hours in order to limit the traffic impact on other road users, particularly peak period school and work commuter traffic. Such activities are limited to the day of turbine foundation concrete pours, which are normally complete in a single day per turbine.

The risks of pollution arising from concrete deliveries will be further reduced by the following:

- Concrete trucks will not be washed out on the site but will be directed back to their batching plant for washout.
- Site roads will be constructed to a high standard to allow transport of the turbine components around the site, and hence, concrete delivery trucks will be able to access all areas where the concrete will be needed. No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport. All concrete used in the construction of turbine bases will be pumped directly into the shuttered formwork from the delivery truck. If this is not practical, the concrete will be pumped from the delivery truck into a hydraulic concrete pump or into the bucket of an excavator, which will transfer the concrete locally to the location where it is needed.
- The arrangements for concrete deliveries to the site will be discussed with suppliers before work starts, confirming routes, prohibiting on-site washout and discussing emergency procedures.
- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site.

4.3.11.4 Concrete Pouring

Because of the scale of the main concrete pours that will be required to construct the Proposed Development, the main pours will be planned days or weeks in advance. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These may include:

- Using weather forecasting to assist in planning large concrete pours and avoiding large pours where prolonged periods of heavy rain is forecast.
- Restricting concrete pumps and machine buckets from slewing over watercourses while placing concrete.
- Ensuring that excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets.
- Ensuring that covers are available for freshly placed concrete to avoid the surface washing away in heavy rain.
- Disposing of any potential, small surplus of concrete after completion of a pour in suitable locations away from any watercourse or sensitive habitats.

4.3.11.5 Dust Suppression

In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

4.3.11.6 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. A wheelwash facility will be provided and a typical detaild of the same is shown in Figure 4-21. The site roads will be well finished with non-friable, compacted hardcore, and so the public road-going vehicles will not be travelling over soft or muddy ground where they might pick up mud or dirt.

A road sweeper will be available if any section of the public roads were to be dirtied by trucks associated with the Proposed Development.

4.3.11.7 Waste Management

The CEMP, Appendix 4-4 of this EIAR, provides a waste management plan (WMP) which outlines the best practice procedures during the demolition, excavation and construction phases of the project. The WMP will outline the methods of waste prevention and minimisation by recycling, recovery and reuse at each stage of construction of the proposed development. Disposal of waste will be seen as a last resort.

The Waste Management Act 1996 and its subsequent amendments provide for measures to improve performance in relation to waste management, recycling and recovery. The Act also provides a regulatory framework for meeting higher environmental standards set out by other national and EU legislation.

The Act requires that any waste related activity has to have all necessary licenses and authorisations. It will be the duty of the Waste Manager on the site of the development to ensure that all contractors hired to remove waste from the site have valid Waste Collection Permits. It will then be necessary to

Note
Wheel washes will be appropriately located at all entrances used during construction of the wind farm

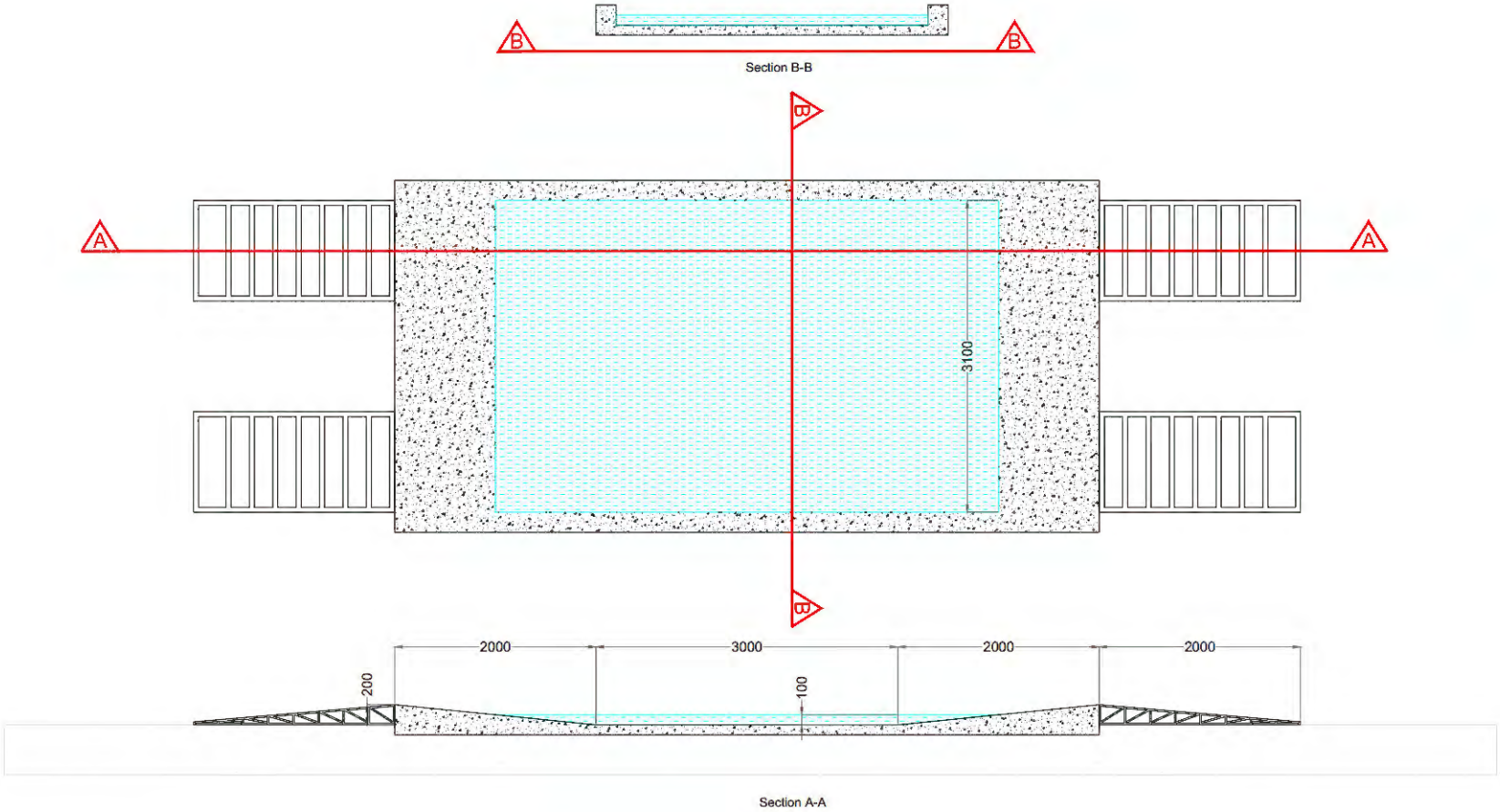

Figure 4-21

DRAWING TITLE:
Typical Wheel Wash Detail

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin McCarthy
PROJECT No.: 180511	DRAWING No.: 180511 - 54
SCALE: 1: 50 @ A3	DATE: 03.07.2020

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ensure that the waste is delivered to a licensed or permitted waste facility. The hired waste contractors and subsequent receiving facilities must adhere to the conditions set out in their respective permits and authorisations.

Prior to the commencement of the development, a Construction Waste Manager will be appointed by the Contractor. The Construction Waste Manager will be in charge of the implementation of the objectives of the plan, ensuring that all hired waste contractors have the necessary authorisations and that the waste management hierarchy is adhered to. The person nominated must have sufficient authority so that they can ensure everyone working on the development adheres to the management plan.

The WMP will provide systems that will enable all arisings, movements and treatments of construction waste to be recorded. This system will enable the contractor to measure and record the quantity of waste being generated. It will highlight the areas from which most waste occurs and allows the measurement of arisings against performance targets. The WMP can then be adapted with changes that are seen through record keeping.

4.4 Access and Transportation

4.4.1 Site Entrances

During the construction of the proposed development, the Croagh Wind Farm site will be accessed via a proposed new construction phase entrance and access road off the L4282 Local Road in the townland of Derrycullinan, Co. Leitrim. This entrance will be used as the primary site entrance during the construction phase of the proposed development. The boundary with the L4282 will be reinstated with fencing upon the completion of the construction stage.

The main site entrance that will be used to access the wind farm site, during both the construction and operational phases of the proposed development, is an existing entrance off the L4282 in the townland of Boleymaguire. The existing entrance will be upgraded to accommodate the delivery of turbine components and abnormal loads during the construction phase of the proposed development. This entrance will be used as the primary site entrance during the operational phase for the access and egress of operational and maintenance staff.

Both site entrances are shown on Figure 4-1 and on the layout drawings included in Appendix 4-1 of this EIAR.

As outlined in Section 4.6.1.1 below, visitors to the site, during the operational phase, will access thesite via an existing entrance off the local road in the townland of Garvagh Glebe.

Both site entrances are shown on Figure 4-1 and on the layout drawings included in Appendix 4-1 of this EIAR.

4.4.1.1 Link Road and Construction Access Road

The site of the proposed development is currently accessed, from the R280 to the west, via the local road network. To facilitate the delivery of large turbine components and other abnormal loads during the construction of the wind farm, this application includes for the construction of:

- a link road between the R280 in the village of Drumkeeran and the L4282 in the townland of Derryboffin; and,
- a construction phase access road between the L4282 at Derrycullinan and the same local road at Bargowla.

Link Road

HGVs and vehicles delivering large turbine components and other abnormal loads to the site of the proposed development will turn west off the R280, in Drumkeeran village, into an existing farmyard. In this yard, there will be temporary removal of a wooden fence adjacent to the R280, partial demolition of a small agricultural storage building and the removal of part of the rear wall of the larger, livestock shed to allow vehicles to continue through the yard. Once through the larger shed, the vehicles will continue west on a proposed new road, measuring approximately 260m, through agricultural land before turning south onto the L4282 in the Derryboffin. The vehicles will travel west along the L4282 before turning south at the new proposed construction site entrance in the townland of Derrycullinan. A plan view of the link road arrangement is shown in detail in Figure 4-22.

Upon completion of the construction phase, corrugated steel gates will be installed in place of a rear masonry wall at the back of the large, livestock shed and stockproof fencing and a gate will also be installed to reinstate the boundary between the agricultural land west of the farm yard and the L4282. The road that will be constructed through this agricultural land will be left in place and the embankments of the road will be seeded or be allowed to revegetate. Existing elevations and details of the proposed works to the agricultural buildings area shown in Figures 4-23 to 4-28. Details of these works are outlined in Section 4.9.7 below.

This link road is only intended for use during the construction phase of the proposed development for the delivery of large turbine components and other abnormal loads. However, it will be used during the operational phase only in the exceptional and unlikely event of the delivery of a replacement turbine component or other abnormal load required for the operational maintenance of the wind farm.

Construction Access Road

From the proposed construction phase site entrance in the townland of Derrycullinan, the construction access road will comprise a combination of proposed new roads and the upgrade of existing forestry roads. The construction access road will from a new junction with L4282 in the townland of Bargowla. The construction access road is shown in Figure 4-1 and in the drawings in Appendix 4-1.

This access road will accommodate the delivery of all of the turbine components and the vast majority of all other construction materials, thereby, significantly reducing the volume of traffic, associated with the construction of the proposed development, using the local road network in the vicinity of the site.

Once the proposed Croagh Wind Farm is operational, the sections of the contructon access road, under the control of the applicant, will remain in use for forestry operations. The road will also be used in the event of the delivery of a replacement turbine component or other abnormal load required for the operational maintenance of the wind farm.

The proposed new junctions in Derrycullinan and Bargowla will be closed off using stockproof fencing and steel barriers or gates.

Road Widening Works Area

As illustrated in Figure 4-1, a hardstanding area will be constructed within agricultural land, adjacent to the L4282, in order to widen the local road between two sharp bends in the townland of Derrycullinan. This widening area is required to facilitate the delivery of large turbine components and other abnormal loads.

Upon completion of the construction phase of the proposed development, the boundary between the local road and the hardstanding area will be reinstated using stockproof fencing.

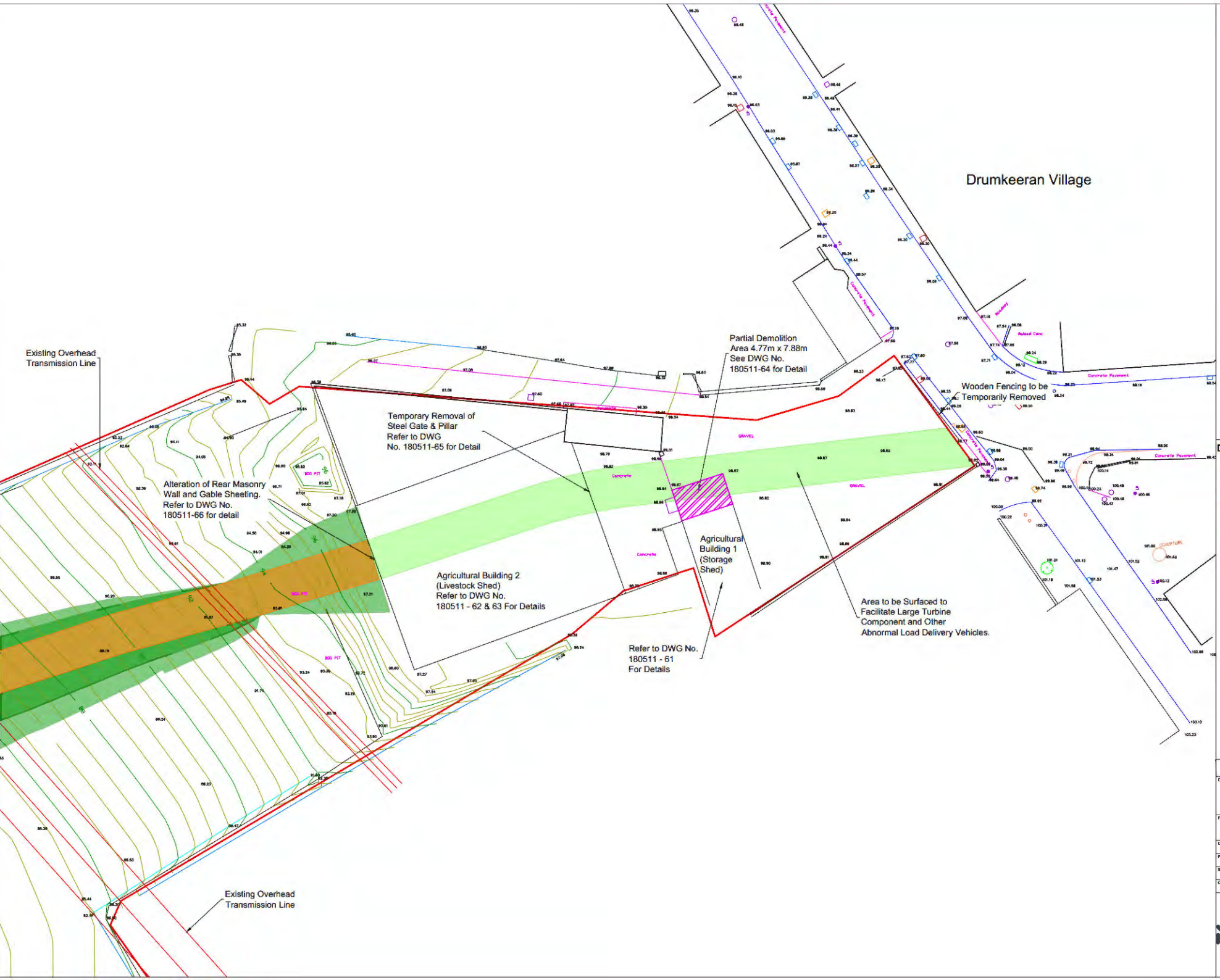

Figure 4-22

DRAWING TITLE:
Link Road Arrangement Detail

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 60
SCALE: 1:500 @ A3	DATE: 03.07.2020

OS SHEET No.: 1196, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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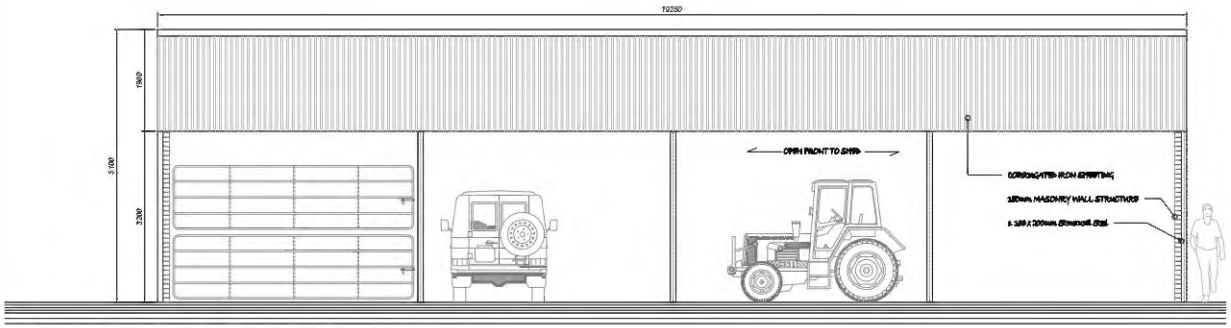

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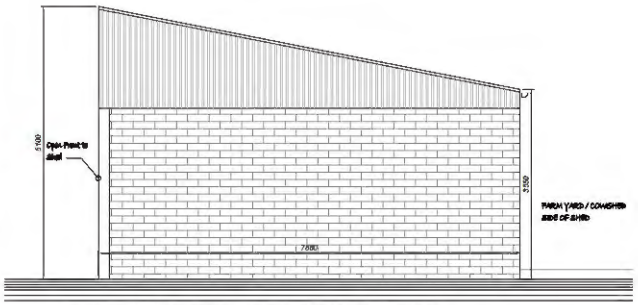
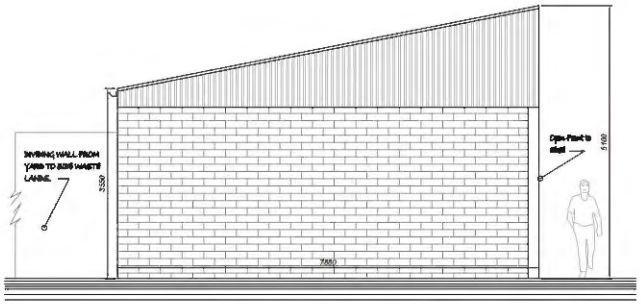


STORAGE SHED: NORTH ELEVATION



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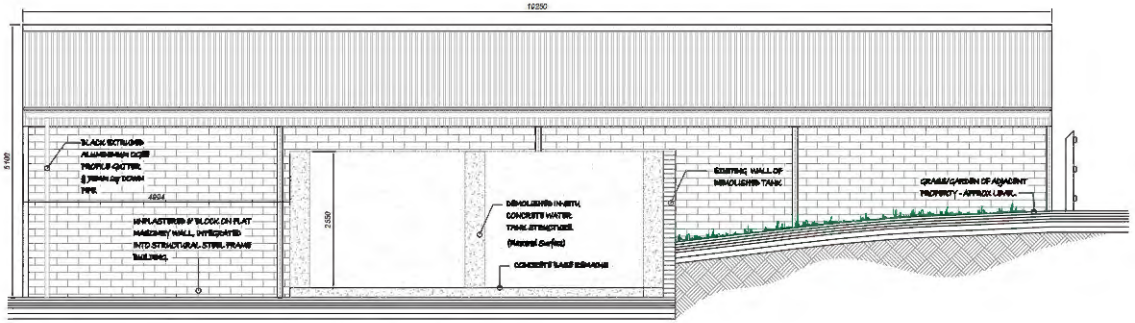

STORAGE SHED: WEST ELEVATION (Rear)



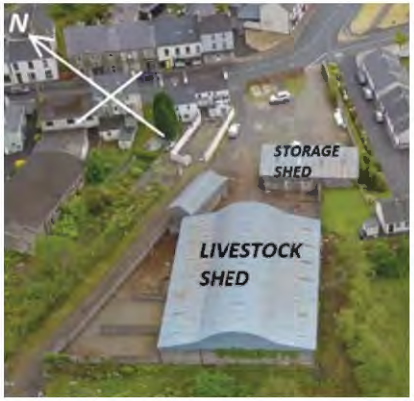



Figure 4-23

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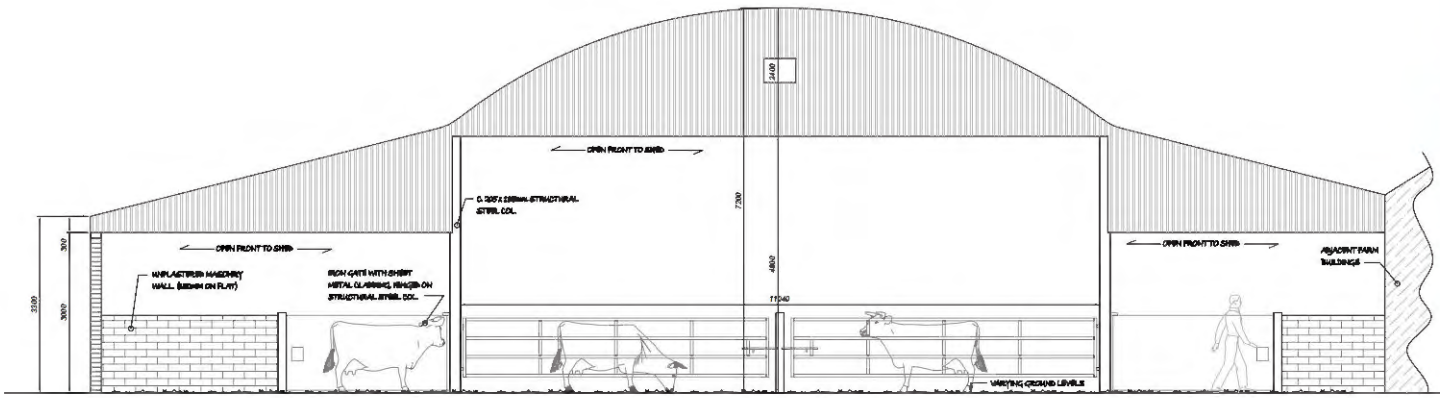
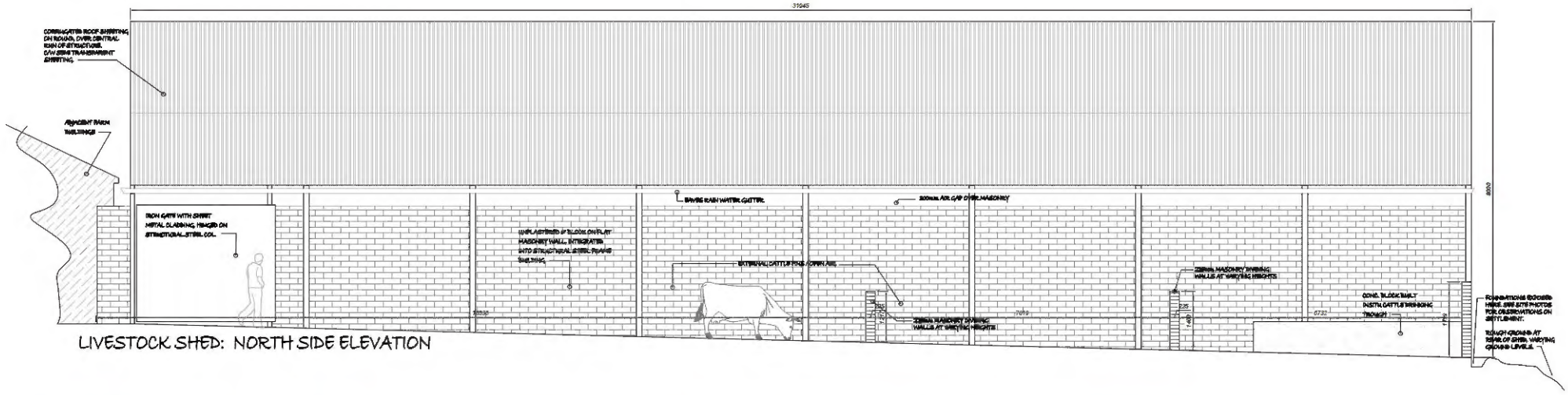
SCALE	1:100	DATE	03.07.2020
JOB NO	20057	DRG NO	DRG NO. 0511-61
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Storage Shed - Existing Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		





LIVESTOCK SHED: EAST ELEVATION (Front)



LIVESTOCK SHED: NORTH SIDE ELEVATION





Figure 4-24

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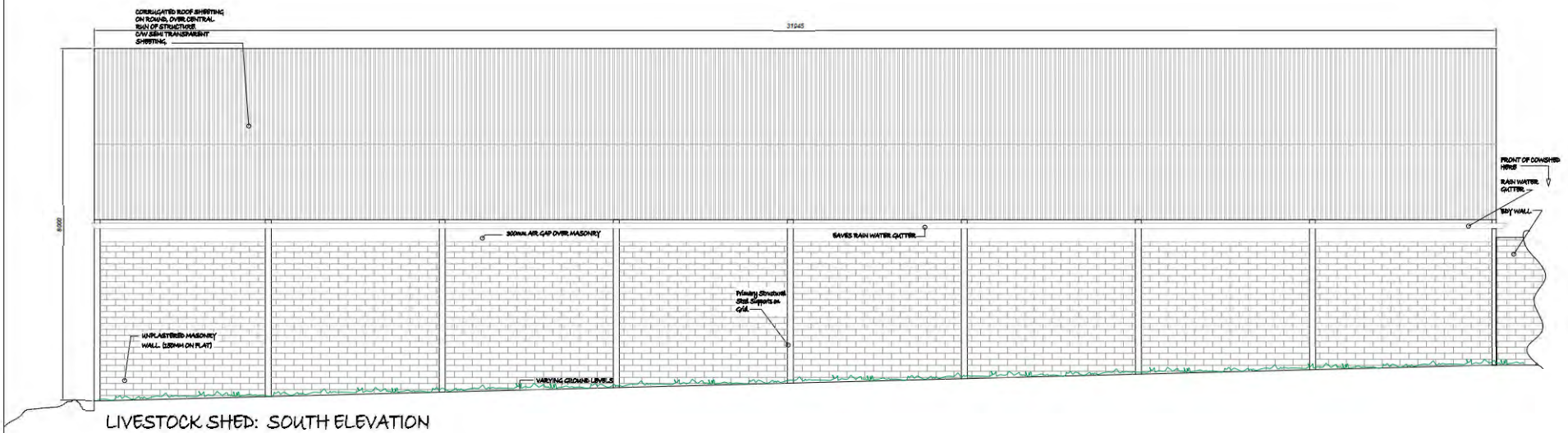
JOB NO	20057	DRG NO	DRG NO 0511-62
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Livestock Shed - Existing North and East Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		



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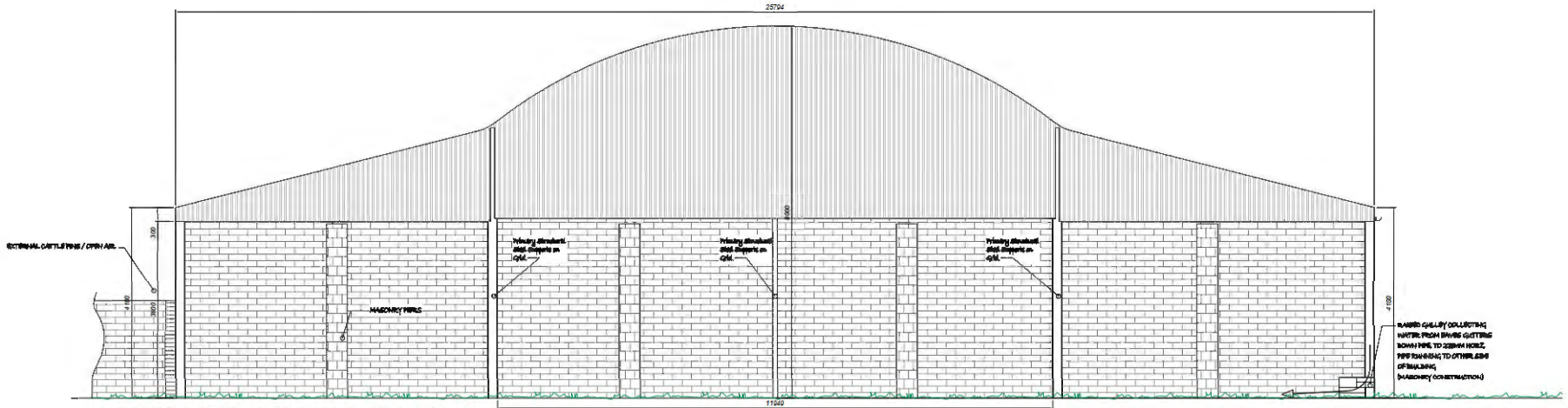

LIVESTOCK SHED: WEST ELEVATION (Rear)









Figure 4-25

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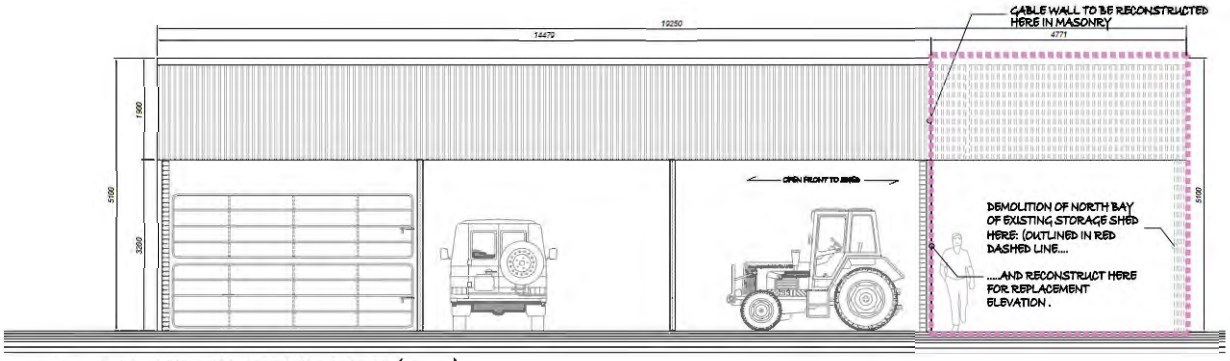
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Livestock Shed - Existing South & West Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		



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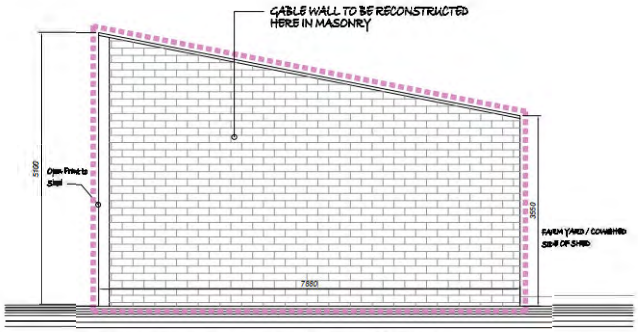

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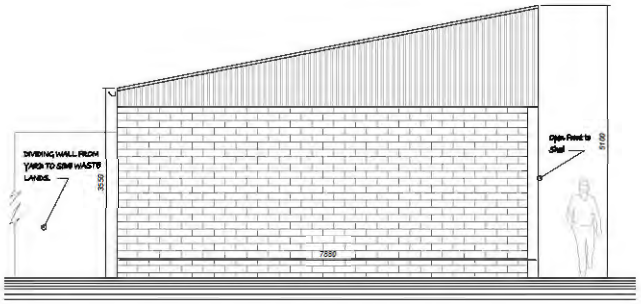

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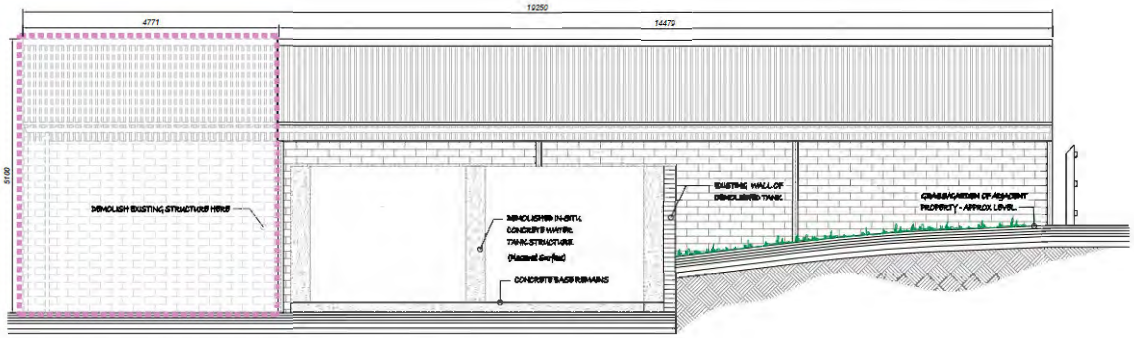

STORAGE SHED: WEST ELEVATION (Rear)



Figure 4-26

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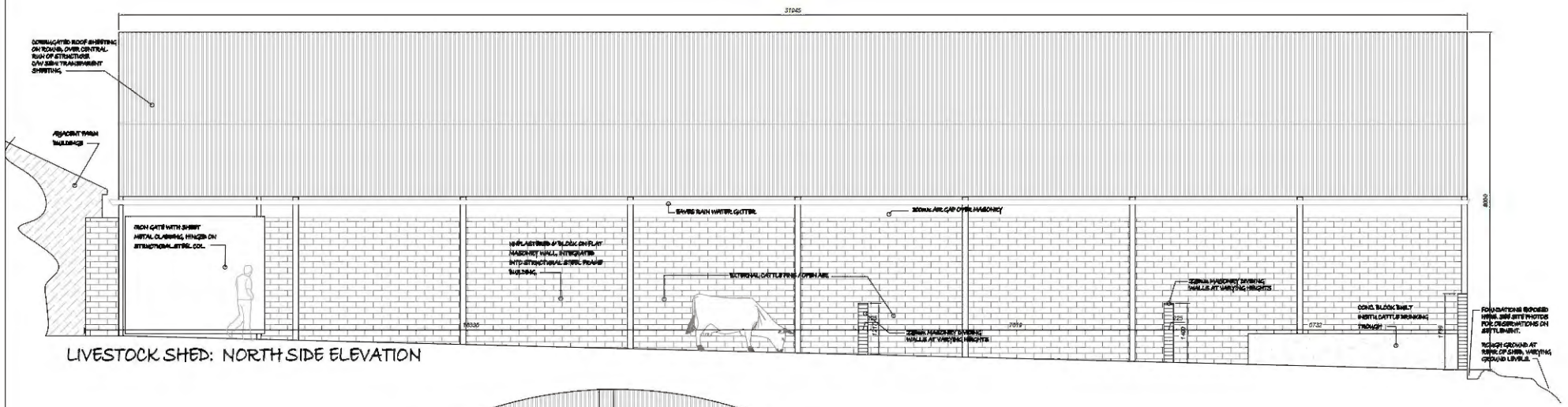
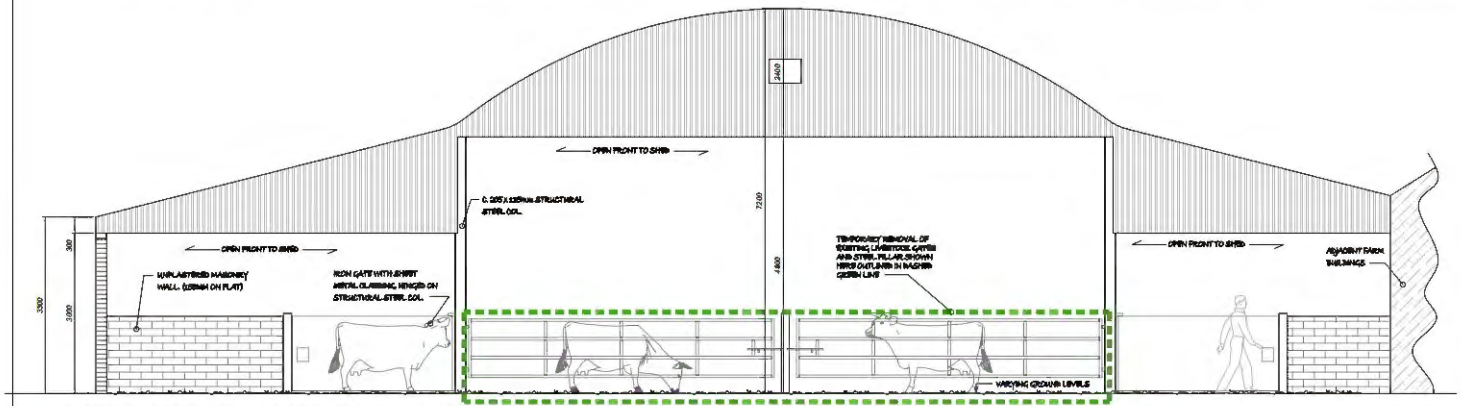
SCALE	1:100	DATE	03.07.2020
JOB NO	20057	DRG NO	DRG NO 0511-64
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Storage Shed - Proposed Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		



LIVESTOCK SHED: NORTH SIDE ELEVATION



LIVESTOCK SHED: EAST ELEVATION (Front)



Figure 4-27

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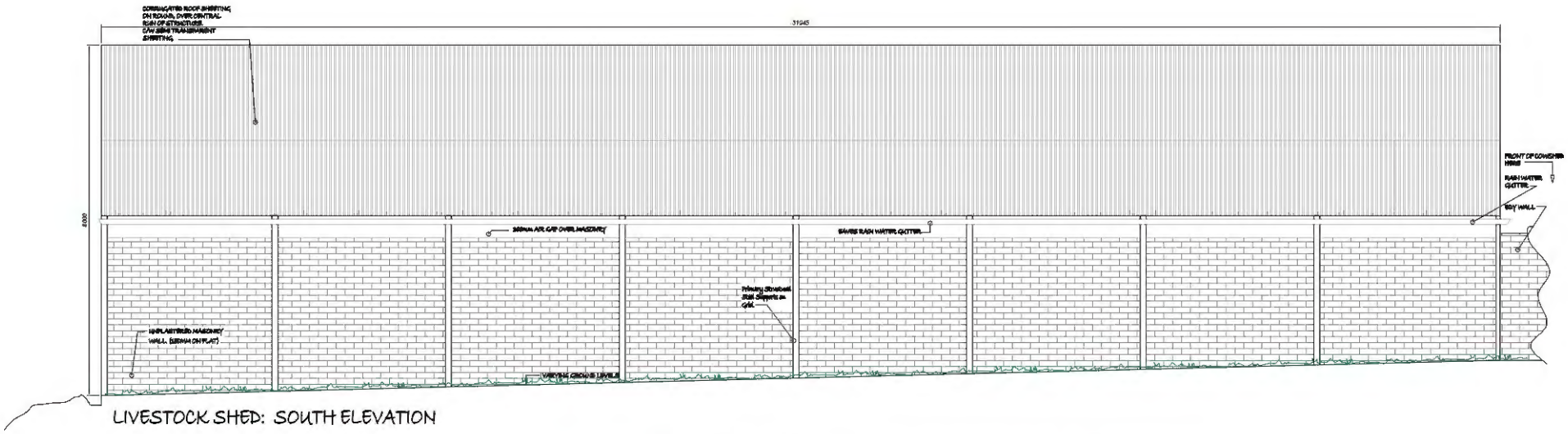
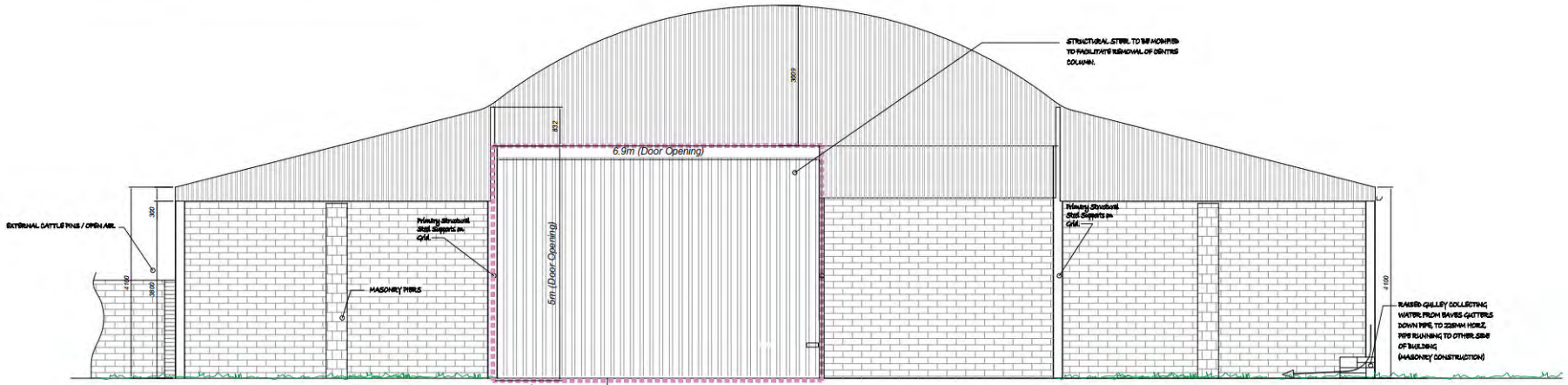
JOB NO	20057	DRG NO	DRG NO 0511-65
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Livestock Shed North & East Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		



LIVESTOCK SHED: SOUTH ELEVATION



LIVESTOCK SHED: WEST ELEVATION (Rear)





Figure 4-28

STATUS: Proposal Document only - Not for Construction

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SCALE	1:100	DATE	03.07.2020
JOB NO	20057	DRG NO	DRG NO 0511-66
CLIENT	Coillte		
PROJECT	Carrane Hill WF PA		
SITE ADDRESS	Drumkeeran, Co Leitrim.		
TITLE	Livestock Shed - Proposed South & West Elevations		
DRAWING BY	Vincent Durkin		
APPROVED BY	Eoin McCarthy		

4.4.2 Turbine and Construction Materials Transport Route

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the M4 Motorway which becomes the N4 National Primary Route at Knocksimon, Co. Westmeath. The delivery vehicles will continue northwest on the N4 before turning will turning on to the R299 Regional Road at Drumsna, Co. Leitrim. From here the delivery vehicles will travel northwest before turning right on to the R280 Regional Road and continuing north before turning left onto the proposed link road in the village of Drumkeeran, as described in Section 4.4.1.1 above. The delivery vehicles will turn south onto the L4282 in the townland of Derrybofin and continue west along the L4282 to the proposed new construction site access road at Derrycullinan, as described in Section 4.4.1.1 above. The delivery vehicles will travel southeast along the proposed construction access road before switching back in a westerly direction and then turning south again onto the L4282 and continue south towards the main site entrance in the townland of Boleymaguire. The proposed route is shown on Figure 4-29.

Other construction materials will be delivered to the site via the existing junction between the R280 and the L4282 in the village of Drumkeeran and continuing on the local road before reaching the construction access junction in Derrycullinan. It is intended that some passenger vehicles carrying construction staff and regular HGVs delivering construction materials will turn onto the L4282 at the crossroads in Drumkeeran and continue to the main site entrance site entrance in Boleymaguire via the local road without using the construction access road.

Traffic movements generated by the proposed development are discussed in Section 14.1 of Chapter 14, Material Assets.

4.4.3 Traffic Management

A turbine with a blade length of 70 metres has been used in assessing the traffic impact of the Proposed Development. The blade transporter for such a turbine blade would have a total vehicle length of 76 metres, including the blade which overhangs the back of the vehicle. The total length of the tower transporter is approximately 50m with the axles located at the front and rear of the load with no overhang. The vehicles used to transport the nacelles will be similar to, but shorter than the tower transporter. All other vehicles requiring access to the site of the Proposed Development will be regular road-going vehicles. The turbine delivery vehicles have been modelled accurately in the Autotrack assessments for the site access junctions, as detailed in Section 14.1 of this EIAR.

The need to transport turbine components on the public roads is not an everyday occurrence in the vicinity of the site of the Proposed Development. However, the procedures for transporting abnormal size loads on the country's roads are well established. While every operation to transport abnormal loads is different and requires careful consideration and planning, escort vehicles, traffic management plans, drive tests, road marshals and convoy escorts from the Garda Traffic Corps are all measures that are regularly employed to gets unusual loads from origin to destination. With over 350 No. wind farms already built and operating in Ireland (Republic and Northern Ireland combined, as per latest available figures on www.iwea.com), transport challenges are something the wind energy industry and specialist transport sector has become particularly adept in finding solutions to.

An outline f the Traffic Management Plan (TMP) has been prepared and set out in Appendix 14-2 of this EIAR. In the event planning permission is granted for the Proposed Development, the final outline Traffic Management Plan will address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned. The plan will include:

- A delivery schedule.
- Details of works or any other minor alteration identified.
- A dry run of the route using vehicles with similar dimensions.



Map Legend

- EIAR Site Boundary
- Turbine Delivery Route

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Drawing Title

Turbine Delivery Route

Project Title	180511 - Croagh Wind Farm EIAR
Drawn By: Daire O'Shaughnessy	Checked By: Eoin McCarthy
Project No.: 180511	Drawing No.: Fig 4-29
Scale: 1:65,000	Date: 29.06.20

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The deliveries of turbine components to the site may be made in convoys of three to five vehicles at a time, and mostly at night when roads are quietest. Convoys will be accompanied by escorts at the front and rear operating a "stop and go" system. Although the turbine delivery vehicles are large, they will not prevent other road users or emergency vehicles passing, should the need arise. The delivery escort vehicles will ensure the turbine transport is carried out in a safe and efficient manner with minimal delay or inconvenience for other road users.

It is not anticipated that any section of the public road network will be closed during transport of turbines, although there will be some delays to local traffic at pinch points. During these periods it may be necessary to operate local diversions for through traffic. All deliveries comprising abnormally large loads where required will be made outside the normal peak traffic periods, at night, to avoid disruption to work and school-related traffic.

Prior to the Traffic Management Plan being finalised, a full dry run of the transport operation along the proposed route will be completed using vehicles with attachments to simulate the dimensions of the wind turbine transportation vehicles. This dry run will inform the Traffic Management Plan submitted for agreement with the local authority. All turbine deliveries will be provided for in a transport management plan which will have to be prepared in advance of the construction stage, when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. Such a transport management plan is typically submitted to the Planning Authority for agreement in advance of any abnormal loads using the local roads, and will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

4.5 Community Gain Proposal

Croagh Wind Farm has the potential to bring significant positive benefit to the local community. The project will create sustainable local employment, it will contribute annual rates to the local authority and it will provide opportunity for local community investment in the project in line with the new Renewable Energy Support Scheme. As with all wind farm projects which Coillte develop, a community benefit fund will be put in place for the lifetime of the project to provide direct funding to those areas surrounding the project.

4.5.1 Renewable Energy Support Scheme

The recent Renewable Energy Support Scheme (RESS) Terms and Conditions, published by the Department of Communications, Climate Action and Environment on the 27th February, make some high level provisions for how this type of benefit fund will work. Any project which wants to export electricity to the national grid must abide by these broad principles. These include the following:

1. *a mininum of €1,000 shall be paid to each household located within a distance of a 1 kilometre radius from the Project;*
2. *a mininum of 40% of the funds shall be paid to not-for-profit community enterprises whose primary focus or aim is the promotion of initiatives towards the delivery of the UN Sustainable Development Goals, in particular Goals 4, 7, 11 and 13, including education, energy efficiency, sustainable energy and climate action initiatives;*
3. *a maximum of 10% of the funds may be spent on administration. This is to ensure successful outcomes and good governance of the Community Benefit Fund.*
4. *the balance of the funds shall be spent on initiatives successful in the annual application process, as proposed by clubs and societies and similar not-for-profit entities, and in respect of Onshore Wind RESS 1 Projects, on "near neighbour payments" for households located outside a distance of 1 kilometre from the Project but within a distance of 2 kilometres from such Project.*

4.5.2 Community Benefit Fund

Coillte expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy we will adjust accordingly.

If this project is constructed as currently designed we estimate that a total of approximately €5 million will be available in the local area for community funding over the lifetime of the project. The above figure is indicative only and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

1. *Number of wind turbines.*
2. *Capacity and availability of energy production of those turbines.*
3. *Quantity of wind.*

4.5.2.1 Administration of the Benefit Fund

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, our first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. Coillte aim to commence this work in autumn 2020.

4.5.3 Community Investment Opportunity

The Renewable Energy Support Scheme (RESS) sets out that future renewable energy project proposals enable the possibility for local communities to invest in projects in a meaningful way as a means to directly gain from the financial dividends that a project can provide should it be consented, built and operated. In response to this, Coillte have been working hard with external agencies to develop workable models of Community Investment. As with the benefit fund, Coillte aim to take this work into the community during 2020, to continue to explore this exciting possibility and see how best to embed its desigu within the community.

4.6 Recreation and Amenity Proposals

The proposal to develop a wind farm on the subject site, provides an opportunity and a mechanism to open up the area for recreational and amenity use by the local community and general public. The scale of the site, extent of infrastructure already in place and proposed as part of the wind farm development, and the accessibility of the area from the public road network, provides a recreation and amenity opportunity of great potential. The recreational and amenity proposals for the site follow an emerging international trend to make wind farm sites accessible to the general public by providing recreation opportunities that complement the wind farm development. Although the site consists of a rural working landscape under commercial forestry plantation with many wind farm developments already permitted in the immediate vicinity and surrounding area, the site has a secluded and isolated feel, which adds to the attractiveness and potential of the area as a recreation location.

The recreation and amenity facilities proposed for the Croagh Wind Farm development are intended to appeal to walkers, cyclists, trail runners, amongst others, and are outlined in the below.

4.6.1 Recreation and Amenity Facilities

The proposed recreation and amenity facilities consist of a series of marked walkways, a boardwalk and a viewing point, complimented by waypoint signage and a visitor car park, each of which are detailed the below. The following proposals should be read in conjunction with Figure 4-30 which maps the proposed recreation and amenity proposals for the site of the Proposed Development.

4.6.1.1 Visitor Entrance and Car Park

Access to the site, for visitors during the operational phase, will be via the local road in the townland of Garvagh Glebe, north of the proposed visitor car park. It is proposed to use an existing site entrance, as shown on Fignre 4-1, for public access to the site and associated amenity facilities during the operational phase. This existing entrance has adequate visibility splays for safe access and egress for passenger vehicles or cyclists. This entrance will not be used to provide access or egress for construction plant or vehicles during the construction or operational phase of the Proposed Development.

A visitor car park will be constructed on the western side of the amenity access track, the detail of which is shown in Figure 4-31. A vehicles height restriction barrier will be installed at the entrance to the car park and this is shown in Figure 4-32. The surface dressing of this car park will be level and compacted Clause 804 stone and will accommodate up to 24 vehicles.

The car park will act as a landing point or trailhead for recreation and amenity users arriving at the site. The car park will provide a safe and easily accessible landing point, allowing visitors to orientate themselves on the site.

4.6.1.2 Amenity Walkways and Viewing Platform

It is proposed to open sections of the wind farm site roads, in combination with proposed new gravel walkways, as marked trails for walkers, cyclists, trail runners and general outdoor recreation. Three separate sections of proposed new gravel walkways are proposed, forming a number of looped trails within the site of the proposed wind farm development. In total, there will be approximately 3.75 kilometres of amenity walkways constructed and linking into wind farm site roads. The proposed walkways are shown on Fignre 4-1. All proposed walkways will have a 2.5 metre-running width, constructed in the same manner as the proposed new floating road sections, as described in Section 4.3.2 above, and will correspond to National Trails Office Class 3 Walking Trails standard, or better.

A wooden boardwalk will extend for approximately 90m from the amenity walkway north of Lough Nacroagh and will terminate at a viewing platform on the shores of the lake. Figure 4-33 shows typical cross section of the proposed boardwalk and viewing platform.

Areas along the amenity walkways and site roads will be targeted for planting with native broadleaved trees to create areas of interest and increase the biodiversity of the site. Further detail is provided in Chapter 6 and Appendix 6.4 of this EIAR.

4.6.1.3 Seating Areas

Seating areas will be provided at different locations along the amenity walkways, including the viewing platform, to allow visitors to rest and take advantage of the scenic views of the wider area from the site and to enjoy the area around Lough Nacroagh. A typical wooden bench is shown in Figure 4-33.

4.6.1.4 Visitor Information and Waypoint Signage

Three different forms of information and waypoint signage will be provided across the proposed recreation and amenity area. The proposed locations of the signage are indicated on Figure 4-30.

Visitor Entrance

Visitor Carpark

Seating Area

Seating Area

Map Legend

- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Proposed 38kV Substation Compound
- Proposed Construction Compound
- Proposed Peat & Soil Repository
- Proposed Visitor Carpark
- Native Woodland Broadleaf Planting Areas
- Development Footprint
- Proposed Amenity Walkways
- Proposed Boardwalk
- Proposed Viewing Platform (Indicative Location)
- Proposed Seating Areas (Indicative Location)
- Proposed Information Signage (Indicative Location)
- Proposed Waypoint Signage (Indicative Location)
- Proposed 'You are Here' Signage (Indicative Location)
- Existing Forestry Access Road/Track
- Local Roads
- Co. Leitrim/ Co. Sligo County Border

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N

Drawing Title
Recreation and Amenity Proposal

Project Title
180511 - Croagh Wind Farm EIAR

Drawn By	Checked By
Daire O'Shaughnessy	Eoin McCarthy
Project No. 180511	Drawing No. 4-30
Scale 1:10,000	Date 29.06.20

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Project Design Drawing Notes

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4. Do not scale off this drawing. Figured metric dimensions only should be taken off this drawing.
5. All contractors, whether main or sub-contractors, must visit the site and are responsible for taking and checking any and all dimensions and levels that relate to the works.
6. The use of or reliance upon this drawing shall be deemed to be acceptance of these conditions of use unless otherwise agreed in writing, such written agreement to be sought from and issued by the copyright holder to the use or reliance upon this drawing.
7. Layout plans show typical Turbine rotor diameter as per turbine drawing.
8. Final levels may vary depending on local ground conditions.
9. Exact location of grid connection cable/joint bay in the road curtilage to be subject to ESB specifications and agreement with Leitrim County Council.

Drawing Legend

- Planning Application Boundary (Leitrim County Council)
- Existing Road to be Upgraded
- Existing Road no Upgrade Proposed

N

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Figure 4-31

DRAWING TITLE:

Visitor Carpark

PROJECT TITLE:

Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 50
SCALE: 1:500 @ A3	DATE: 03.07.2020

OS SHEET No.: 1195, 1197, 1198, 1262, 1263, 1264, 1331, 1332, 1333

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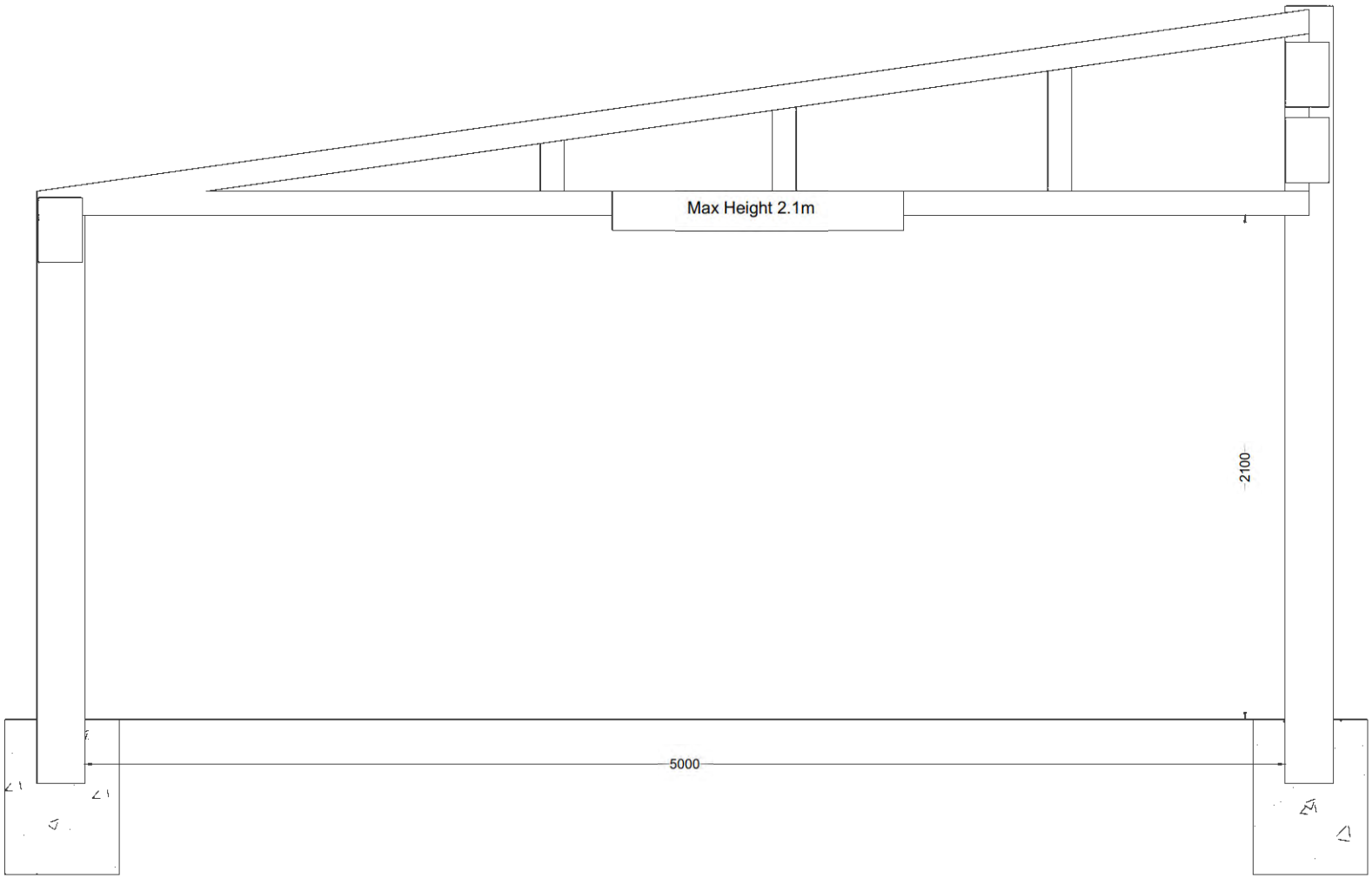

Figure 4-32

DRAWING TITLE:
Proposed Height Restriction Barrier Typical Detail

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: Joseph O Brien	CHECKED BY: Eoin McCarthy
PROJECT No.: 180511	DRAWING No.: 180511 - 51
SCALE: 1 :20 @ A3	DATE: 03.07.2020

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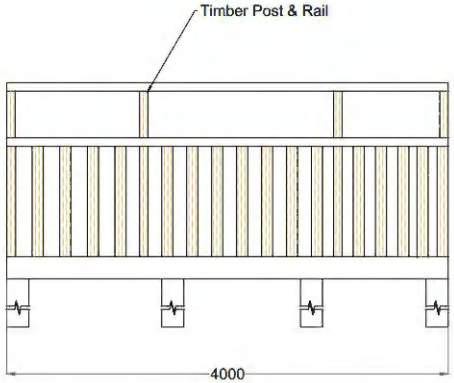
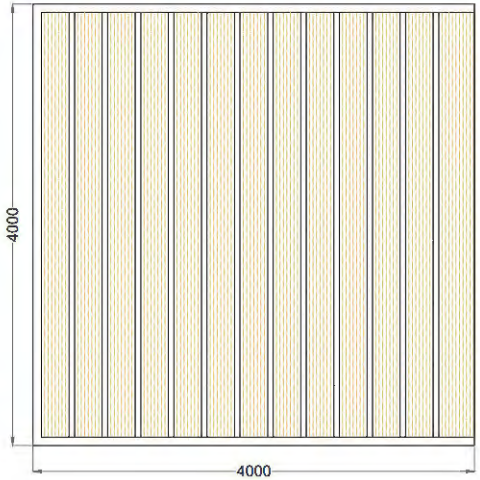
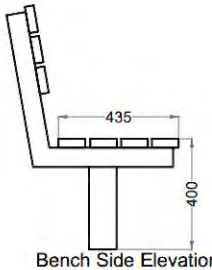
Boardwalk & Viewing Area Plan
1:50

Viewing Area
Elevation
1:50

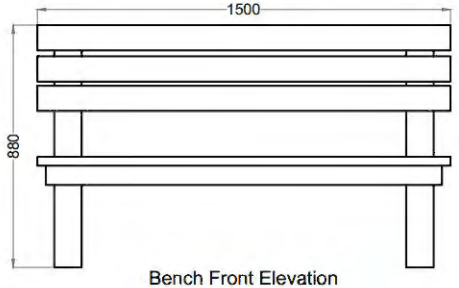


Viewing Area
Plan
1:50





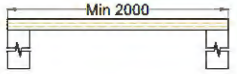
Bench Side Elevation
1:20



Bench Front Elevation
1:20



Boardwalk
Plan
1:50



Boardwalk
Elevation
1:50

Figure 4-33

DRAWING TITLE:
Proposed Boardwalk, Viewing Area & Bench Typical Detail

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin McCarthy
PROJECT No.: 180511	DRAWING No.: 180511 - 52
SCALE: As Shown @ A3	DATE: 03.07.2020

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Entry point signage will be provided at various locations, where recreation users could enter the site, all at points on the marked walkways. The entry point information boards will clearly indicate each of the marked trails on a map, as well as outlining the distance, suitability and length of each trail. The signage will also indicate the principles of 'Leave No Trace'. Waypoint map information signage indicating the location of the sign in the context of the overall site will be provided at five locations across the site, which will indicate to users "You Are Here" and outline the options available to them for continuing through the recreation area and provide information in relation to wind energy and the flora and fauna present along the walkways and within the local area. Waypoint direction signage will be provided at all junctions or at least at every one kilometre along the trails as reassurance waymarkers, to indicate the recommended direction of travel and distance to trail end and return distance to trailhead and will be colour coded to indicate the marked trail(s) on the route being followed. Elevation drawings of the proposed typical signage is shown on Figure 4-34.

4.6.2 Further Potential

The proposed recreation and amenity proposals outlined above form part of the Proposed Development, and will be provided subject to planning permission being granted. It is acknowledged that any investment in the creation of recreation and amenity proposals on the site of the Proposed Development will have to be matched by an ongoing commitment from the wind farm developer to maintain the recreation amenities once they are put in place. The amenity proposals which have been included as part of the Proposed Development can operate as standalone destination amenity walks, however, they would also facilitate and augment any future amenity proposals which may be brought forward in the wider area in the future.

The site is very well placed within the wider recreational area with the existing Miners Way very close to the site. Coillte is already active in this area with Sligo & Leitrim County Councils and we propose that the project support the development of the wider area which could be uncovered as part of a wider regional strategy.

4.7 Site Drainage

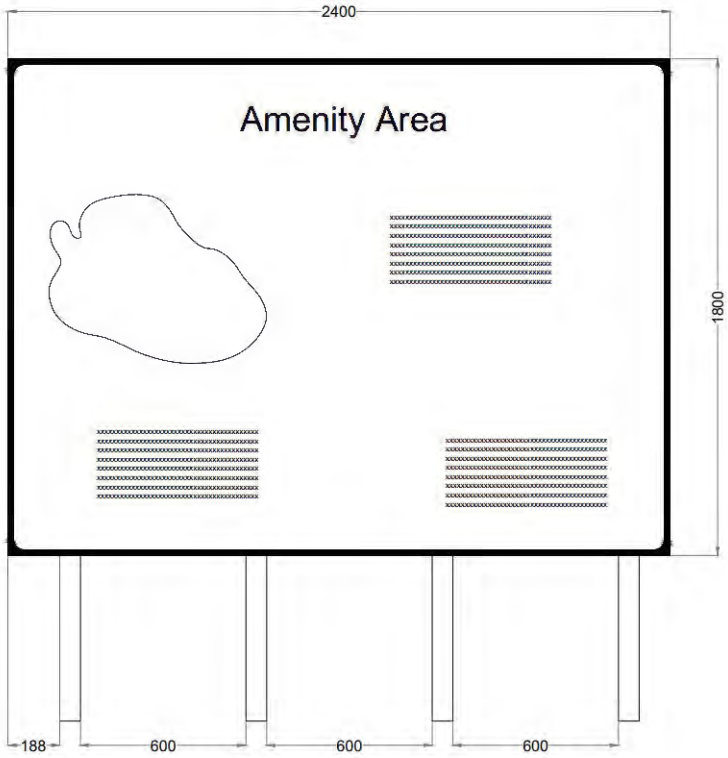
4.7.1 Introduction

The drainage design for the Proposed Development has been prepared by Hydro Environmental Services Ltd. (HES), and by the firm's principal, Mr. Michael Gill. The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the Proposed Development. The Proposed Development's drainage design has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems. No routes of any natural drainage features will be altered as part of the Proposed Development and turbine locations and associated new roadways were originally selected to avoid natural watercourses, and existing roads are to be used wherever possible. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made over vegetation filters at an appropriate distance from natural watercourses. Buffer zones of 100m and 50m around rivers and streams, respectively, have been used to inform the layout of the Proposed Development.

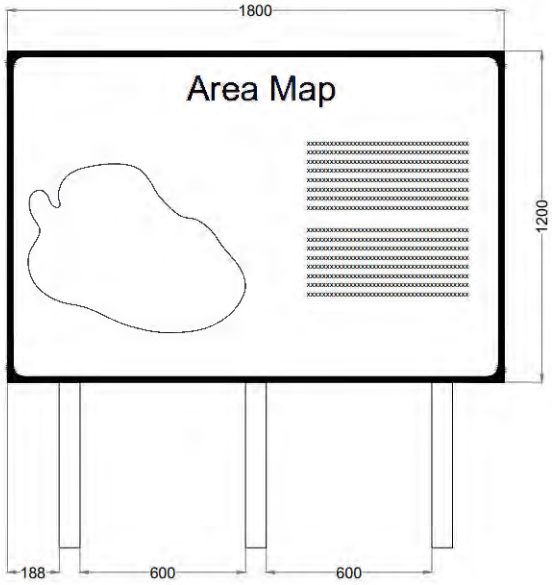
4.7.2 Existing Drainage Features

The routes of any natural drainage features will not be altered as part of the Proposed Development. Turbine locations have been selected to avoid natural watercourses. Up to 9 no. new watercourse crossings and 16 no. potential crossing upgrades will be required as part of the Proposed Development. One new crossing would be required along the alternative construction access road.

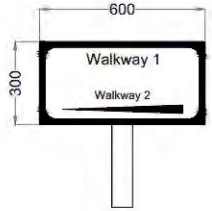
Note
For illustrative purposes only
exact details to be confirmed



Signage Type A - Waypoint Map Signage



Signage Type B - Entry Point Signage



Signage Type C - Way Point Direction Signage

Figure 4-34

DRAWING TITLE:
Amenity Signage Typical Detail

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY:	CHECKED BY:
Joseph O Brien	Eoin McCarthy
PROJECT No.: 180511	DRAWING No.: 180511 - 53
SCALE: 1 :20 @A3	DATE: 03.07.2020

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There will be no direct discharges to natural watercourses. All discharges from the proposed works areas or from interceptor drains will be made over vegetated ground at an appropriate distance from natural watercourse and lakes. Buffer zones around the existing natural drainage features have informed the layout of the Proposed Development and are indicated on the drainage design drawings.

Where artificial drains are currently in place in the vicinity of proposed works areas, these drains may have to be diverted around the proposed works areas to minimise the amount of water in the vicinity of works areas. Where it may not be possible to divert artificial drains around proposed work areas, the drains will be blocked to ensure sediment laden water from the works areas has no direct route to other watercourses. Where drains have to be blocked, the blocking will only take place after an alternative drainage system to handle the same water has been put in place.

Existing artificial drains in the vicinity of existing site roads will be maintained in their present location where possible. If it is expected that these artificial drains will receive drainage water from works areas, check dams will be added (as specified below) to control flows and sediment loads in these existing artificial drains. If road widening or improvement works are necessary along the existing roads, where possible, the works will take place on the opposite side of the road to the drain.

4.7.3 Drainage Design Principles

Drainage water from any works areas of the site of the Proposed Development will not be directed to any natural watercourses within the site. Two distinct methods will be employed to manage drainage water within the site. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, to allow attenuation and settlement prior to controlled diffuse release.

The drainage design is intended to maximise erosion control, which is more effective than having to control sediment during high rainfall. Such a system also requires less maintenance. The area of exposed ground will be minimised. The drainage measures will prevent runoff from entering the works areas of the site from adjacent ground, to minimise the volume of sediment-laden water that has to be managed. Discoloured run-off from any construction area will be isolated from natural clean run-off.

The proposed wind farm drainage process flow is presented in Figure 4-35 below.

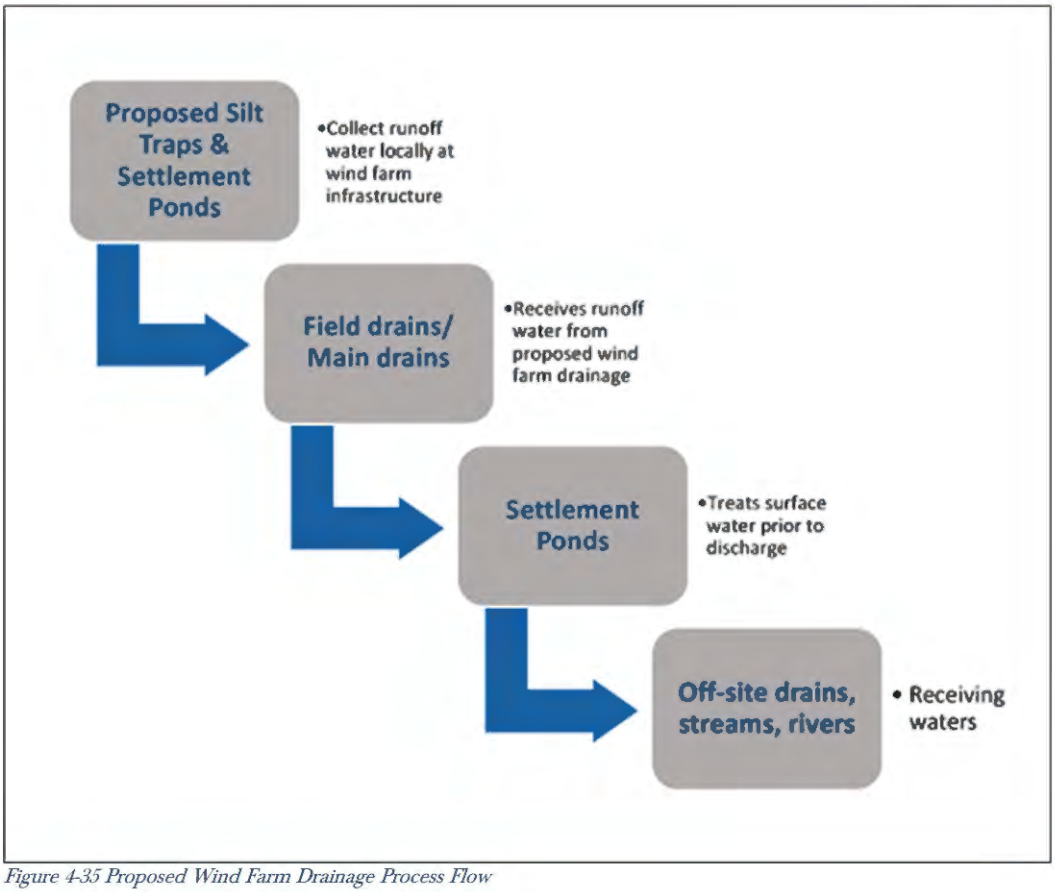


Figure 4-35 Proposed Wind Farm Drainage Process Flow

4.7.4 References

The drainage design has been prepared based on experience of the project team of other wind farm sites in peat-dominated environments, and the number of best practice guidance documents referred to in the References section of the EIAR.

4.7.5 Drainage Design

A detailed drainage design for the Proposed Development, incorporating all principles and measures outlined in this drainage design description, has been prepared, and is included in Appendix 4-5 of this EIAR. The drainage design employs the various measures further described below.

4.7.5.1 Interceptor Drains

Interceptor drains will be installed upgradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site where it might otherwise have come into contact with exposed surfaces and picked up silt and sediment. The drains will be used to divert upslope runoff around the works area to a location where it can be redistributed over the ground surface as sheet flow. This will minimise the volume of potentially silty runoff to be managed within the construction area.

The interceptor drains will be installed in advance of any main construction works commencing. The material excavated to make the drain will be compacted on the downslope edge of the drain to form a diversion dike. On completion of the construction phase works, it is envisaged that the majority of the interceptor drains could be removed. At that stage, there will be no open excavations or large areas of exposed ground that are likely to give rise to large volumes of potentially silt-laden run off. Any areas in which works were carried out to construct roads, turbine bases or hardstands, will have been built up

with large grade hardcore, which even when compacted in place, will retain sufficient void space to allow water to infiltrate the subsurface of these constructed areas. It is not anticipated that roadways or other installed site iufrastructure will intercept ground-conveyed surface water runoff to any significant extent that would result in scouring or over-topping or spill over. Where the drains are to be removed, they will be backfilled with the material from the diversion dike. Interceptor drains may have to be retained in certain locations, for example where roadways are to be installed on slopes, to prevent the roadways acting of conduits for water that might infiltrate the roadway sub-base. In these cases, interceptor drains would be maintained in localised areas along the roadway with culverts under the roadway, which would allow the intercepted water to be discharged to vegetation filters downgradient of the roadway. Similarly, in localised hollows where water is likely to be funnelled at greater concentrations than on broader slopes, interceptor drains, and culverts may be left in situ following construction.

The velocity of flow in the interceptor will be controlled by check dams (see Section 4.7.5.3 below), which will be installed at regular intervals along the drains to ensure flow in the channel is non-erosive. On steeper sections where erosion risks are greater, a geotextile membrane will be added to the channel.

Interceptor drains will be installed horizontally across slopes to run in parallel with the natural contour line of the slope. Intercepted water will travel along the interceptor drains to areas downgradient of works areas, where the drain will terminate at a level spreader (see Section 4.7.5.4 below). Across the entire length of the interceptor drains, the design elevation of the water surface along the route of the drains will not be lower than the design elevation of the water surface in the outlet at the level spreader.

4.7.5.2 Swales

Drainage swales are shallow drains that will be used to intercept and collect run off from construction areas of the site during the construction phase. Drainage swales will remain in place to collect runoff from roads and hardstanding areas of the proposed development during the operational phase. A swale is an excavated drainage channel located along the downgradient perimeter of construction areas, used to collect and carry any potentially sediment-laden runoff to a sediment-trapping facility and stabilised outlet. Swales are proven to be most effective when a dike is installed on the downhill side. They are similar in design to interceptor drains and collector drains described above.

Drainage swales will be installed downgradient of any works areas to collect surface flow runoff where it might have come into contact with exposed surfaces and picked up silt and sediment. Swales will intercept the potentially silt-laden water from the excavations and construction areas of the site and prevent it reaching natural watercourses.

Drainage swales will be installed in advance of any main construction works commencing. The material excavated to make the swale will be compacted on the downslope edge of the drain to form a diversion dike.

4.7.5.3 Check Dams

The velocity of flow in the interceptor drains and drainage swales, particularly on sloped sections of the channel, will be controlled by check dams, which will be installed at regular intervals along the drains to ensure flow in the swale is non-erosive. Check dams will also be installed in some existing artificial drainage channels that will receive waters from works areas of the site.

Check dams will restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam. The check dams will be installed as the interceptor drains are being excavated.

The proposed check dams will be made up of straw bales or stone, or a combination of both depending on the size of the drainage swale it is being installed in. Where straw bales are to be used,

they will be secured to the bottom of the drainage swale with stakes. Clean 4-6 inch stone will be built up on either side and over the straw bale to a maximum height of 600mm over the bottom of the interceptor drain. In smaller channels, a stone check dam will be installed and pressed down into place in the bottom of the drainage swale with the bucket of an excavator.

The check dams will be installed at regular intervals along the interceptor drains to ensure the bottom elevation of the upper check dam is at the same level as the top elevation of the next down-gradient check dam in the drain. The centre of the check dam will be approximately 150mm lower than the edges to allow excess water to overtop the dam in flood conditions rather than cause upstream flooding or scouring around the dams.

Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be left in place at the end of the construction phase to limit erosive linear flow in the drainage swales during extreme rainfall events.

Check dams are designed to reduce velocity and control erosion and are not specifically designed or intended to trap sediment, although sediment is likely to build up. If necessary, any excess sediment build up behind the dams will be removed. For this reason, check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

4.7.5.4 Level Spreader

A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain, into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.

The water carried in interceptor drains will not have come in contact with works areas of the site, and therefore should be free of silt and sediment. The level spreaders will distribute clean drainage water onto vegetated areas where the water will not be reconcentrated into a flow channel immediately below the point of discharge. The discharge point will be on level or only very gently sloping ground rather than on a steep slope so as to prevent erosion.

The slope in the channel leading into the spreader will be less than or equal to 1%. The slope downgradient of the spreader onto which the water will dissipate will have a grade of less than 6%. The availability of slopes with a grade of 6% or less will determine the locations of level spreaders. If a slope grade of less than 6% is not available in the immediate area downgradient of a works area at the end of a diversion drain, a piped slope drain (see Section 4.7.5.5 below) will be used to transfer the water to a suitable location.

The spreader lip over which the water will spill will be made of a concrete kerb, wooden board, pipe, or other similar piece of material that can create a level edge similar in effect to a weir. The spreader will be level across the top and bottom to prevent channelised flow leaving the spreader or ponding occurring behind the spreader. The top of the spreader lip will be 150mm above the ground behind it. The length of the spreader will be a minimum of four metres and a maximum length of 25 metres, with the actual length of each spreader to be determined by the size of the contributing catchment, slope and ground conditions.

Clean four-inch stone can be placed on the outside of the spreader lip and pressed into the ground mechanically to further dissipate the flow leaving the level spreader over a larger area.

4.7.5.5 Piped Slope Drains

Piped slope drains will be used to convey surface runoff from diversion drains safely down slopes to flat areas without causing erosion. Once the runoff reaches the flat areas it will be reconverted to diffuse sheet flow. Level spreaders will only be established on slopes of less than 6% in grade. Piped slope drains will be used to transfer water away from areas where slopes are too steep to use level spreaders.

The piped slope drains will be semi-rigid corrugated pipes with a stabilised entrance and a rock apron at the outlet to trap sediment and dissipate the energy of the water. The base of drains leading into the top of the piped slope drain will be compacted and concavely formed to channel the water into the corrugated pipe. The entrance at the top of the pipe will be stabilised with sandbags if necessary. The pipe will be anchored in place by staking at approximately 3-4 metre intervals or by weighing down with compacted soil. The bottom of the pipe will be placed on a slope with a grade of less than 1% for a length of 1.5 metres, before outflowing onto a rock apron.

The rock apron at the outlet will consist of 6-inch stone to a depth equal to the diameter of the pipe, a length six times the diameter of the pipe. The width of the rock apron will be three times the diameter of the pipe where the pipe opens onto the apron and will fan out to six times the diameter of the pipe over its length.

Piped slope drains will only remain in place for the duration of the construction phase of the Proposed Development. On completion of the works, the pipes and rock aprons will be removed, and all channels backfilled with the material that was originally excavated from them.

Piped slope drains will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and blockages. Stake anchors or fill over the pipe will be checked for settlement, cracking and stability. Any seepage holes where pipe emerges from drain at the top of the pipe will be repaired promptly.

4.7.5.6 Vegetation Filters

Vegetation filters are the existing vegetated areas of land that will be used to accept surface water runoff from upgradient areas. The selection of suitable areas to use as vegetation filters will be determined by the size of the contributing catchment, slope and ground conditions.

Vegetation filters will carry outflow from the level spreaders as overland sheet flow, removing any suspended solids and discharging to the groundwater system by diffuse infiltration.

Vegetation filters will not be used in isolation for waters that are likely to have higher silt loadings. In such cases, silt-bearing water will already have passed through stilling ponds prior to diffuse discharge to the vegetation filters via a level spreader.

4.7.5.7 Stilling Ponds

Stilling ponds will be used to attenuate runoff from works areas of the site of the Proposed Development during the construction phase and will remain in place to handle runoff from roads and hardstanding areas of the proposed development during the operational phase. The purpose of the stilling ponds is to intercept runoff potentially laden with sediment and to reduce the amount of sediment leaving the disturbed area by reducing runoff velocity. Reducing runoff velocity will allow larger particles to settle out in the stilling ponds, before the run-off water is redistributed as diffuse sheet flow in filter strips downgradient of any works areas.

Stilling ponds will be excavated/constructed at each required location as two separate ponds in sequence, a primary pond and a secondary pond. The points at which water enters and exits the stilling ponds will be stabilised with rock aprons, which will trap sediment, dissipate the energy of the water

flowing through the stilling pond system, and prevent erosion. The primary stilling pond will reduce the velocity of flows to less than 0.5 metres per second to allow settlement of silt to occur. Water will then pass from the primary pond to the secondary pond via another rock apron. The secondary stilling pond will reduce the velocity of flows to less than 0.3 metres per second. Water will flow out of the secondary stilling pond through a stone dam, partially wrapped in geo-textile membrane, which will control flow velocities and trap any sediment that has not settled out.

Water will flow by gravity through the stilling pond system. The stilling ponds will be sized according to the size of the area they will be receiving water from but will be sufficiently large to accommodate peak flows storm events. The stilling ponds will be dimensioned so that the length to width ratio will be greater than 2:1, where the length is the distance between the inlet and the outlet. Where ground conditions allow, stilling ponds will be constructed in a wedge shape, with the inlet located at the narrow end of the wedge. Each stilling pond will be a minimum of 1-1.5 metres in depth. Deeper ponds will be used to minimise the excavation area needed for the required volume.

The embankment that forms the sloped sides of the stilling ponds will be stabilised with vegetated turves, which will have been removed during the excavation of the stilling ponds area.

Stilling ponds will be located towards the end of swales, close to where the water will be reconverted to diffuse sheet flow. Upon exiting the stilling pond system, water will be immediately reconverted to diffuse flow via a fan-shaped rock apron if there is adequate space and ground conditions allow. Otherwise, a swale will be used to carry water exiting the stilling pond system to a level spreader to reconvert the flow to diffuse sheet flow.

A water level indicator such as a staff gauge will be installed in each stilling pond with marks to identify when sediment is at 10% of the stilling pond capacity. Sediment will be cleaned out of the still pond when it exceeds 10% of pond capacity. Stilling ponds will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

4.7.5.8 Siltbuster

A "siltbuster" or similar equivalent piece of equipment will be available to filter any water pumped out of excavation areas if necessary, prior to its discharge to stilling ponds or swales.

Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction sites.

The unit stills the incoming water/solids mix and routes it upwards between a set of inclined plates for separation. Fine particles settle onto the plates and slide down to the base for collection, whilst treated water flows to an outlet weir after passing below a scum board to retain any floating material. The inclined plates dramatically increase the effective settling area of the unit giving it a very small footprint on site and making it highly mobile. Figure 4-36 below shows an illustrative diagram of the Siltbuster.

The Siltbuster units are now considered best practice for the management of dirty water pumped from construction sites. The UK Environment Agency and the Scottish Environmental Protection Agency have all recommended/specified the use of Siltbuster units on construction projects.

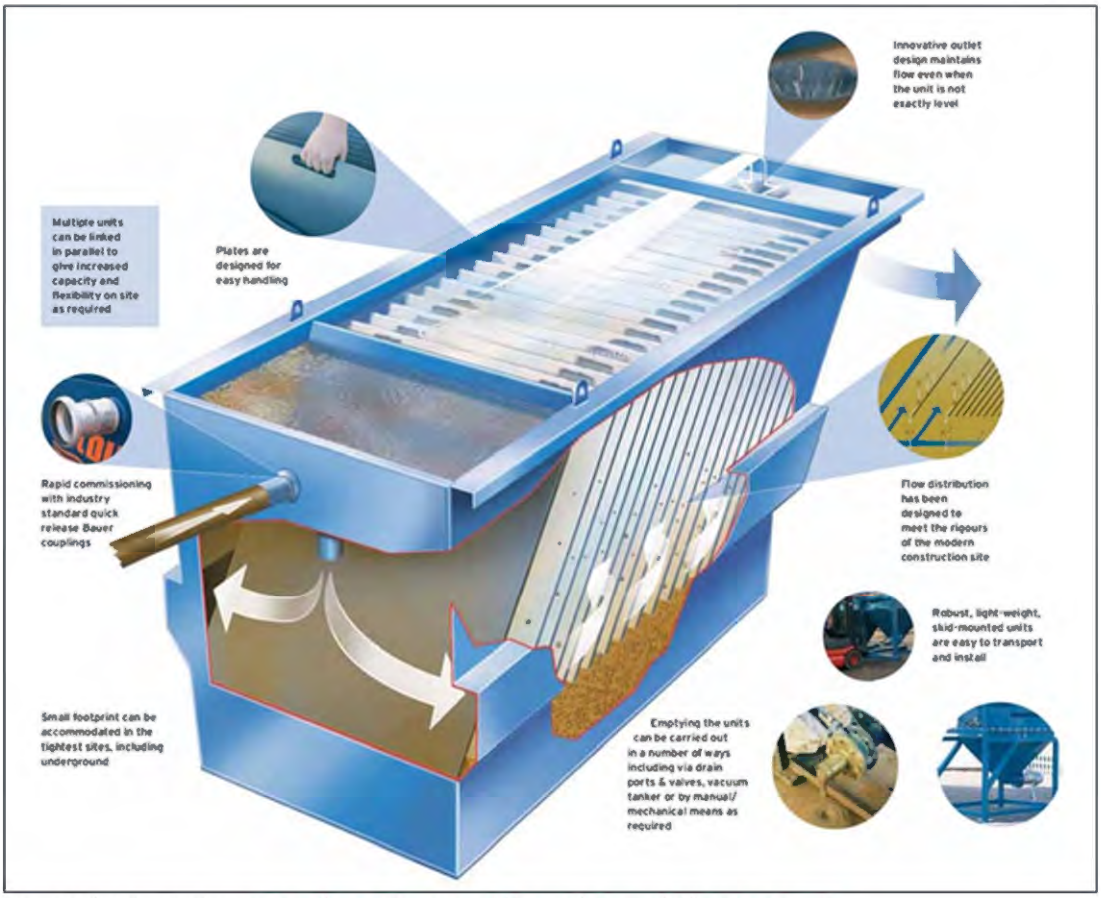


Figure 4-36 Siltbuster (Source: https://www.siltbuster.co.uk/sb_prod/siltbuster-fb50-settlement-unit/)

4.7.5.9 Silt Bags

Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing any remaining silt contained in the potentially silt-laden water collected from works areas within the site.

Dewatering silt bags are an additional drainage measure that can be used downgradient of the stilling ponds at the end of the drainage swale channels and will be located, wherever it is deemed appropriate, throughout the site. The water will flow, via a pipe, from the stilling ponds into the silt bag. The silt bag will allow the water to flow through the geotextile fabric and will trap any of the finer silt and sediment remaining in the water after it has gone through the previous drainage measures. The dewatering silt bags will ensure that there will be no loss of peaty silt into the stream.

The dewatering silt bag that will be used will be approximately 3 metres in width by 4.5 metres (see Plate 4-5 and Plate 4-6 below) in length and will be capable of trapping approximately four tonnes of silt. The dewatering silt bag, when full, will be removed from site by a waste contractor with the necessary waste collection permit, who will then transport the silt bag to an appropriate, fully licensed waste facility.



Plate 4-3 Silt Bag with water being pumped through



Plate 4-4 Silt bag under inspection

4.7.5.10 Sedimats

Sediment entrapment mats, consisting of coir or jute matting, will be placed at the outlet of the silt bag to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

4.7.5.11 Culverts

All new proposed culverts and proposed culvert upgrades will be suitably sized for the expected peak flows in the watercourse.

Some culverts may be installed to manage drainage waters from works areas of the proposed development, particularly where the waters have to be taken from one side of an existing roadway to the other for discharge. The size of culverts will be influenced by the depth of the track or road sub-base. In some cases, two or more smaller diameter culverts may be used where this depth is limited, though this will be avoided as they will have a higher associated risk of blockage than a single, larger pipe. In all cases, culverts will be oversized to allow mammals to pass through the culvert.

Culverts will be installed with a minimum internal gradient of 1% (1 in 100). Smaller culverts will have a smooth internal surface. Larger culverts may have corrugated surfaces which will trap silt and contribute to the stream ecosystem. Depending on the management of water on the downstream side of the culvert, large stone may be used to interrupt the flow of water. This will help dissipate its energy and help prevent problems of erosion. Smaller water crossings will simply consist of an appropriately sized pipe buried in the sub-base of the road at the necessary invert level to ensure ponding or pooling doesn't occur above or below the culvert and water can continue to flow as necessary.

All culverts will be inspected regularly to ensure they are not blocked by debris, vegetation or any other material that may impede conveyance.

4.7.5.12 Silt Fences

Silt fences will be installed as an additional water protection measure around existing watercourses in certain locations, particularly where works are proposed within the 50-metre buffer zone of a stream or 100m buffer zone of a lake, which is inevitable where existing roads in proximity to watercourses are to be upgraded as part of the proposed development. These areas include around existing culverts, around the headwaters of watercourses, and the proposed locations are indicated on the detailed drainage desigu drawings included in Appendix 4-5.

Silt fences will be installed as single, double or a series of triple silt fences, depending on the space available and the anticipated sediment loading. The silt fence desigus follow the technical guidance document 'Control of Water Pollution from Linear Construction Projects' published by CIRIA (Ciria, No. C648, 1996). Up to three silt fences may be deployed in series.

All silt fencing will be formed using Terrastop Premium or equivalent silt fence product.

Site fences will be inspected regularly to ensure water is continuing to flow through the fabric, and the fence is not coming under strain from water backing up behind it.

4.7.6 Forestry Felling Drainage Measures

Tree felling to facilitate the Proposed Development will not be undertaken simultaneously with construction groundworks. Keyhole felling to facilitate construction works will take place prior to groundworks commencing.

Before the commencement of any felling works, an Environmental Clerk of Works (ECoW) shall be appointed to oversee the keyhole and extraction works. The ECoW shall be experienced and competent, and shall have the following functions and operate their record using a Schedule of Works Operation Record (SOWOR), as proposed in the planning application:

- Attend the site for the setup period when drainage protection works are being installed and be present on site during the remainder of the forestry keyhole felling works.
- Prior to the commencement of works, review and agree the positioning by the Operator of the required Aquatic Buffer Zones (ABZs), silt traps, silt fencing (see below), water crossings and onsite storage facilities for fuel, oil and chemicals (see further below).
- Be responsible for preparing and delivering the Environmental Tool Box Talk (TBT) to all relevant parties involved in site operations, prior to the commencement of the works.
- Conduct daily and weekly inspections of all water protection measures and visually assess their integrity and effectiveness in accordance with Section 3.4 (Monitoring and Recording) and Appendix 3 (Site Monitoring Form (Visual Inspections)) of the Forestry & FPM Requirements.
- Take representative photographs showing the progress of operation onsite, and the integrity and effectiveness of the water protection measures.
- Collect water samples for analysis by a 3rd party accredited laboratory, adhering to the following requirements:
    - Surface water samples shall be collected upstream and downstream of the keyhole felling site at suitable sampling locations.
    - Sampling shall be taken from the stream / riverbank, with no in-stream access permitted.
    - The following minimum analytical suite shall be used: pH, EC, TSS, BOD, Total P, Ortho-P, Total N, and Ammonia.
- Review of operator's records for plant inspections, evidence of contamination and leaks, and drainage checks made after extreme weather conditions.
- Prepare and maintain a contingency plan.
- Suspend work where potential risk to water from siltation and pollution is identified, or where operational methods and mitigation measures are not specified or agreed.
- Prepare and maintain a Water Protection Measure Register. This document is to be updated weekly by the ECoW.

All relevant measures set out in the Forestry & Freshwater Pearl Mussel Requirements, Forestry & Water Quality Guidelines, Forest Harvesting & the Environment Guidelines and the Forest Protection Guidelines will apply. To protect watercourses, the following measures will be adhered to during all keyhole/tree felling activities.

- Works will be overseen by an ECoW as described above.
- The extent of all necessary tree felling will be identified and demarcated with markings on the ground in advance of any felling commencing.
- All roads and culverts will be inspected prior to any machinery being brought on site to commence the felling operation. No tracking of vehicles through watercourses will occur. Vehicles will only use existing road infrastructure and established watercourse crossings.

- Existing drains that drain an area to be felled towards surface watercourses will be blocked, and temporary silt traps (ie. check dam / silt fence) will be constructed to ensure collection of all silt within felling areas. These temporary silt traps will be cleaned out and backfilled once felling works are complete. This ensures there is no residual collected silt remaining in blocked drains after felling works are completed. No direct discharge of such drains to watercourses will occur from within felling areas.
- New collector drains and sediment traps will be installed during ground preparation to intercept water upgradient of felling areas and divert it away. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities.
- All silt traps will be sited outside of buffer zones and have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones.
- All new collector drains will taper out before entering the aquatic buffer zone to ensures the discharging water gently fans out over the buffer zone before entering the aquatic zone.
- Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Mechanised operations will be suspended during and immediately after heavy rainfall.
- Where brash is required to form brash mats, it is to be laid out at harvesting stage to prevent soil disturbance by machine movement.
- Brash which has not been pushed into the soil may be moved within the site to facilitate the creation of mats in more demanding locations.
- Felling of trees will be pointed directionally away from watercourses.
- Felling will be planned to minimise the number of machine passes in any one area.
- Extraction routes, and hence brash mats, will be aligned parallel to the ground contours where possible.
- Harvested timber will be stacked in dry areas, and outside any 50-metre watercourse buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed but removing of natural debris deflectors will be avoided.

4.7.7 Borrow Pit Drainage

While surface water will be contained in the borrow pits area, the design proposal is to control the level of water in the borrow pit area by creating a single point outlet from the basin-like area that will ensure the water does not overtop the pit area. Run-off from the proposed borrow pit area will be controlled via a single outlet that will be installed at the edge of the borrow pit. The single outfall point will be constructed to manage runoff from the borrow pit and its immediate surrounds. Interceptor drains will already have been installed upgradient of the borrow pit area before any extraction begins.

During the construction phase of the project, it will be necessary to keep the borrow pit area free of standing water while rock is still being extracted. This will be achieved by using a mobile pump, which will pump water into the same series of drains, settlement ponds and level spreader, which will receive the water from the single outlet.

4.7.8 Floating Road Drainage

Where sections of floating road are to be installed, cross drains will be installed beneath the road construction corridor to maintain existing clean water drainage paths. Large surface water drainage pipes will be placed to from the cross-drains below the level of the proposed road sub-base. These drainage pipes will be extended each side of the proposed road and cable trench construction corridor, along the paths of the existing drains.

With the exception of the installation of cross drains under the floating road corridor, minimal additional drainage will be installed to run parallel to the roads, in order to maintain the natural hydrology of the peatland areas over which the roads will be floated.

4.7.9 Cable Trench Drainage

Cable trenches are typically developed in short sections, thereby minimising the amount of ground disturbed at any one time and minimising the potential for drainage runoff to pick up silt or suspended solids. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section coruuences.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the upgradient side of the trench. Should any rainfall cause runoff from the excavated material, the material is contained in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the Proposed Development, would be transported to one of the on-site borrow pits or used for landscaping and reinstatements of other areas elsewhere on site.

On steeper slopes, silt fences, as detailed in Section 4.7.5.12, above, will be installed temporarily downgradient of the cable trench works area, or on the downhill slope below where excavated material is being temporarily stored to control run-off.

4.7.10 Site and Drainage Management

4.7.10.1 Preparative Site Drainage Management

All materials and equipment necessary to implement the drainage measures outlined above, will be brought on-site in advance of any works commencing. An adequate number of straw bales, clean stone, terram, stakes, etc will be kept on site at all times to implement the drainage design measures as necessary. The drainage measures outlined in the above will be installed prior to, or at the sarue time as the works they are intended to drain.

4.7.10.2 Pre-emptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the Proposed Development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations, large movements of overburden or large-scale overburden or soil stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

4.7.10.3 Reactive Site Drainage Management

The final drainage design prepared for the Proposed Development prior to commencement of construction will provide for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat potentially silt-laden water from the works areas, will be monitored continuously by the ECoW or supervising hydrologist on-site. The ECoW or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained. This may require the installation of additional check dams, interceptor drains, or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to the situation on the ground at a particular time.

In the event that works are giving rise to siltation of watercourses, the ECoW or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

4.7.11 Drainage Maintenance

An inspection and maintenance plan for the drainage system onsite will be prepared in advance of commencement of any works on the Proposed Development. Regular inspections of all installed drainage features will be necessary, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water at parts of the systems where it is not intended. The inspection of the drainage system will be the responsibility of the ECoW or the supervising hydrologist.

If necessary, any excess sediment build up behind check dams will be removed. For this reason, check dams will be inspected and maintained weekly during the construction phase of the project to insure adequate performance. Maintenance checks will also ensure the centre elevation of the dam remains lower than the sides of the dam.

Check dams will also be inspected weekly during the construction phase of the Proposed Development and following rainfall events to ensure the structure of the dam is still effective in controlling flow. Any scouring around the edges of the check dams or overtopping of the dam in normal flow conditions will be rectified be reinforcement of the check dam.

Drainage swales will be regularly inspected for evidence of erosion along the length of the swale. If any evidence of erosion is detected, additional check dams will be installed to limit the velocity of flow in the channel and reduce the likelihood of erosion occurring in the future.

A water level indicator such as a simple staff gauge or level marker will be installed in each silt trap with marks to identify when sediment is at 50% of the trap's capacity. Sediment will be cleaned out of the silt trap when it exceeds 50% of trap capacity. Silt traps will be inspected weekly during the construction phase of the Proposed Development and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

The frequency of drainage system inspections will be reduced following completion of the construction phase of the Proposed Development. Weekly inspections during the construction phase will be reduced to monthly, bi-monthly and eventually quarterly inspections during the operational phase up until the site has revegetated and the natural silt controls regenerate. The frequency will be increased or decreased depending on the effectiveness of the measures in place and the amount of remedial action required in any given period.

4.8 Construction Phasing and Timing

It is estimated that the construction phase of the Proposed Development will take approximately 12-18 months from starting on site to the commissioning of the electrical system. In the interest of breeding birds, construction will not commence during the Breeding Bird season from April to July inclusive. Construction may commence at any stage from August onwards to the end of March, so that construction activities are ongoing by the time the next breeding bird season comes around and can continue throughout the next breeding season.

4.8.1 Construction Sequencing

The construction phase can be broken down into three main phases, 1) civil engineering works - 10 months, 2) electrical works - 6 months, and 3) turbine erection and commissioning - 8 months. The main task items under each of the three phases are outlined below.

Civil Engineering Works

- Create new entrance(s) and hardcore existing entrances (where required).
- Clearfelling of forestry (as outlined in Section 4.3.10)
- Construct new site roads (permanent and temporary), drainage ditches and culverts.
- Clear and hardcore area for temporary site offices. Install sarue.
- Construct remaining new site roads and hard-standings and crane pads.
- Construct the substation, control buildings and groundworks for the substation compound.
- Excavate/pile for turbine bases where required. Store soil/peat locally for backfilling and re-use. Place blinding concrete to turbine bases. Fix reinforcing steel and anchorage system for tower section. Construct shuttering. Fix any ducts etc. to be cast in. Pour concrete bases. Cure concrete. Remove shutters after 1-2 days.

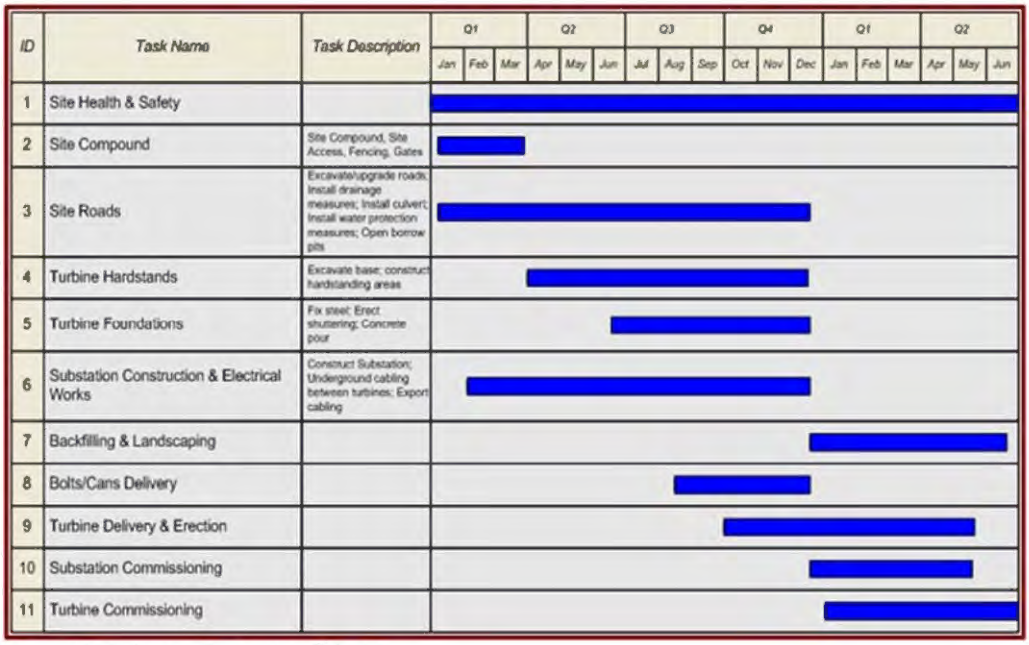
Electrical Works

- Construct bases/plinths for transformer.
- Excavate trenches for site cables, lay cables and backfill. Provide ducts at road crossings.
- Install external electrical equipment at substations
- Install transformer at compound.
- Erect stock proof and palisade fencing around substation area.
- Install internal collector network and communication cabling.
- Construct grid connection.

Turbine Erection and Commissioning

- Backfill tower foundations and cover with suitable material.
- Erect towers, nacelles and blades.
- Complete electrical installation.
- Install anemometry masts and decommission and remove existing mast.
- Commission and test turbines.
- Complete site works, reinstate site.
- Remove temporary site offices. Provide any gates, landscaping, signs etc. which may be required.

The phasing and scheduling of the main construction task items are outlined in Figure 4-37 below, where 1st January has been selected as an arbitrary start date for construction activities.



ID	Task Name	Task Description
1	Site Health & Safety	
2	Site Compound	Site Compound, Site Access, Fencing, Gates
3	Site Roads	Excavate/upgrade roads; Install drainage measures; Install culvert; Install water protection measures; Open borrow pits
4	Turbine Hardstands	Excavate base; construct hardstanding areas
5	Turbine Foundations	Fix steel; Erect shuttering; Concrete pour
6	Substation Construction & Electrical Works	Construct Substation; Underground cabling between turbines; Export cabling
7	Backfilling & Landscaping	
8	Bolts/Cans Delivery	
9	Turbine Delivery & Erection	
10	Substation Commissioning	
11	Turbine Commissioning	

Figure 4-37 Indicative Construction Schedule

4.8.2 Construction Phase Monitoring and Oversight

The requirement for a Construction and Environmental Management Plan (CEMP) to be prepared in advance of any construction works commencing on any wind farm site and submitted for agreement to the Planning Authority is now well-established. The proposed procedures for the implementation of the mitigation rueasures outlined in such a CEMP and their effectiveness and completion is typically audited by way of a Construction and Environmental Management Plan Audit Report. The CEMP Audit Report effectively lists all mitigation measures prescribed in any of the planning documentation and all conditions attached to the grant of planning permission and allows them to be audited on a systematic and regular basis. The first assessment is a simply Yes/No question, has the mitigation measure been employed on-site or not? Following confirmation that the mitigation measure has been implemented, the effectiveness of the mitigation measures has to be the subject of regular review and audit during the full construction stage of the project. If some remedial actions are needed to improve the effectiveness of the mitigation measure, then these are notified to the site staff immediately during the audit site visit, and in writing by way of the circulation of the audit report. Depending on the importance and urgency of rectifying the issue, the construction site manager is given a timeframe by when the remedial works need to be completed.

A Construction Environmental Management Plan (CEMP) has been prepared for the Proposed Development and is included in Appendix 4-4 of this EIAR. The CEMP includes details of drainage, peat and overburden management, waste management etc, and describes how the above-mentioned Audit Report will function and be presented. In the event planning permission is granted for the Proposed Development, the CEMP will be updated prior to the commencement of the development, to address the requirements of any relevant planning conditions, including any additional mitigation measures which are conditioned and will be submitted to the Planning Authority for written approval.

The on-site construction staff will be responsible for implementing the mitigation measures specified in the EIAR and compiled in the Audit Report. Their implementation will be overseen by the ECoW or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.

4.9 Construction Methodologies

4.9.1 Turbine Foundations

Each of the turbines to be erected on site will have a reinforced concrete base. Overburden will be stripped off the foundation area to a suitable formation using a 360° excavator and will be removed to the onsite borrow pit or one of the peat repositories. A five-metre-wide working area will be required around each turbine base, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be sealed using the back of the excavator bucket to ensure no water is trapped within the material and it will be surrounded by silt fences to ensure sediment-laden run-off does not occur.

The formation material will have to be approved by an engineer as meeting the turbine manufacturer's requirements. If the formation level is reached at a depth greater than the depth of the foundation, the ground level will be raised with clause 804 or similar hardcore material, compacted in 250 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with seven passes using 12 tonne roller). Drainage measures will be installed to protect the formation by forming an interceptor drain around the perimeter of the base which will outfall out at the lowest point level spreader or settlement pond.

An embankment approximately 600 mm high will be constructed around the perimeter of each turbine base and a fence will be erected to prevent construction traffic from driving into the excavated hole and to demarcate the working area. All necessary health and safety signage will be erected to warn of deep excavations etc. Access to and from excavated bases will be formed by excavating a pedestrian walkway to 1:12 grade.

There will be a minimum of 100 mm of blinding concrete laid on the formation material positioned using concrete skip and 360° excavator to protect ground formation and to give a safe working platform.

The anchor cage is delivered to site in 2 or more parts depending on the turbine type. A 360° excavator with suitable approved lifting equipment will be used to unload sections of the anchor cage and reinforcing steel. The anchor cage is positioned in the middle of the turbine base and is assembled accordingly. When the anchor cage is in final position it is checked and levelled by using an appropriate instrument. The anchor cage is positioned 250mm – 300mm from formation level by use of adjustable legs. Reinforcement bars are then placed around the anchor cage, first radial bars, then concentric bars, shear bars and finally the superior group of bars. Earthing material is attached during the steel foundation build up. The level of the anchor cage will be checked again prior to the concrete pour and during the concrete pour

Formwork to concrete bases will be propped/supported sufficiently so as to prevent failure. Concrete for bases will be poured using a concrete pump. Each base will be poured in three stages. Stage 1 will see the concrete being poured and vibrated in the centre of the anchor cage to bring the concrete up to the required level inside the cage. Stage 2 will see the centre of the steel foundation being poured and vibrated to the required level. Stage 3 will see the remaining concrete being poured around the steel foundation to bring it up to the required finished level. After a period of time when the concrete has set sufficiently the top surface of the concrete surface is to be finished with a power float.

Once the base has sufficient curing time it will be filled with suitable fill up to existing ground level. The working area around the perimeter of the foundation will be backfilled with the original material that was excavated.

4.9.2 Site Roads and Crane Pad Areas

Site roads will be constructed to each turbine base and at each base a crane hard standing will be constructed to the turbine manufacturer's specifications and the largest predicted area has been assessed in this EIAR. Tracked excavators will carry out excavation for roads with appropriate equipment attached. The excavations shall follow a logical route working away from the borrow pit locations. Excavated material will be transported back to the borrow pits in haul trucks. A two to three-metre-wide working area will be required around each hardstanding area, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be covered with polythene sheets and surrounded by silt fences to ensure sediment-laden run-off does not occur.

When the formation layer has been reached, stone from the on-site borrow pit shall be placed to form the road foundation. In the event of large clay deposits being encountered in sections of road, a geotextile layer will be required at sub-base level. The sub grade will be compacted with the use of a roller. The final wearing course will not be provided until all bases have been poured. This prevents damage to the wearing course due to stone and concrete trucks movements. The road will be upgraded prior to the arrival of the first turbine. All roads will be maintained for the duration of the operation of the Proposed Development.

4.9.3 Proposed Clear-span Watercourse Crossings

It is proposed to construct clear-span watercourse crossings along the access roads to Turbine No. 1 and Turbine No. 10 using corrugate metal arches. The locations of these crossings are shown as *Proposed New Watercourse Crossing No. 1* and *No. 2* on the layout drawings included in Appendix 4-1 of this EIAR. It is proposed that these crossings will be constructed using a corrugated metal arch and appropriate backfill.

The typical construction methodology for the installation of a corrugated metal arch and stone clear-span bridge is presented below:

- The access road on the approach to the watercourse will be completed to a formation level which is suitable for the passing of plant and equipment required for the installation of the watercourse crossing.
- The foundation will consist of concrete panels which will be installed on a concrete lean mix foundation to provide a suitable base. The base will be excavated to rock or competent ground with a mechanical excavator with the foundation formed in-situ using a semi-dry concrete lean mix. The base will be excavated along the stream bank with no instream works required.
- The bottom plate of the arch will be bolted to the foundation on both sides of the stream. The top section of the culvert will be bolted together and lifted into position and bolted to the two bottom sections. This sequence will continue until the full length of culvert is in position.
- Once the arch is in position stone backfill will be placed and compacted against the culvert up to the required level above the foundations. A concrete beam will then be shuttered, fixed and poured along the two shoulders of the steel culvert.
- When the concrete beams are cured the filling and compaction of the road will be completed.

The design drawings for the 2 No. proposed, corrugate metal arch clear-span watercourse crossings are shown in Figure 4-38 and Figure 4-39.

A further four new water course crossings will be required as part of the proposed development. The locations of these crossings are shown as *Proposed New Watercourse Crossing No. 3* to *No. 7* on the

layout drawings in Appendix 4-1. It is proposed that these crossings will be constructed using bottomless, pre-cast concrete structures.

The typical construction methodology for the installation of a pre-cast concrete clear-span bridge is presented below:

- The access road on the approach to the watercourse will be completed to a formation level which is suitable for the passing of plant and equipment required for the installation of the watercourse crossing.
- All drainage measures along the proposed road will be installed in advance of the works.
- The abutment will consist of concrete panels which will be installed on a concrete lean mix foundation to provide a suitable base. The base will be excavated to rock or competent ground with a mechanical excavator with the foundation formed in-situ using a semi-dry concrete lean mix. The base will be excavated along the stream bank with no instream works required.
- Access to the opposite side of the river for excavation and foundation installation will require the installation of pre-cast concrete slab across the river to provide temporary access for the excavator.
- All pre-cast concrete panels and slabs/beams will be installed using a crane which will be set up on the bank of the watercourse and will be lifted into place from the bank with no contact with the watercourse.
- A concrete deck will be poured over the beams/slabs which span across the river. This will be shuttered, sealed and water tested before concrete pouring can comruence.

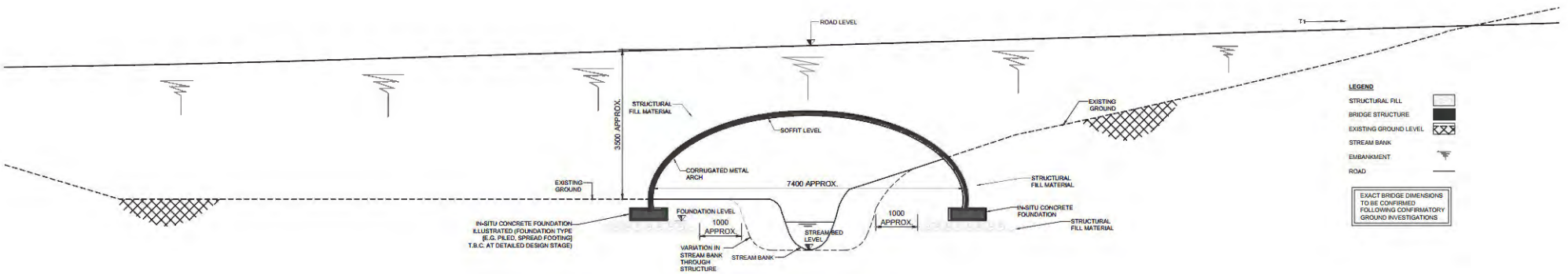
A typical design drawing of a pre-cast concrete, clear span crossing is shown in Figure 4-40.

The watercourse crossings will be constructed to the specifications of the OPW bridge design gnidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland. Abutments will be constructed from precast units combined with in-situ foundations, placed within an acceptable backfill material.

4.9.4 Onsite Electricity Substation and Control Building

Once tree felling as described in Section 4.3.10, above, is completed, the onsite substation will be constructed by the following methodology:

- The area of the onsite substation will be marked out using ranging rods or wooden posts and the soil and overburden stripped and removed to nearby temporary storage area for later use in landscaping. Any excess material will be sent to one of the on-site peat repositories or the proposed borrow pit, for reinstateruent purposes.
- The dimensions of the onsite substation area have been designed to meet the requirements of the ESB and the necessary equipment to safely and efficiently operate the proposed wind farm;
- A control building will be built within the onsite substation compound;
- The foundations will be excavated down to the level indicated by the designer and appropriately shuttered reinforced concrete will be laid over it. An anti-bleeding admixture will be included in the concrete mix;
- The block work walls will be built up from the footings to DPC level and the floor slab constructed, having first located any ducts or trenches required by the follow on mechanical and electrical contractors;
- The block work will then be raised to wall plate level and the gables & internal partition walls formed. Scaffold will be erected around the outside of the building for this operation;
- The roof slabs will be lifted into position using an adequately sized mobile crane;



BRIDGE CROSS SECTION
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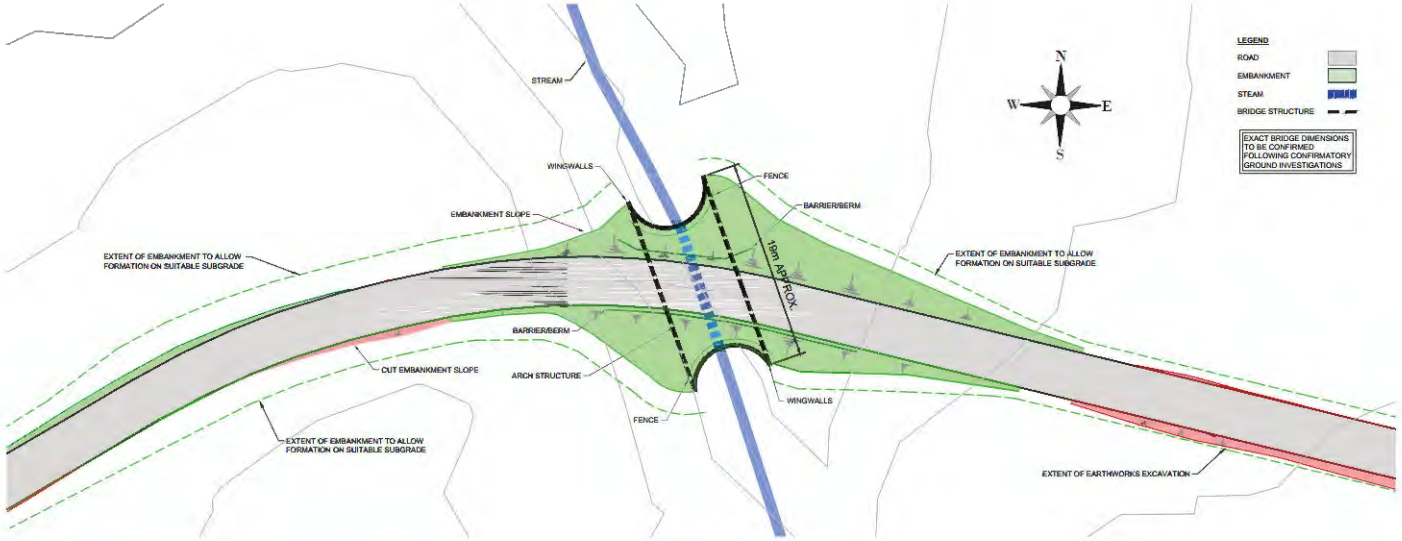

BRIDGE PLAN
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Figure 4.38

NOTES

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D	03.07.20	M.B	J.S	LEGEND ADDED
C	01.11.19	M.B.	J.S.	CLIENT COMMENTS INCLUDED
B	04.10.19	M.B.	J.S.	PLAN INCLUDED
A	26.07.19	M.B.	J.S.	DRAFT ISSUE - FOR DISCUSSION

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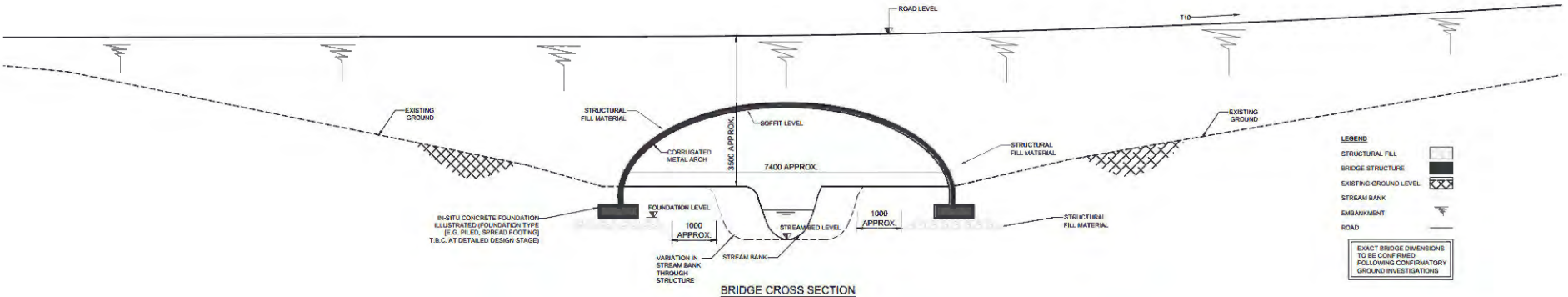
CLIENT

PROJECT: CROAGH WIND FARM

TITLE: PROPOSED NEW WATERCOURSE CROSSING NO.1

REVISION: D

DRAWN BY: M. BROWNE	DATE: 26/07/2019	PAPER SIZE: A3	SCALE: AS SHOWN
CHECKED AND APPROVED: J. SHANAHAN	DATE: 26/07/2019	STATUS: INFORMATION	DRAWING NUMBER: 0511-55



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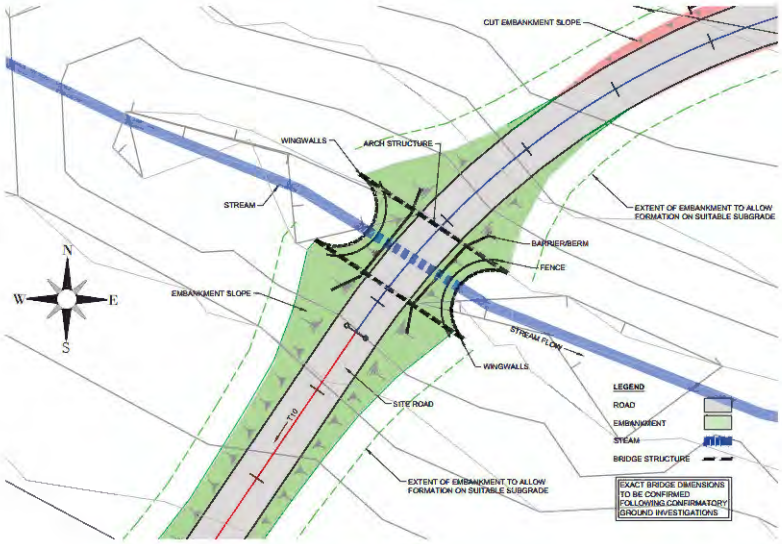

BRIDGE PLAN
Scale 1:500

Figure 4.39

NOTES

REV	DATE	DRAWN BY	CHECKED BY	DETAILS
C	03.07.20	M.B.	J.S.	LEGEND ADDED
B	01.11.19	M.B.	J.S.	CLIENT COMMENTS INCLUDED
A	01.10.19	M.B.	J.S.	FIRST ISSUE

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PROJECT: CROAGH WIND FARM

TITLE: PROPOSED NEW WATERCOURSE CROSSING NO.2

REVISION: C

DRAWN BY	DATE	PAPER SIZE	SCALE
M. BROWNE	01/10/2019	A3	AS SHOWN

CHECKED AND APPROVED	DATE	STATUS	DRAWING NUMBER
J. SHANAHAN	01/10/2019	INFORMATION	0511-56

- The timber roof trusses will then be lifted into position using a telescopic load all or mobile crane depending on site conditions. The roof trusses will then be felted, battened, tiled and sealed against the weather.
- The electrical equipment will be installed and commissioned.
- Perimeter fencing will be erected.
- The construction and components of the substation are to ESB specifications.

4.9.5 Temporary Construction Compounds

The temporary construction compounds will be constructed as follows:

- The area to be used as the compound will be marked out at the corners using ranging rods or timber posts. Drainage runs and associated settlement ponds will be installed around the perimeter;
- The compound platform will be established using a similar technique as the construction of the substation platform discussed above;
- A layer of geo-grid will be installed, and compacted layers of well graded granular material will be spread and lightly compacted to provide a hard area for site offices and storage containers;
- Areas within the compound will be constructed as site roads and used as vehicle hardstandings during deliveries and for parking;
- The compound will be fenced and secured with locked gates if necessary; and,
- Upon completion of the Proposed Development the temporary construction compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with topsoil as required.

The car park that is proposed as part of the recreation and amenity facilities will be constructed in a similar manner to the proposed temporary construction compounds.

4.9.6 Grid Connection Cable Trench

The underground cabling (UGC) works will consist of the installation of ducts in an excavated trench to accommodate power cables, and a fibre communications cable to allow communications between the Croagh Wind Farm Substation and Garvagh Substation.

The UGC will either be a single circuit or a double circuit 38kV connection, in accordance with the requirements and specifications of ESB . The difference between the two connection types is the number of ducts, the number of cables and the width of the trench and associated joint bay chambers. A single circuit connection typically consists of 3 no. 110mm diameter HDPE power cable ducts and 1 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 600mm wide by 1,220mm deep. A double circuit connection typically consists of 6 no. 110mm diameter HDPE power cable ducts and 2 no. 110mm diameter HDPE communications duct to be installed in an excavated trench, typically 900mm wide by 1,220mm deep. For trench designs there will be variations on the design to adapt to service crossings and watercourse crossings.

The power cable ducts will accommodate the power cables and the communications duct(s) will accommodate a fibre cable(s) to allow communications between the Croagh Wind Farm substation and Garvagh Substation. The ducts will be installed, the trench reinstated in accordance with landowner or local authority specification, and then the electrical cabling/fibre cable is pulled through the installed ducts in approximately 650/750m sections. Construction methodologies to be implemented and materials to be used will ensure that the UGC is installed in accordance with the requirements and specifications of ESB.

The underground cable required to facilitate the grid connection will be laid beneath the surface of the site and/or public road using the following the methodology summarised below, and outlined in detail

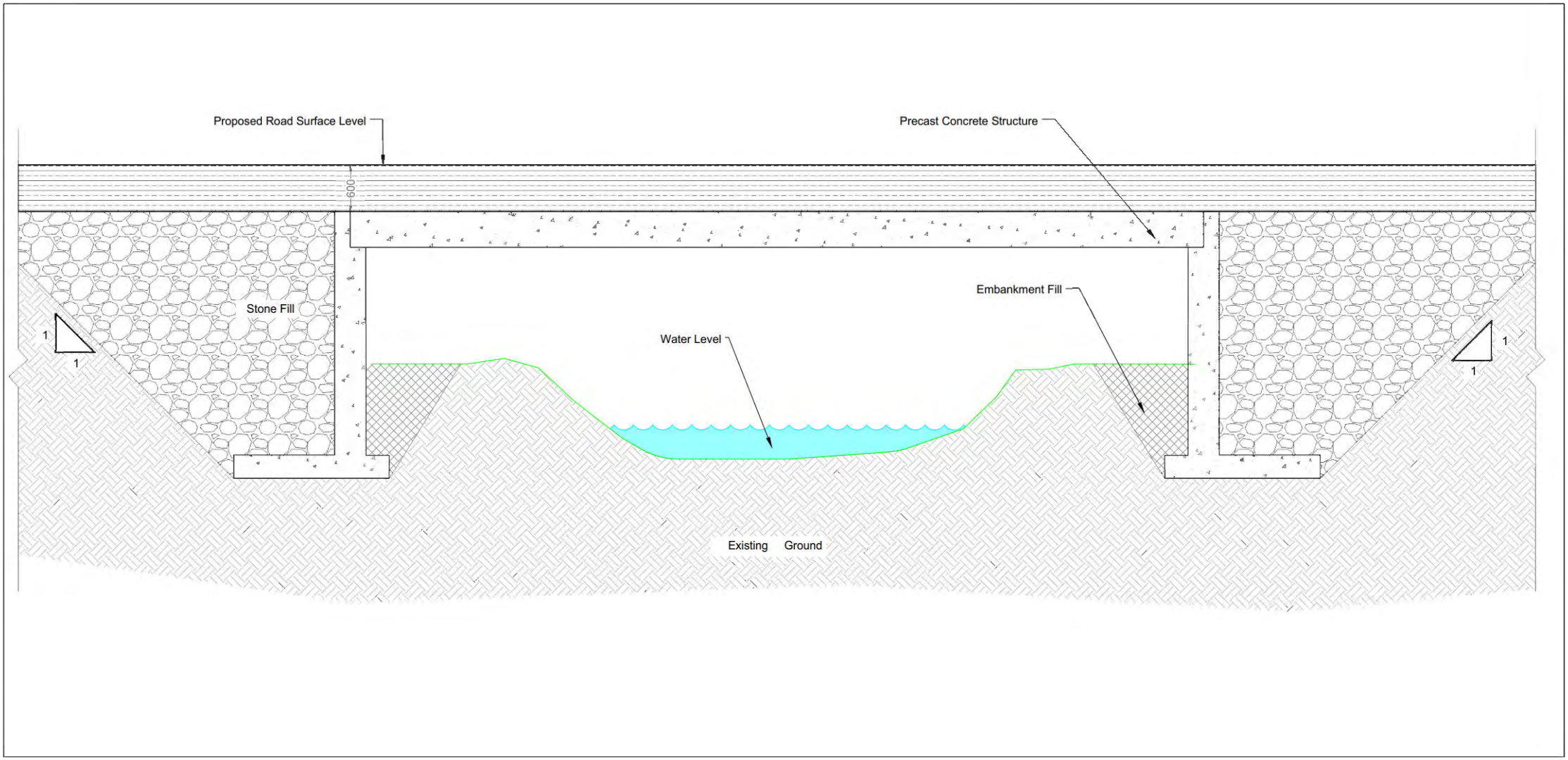

Figure 4-40

DRAWING TITLE:
Typical Pre-cast Concrete Clearspan Watercourse Crossing

PROJECT TITLE:
Croagh Wind Farm, Co. Leitrim/ Co. Sligo

DRAWING BY: Joseph O Brien	CHECKED BY: Michael Watson
PROJECT No.: 180511	DRAWING No.: 180511 - 57
SCALE: 1:50 @ A3	DATE: 03.07.2020

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in TLI Group's Croagh Wind Farm 38kVGrid Connection – Construction Methodology included as Appendix 4-5 of this EIAR:

The Contractor, and their appointed Site Manager, will prepare a targeted Method Statement concisely outlining the construction methodology and incorporating all mitigation and control measures included within the planning application and accompanying reports and as required by planning conditions where relevant;

- All existing underground services shall be identified on site prior to the commencement of construction works;
- At watercourse crossings, the contractor will be required to adhere to the environmental control measures outlined within the planning application and accompanying reports, the final Construction Environmental Management Plan (CEMP) and best practice construction methodologies;
- Where the cable route intersects with culverts, the culvert will remain in place (where possible) and the ducting will be installed either above or below the culvert to provide minimum separation distances in accordance with ESB specifications;
- Traffic management measures will be implemented in accordance with those included in the Chapter 14 of this EIAR and a final Traffic Management Plan will be prepared and agreed with the local authority;
- The excavated trench will be approximately 600/900mm in width and approximately 1220mm deep both within the public road network and within Coillte lands;
- The base of the excavated trench will be lined with sand bedding to be imported to site from a local licensed supplier. The 110mm diameter HDPE cable ducting will be placed into the prepared trench, inspected and backfilled as per Figures 4 & 5;
- Excavated material will be temporarily stockpiled onsite for re-use during reinstatement. Stockpiles will be restricted to less than 2m in height. Stockpiles will be located a minimum of 50m from surface water features and all stockpiling locations will be subject to approval by the Site Manager and Project Ecological Clerk of Works (ECoW);
- Excavated material shall be reused to backfill the trench where appropriate and any surplus material will be transported to either the proposed onsite borrow pit or repository areas;
- Any earthen (sod) banks to be excavated will be carefully opened with the surface sods being stored separately and maintained for use during reinstatement;
- The excavated trench will be dewatered if required, from a sump installed within the low section of the opened trench. Where dewatering is required, silt laden water will be fully and appropriately attenuated, through silt bags, before being appropriately discharged to vegetation or surface water drainage feature (please refer to drainage design in the proposed development);
- Where required, grass will be reinstated by either seeding or by replacing with grass turves;
- No more than a 100 metre section of trench will be opened at any one time. The second 100 metres will only be excavated once the majority of reinstatement has been completed on the first;
- The excavation, installation and reinstatement process will take on average of 1 no. day to complete a 100m section;
- Where the cable is being installed in a roadway, temporary reinstatement may be provided to allow larger sections of road to be permanently reinstated together;
- Following the installation of ducting, pulling the cable will take approximately 1 day between each joint bay, with the jointing of cables taking approximately 1-2 days.

4.9.6.1 Site Cable Trenching

The transformer in each turbine is connected to the substation through a network of buried electrical cables. The ground is trenched typically using a mechanical excavator. The top layer of soil is removed and saved so that it is replaced on completion. The cables will be bedded with suitable material. The cables will be laid at a depth that meets all national and international requirements, and will generally

be approximately 1.3m below ground level; a suitable marking tape is installed between the cables and the surface (see Plate 4-7below). On completion, the ground will be reinstated as previously described above. The route of the cable ducts will follow the access track to each turbine location, and are visible on the site layout drawings included as Appendix 4-1 of the EIAR.



Plate 4-5 Typical Cable Trench View

4.9.6.2 Existing Underground Services

In order to facilitate the installation of the proposed UGC, it may be necessary to relocate existing underground services such as water mains or existing cables. In advance of any construction activity, the contractor will undertake additional surveys of the proposed route to confirm the presence or otherwise of any services. If found to be present, the relevant service provider will be consulted with in order to determine the requirement for specific excavation or relocation methods and to schedule a suitable time to carry out works.

If existing low voltage underground cables are found be present, a trench will be excavated, and new ducting and cabling will be installed along the new alignment and connected to the network on either end. The trench will be backfilled with suitable material to the required specification. Warning strip and marking tape will be laid at various depths over the cables as required. Marker posts and plates will be installed at surface level to identify the new alignment of the underground cable, the underground cables will then be re-energised.

In the event that water mains are encountered the water supply will be turned off by the utility so work can commence on diverting the service. The section of existing pipe will be removed and will be replaced with a new pipe along the new alignment of the service. The works will be carried out in accordance with the utility standards.

4.9.6.3 Joint Bays

Joints Bays are to be provided approximately every 750m - 800m along the UGC route to facilitate the jointing of 2 no. lengths of UGC. The joint bays will be pre-cast concrete structures installed below finished ground level. The joint bay width varies between single and double circuits (2.03 – 2.7m). Joint Bays will be located in the non-load bearing strip of roadways insofar as possible.

In association with Joint Bays, Communication Chambers are required at every joint bay location to facilitate communication links between the Croagh Wind Farm substation and the existing Garvagh 110kV Substation. Earth Sheath Link Chambers are also required approximately every second joint bay along the cable route. Earth Sheath Links are used for earthing and bonding cable sheaths of underground power cables, installed in a flat formation, so that the circulating currents and induced voltages are eliminated or reduced. Earth Sheath Link Chambers and Communication Chambers are located in close proximity to Joint Bays. Earth Sheath Link Chambers and Communication Chambers will typically be pre-cast concrete structures with an access cover at finished surface level. The locations of the joint bays and chambers are shown on the site layout drawings in Appendix 4-1.

The precise siting of all Joint Bays, Earth Sheath Link Chambers and Communication Chambers within the planning corridor is subject to approval by ESBN.

4.9.6.4 Grid Connection Watercourse/Culvert Crossings

Nine watercourse crossing locations were identified along the cable route. All of the watercourse crossings identified are culverts and no bridge crossings have been identified. It is proposed to cross all watercourses using open trenching with either an undercrossing or an overcrossing, depending on the depth of the culvert. A schedule of the culverts identified and the proposed crossing method to be implemented is detailed in Appendix 4-6 of this EIAR and the locations are shown on the site layout drawings included in Appendix 4-1. Should an alternative methodology option be required for individual crossings during the construction process this will be agreed with the relevant authorities including prior to works commencing. The proposed culvert crossing methods are detailed in Figure 4-42 below, the number of ducts will vary between a single and double circuit connection.

Where the cable route intersects with existing watercourses, a detailed construction method statement will be prepared by the Contractor prior to the commencement of construction and is to be approved by the Local Authority and relevant environmental agencies as required.

Inland Fisheries Ireland have published guidelines relating to construction works along water bodies entitled "*Requirements for the Protection of Fisheries Habitats during Construction and Development Works at River Sites*", and these guidelines will be adhered to during the construction of the proposed development.

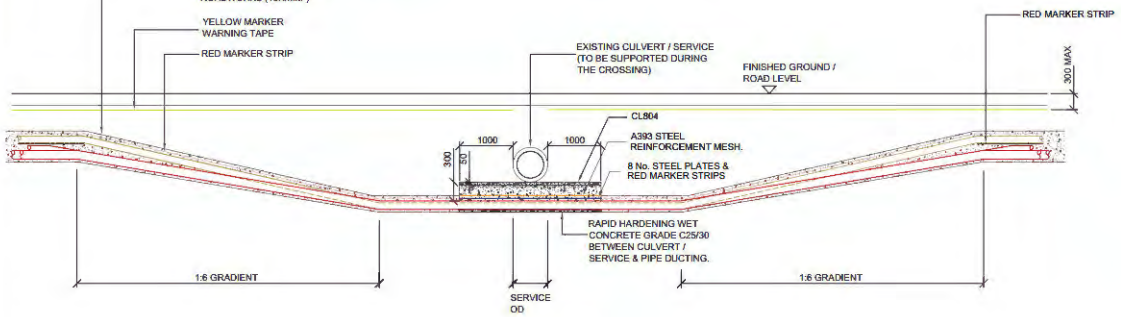
4.9.6.5 Horizontal Direction Drilling

It is not currently proposed to implement Horizontal Directional Drilling (HDD) for any crossings. However, following confirmatory site investigations prior to construction it may be necessary to utilise HDD for some crossings.

Horizontal Direction Drilling (HDD) is a method of drilling under obstacles such as bridges, culverts, railways, water courses, etc. in order to install cable ducts under the obstacle. This method is employed where installing the ducts using standard installation methods is not possible. The proposed HDD methodology is as follows: -

- A works area of circa .40 square metres will be fenced on both sides of a crossing
- The drilling rig and fluid handling units will be located on one side of the bridge and will be stored on double bunded 0.5mm PVC bunds which will contain any fluid spills and storm water run-off.
- Entry and exit pits (1m x 1m x 2m) will be excavated using an excavator, the excavated material will be temporarily stored within the works area and used for reinstatement or disposed of to a licensed facility.
- A 1m x 1m x 2m steel box will be placed in each pit. This box will contain any drilling fluid returns from the borehole.

ISO A1 594mm x 841mm



SECTION A-A

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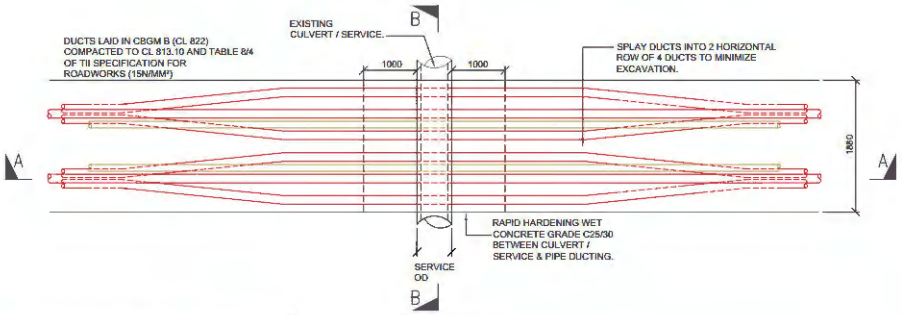

PLAN VIEW

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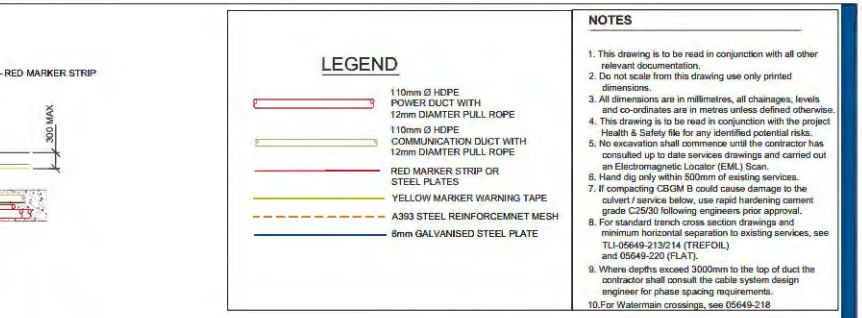
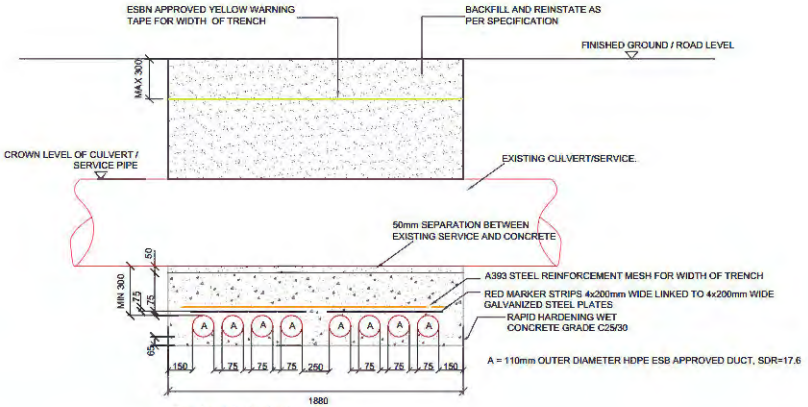
38kV DOUBLE CIRCUIT DETAILS - 1. SERVICE/CULVERT UNDERCROSSING



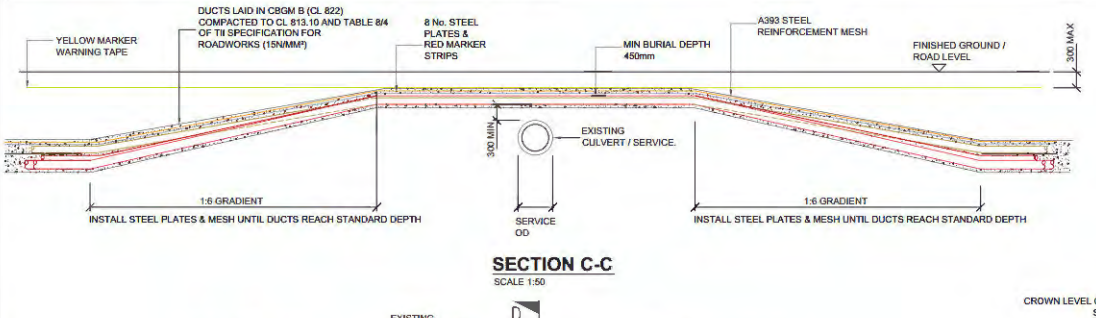
NOTES

1. This drawing is to be read in conjunction with all other relevant documentation.
2. Do not scale from this drawing use only printed dimensions.
3. All dimensions are in millimetres, all chainages, levels and co-ordinates are in metres unless defined otherwise.
4. This drawing is to be read in conjunction with the project Health & Safety file for any identified potential risks.
5. No excavation shall commence until the contractor has consulted up to date services drawings and carried out an Electromagnetic Locator (EML) Scan.
6. Hand dig only within 500mm of existing services.
7. If compacting CBGM B could cause damage to the culvert / service below, use rapid hardening cement grade C25/30 following engineers prior approval.
8. For standard trench cross section drawings and minimum horizontal separation to existing services, see TLI-05649-213/214 (TREFOIL) and 05649-220 (FLAT).
9. Where depths exceed 3000mm to the top of duct the contractor shall consult the cable system design engineer for phase spacing requirements.
10. For Watermain crossings, see 05649-218



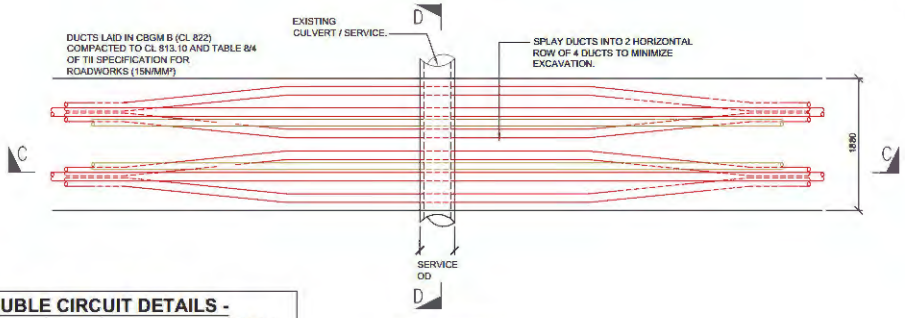
SECTION B-B

SCALE: NTS



SECTION C-C

SCALE 1:50



PLAN VIEW

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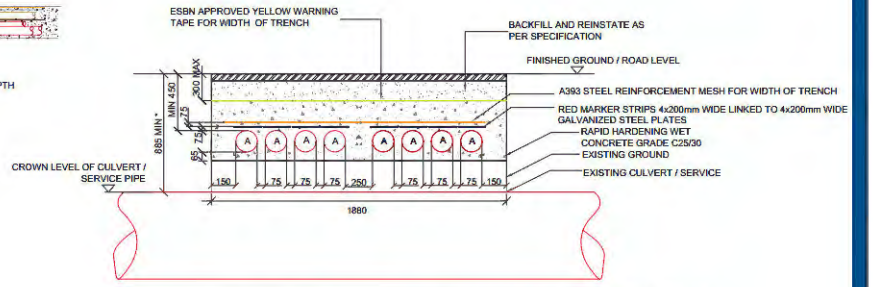
38kV DOUBLE CIRCUIT DETAILS - 2. SERVICE/CULVERT OVERCROSSING



SECTION D-D

SCALE: NTS

Project Management Initials: Designer: CH Checked: SK Approved: RG

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PROJECT

Croagh Wind Farm
38kV Grid Connection

CLIENT

COILLTE

CONSULTANTS

MKO

NOTES: -

- See notes in drawing window

LEGEND: -

Figure 4-41

ISSUE/REVISION

03	01.07.20	Issued for Planning
02	12.06.20	Issued for Planning
01	19.11.19	Issued for Planning
00	29.08.19	Issued for Information
I/R	DATE	DESCRIPTION

PROJECT NUMBER

05-649

SHEET TITLE

38kV Double Circuit - Service/Culvert Crossing Detail

SHEET NUMBER

05649-217(0511-73)

- The drill bit will be set up by a surveyor, and the driller will push the drill string into the ground and will steer the bore path under the watercourse.
- A surveyor will monitor drilling works to ensure that the modelled stresses and collapse pressures are not exceeded.
- The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit.
- Once the first pilot hole has been completed a hole-opener or back reamer will be fitted in the exit pit and will pull a drill pipe back through the bore to the entry side.
- Once all bore holes have been completed, a towing assembly will be set up on the drill and this will pull the ducting into the bore.
- The steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.
- The ducts will be cleaned and proven and their installed location surveyed.
- The entry and exit pits will be reinstated to the specification of ESB Networks and the landowner.

A joint bay or transition chamber will be installed on either side of the bridge following the horizontal directional drilling as per ESB requirements. The horizontal direction drilling method is illustrated in Figure 4-44 below.

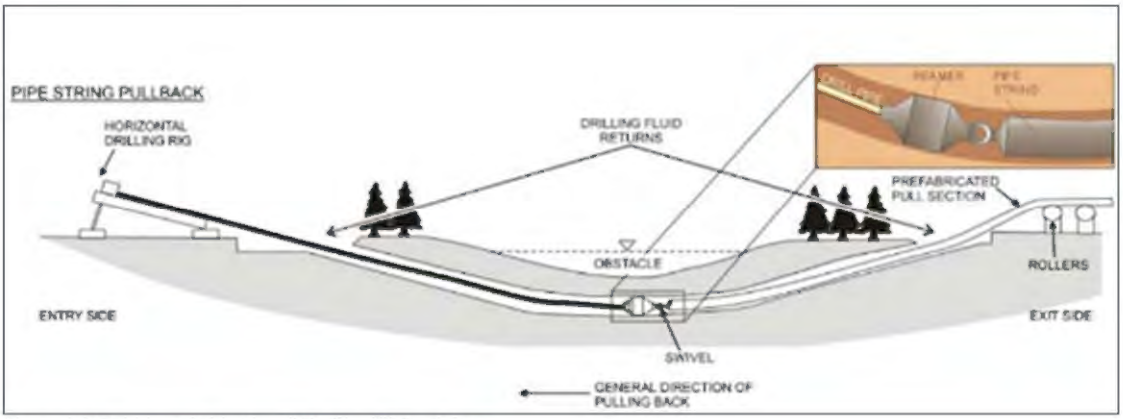

Figure 4-44 Horizontal Directional Drilling Methodology

4.9.7 Proposed Demolition Works

As outline in Section 4.4.1.1 it is proposed to carry out partial demolition works on two agricultural buildings as part of the development of the proposed link road for turbine component and abnormal load deliveries. A single bay on the northern side of the storage shed will be demolished and the masonry wall will be reconstructed at the end of the adjacent bay. This detail is shown in Figure 4-26. A 6.9m length of the rear masonry wall of the livestock shed will be demolished and part of the gable sheeting will be removed. The central steel support structure will be relocated by one metre to increase the size of the opening at the rear of the livestock shed. This will be replaced with a corrugated, galvanised steel door. This detail is shown in Figure 4-28. The demolition will be carried out using the following methodology.

- An inventory of the waste types that will be generated by the demolition works will be carried out.
- Any equipment or miscellaneous materials within northern bay of the storage shed will be removed.
- Removal of all fixtures and supporting structures.
- Removal of the roof sheeting over the northern bay of the storage shed and the section of gable sheeting at the rear of the livestock shed.
- Demolition will be completed by way of a mechanical excavator which will remove the structure and all associated groundworks.
- The demolition of the masonry wall structures will be carried out by a mechanical excavator.

- The majority of the waste generated by the demolition of the existing shed will consist of concrete rubble and stones from the existing wall structure, floor and foundations. This material will be segregated from all other waste components and sent by an authorised waste collector to an authorised waste recovery facility.
- The remaining volume of waste material will not be large enough to warrant any further segregation therefore, all waste generated during the demolition of the building will be deposited into a single skip that will be brought by a waste collector to an appropriately authorised facility.

4.10 Operation

The Proposed Development is expected to have a lifespan of approximately 30 years. Planning permission is being sought for a 30-year operation period commencing from the date of full operational commissioning of the wind farm. During the operational period, on a day-to-day basis the wind turbines will operate automatically, responding by means of anemometry equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together, and data relayed from the wind turbines to an off-site control centre. Each turbine will also be monitored off-site by the wind turbine supplier. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at an off-site control centre 24-hours per day.

Each turbine will be subject to a routine maintenance programme involving a number of checks and changing of consumables, including oil changes. In addition, there will be a requirement for unscheduled maintenance, which could vary between resetting alarms to major component changes requiring a crane. Typically, maintenance traffic will consist of four-wheel drive vehicles or vans. The electricity substation and battery storage components and site tracks will also require periodic maintenance.

4.11 Decommissioning

The wind turbines proposed as part of the Proposed Development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the Proposed Development may be decommissioned fully. The onsite substation will remain in place as it will be under the ownership of the ESB and will form a permanent part of the national electricity grid.

Upon decommissioning of the Proposed Development, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration. Site roadways will be left in situ, for future forestry operations. The amenity and recreation infrastructure will also be left in-situ. Underground cables, including grid connection, will be removed and the ducting left in place. A decommissioning plan will be agreed with the local authorities three months prior to decommissioning the Proposed Development.

However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

5. POPULATION AND HUMAN HEALTH

5.1 Introduction

This section of the Environmental Impact Assessment Report (EIAR) identifies, describes and assesses the potential, significant, direct and indirect effects of the proposed Croagh Wind Farm on population and human health and has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA), in particular the *'Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports'* (EPA, August 2017). The full description of the proposed development is provided in Chapter 4 of this EIAR.

One of the principal concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect impacts arising from the construction and operation of a development. Ultimately, all the impacts of a development impinge on human health, directly and indirectly, positively and negatively. The key issues examined in this chapter of the EIAR include population, human health, employment and economic activity, land-use, residential amenity, community facilities and services, tourism, property values, shadow flicker, noise and health and safety.

A significant minimum separation distance from houses of 850m has been achieved with the project design. Just 5 no. dwellings located within 1 km of any proposed wind turbine location with only one of these dwellings being occupied. This occupied dwelling is located approximately 850 metres north of the closest proposed turbine location.

5.1.1 Statement of Authority

This section of the EIAR has been prepared by Órla Murphy and reviewed by Michael Watson, of MKO. Órla is an environmental scientist with over two years of experience with MKO and has prepared the Population and Human Health chapter for a number of wind energy EIARs in that time. She holds a BSc (Hons) in Geography and a MSc. in Environmental Protection and Management. Michael Watson is a Project Director with MKO; with over 18 years' experience in the environmental sector. His project experience includes the management and production of Environmental Impact Statements (EISs)/EIARs, particularly within the wind energy sector.

5.2 Population

5.2.1 Receiving Environment

Information regarding human beings and general socio-economic data were sourced from the Central Statistics Office (CSO), the Leitrim County Development Plan 2015 – 2021, Sligo County Development Plan 2017 – 2023 and Fáilte Ireland. The study included an examination of the population and employment characteristics of the area. This information was sourced from the Census of Ireland 2016, which is the most recent census for which a complete dataset is available, also the Census of Ireland 2011 and from the CSO website, www.cso.ie. Census information is divided into State, Provincial, County, Major Town and District Electoral Division (DED) level.

The proposed development is located in a number of townlands as listed in Table 1-1 of Section 1.1 of this EIAR. The proposed wind turbines are located within existing commercial forestry adjacent to the village of Drumkeeran, Co. Leitrim and 8 km southeast of the town of Dromahair, Co. Leitrim.; The site location is shown in Figure 1-1 of Chapter 1 of this EIAR.

In order to assess the population in the vicinity of the site, the Study Area for the Population section of the EIAR was defined in terms of the District Electoral Divisions (DEDs) within which the proposed wind turbines were located, as well as DEDs within close proximity of the proposed wind turbines and the core of the proposed development site. The site of the wind farm development lies within the Garvagh/Arigna DED and Shancough DED, as shown on Figure 5-1. An adjacent DED considered is the Killanummery DED, the boundary of which is located approximately 447m west of Turbine No. 1. All 3 no. of these DEDs will collectively be referred to hereafter as the Population Study Area for this chapter.

The Population Study Area has a combined population of 677 persons, as of 2016, and comprises a total land area of 7,588 hectares or 75.88 square kilometres (km^2). (Source: CSO Census of the Population 2016).

5.2.2 Population

5.2.2.1 Population Trends

In the period 2011 to 2016, the population of Ireland increased by 3.8%. Between 2011 and 2016, the population of Co. Leitrim and Co. Sligo increased by 0.8% to 32,044 persons and by 0.2% to 65,535 persons respectively. Population statistics for the Republic, County Leitrim, County Sligo and the Study Area have been obtained from the Central Statistics Office (CSO) and are presented in Table 5-1.

Table 5-1 Population 2011 – 2016 (Source: CSO)

Area	Population		% Population Change
	2011	2016	2011-2016
Republic of Ireland	4,588,252	4,761,865	+3.8%
County Leitrim	31,798	32,044	+0.8%
County Sligo	65,393	65,535	+0.2%
Study Area	704	677	-3.8%

The data presented in Table 5-1 shows that the population of the 3 no. DEDs within the Population Study Area decreased by 3.8% between 2011 and 2016. When the population data is examined in closer detail, it shows that the rate of population change within the 3 no. DEDs has been unevenly distributed between the DEDs. The smaller population in Shancough contributes to a larger percentage change, even though the difference in population is similar to that of Garvagh / Arigna DED. Garvagh / Arigna DED was the only DED that showed an increase in population between 2011 and 2016, experiencing an 8.4% increase. In comparison, the population of Shancough DED decreased by 19.6% during the same period.

Of the three DEDs that make up the study area around the wind farm site for this assessment, the highest population was recorded in Killanummery DED, with 374 persons recorded during the 2016 Census, while Shancough DED had just 123 persons recorded during the 2016 Census.

5.2.2.2 Population Density

The population densities recorded within the Republic, County Leitrim, County Sligo and the Population Study Area during the 2011 and 2016 Census are shown in Table 5-2.



Map Legend

- EIAR Site Boundary
- District Electoral Division Boundary/ Study Area
- County Border

MAP TITLE: **Population Study Area Map**		MAP NO.: **Figure 5.1**	SCALE: **1:75,000**
PROJECT TITLE: **180511 Croagh Wind Farm**			DATE: **26-06-2020**
DRAWING BY: **Eoin McCarthy**	CHECKED BY: **Michael Watson**	ISSUE NO.: **180511-2020.06.26-F**	

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Table 5-2 Population Density in 2011 and 2016 (Source: CSO)

Area	Population Density (Persons per square kilometre)		% change in Population Density
	2011	2016	
Republic of Ireland	65.57	68.06	+3.8%
County Leitrim	20.09	20.24	+0.7%
County Sligo	35.75	35.83	+0.2%
Study Area	9.28	8.92	-3.9%

The population density of the Population Study Area around the main wind farm site recorded during 2016 was 8.92 persons per square kilometre. This figure is significantly lower than the national population density of 68.06 persons per km^2 and the both county population densities of 20.24 and 35.83 and persons per square kilometre recorded for County Leitrim and County Sligo respectively. These findings confirm that the site of the proposed development is located within a very sparsely populated area.

Similar to the trends observed in population, the population density recorded during 2016 around the proposed wind farm site varies between DEDs. Garvagh / Arigna and Shancough DEDs had the lowest population density, at 5.05 and 6.25 persons per square kilometre respectively, while Killanummery DED had the highest population density, at 18.08 persons per square kilometre.

5.2.2.3 Household Statistics

The number of households and average household size recorded within the Republic of Ireland, County Leitrim, County Sligo and the Study Area during the 2011 and 2016 Census is shown in Table 5-3.

Table 5-3 Number of Households and Average Household Size 2011 – 2016 (Source: CSO)

Area	2011		2016	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
Republic of Ireland	1,654,208	2.8	1,697,665	2.8
County Leitrim	12,308	2.6	12,452	2.5
County Sligo	24,525	2.6	24,831	2.6
Study Area	259	2.7	247	2.7

In general, the figures in Table 5-3 show that while the number of households within the Republic of Ireland and County Sligo around the site of the wind farm has increased slightly, the average number of people per household has generally stayed the same, i.e. there are more households and the same amount of people per house. County Leitrim also showed an increase in the number of households, but a slight reduction in the average number of people per household. Average household size recorded within the Population Study Area during the 2011 and 2016 Censuses is similar to that observed at State

and County level during the same periods, with an average of 2.7. Shancough was the highest during 2011, having an average household size of 2.9, while Killanummery having the highest average household size of 2.8 during 2016.

5.2.2.4 Age Structure

Table 5-4 presents the percentages of the Republic of Ireland, County Leitrim, County Sligo and the Study Area within different age groups as defined by the Central Statistics Office during the 2016 Census. This data is also displayed in Figure 5-2.

Table 5-4 Population per Age Category in 2016 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
Republic of Ireland	21.1%	12.1%	29.5%	23.8%	13.4%
County Leitrim	21.6%	9.9%	25.2%	26.4%	16.9%
County Sligo	20.3%	12.2%	25.5%	25.7%	16.2%
Study Area	20.7%	12.0%	19.2%	32.2%	16.0%

The proportion of the Study Area population within each age category is similar to those recorded at national and County level for most categories. Within the Study Area, the highest population percentage occurs within the 45-64 age category.

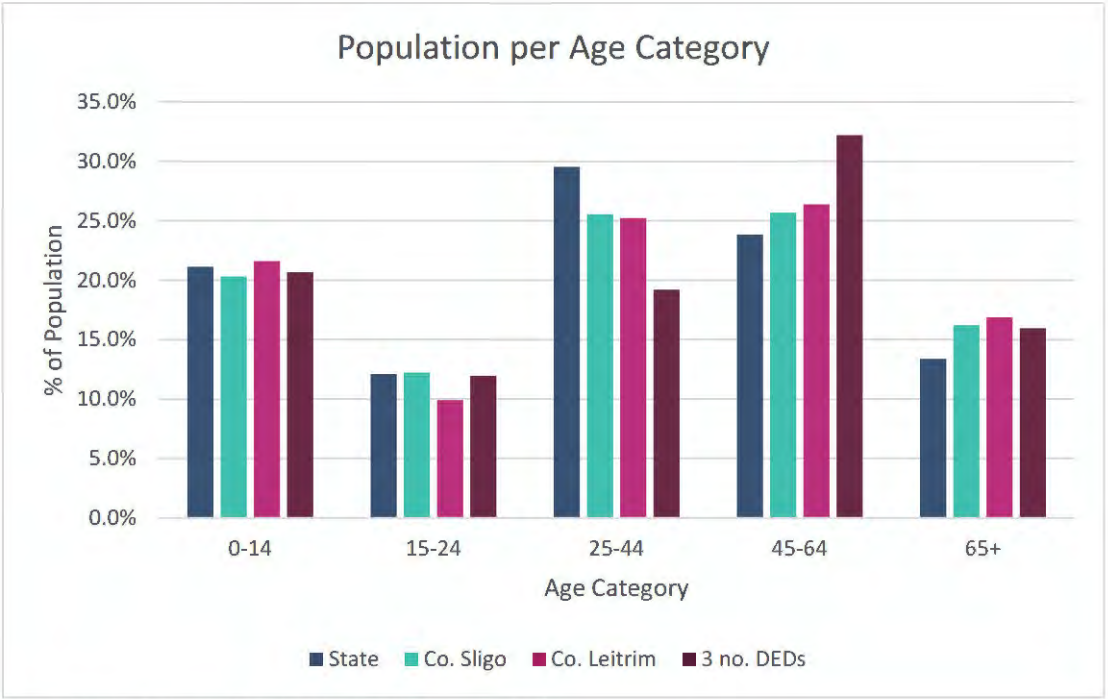


Figure 5-1 Population per Age Category in 2016 (Source: CSO)

5.2.3 Employment and Economic Activity

5.2.3.1 Economic Status

The labour force consists of those who are able to work, i.e. those who are aged 15+, out of full-time education and not performing duties that prevent them from working. In 2016, there were 3,755,313 persons in the labour force in the Republic of Ireland. Table 5-5 shows the percentage of the total population aged 15+ who were in the labour force during the 2016 Republic of Ireland Census. This figure is further broken down into the percentages that were at work, seeking first time employment or unemployed. It also shows the percentage of the total population aged 15+ who were not in the labour force, i.e. those who were students, retired, unable to work or performing home duties.

Table 5-5 Economic Status of the Total Population Aged 15+ in 2016 (Source: CSO)

Status		Republic of Ireland	County Leitrim	County Sligo	Study Area
% of population aged 15+ who are in the labour force		**61.4%**	**59.5%**	**57.9%**	**55.3%**
% of which are:	At work	87.1%	85.5%	86.0%	87.9%
	First time job seeker	1.4%	1.4%	1.4%	2.0%
	Unemployed	11.5%	11.5%	12.6%	10.1%
% of population aged 15+ who are not in the labour force		**38.6%**	**40.7%**	**42.1%**	**44.7%**
% of which are:	Student	29.4%	22.9%	28.8%	22.1%
	Home duties	21.1%	20.0%	16.4%	22.9%
	Retired	37.6%	44.4%	42.0%	37.9%
	Unable to work	10.9%	11.8%	11.6%	16.3%
	Other	1.0%	0.9%	1.2%	0.8%

Overall, the principal economic status of those living in the Study Area is similar to that recorded at national and County level, with between 0-5% average difference apparent. Of those who were not in the labour force during the 2016 Census, the highest percentage of the population in the 3 no. DEDs was in the 'Retired' category, which is the same as figures recorded at national and County level that also show 'Retired' as the highest category.

5.2.3.2 Employment and Investment Potential in the Irish Wind Energy Industry

5.2.3.2.1 *Background*

A report entitled 'Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy' was published in 2009 by Deloitte, in conjunction with the Irish Wind Energy Association (IWEA). This report focused on the ability of the Irish wind energy industry to create investment and jobs. In terms of the overall economic benefit to be obtained from wind energy, the report states in its introduction:

> *"Ireland is fortunate to enjoy one of the best wind resources in the world. Developing this resource will reduce and stabilise energy prices in Ireland and boost our long-term competitiveness as an economy. It will also significantly reduce our dependence on imported fossil fuels."*

More recently, a report published in 2014 by Siemens entitled '"An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland', also in conjunction with the Irish Wind Energy Association (IWEA), concluded that, *'a major programme of investment in wind could have a sizeable positive effect on the labour market, resulting in substantial growth in employment.'* The report considers the three potential types of direct employment created, as a result of increased investment in wind energy, to be:

- Wind Energy Industry Employment:
  - Installation
  - Development
  - Planning
  - Operation and Maintenance
  - Investor activity
- Electricity Grid Network Employment
- Potential Wind Turbine Manufacturing Employment

5.2.3.2.2 *Energy Targets*

The Climate Action Plan 2019 (CAP) was published on the 1st August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. The CAP includes a commitment that 70% of Ireland's electricity needs will come from renewable sources by 2030. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target.

5.2.3.2.3 *Employment Potential*

The Deloitte report (2009) estimated at the time of its publication that the Island of Ireland's installed wind energy capacity would need to reach 7,800 Megawatts (MW) by 2020, in order to meet the Government's renewable energy targets. Based on these estimates, the Deloitte report stated that the Irish wind energy sector to 2020 would be capable of supporting more than 10,760 jobs through direct and indirect involvement in the sector. This number includes construction, operation and maintenance of all wind farms and assumes a steady growth in the industry over the period to 2020. It also encompasses planning and financing of wind farms, and support services such as administration, payroll and marketing/communications. There are also further employment opportunities available in other areas of the wind energy sector relating to policy, Research and Development, support services and other, which total to 935 jobs across Ireland.

Of the 10,760 jobs estimated to be created through the development of the wind energy sector, the Deloitte report states the majority of these would be provided within the construction industry:

"The wind sector offers great opportunities to a sector such as construction, which is currently facing downturn and rising unemployment. It is estimated that approximately 7,258 jobs will be supported by the construction element of wind farms."

The Deloitte study on employment and investment potential assumed that there would be a steady growth in the amount of wind power rolled out between 2009 and 2020. The report states:

"It is crucial that the industry expands at a sustainable rate. If Ireland's increase in installed capacity is rolled out at a steady growth rate over the next eleven years then Irish companies will have sufficient time to adapt and build up their companies in order to cope with the increasing number of MW being added every year."

As of March 2020, there were over 5,400 Megawatts (MW) of wind energy capacity installed on the island of Ireland. Of this, 4,130 MW was installed in the Republic of Ireland, with 1,282 MW installed in Northern Ireland. The majority of the Republic of Ireland's installed wind energy capacity is located in Counties Donegal, Galway, Cork and Kerry.

The Sustainable Energy Authority of Ireland estimates, in their 2011 report, 'Wind Energy Roadmap 2011-2050', that onshore and offshore wind could create 20,000 direct installation and operation/maintenance jobs by 2040 and that the wind industry would also have an annual investment potential of €6-12 million by the same year.

The 2014 report 'The Value of Wind Energy to Ireland', published by Pőyry, stated that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to not develop any more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

5.2.3.2.4 Economic Value

The Deloitte report states that the construction and development of wind energy projects across the island of Ireland would involve approximately €14.75 billion of investment from 2009 up to 2020, €5.1 billion of which would be retained in the Irish economy (€4.3 billion invested in the Republic of Ireland and €0.8 billion in Northern Ireland).

The report also states that increasing the share of our energy from renewable sources will deliver significant benefits for the electricity customer, the local economy and society. It estimates that between 25 and 30% of capital investment is retained in the local economy. This typically flows to companies in construction, legal, finance and other professional services. The report states:

".. the framework acknowledges the need to put the energy/climate change agenda at the heart of Ireland's economic renewal. Every new wind farm development provides a substantial contribution to the local and national economy through job creation, authority rates, land rents and increased demand for local support services. More wind on the system will also result in lower and more stable energy prices for consumers while helping us achieve our energy and emissions targets."

A 2019 report by Baringa, 'Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020', has analysed the financial impact for end consumers of the deployment of wind generation in Ireland over the period 2000-2020. The report calculates how the costs and benefits for consumers would have differed if no wind farms had been built. The analysis indicated that the deployment of 4.1 GW of wind generation capacity in Ireland between 2000 and 2020 (2018-2020 results being projective) will result in a total net cost to consumers, over 20 years, of €0.1bn (€63 million to be exact), which equates to a cost of less than €1 per person per year since 2000. Further cost benefit analysis noted that wind energy has delivered €2.3 billion in savings in the wholesale electricity market. As such, the economic benefit of renewable energy to consumers is greater than what would have been if Ireland did not invest in wind

power. This tallies with the Deloitte report which indicated that more wind energy feeding into the national grid would result in lower and more stable energy costs for consumers.

The proposed development will, if consent is granted, contribute to the economic value that renewable energy brings to the country.

5.2.4 Land-use

As previously noted, the proposed wind farm is located within existing commercial forestry. The primary, surrounding land use within the Population Study Area is that of farmland. The total area of farmland within the 2 DEDs[1] around the wind farm site measures approximately 2,202 hectares, comprising 54.7% of the Study Area, according to the CSO Census of Agriculture 2010. There are 90 farms located within the 2 DEDs, with an average farm size of 24.5 hectares. This is slightly smaller than the 25.1-hectare average farm size for Co. Leitrim and 26.3 hectare average farm size for Co. Sligo.

Within the Study Area, farming employs 161 people, and the majority of farms are family-owned and run. Table 5-6 shows the breakdown of farmed lands within the 2 DEDs. Pasture accounts for the largest proportion of farmland, followed by silage.

Table 5-6 Farm Size and Classification within the area of the wind farm in 2010 (Source: CSO)

Characteristic	Value
Size of 2 DEDs	4,027 hectares
Total Area Farmed within 2 DEDs	2,202 hectares
Farmland as % of 2 DEDs	54.7%
Breakdown of Farmed Land	**Area (hectares)**
Total Pasture	1,417 ha
Total Silage	354 ha
Grazing	307 ha
Total Hay	124 ha
Total Potatoes	0 ha
Total Cereals	0 ha
Total Crops	0 ha

5.2.5 Services

The EIAR Site Boundary is located adjacent to the village of Drumkeeran, Co. Leitrim at its closest point (the closest proposed turbine is located 4.8km from the village) and 7.3 km southeast of the town of Dromahair, Co. Leitrim, both in which the main services and local amenities including a community centre, church and shop are located.

[1] *Note: Garvagh/Arigna DED has no data available and is not included in the above results.*

5.2.5.1 Education

The closest primary school to the site of the proposed development is the Drumkeeran Central National School, located in Drumkeeran, Co. Leitrim, approximately 600m northeast of the site. The closest secondary school to the wind farm site is Lough Allen College, Drumkeeran, Co. Leitrim, which lies approximately 1.2 km northeast of the proposed development site. The schools are located approximately 4.9 and 5.3 km east of the nearest proposed turbine, respectively.

The third-level institutions of St Angela's College, Sligo and the Institute of Technology Sligo (IT Sligo) are located approximately 12.5 and 17.4 km to the northwest respectively of the proposed development site.

5.2.5.2 Access and Public Transport

The proposed development site is accessed via a proposed new entrance off the R280close to the village of Drumkeeran.

There are Bus Eireann direct connections from Sligo to Dromahair, Carrick on Shannon, Longford, Cavan, Ballyshannon and Derry from which most other destinations may be reached. The nearest train station to the wind farm site is in Collooney Train Station, located approximately 15 kilometres northwest of the site.

5.2.5.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas, available in the area are in the nearby settlements of Drumkeeran and Dromahair.

There are a wide range of services available in the area. Retail, personal and religious services and Community Centres are centred in both Drumkeeran and Dromahair, and there are other shops and businesses located in Sligo Town.

The varied environment of this area of Co. Leitrim and Co. Sligo provides many opportunities for walking, cycling, scenic drives and tourist routes. Although there are no scenic routes within 5km of the proposed development site, there are many walking routes that pertain to the surrounding area, namely Miner's Way, the Sligo Way and the Northwest Cycle Trail. All amenity routes are detailed in Chapter 12 Landscape and Visual, Section 12.5.1 and in Figure 12-6 – Landscape Designations.

Recreation and amenity proposals, which will enhance local amenities and community facilities, are described in Section 4.6 of this EIAR, in Chapter 4: Description of the Proposed Development.

5.3 Tourism

5.3.1 Tourist Numbers and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. During 2018, total tourism revenue generated in Ireland was approximately €9.4 billion, an increase on the €8.8 billion revenue recorded in 2017. Overseas tourist visits to Ireland in 2018 grew by 6.5% to 9.6 million (*'Tourism Facts 2018'*, Fáilte Ireland, July 2019).

Ireland is divided into eight tourism regions. Table 5-7 shows the total revenue and breakdown of overseas tourist numbers to each region in Ireland during 2018 (*'Tourism Facts 2018*, Fáilte Ireland, July 2019)

Table 5-7 Overseas Tourists Revenue and Numbers 2018 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€2,095m	6,309
Mid-East/Midlands	€ 393m	1,030
South-East	€261m	1,028
South-West	€987m	2,512
Mid-West	€511 m	1,497
West	€727m	1,963
Border	€244m	752
Total	€5,218 m	15,091

The Border region, in which the site of the proposed development is located, comprises Counties Cavan, Donegal, Leitrim, Monaghan, Sligo and Louth. This Region benefited from approximately 5.0% of the total number of overseas tourists to the country and approximately 4.7% of the total tourism income generated in Ireland in 2018.

Although the data for 2018 is not available, Table 5-8 presents the breakdown of overseas tourist numbers and revenue to the Border region during 2017 ('2017 *Topline Tourism Performance By Region*, Fáilte Ireland, August 2018). As can be observed in Table 5-8, County Sligo has the fourth highest tourism revenue within the Region during 2017 at €45 million, with County Leitrim coming in lower at €18 million.

Table 5-8 Overseas Tourism to Border Region during 2017 (Source: Fáilte Ireland)

County	Revenue Generated by Overseas Tourists (€m)	No. of Overseas Tourists (000s)
Cavan	48	107
Donegal	82	255
Leitrim	18	41
Monaghan	25	60
Sligo	45	173
Louth	55	172

5.3.2 Tourist Attractions

There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself. The varied natural landscape and scenic amenity of this area provide many opportunities for general outdoor recreation within the wider area, as described in Section 5.2.5.3 above.

The nearest tourist centres to the proposed development site are Sligo town, located approximately 17km northwest of the site, Carrick-on-Shannon, located approximately 22km south of the site, and

Manorhamilton, located 15.5km north of the site. Tourist attractions within Sligo town include the Sligo County Museum, Sligo Abbey, Doorly Park and Yeats' Building and Society. Tourists attractions within the area of Carrick-on-Shannon include St George's Heritage and Visitor Centre and Costello Chapel. Tourist attractions within Manorhamilton include Manorhamilton Castle, Manoorhamilton Town Trail and Leitrim Sculpture Centre.

County Leitrim has a wide range of nationally significant tourism assets which include but are not limited to the following:

- Drumkeeran Heritage Centre - The Drumkeeran Heritage Centre's Irish cottage and farmyard includes a traditional sweat house, pig sty, old style garden, agricultural machinery, artefacts, and a craft shop. It is surrounded by scenic mountains, lakes, and woods.
- Fenagh Visitor Centre – Visitors can make use of an indoor soft play centre, coffee shop, and heritage centre.
- Sliabh An Iarainn Visitor Centre - The centre provides audio-visual displays about the Arigna and the Sliabh an Iarainn mountains area, in Drumshanbo County Leitrim, with a special emphasis on the railway, the canal, lakes, and iron and coal mining.
- Creevelea Abbey - one of the last monasteries established in Ireland prior to the suppression under Henry VIII. It is particularly noted for a lovely stone carving of Francis of Assisi.
- Glenview Folk Museum - Glenview Folk Museum, in Ballinamore, County Leitrim, houses a private collection of over 6,000 antique, historical, and novel items from pre-Famine Ireland.
- Kiltyclogher Heritage Centre and Seán MacDiarmada's Cottage – Home to an exhibition about the 1916 Proclamation signatory Seán MacDiarmada. The exhibition contains an audio-visual facility and interpretive panels, providing visitors with information about Seán MacDiarmada and the history of the locality. Guided tours also available.
- Glencar Waterfall - Situated near Glencar Lake, the facilities on site include a car park, picnic area, public toilets, playground, tearoom and Tourist Information Point.
- Lough Allen Adventure – Outdoor recreation centre in Leitrim. Activities include kayaking, canoeing, windsurfing, glamping.
- Parkes Castle – restored plantation castle of the early 17th century, picturesquely situated on the shores of Lough Gill, once the home of Robert Parke and his family. The Courtyard grounds contain evidence of an earlier 16th century Tower House structure once owned by Sir Brian O'Rourke who subsequently was executed at Tyburn, London in 1591. The Castle has been restored using Irish oak and traditional craftsmenship.
- Lough Allen Canal - developed by the ESB in the early 1900s and rarely rarely used, until its restoration in 1996. It is now used as an amenity area where the towpaths have been developed for walking and cycling along the Shannon Blueway.
- Lough Key Forest Park (located in Co. Roscommon but within 20km of the proposed wind farm) - Located in an area of great historical interest and is comprised of vast woodland and numerous islands. A wealth of historical and archaeological points of interest can be found throughout the Park including ringforts, a souterrain, Fishing Pavilion, Fairy Bridge, Wishing Chair, Icehouse, Stables and Estate Chapel. The park also includes a visitor centre, café, caravan park and marina.

County Sligo has a wide range of nationally significant tourism assets which include but are not limited to the following:

- The Fireside Folklore Experience - The Fireside Folklore Experience is located at Drumcliffe, an area rich in ancient history. It tells of local customs, traditions and the ways of its people from the past right up to the present.
- Carrowmore Megalithic Cemetery – The largest and one of the most important, megalithic sites in Europe. Over 60 tombs have been located by archaeologists. The oldest pre-dates Newgrange by 700 years and is older than the pyramids.

- Clogher Castle - Located on a rounded ridge with ground sloping away on all sides and surrounded by mature woodland within Coolavin Demesne of the McDermott family.
- Sligo Folk Park - Highlights include a tour of the recreated turn of the century village street, the worlds most travelled cottage, the forge, 18th century farmhouse, huge collection of artifacts restored farm equipment and farm animals.
- Sligo Abbey – This Dominican abbey survives from medieval days. It was built in 1252 and was accidentally burnt down in 1414, 'The Abbey', as it is known locally, was further damaged during the 1641 rebellion.
- Lissadell House & Gardens – Lissadell House & Gardens is situated on the shores of Sligo Bay, 7km north of Sligo on the N15 Donegal Road along the Wild Atlantic Way. The historic and literary associations of Lissadell and the wild dramatic natural beauty of its setting surrounded by mountains, sea and woodlands makes Lissadell a must visit heritage attraction in the North West.
- Woodville Farm – A guided tour of Woodville Farm takes you through mature woodland, green fields, and historic farm buildings where a variety of farm animals including some rare breeds, live in natural surroundings.
- Doorley Park - Once a wetland, now a semi wild landscaped park, it was transformed in the 19th Century. Today, lakes, woodland and wetlands offer great picnicking and walking. There is a nature trail that takes in the best plant life, wildlife and views.
- Creevykeel Court Tomb – This monument is situated at the foothills of Tievebaun Mountain, near the sea at Mullaghmore, and is one of the finest examples in Ireland of what is known as a full-court tomb.

5.3.3 Tourist Attitudes to Wind Farms

5.3.3.1 Scottish Tourism Survey 2016

BiGGAR Economics undertook an independent study in 2016, entitled '*Wind Farms and Tourism Trends in Scotland*', to understand the relationship, if any, that exists between the development of onshore wind energy and the sustainable tourism sector in Scotland. In recent years the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. The study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Eight local authorities had seen a faster increase in wind energy deployment than the Scottish average. Of these, five also saw a larger increase in sustainable tourism employment than the Scottish average, while only three saw less growth than the Scottish average. The analysis presented in this report shows that, at the Local Authority level, the development of onshore wind energy does not have a detrimental impact on the tourism sector. This found that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. There was no pattern emerging that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development. However the report also concluded that '*Although this study does not suggest that there is any direct relationship between tourism sector growth and wind farm development, it does show that wind farms do not cause a decrease in tourism employment either at a local or a national level.*'

5.3.3.2 Fáilte Ireland Surveys 2007 and 2012

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether or not the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The survey involved face-to-face interviews with 1,300 tourists (25% domestic and 75% overseas). The results of the survey are presented in the Fáilte Ireland Newsletter 2008/No.3 entitled '*Visitor Attitudes on the Environment: Wind Farms'.*

The Fáilte Ireland survey results indicate that most visitors are broadly positive towards the idea of building wind farms in Ireland. There exists a sizeable minority (one in seven) however who are negative towards wind farms in any context. In terms of awareness of wind farms, the findings of the survey include the following:

- Almost half of those surveyed had seen at least one wind farm on their holiday to Ireland. Of these, two thirds had seen up to two wind farms during their holiday.
- Typically, wind farms are encountered in the landscape while driving or being driven (74%), while few have experienced a wind farm up close.
- Of the wind farms viewed, most contained less than ten turbines and 15% had less than five turbines.

With regard to the perceived impact of wind farms on sightseeing, the Fáilte Ireland report states:

> *"Despite the fact that almost half of the tourists interviewed had seen at least one wind farm on their holiday, most felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing, with 15% claiming that they had a negative impact."*

In assessing the perceived impact of wind farms on beauty, visitors were asked to rate the beauty of five different landscapes types: Coastal, Mountain, Farmland, Bogland and Urban Industrial, and then rate on a scale of 1-5 the potential impact of a wind farm being sited in each landscape. The survey found that each potential wind farm must be assessed on its own merits. Overall however, in looking at wind farm developments in different landscape types, the numbers claiming a positive impact on the landscape due to wind farms were greater than those claiming a negative impact, in all cases.

Regarding the perceived impact of wind farms on future visits to the area, the Fáilte Ireland survey states:

> *"Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland. Of those who feel that a potentially greater number of wind farms would positively impact on their likelihood to visit, the key driver is their support for renewable energy and potential decreased carbon emissions."*

The report goes on to state that while there is a generally positive disposition among tourists towards wind development in Ireland, it is important also to take account of the views of the one in seven tourists who are negatively disposed towards wind farms. This requires good planning on the part of the wind farm developer as well as the Local Authority. Good planning has been an integral component of the proposed development throughout the site design and assessment processes. Reference has been had to the Department of the Environment, Heritage and Local Government's '*Planning Guidelines on Wind Energy Development'* (2006) throughout all stages, including pre-planning consultation and scoping.

The 2007 survey findings are further upheld by a more recent report carried out by Fáilte Ireland on tourism attitudes to wind farms in 2012. The results of the updated study were published in the 'Fáilte Ireland Newsletter 2012/No.1 entitled '*Visitor Attitudes on the Environment: Wind Farms – Update on 2007 Research*'. The updated survey found that of 1,000 domestic and foreign tourists who holidayed in Ireland during 2012, over half of tourists said that they had seen a wind turbine while travelling around the country. Of this number of tourists, 21% claimed wind turbines had a negative impact on the landscape. However, 32% said that it enhanced the surrounding landscape, while 47% said that it made no difference to the landscape. Almost three quarters of respondents claim that potentially greater numbers of wind farms would either have no impact on their likelihood to visit or have a strong or fairly strong positive impact on future visits to the island of Ireland.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 5.4 below.

5.4 Public Perception of Wind Energy

5.4.1 Sustainable Energy Ireland Survey 2003

5.4.1.1 Background

The results of a national survey entitled '*Attitudes Towards the Development of Wind Farms in Ireland*' were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

5.4.1.2 Findings

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual impact of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that impact on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental impacts of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the impact of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

5.4.1.3 Survey Update 2017

Additionally, a survey carried out by Interactions in October 2017, published by the SEAI, show 47% of Irish adults polled said they were are strongly in favour of wind power in Ireland while a further 38% favour it. Overall this is a 4% increase in favourable attitudes towards wind power compared with similar research in 2013.

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents in favour of the use of wind energy in Ireland. Approximately two thirds of respondents (70%) would prefer to power their home with renewable energy over fossil fuels, and 45% would be in favour of a wind farm development in their area.

The survey also captured the perceived benefits of wind power among the public. Of those surveyed three quarters selected good for the environment and reduced Carbon Dioxide emissions while fewer people, just over two in three, cited cheaper electricity.

5.4.1.4 Conclusions

The main findings of the SEAI survey indicate that the overall attitude to wind farms is "almost entirely positive". The study highlights that, in 2017, two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a "Not In My Back Yard" (NIMBY) effect. The final section of the 2017 report states:

> *"The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments – especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities."*

5.4.2 Public Perceptions of Wind Power in Scotland and Ireland Survey 2005

5.4.2.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen ('*Green on Green: Public Perceptions of Wind Power in Scotland and Ireland*', Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

5.4.2.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. in Ireland Surveys were carried out, at two sites in Counties Cork and Kerry, each of which has two wind farms in close proximity.

5.4.2.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as "*overwhelmingly positive*" at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed wind farms than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, may people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative impacts of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is "*not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)*".

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that "*those who see the wind farms most often are most accepting of the visual impact*". The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse impact on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals "*a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms*".

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

5.4.2.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY syndrome does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

5.4.3 IWEA Interactions Opinion Poll on Wind Energy

Published in January 2020, IWEA undertook a national opinion poll on Wind Energy November 2019 with the objective to "*measure and track public perceptions and attitudes around wind energy amongst Irish adults.*" Between November 20th – 30th 2019, a nationally represented sample of 1,019 adults and a booster sample of 200 rural residents participated in an online survey. The 2019 results indicate that 79% of both the nationally represented sample and rural sample strongly favour or oppose wind power while 16% of both samples neither favour or oppose it. Amongst those in favour of wind power, the majority cited environmental and climate concerns as their main reasons for supporting such developments. Other reasons cited for supporting wind energy developments include: "economic benefits," "reliable/efficient," "positive experience with wind energy" and recognise it as a "safe resource." When questioned about wind developments in their local area, 55% of nationally represented sample favour or tend to favour such proposals and 51% of the rural population reported the same. Reasons cited for supporting wind developments in their local area include: "good for the environment," "social responsibility," "create jobs," "good for the community."

The IWEA November 2019 survey follows previous national opinion polls on wind energy undertaken in October 2017 and November 2018. The 2019 survey results are consistent with the 2017 and 2018 figures and thus indicate that approximately 4 out of 5 Irish adults have continued to support for wind energy in recent years.

5.5 Health Impacts of Wind Farms

5.5.1 Health Impact Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research has generally not supported these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Syndrome - An independent review of the state of knowledge about the alleged health condition'**, Expert Panel on behalf of Renewable UK, July 2010*

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled '*Wind Turbine Syndrome*', in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and also assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- *"The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;*
- *The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and*
- *Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpoint's respondents by the mechanisms proposed."*

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects arising in humans arising from noise at the levels of that generated by wind turbines.

2. ***'Wind Turbine Sound and Health Effects - An Expert Panel Review'**, American Wind Energy Association and Canadian Wind Energy Association, December 2009*

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- *"There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.*
- *The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.*
- *The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences."*

The report found, amongst other things, that:

- *"Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.*
- *Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;*
- *The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."*

3. ***'A Rapid Review of the Evidence'**, Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010*

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential impacts on human health and, in particular, to validate the finding of the 'Wind Turbine Sound and Health Effects - An Expert Panel Review' (see Item 2 above) that:

- *"There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*
- *There is currently no published scientific evidence to positively link wind turbines with adverse health effects.*
- *'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

4. ***'Position Statement on Health and Wind Turbines'**, Climate and Health Alliance, February 2012*

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. There is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from infrasound (a component of low frequency sound) at the low levels that may be emitted by wind turbines."*

The Position Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. It states that:

> *"Fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms... Local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of place and people's sense of identity."*

CAHA notes the existence of "*misinformation about wind power*" and, in particular, states that:

> *"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."*

CAHA notes that:

> *"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."*

This, it states, is in contrast to the health impacts of fossil fuel energy generation.

5. ***'Wind Turbine Health Impact Study -Report of Independent Expert Panel' –*** *Massachusetts Departments of Environmental Protection and Public Health (2012)*

An expert panel was established with the objective to, inter alia, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential impacts and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under a number of headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

- *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
- *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.*
- *None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."*

In relation to shadow flicker, the expert panel found the following:

- *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
- *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

6. ***Wind Turbines and Health, A Critical Review of the Scientific Literature,*** *Massachusetts Institute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)*

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, were compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 5-1 of this EIAR. Another recent publication by Chapman and Crichton (2017) entitled '*Wind turbine syndrome; A communicated disease*' critically discusses why certain health impacts might often be incorrectly attributed to wind turbines.

7. ***Position Paper on Wind Turbines and Public Health***
HSE Public Health Medicine Environment and Health Group, February 2017

The Health Service Executive (HSE) position paper on wind turbines and public health was published in February 2017 to address the rise in wind farm development and concerns regarding potential impacts on public health. The paper discusses previous observations and case studies which describe a broad range of health effects that are associated with wind turbine noise, shadow flicker and electromagnetic radiation.

A number of comprehensive reviews conducted in recent years to examine whether these health effects are proven has highlighted the lack of published and high quality scientific evidence to support adverse effects of wind turbines on health.

The HSE position paper determines that current scientific evidence on adverse impacts of wind farms on health is weak or absent. Further research and investigative processes are required at a larger scale in order to be more informative for identifying potential health effects of exposure to wind turbine effects. They advise developers on making use of the Draft Wind Energy Development Guidelines (2006), as a means of setting noise limits and set back distances from the nearest dwellings.

8. *Environmental Noise Guidelines for the European Region: World Health Organisation Regional Office for Europe, 2018.*

The WHO Environmental Noise Guidelines provide recommendations for protecting human health from exposure to environmental noise originating from various sources such as transportation noise, wind turbine noise and leisure noise. The Guideline Development Group (GDG) defined priority health outcomes and from this were able to produce guideline exposure levels for noise exposure.

For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB Lden. The GDG recognise the potential for increased risk of annoyance at levels below this value but cannot determine whether this increase risk can impact health. Wind turbine noise above this level is associated with adverse health effects.

The GDG points out that evidence on health effects from wind turbine noise (apart from annoyance) is either absent or rated low/very low quality and, therefore, effects related to attitudes towards wind turbines are hard to differentiate from those related to noise and may be partly responsible for the associations. The GDG also recognises that the percentage of people exposed to noise from wind turbines is far lower than other sources such as road traffic and state that any benefit from specifically reducing population exposure to wind turbine noise in all situations remains unclear.

That being said, the GDG recommends renewable energy policies include provisions to ensure noise levels from wind farm developments do not rise above the gnideline values for average noise exposure. The GDG also provides a conditional recommendation for the implementation of suitable measures to reduce noise exposure, however, it states that no evidence is available to facilitate the recommendation of one type of intervention over another

5.5.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s 'Wind Energy Development Guidelines

for Planning Authorities 2006' and the 'Draft Revised Wind Energy Development Guidelines' (Department of Housing, Planning and Local Government (DoHPLG), December 2019) (currently out for public consultation), iterate that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations and should be kept to a minimum. People or animals can safely walk up to the base of the turbines.

The adopted 2006 Guidelines and the Draft 2019 Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to resuming operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the site of the proposed development or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

5.5.3 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The ESB document 'EMF & You' (ESB, 2017) provides further practical information on EMF (https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0).

Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in Section 14.2 of this EIAR.

5.5.4 Assessment of Effects on Human Health

As set out in the Department of Housing, Planning, Community and Local Government 'Key Issues Consultation Paper on the Transposition of the EIA Directive 2017' and the gnidance listed in Section 1.8.1 of Chapter 1: Introduction, the consideration of the effects on populations and on human health should focus on health issues and environmental hazards arising from the other environmental factors, for example water contamination, air pollution, noise, accidents, disasters.

Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, Chapter 10: Air and Climate, Chapter 11: Noise and Vibration and Chapter 14: Material Assets (Roads and Traffic) provide an assessment of the effects of the proposed development on these areas of consideration. There is the potential for negative effects on human health during the wind farm construction phase related to potential emissions to air of dust, potential emissions to land and water of hydrocarbons, release of potentially silt-laden runoff into watercourses and noise emissions. The assessments however show that the residual impacts are not significant and will not lead to significant effects on any environmental

media with the potential to lead to health effects for humans. On this basis, the potential for negative health effects associated with the proposed development is imperceptible.

The proposed site design and mitigation measures outlined in Chapter 8 and Chapter 9 ensures that the potential for impacts on the water environment are not significant. No impacts on local water supplies are anticipated.

As set out in Chapter 9, potential health effects are associated with negative impacts on public and private water supplies and potential flooding. There are no mapped public or group groundwater scheme protection zones in the area of the proposed wind farm site.

The preliminary Flood Risk Assessment (Appendix 9-1) has also shown that the risk of the proposed wind farm contributing to downstream flooding is low.

A wind farm is not a recognised source of pollution. It is not an activity which requires Environmental Protection Agency licensing under the Environmental Protection Agency Act 1992, as amended. As such, a wind farm is not considered to have ongoing significant emissions to environmental media and the subsequent potential for human health effects.

The proposed project is for the development of a renewable energy project, a wind farm, capable of offsetting carbon emissions associated with the burning of fossil fuels. During the operational stage the wind farm will have a long term, slight, positive effect on air quality as set out in Chapter 10 which will contribute to positive effects on human health.

5.5.5 Vulnerability of the Project to Natural Disaster

As outlined in Section 5.5.4 above a wind farm is not a recognised source of pollution. Should a major accident or natural disaster occur the potential sources of pollution onsite during both the construction and operational phases are limited. Sources of pollution with the potential to cause significant environmental pollution and associated negative effects on health such as bulk storage of hydrocarbons or chemicals, storage of wastes etc. are limited.

There is limited potential for significant natural disasters to occur at the Croagh Wind Farm site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to flooding, fire and landslide events. The risk peat instability and failure (landslide) occurring on the site is addressed in the Geotechnical and Peat Stability Assessment Report included in Appendix 8-1 of this EIAR which concludes that the proposed Croagh wind farm site has an acceptable margin of safety and is suitable for wind farm development . The risk of flooding is addressed in Chapter 9. It is considered that the risk of significant fire occurring, affecting the wind farm and causing the wind farm to have significant environmental effects is limited. As described earlier, there are no significant sources of pollution in the wind farm with the potential to cause environmental or health effects. Also, the spacing of the turbines and distance of turbines from any properties limits the potential for impacts on human health. The issue of turbine safety is addressed in Section 5.5.2.

Major industrial accidents involving dangerous substances pose a significant threat to humans and the environment; such accidents can give rise to serious injury to people or serious damage to the environment, both on and off the site of the accident. The wind farm site is not regulated or connected to or close to any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations i.e. SEVESO sites and so there is no potential effects from this source.

5.6 Property Values

In the absence of any Irish studies on the effect of wind farms on property values, this section provides a summary of the largest and most recent studies from the United States and Scotland.

The largest study of the impact of wind farms on property values has been carried out in the United States. 'The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single-family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study was visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that "The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact."*

This study has been recently updated by LBNL who published a further paper entitled "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States", in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property prices. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

Both LBNL studies note that their results do not mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they are considered to be statistically insignificant. Therefore, although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialise in all the major U.S. studies conducted thus far.

A further study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. Its main conclusions are:

- Overall the analysis found that the county-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the five sites examined across England and Wales has not had a detectable negative impact on house price growth within a five-kilometre radius of the sites.

A relatively new study issued in October 2016 'Impact of wind Turbines on House Prices in Scotland' (2016) was published by Climate Exchange. Climate Exchange is Scotland's independent centre of expertise on climate change which exists to support the Scottish Governments policy development on climate and the transition to a low carbon economy. A copy of the report is included as Appendix 5-2 of this EIAR.

The report presents the main findings of a research project estimating the impact on house prices from wind farm developments. It is based on analysis of over 500,000 property sales in Scotland between 1990 and 2014. The key findings from the study are:

- No evidence of a consistent negative effect on house prices: Across a very wide range of analyses, including results that replicate and improve on the approach used by Gibbons (2014), we do not find a consistent negative effect of wind turbines or wind farms when averaging across the entire sample of Scottish wind turbines and their surrounding houses. Most results either show no significant effect on the change in price of properties within 2km or 3km or find the effect to be positive.
- Results vary across areas: The results vary across different regions of Scotland. Our data does not provide sufficient information to enable us to rigorously measure and test the underlying causes of these differences, which may be interconnected and complex.

Although there have been no empirical studies carried out in Ireland on the impacts of wind farms on property prices, the literature described above demonstrates that at an international level, wind farms have not impacted property values in the local areas. It is a reasonable assumption based on the available international literature, that the provision of a wind farm at the proposed location would not impact on the property values in the area.

5.7 Shadow Flicker

5.7.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room, and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker impact depends on several factors, each of which is outlined below.

1. *Whether the sunlight is direct and unobstructed or diffused by clouds:*

If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud for well over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to our geographical position off the northwest of Europe, close to the path of Atlantic low-pressure systems which tend to keep us in humid, cloudy airflows for much of the time. A study of mean cloud amounts at 12 stations over a 25-year period showed that the mean cloud amounts were at their minimum in April and their maximum in July. Cloud amounts were less by night than by day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum between 1000 and 1500 GMT at most stations. *(Source: Met Éireann, www.met.ie)*

2. *The presence of intervening obstructions between the turbine and the observer:*

For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. *How high the sun is in the sky at a given time:*

At distances of greater than approximately 500 metres between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. At distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low *('Wind Energy Development Guidelines for Planning Authorities'*, DoEHLG, 2006). Figure 5-3 illustrates the

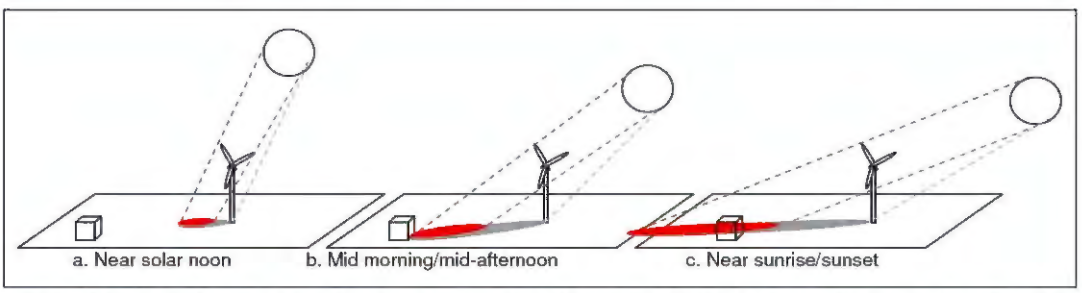


Figure 5-2 Shadow-Prone Area as a Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, December 2008

shadow cast by a turbine at various times during the day, where the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

4. *Distance and bearing, i.e. where the property is located relative to a turbine and the sun:*

The further a property is from the turbine the less pronounced the impact will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and, the centre of the rotor's shadow passes more quickly over the land reducing the duration of the impact.

At distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This impact occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak impact is observed at distance from the turbines. (Source: *Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change,* 2010)

5. *Property usage and occupancy:*

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed.

6. *Wind direction, i.e. position of the turbine blades:*

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades have to be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 5-4.

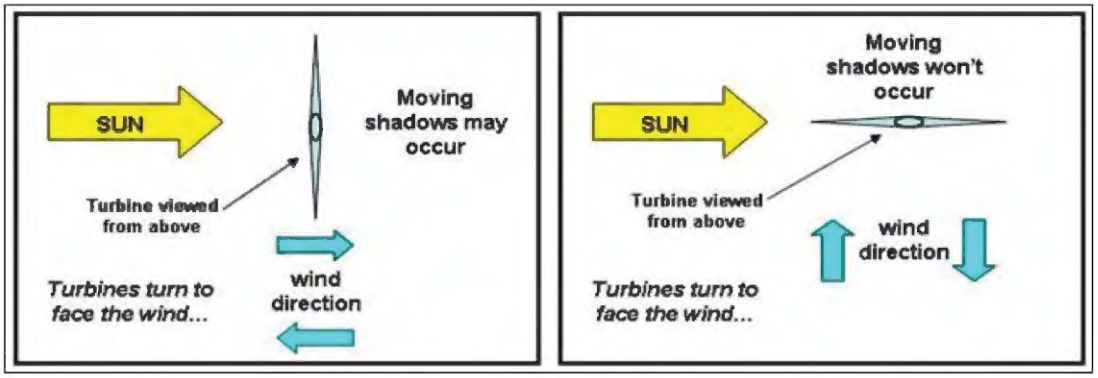


Figure 5-3 Turbine Blade Position and Shadow Flicker Impact (Source: Wind Fact Sheet: Shadow Flicker, Noise Environmental Power LLC)

7. *Rotation of turbine blades:*

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at

which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, no shadow flicker will occur.

5.7.2 Guidance

The relevant Irish guidance for shadow flicker is derived from the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government (DoEHLG), 2006) and the '*Best Practice Guidelines for the Irish Wind Energy Industry*' (Irish Wind Energy Association, 2012).

The DoEHLG 2006 wind energy guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year or 30 minutes per day. A significant minimum separation distance from houses of 850m has been achieved with the project design. There are only 5 no. dwellings located within 1 km of any proposed wind turbine location with only one of these dwellings being occupied. This occupied dwelling is located approximately 850 metres north of the closest proposed turbine location.

The DoEHLG guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

Although the DoEHLG thresholds apply to dwellings located within 500 metres of a proposed turbine location, for the purposes of this assessment, the guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all properties located within ten rotor diameters (i.e. assumed at 1.4 kilometres as a worst-case scenario) of the proposed turbines within the proposed development site (as per IWEA guidelines, 2012). The DoEHLG Guidelines state that at distances greater than 10 rotor diameters from a turbine, the potential for shadow flicker is very low.

The adopted 2006 DoEHLG guidelines are currently under review. The DoHPLG released the 'Draft Revised Wind Energy Development Guidelines' in December 2019.. The Draft 2019 guidelines recommend local planning authorities and/or An Bord Pleanála impose conditions to ensure that:

"no existing dwelling or other affected property will experience shadow flicker as a result of the wind energy development subject of the planning application and the wind energy development shall be installed and operated in accordance with the shadow flicker study submitted to accompany the planning application, including any mitigation measures required."

The Draft 2019 Guidelines are based on the recommendations set out in the 'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review' (December 2013) and the 'Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach' (June 2017).

The assessment herein is based on compliance with the current DoEHLG Guidelines limit (30 hours per year or 30 minutes per day However, it should also be noted the proposed development can be brought in line with the requirements of the 2019 draft guidelines, should they be adopted while this application is in the planning system, through the implementation of the mitigation measures outlined in Section 5.9.3.3.

5.7.3 Shadow Flicker Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The Department of the Environment, Heritage and Local Government (DoEHLG) guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker in the first instance, all of which have been employed at the site of the proposed development. Proper siting of wind turbines is key to reducing or eliminating shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential shadow flicker impact can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker impact is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed if the model indicates that an exceedance of the shadow flicker guideline limit might occur, as detailed further below.

For the purposes of this shadow flicker assessment, the software package WindFarm Version 4.1.2.3 has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

5.7.4 Shadow Flicker Assessment Criteria

5.7.4.1 Turbine Dimensions

Planning permission is being sought for a turbine size envelope with a maximum tip height of up to 170 metres. For the purposes of this assessment, a turbine with a rotor diameter of 140 metres and a hub height of 100 metres was modelled in order to assess a worst-case scenario. While these dimensions have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process, and could include turbines of a different rotor diameter and hub height configuration (within the 170-metre tip height envelope) than considered as part of this assessment.

Regardless of the make or model of the turbine eventually selected for installation on site, it will have a maximum tip height of up to 170 metres and the potential shadow flicker impact it will give rise to will be no more than that predicted in this assessment. With the benefit of the mitigation measures outlined in this section, any turbine to be installed onsite will be able to comply with the DoEHLG 2006 guidelines thresholds of 30 minutes per day or 30 hours per year, or with the revised guidelines if required, through the use of turbine control software. Any references to the turbine dimensions in this shadow flicker assessment should be considered in the context of the above and should not be construed as pre-determining the dimensions of the wind turbine to be used on the site.

5.7.4.2 Study Area

There is a total of 24 No. residential buildings including occupied, unoccupied/derelict dwellings, located within a distance of 10 rotor diameters (assumed at 1,400 metres) from the proposed turbine locations.

The area was also the subject of a planning history search, to identify properties that may have been granted planning permission, but not yet been constructed. Of the 24 No. buildings, 23 are dwellings and 1 is derelict (formerly residential). The locations of the buildings are shown in Figure 5-5, with all residential buildings detailed in Table 5-9 in Section 5.7.6 below..

5.7.4.3 Assumptions and Limitations

At each property, shadow flicker calculations were carried out based on 4 no. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The degrees from north value for each window is:

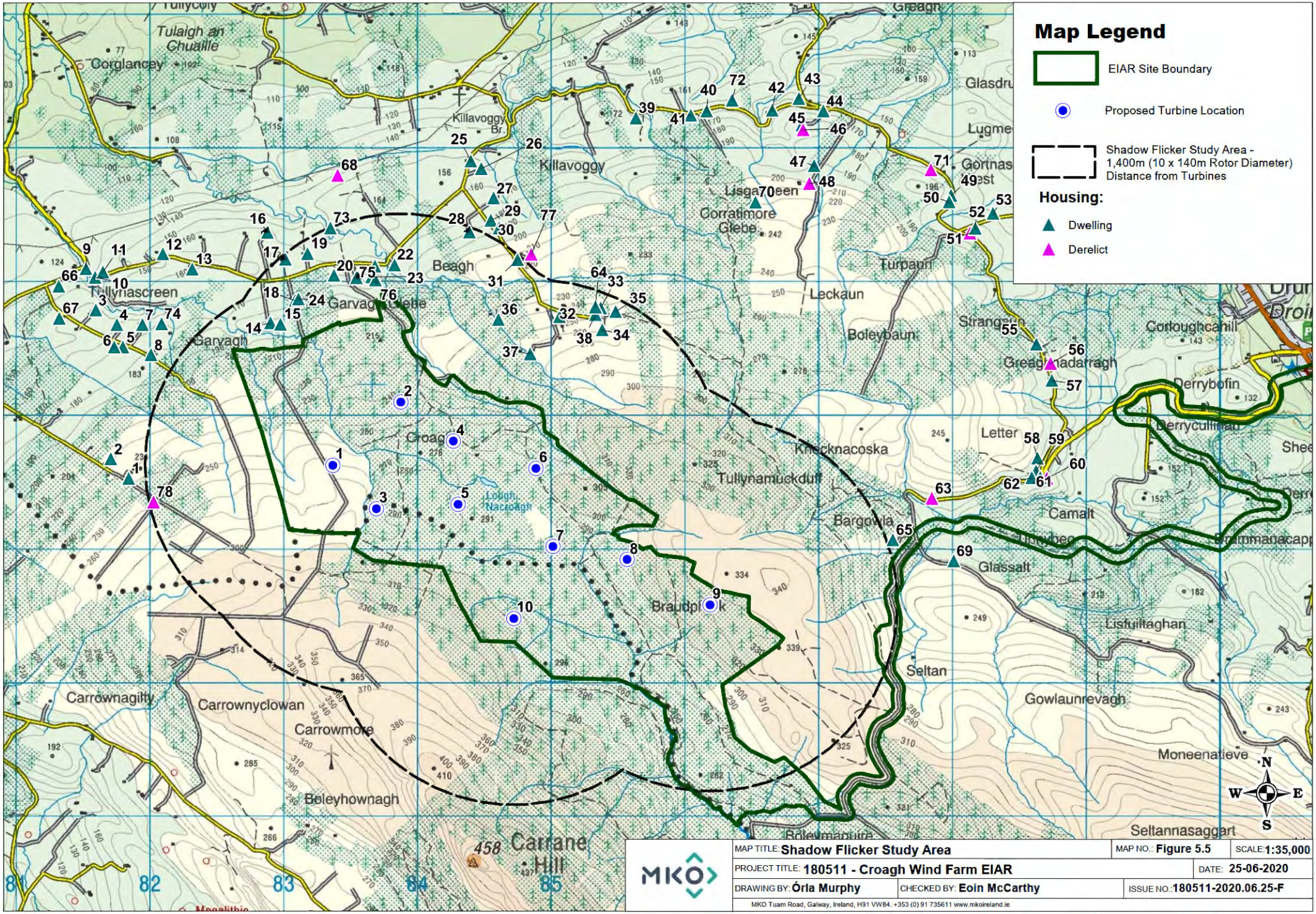
- Window 1: 0 degrees from North
- Window 2: 90 degrees from North
- Window 3: 180 degrees from North
- Window 4: 270 degrees from North

Each window measures one-metre-high by one-metre-wide, and tilt angle is assumed to be zero. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the study area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker impact, with larger windows resulting in slightly longer shadow flicker durations, any additional incidences or durations or shadow flicker over and above those predicted in this assessment can be countered by extending the mitigation strategies outlined in Section 5.9.3.9.

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, referred to as the '*worst-case impact*', due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific 'cut-in speed', and cease operating at a specific 'cut-out speed'. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turned on at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modelled maximum aspect.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average



MAP TITLE: **Shadow Flicker Study Area**		MAP NO.: **Figure 5.5**	SCALE: **1:35,000**
PROJECT TITLE: **180511 - Croagh Wind Farm EIAR**			DATE: **25-06-2020**
DRAWING BY: **Órla Murphy**	CHECKED BY: **Eoin McCarthy**		ISSUE NO.: **180511-2020.06.25-F**

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for 24% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Claremorris, the closest weather station with long-term data, over the 30-year period from 1971 to 2000 (www.met.ie). The actual sunshine hours at the proposed development site and therefore the percentage of time shadow flicker could actually occur is 24% of daylight hours. Table 5-9 below therefore lists the annual shadow flicker calculated for each property when the regional average of 24% sunshine is taken into account, to give a more accurate annual average shadow flicker prediction.

Table 5-9 below also outlines whether a shadow flicker mitigation strategy is required for each property to mitigate potential exceedances of the daily and/or annual threshold figure.

5.7.5 Shadow Flicker Assessment Results

5.7.5.1 Daily and Annual Shadow Flicker

The WindFarm computer software was used to model the predicted daily and annual shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker.

The model results assume worst-case conditions, including

- 100% sunshine during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the sun is behind the turbine blades,
- That the turbine blades are always facing the property, and
- That the turbine blades are always moving.

The maximum daily shadow flicker model is based on the assumption that daylight hours consist of 100% sunshine. This is a conservative assumption which represents a worst-case scenario. Following the detail provided above on sunshine hours, a sunshine factor of 24% has been applied. Taking these probabilities into consideration, an approximation of the 'estimated actual' annual shadow flicker occurrence has been calculated and is presented in Table 5-9.

The predicted maximum daily and annual shadow flicker levels are then considered in the context of the DoEHLG's guideline daily threshold of 30 minutes per day and annual threshold of 30 hours per year. If there is a predicted exceedance of the threshold limits at any property, the turbines that contribute to the exceedance are also identified.

The DoEHLG Wind Energy Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 minutes per day or 30 hours per year. As detailed in Section 5.1, a siguificant minimum separation distance from houses of 850m has been achieved with the project design. There are only 5 no. dwellings located within 1 kilometre of any proposed wind turbine location with only one of these dwellings being occupied. This occupied dwelling is located approximately 850 metres north of the closest proposed turbine location. However, for the purposes of this assessment, the guideline threshold has been applied to all residential properties within 1,400 metres of the proposed turbine locations.

Note a total of 24 No. buildings have been modelled as part of the shadow flicker assessment, the results of which are presented in Table 5-9 below. Former residential dwellings termed as "derelict" within this assessment are defined as properties that are currently in an uninhabitable condition, but which may have the potential to be restored to their former use.

Table 5-9 Maximum Potential Daily & Annual Shadow Flicker

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (km)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)? *
14	582,856	824,696	Dwelling	1.13	2	0:31:48	43:12:00	10:22:05	1,2	Yes
15	582,931	824,685	Dwelling	1.06	2	0:33:00	44:00:00	10:33:36	1,2	Yes
16	582,833	825,372	Dwelling	1.60	2	0:00:00	0:00:00	0:00:00		No
17	582,968	825,171	Dwelling	1.36	2	0:27:00	24:18:00	5:49:55		No
18	583,040	824,862	Dwelling	1.08	2	0:32:24	26:48:00	6:25:55	1,2	Yes
19	583,133	825,213	Dwelling	1.30	2	0:28:48	29:54:00	7:10:34		No
20	583,331	825,051	Dwelling	1.06	2	0:34:12	35:18:00	8:28:19	2	Yes
21	583,637	825,119	Dwelling	1.02	2	0:31:48	20:42:00	4:58:05	2	Yes
22	583,784	825,128	Dwelling (unoccupied)	1.01	2	0:49:48	25:18:00	6:04:19	2,4	Yes
23	583,612	825,040	Dwelling (unoccupied)	0.95	2	1:03:00	50:48:00	12:11:31	2,4	Yes
24	583,065	824,874	Dwelling	1.08	2	0:33:00	25:48:00	6:11:31	1,2	Yes
28	584,344	825,375	Dwelling	1.36	2	0:13:12	3:24:00	0:48:58		No
31	584,704	825,168	Dwelling (unoccupied)	1.36	2	0:27:36	28:36:00	6:51:50		No
32	585,018	824,742	Dwelling	1.21	4	0:30:36	47:42:00	11:26:53	2,4	Yes
33	585,326	824,807	Dwelling	1.28	6	0:15:00	4:24:00	1:03:22		No
34	585,337	824,644	Dwelling	1.14	6	0:28:12	30:12:00	7:14:53		No
35	585,438	824,780	Dwelling	1.30	6	0:24:00	12:42:00	3:02:53		No
36	584,561	824,721	Dwelling (unoccupied)	0.95	2	0:51:36	63:12:00	15:10:05	2,4,6	Yes
37	584,799	824,463	Dwelling	0.85	6	1:07:12	96:42:00	23:12:29	2,4,5,6	Yes

Building No.	ITM Coordinates (Easting)	ITM Coordinates (Northing)	Description	Distance to Nearest Turbine (km)	Nearest Turbine	Max. Daily Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker: Pre-Mitigation (hrs:min:sec)	Max. Annual Shadow Flicker Adjusted for Average Regional Sunshine (hrs:min:sec)	Turbine(s) Giving Rise to Shadow Flicker Exceedance	Mitigation Strategy Required (for Potential Day Exceedance)? *
38	585,286	824,757	Dwelling	1.22	6	0:16:48	5:12:00	1:14:53		No
73	583,304	825,405	Dwelling	1.40	2	0:22:48	11:48:00	2:49:55		No
75	583,499	825,033	Dwelling (unoccupied)	0.98	2	0:35:24	32:42:00	7:50:53	2	Yes
76	583,641	825,016	Dwelling (unoccupied)	0.92	2	1:04:12	52:06:00	12:30:14	2,4	Yes
78	581,981	823,356	Derelict	1.36	1	0:26:24	12:42:00	3:02:53		No*

** A mitigation strategy is not considered necessary on a property that is derelict*

Of the 24 No. residential properties modelled, it is predicted that 13 No. properties may experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day. This prediction is assuming worst-case conditions (i.e. 100% sunshine on all days where the shadow of the turbines passes over a house, wind blowing in the correct direction, no screening present, etc.) and in the absence of any turbine control measures.

Of the 13 No. properties where shadow flicker is predicted to occur, when the regional sunshine average (i.e. the mean number of sunshine hours throughout the year) of 24% is taken into account, the DoEHLG total annual guideline limit of 30 hours is predicted as not being exceeded at any of the modelled properties.

It is worth nothing that in reality, the 'estimated actual' shadow flicker is considered conservative and likely to be siguificantly less than predicted in Table 5-9 as the following items are not considered by the model:

- Receivers may be screened by cloud cover and/or vegetation/built form i.e. hedging, adjacent buildings, farm buildings, garages or barns;
- Each receiver will not have windows facing in all directions onto the wind farm;
- At distances, greater than 500-1000m '*the rotor blade of a wind turbine will not appear to be chopping the light but the turbine will be regarded as an object with the sun behind it. Therefore, it is generally not necessary to consider shadow casting at such distances'.*

Section 5.9.3.9 outlines the mitigation strategies which may be employed at the potentially affected properties. to ensure the daily shadow flicker threshold will not be exceeded.

5.7.5.2 Cumulative Shadow Flicker

For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farms are considered where they are located within two kilometres of the proposed turbines. In this case, a cumulative shadow flicker assessment was carried out to include the existing Garvagh Glebe, Black Banks, and Geevagh Wind Farms.

The cumulative model results show that there is no cumulative shadow flicker experienced at the 24 no. properties assessed due the existing Garvagh Glebe, Black Banks, and Geevagh Wind Farms in conjunction with the proposed Croagh Wind Farm.

5.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

The wind farm site is located on a site mainly consisting of commercial forestry. The closest occupied dwelling to the proposed development is located 850m north of the closest proposed turbine location.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, 3) Visual Amenity and 4) Telecommunications. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise modelling have been completed as part of this EIAR (Section 5.7 above refers to shadow flicker modelling, Chapter 11 of the EIAR addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Chapter 12 of this EIAR. Impacts on human beings during the construction,operational and decommissioning phases of the proposed development are assessed in relation to each of these key

issues and other environmental factors such as traffic and dust; see Impacts in Section 5.9 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

5.9 Likely Significant Impacts and Associated Mitigation Measures

The below assessment evaluates the impact (where there is the potential for an impact to occur) on health and safety, employment, population, land-use, tourism, noise, dust, traffic, shadow flicker and residential amenity during the construction, operation and decommissioning phases, as a result of the proposed development.

5.9.1 'Do-Nothing' Scenario

If the Proposed Development were not to proceed, the existing uses of the site for commercial forestry would continue. These land-uses will also continue if the Proposed Development does proceed.

If the proposed development were not to proceed, the opportunity to capture an even greater part of County Leitrim and County Sligo's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment and to diversify the local economy would also be lost.

5.9.2 Construction Phase

5.9.2.1 Health and Safety

Pre-Mitigation Impacts

Construction of the proposed development will necessitate the presence of a construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative impact.

Proposed Mitigation Measures

The proposed development will be constructed, operated and decommissioned in accordance with all relevant Health and Safety Legislation, including:

- Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005);
- Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended;
- Safety, Health and Welfare at Work (Construction) Regnlations 2013 (S.I. 291 of 2013), as amended; and
- Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006).

A Health and Safety Plan covering all aspects of the construction process will address the Health and Safety requirements in detail. This will be prepared at the procurement stage and developed further at construction stage.

All hazards will be identified, and risks assessed. Where elimination of the risk is not feasible, appropriate mitigation and/or control measures will be established. The contractor will be obliged under the construction contract and current health and safety legislation to adequately provide for all hazards and risks associated with the construction phase of the project. Safepass registration cards are required for all construction, delivery and security staff. Construction operatives will hold a valid Construction Skills Certificate Scheme card where required. The developer is required to ensure a competent contractor is appointed to carry out the construction works. The contractor will be responsible for the implementation of procedures outlined in the Safety and Health Plan. Public safety will be addressed by restricting site access during construction. Fencing will be erected in areas of the site where uncontrolled access is not permitted. Appropriate warning signs will be posted, directing all visitors to the site manager. Appropriate warning measures including 'goalposts' will be used as appropriate to prevent contact with any overhead lines that traverse the site.

The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's '*Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006*'.

The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regnlations. These duties include (but are not limited to):

- Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project;
- Where possible, eliminate the hazards or reduce the risks;
- Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan;
- Ensure that the work of designers is coordinated to ensure safety;
- Organise co-operation between designers;
- Prepare a written Safety and Health Plan;
- Prepare a safety file for the completed structure and give it to the client; and
- Notify the Authority and the client of non-compliance with any written directions issued.

The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regnlations. These duties include (but are not limited to):

- Development of the Safety and Health Plan for the construction stage with updating where required as work progresses;
- Compile and develop safety file information
- Reporting of accidents / incidents;
- Weekly site meeting with PSCS;
- Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out:
- Induction of all site staff including any new staff enlisted for the project from time to time;
- Toolbox talks as necessary;
- Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date;
- Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance;
- Monitor the compliance of contractors and others and take corrective action where necessary; and
- Notify the Authority and the client of non-compliance with any written directions issued.

Residual Impact

With the implementation of the above, there will be a short-term potential slight negative residual impact on health and safety during the construction phase of the proposed development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.2 Employment and Investment

The design, construction and operation of the wind farm will provide employment for technical consultants, contractors and maintenance staff. Approximately, 80-100 jobs could be created during the construction, operation and maintenance phases of the proposed development. The construction phase of the wind farm will last between approximately 12 – 18 months. The majority of construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade. This will have a short-term significant positive impact.

The injection of money in the form of salaries and wages to those employed during the construction phase of the project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive impact on their cash flow. This will have a short-term slight positive indirect impact.

The proposed development will result in an influx of skilled people into the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive impact on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. This will have a long-term moderate positive indirect impact. According to the Irish Wind Energy Association there were over 3,400 jobs directly related to wind energy in Ireland in 2016, a figure which is projected to grow to over 8,000 by 2020.

Rates payments for the wind farm will contribute significant funds to Leitrim and Sligo County Councils, which will be redirected to the provision of public services within Co. Leitrim and Co. Sligo. These services include provisions such as road upkeep, fire services, environmental protection, street lighting, footpath maintenance etc. along with other community and cultural support initiatives.

Proposed Community Benefit Scheme

Two important areas of Government policy development which will have a bearing on the establishment of future community benefit funds, the draft Wind Energy Guidelines and the Renewable Energy Support Scheme (RESS), the terms and conditions for which were published in February 2020. Both sets of policy are expected to provide the Government requirements on future community benefit funds for renewable energy projects

Coillte expects that for each megawatt hour (MWh) of electricity produced by the wind farm, the project will contribute €2 into a community fund for the RESS period i.e. first 15 years of operation and €1 per MWh for the remaining lifetime of the wind farm. If this commitment is improved upon in upcoming Government Policy we will adjust accordingly.

If this project is constructed as currently designed we estimate that a total of approximately 5 million euro will be available in the local area for community funding over the lifetime of the project. The above figure is indicative only and will be dependent on the generation capacity of the wind farm which is influenced by a number of factors including:

1. *Number of wind turbines.*
2. *Capacity and availability of energy production of those turbines.*
3. *Quantity of wind.*

The Community Benefit Fund belongs to the local community. The premise of the fund is that it should be used to bring about significant, positive change in the local area. To make this happen, our first task will be to form a benefit fund development working group that clearly represents both the close neighbours to the project as well as nearby communities. This group will then work on designing the governance and structure of a community entity that would administer the Community Benefit Fund. We aim to commence this work in summer 2020.

5.9.2.3 Population

Those working on the construction phase of the proposed development will travel daily to the site from the wider area. The construction phase will have no impact on the population of the area in terms of changes to population trends or density, household size or age structure.

5.9.2.4 Land-use

The existing land-use of commercial forestry will continue on the site of the proposed development. However, a small section of commercial forestry within the site will be felled as part of the wind farm development. Whilst there will be a change of land use in these areas to facilitate the development of the wind turbines and infrastructure, this is an acceptable and unavoidable part of the proposed development.

The existing land-use of road networks will continue on the proposed grid connection route options. There will be no change to existing land-uses in the wider area as a result of the proposed grid connection.

5.9.2.5 Tourism and Amenity

Given that there are currently no tourism attractions specifically pertaining to the site there are no impacts associated with the construction phase of the development. With regard to tourist attractions and amenity use around the site, described in Section 5.3.2, traffic management measures will be in place. Please see Traffic impacts below for further details on proposed mitigation measures.

5.9.2.6 Noise

Pre-Mitigation Impacts

There will be an increase in noise levels in the vicinity of the Proposed Development site during the construction phase, as a result of heavy machinery and construction work. These effects will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation, pouring of the turbine bases and the extraction of stone from the borrow pit. Excavation of a base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise effects that will occur during the construction phase of the Proposed Development are further described in Chapter 12 of this EIAR. This will have a temporary slight negative impact.

With regard to the proposed grid connection route; construction works will give rise to noise, however these noise impacts will have no additional effect as there are no sensitive receptors located along the proposed grid connection cabling route.

Proposed Mitigation Measures

Best practice measures for noise control will be adhered to onsite during the construction phase of the proposed development in order to mitigate the slight short-term negative impact associated with this phase of the development. The measures include:

- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in **Error! Reference source not found.Error! Reference source not found.** using methods outlined in British Standard BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it could occasionally be necessary to work out of these hours.

Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Fit suitably designed muffler or sound reduction equipment to the rock breaking tool to reduce noise without impairing machine efficiency.
- Ensure all leaks in air lines are sealed.
- Use a dampened bit to eliminate ringing.
- Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured.
- Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.

Where blasting is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

- Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs).
- Notification to nearby residents before blasting starts (e.g. 24-hour written notification).
- The firing of blasts at similar times to reduce the 'startle' effect.
- On-going circulars informing people of the progress of the works.
- The implementation of an onsite documented complaints procedure.
- The use of independent monitoring by external bodies for verification of results.

- Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.

Residual Impact

Following the implementation of the above mitigation measures, there will be a short-term imperceptible negative residual impact due to an increase in noise levels during the construction phase of the proposed development.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.7 Dust

Pre-Mitigation Impacts

Potential dust emission sources during the construction phase of the proposed development include upgrading of existing access tracks and construction of new access roads, turbine foundations and substation. The entry and exit of construction vehicles from the site may result in the transfer of mud to the public road, particularly if the weather is wet. This may cause nuisance to residents and other road users. These impacts will not be significant and will be relatively short-term in duration.

Proposed Mitigation Measures

The majority of aggregate material for the construction of roads and turbine bases will be sourced from the proposed borrow pit located within the main site of the proposed wind farm development, therefore limiting the distance needed to transport this material to the site. Truck wheels will be washed to remove mud and dirt before leaving the site. All plant and materials vehicles shall be stored in the compound area or other dedicated areas. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. Construction traffic will be restricted to defined routes and a speed limit will be implemented.

In periods of extended dry weather, dust suppression may be necessary along haul roads to ensure dust does not cause a nuisance. If necessary, water will be taken from the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and the temporary site compound to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

The active construction area along the proposed grid connection route options will be small, ranging from 150-300m in length at any one time. Should separate crews be used during the construction phase they will generally be separated by 1-2km. All construction machinery will be maintained in good operational order while on-site, minimising any emissions that are likely to arise. Aggregate materials for the construction of the cabling route will be sourced locally to reduce the amount of emissions associated with vehicle movements. Potential dust emissions during the construction period will not be significant and will be relatively short-term in duration.

Residual Impact

Short-term imperceptible negative impact

Significance of Effects

Based on the assessment above there will be no significant direct and indirect effects.

5.9.2.8 Traffic

Pre-Mitigation Impacts

It is proposed that large wind turbine components will be delivered to the site of the proposed development, from Dublin Port or Galway Port, via the M4 Motorway which becomes the N4 National Primary Route at Knocksimon, Co. Westmeath. The delivery vehicles will continue northwest on the N4 before turning will turning on to the R299 Regional Road at Drumsna, Co. Leitrim. From here the delivery vehicles will travel northwest before turning right on to the R280 Regional Road and continuing north before turning left onto the proposed link road in the village of Drumkeeran, as described in Section 4.4.1.1 above. The delivery vehicles will turn south onto the L4282 in the townland of Derryboffin and continue west along the L4282 to the proposed new construction site access road at Derrycullinan, as described in Section 4.4.1.1 above. The delivery vehicles will travel southeast along the proposed construction access road before swithing back in a westerly direction and then turning south again onto the L4282 and continue south towards the main site entrance in the townland of Boleymaguire. The proposed route is shown on Figure 4-29 of this EIAR.

Other construction materials will be delivered to the site via the existing junction between the R280 and the L4282 in the village of Drumkeeran before and continue on the local road before reaching the construction access junction in Derrycullinan. It is intended that some passenger vehicles carrying construction staff and regular HGVs delivering construction materials will turn onto the L4282 at the crossroads in Drumkeeran and continue to the main site entrance site entrance in Boleymaguire via the local road without using the construction access road.

Traffic movements generated by the proposed development are discussed in in Section 14.1 of Chapter 14, Material Assets. Non-turbine construction traffic will be comprised of Heavy Goods Vehicle (HGV) and Light Goods Vehicle (LGV) movements involved in the delivery of construction materials to the site and the export of excess construction materials and plant from the site. A complete Traffic and Transportation Assessment (TTA) of the proposed development has been carried out by Alan Lipscombe Traffic and Transport Consultants. The full results of the TTA are presented in Section 14.1 of this EIAR.

The types of vehicles that will be required to negotiate the local network represent abnormal size loads and a detailed assessment of the geometry of the proposed route was therefore undertaken. This will have a short-term slight negative impact.

With regard to the proposed grid connection route, there is the potential for short term nuisance to local road users along the short section of cabling route located along the public road network, giving rise to a short-term slight negative impact.

Proposed Mitigation Measures

A traffic management plan an outline of which is included as Appendix 14-2 will be developed and implemented to ensure any impact is short term in duration and slight in siguificance along the proposed grid connection route. Prior to commencement of any works, the occupants of dwellings in the vicinity of the proposed works will be contacted and the scheduling of works will be identified in line with the Engagement plan. Local access to properties will also be maintained throughout any construction works and local residents will also be supplied with the number of the works supervisor in order to ensure that disruption will be kept to a minimum. In relation to the cable laying works, the works area in any one day will be approximately 100-150m in length and so the potential for significant disruption is limited.

Residual Impact

Once the traffic management plan is implemented for the construction phase of the proposed development, there will be a short-term imperceptible negative residual impact on local road users.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.2.9 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 5.7 of this chapter of the EIAR, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker impacts associated with the construction phase of the proposed development.

5.9.3 Operational Phase

The effects set out below relate to the operational phase of the proposed development.

5.9.3.1 Health and Safety

Pre-Mitigation Impact

It is not anticipated that the operation of the wind farm will present a danger to the public and livestock. Rigorous safety checks are conducted on the turbines during design, construction, commissioning and operation to ensure the risks posed to staff, landowners and general public are negligible.

Proposed Mitigation Measures

Notwithstanding the above, the following mitigation measures will be implemented during the operation of the proposed development to ensure that the risks posed to staff, landowners and general public remain negligible throughout the operational life of the wind farm.

Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits.

Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary.

Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include:

- Buried cable route markers at 50m (maximum) intervals and change of cable route direction;
- Directions to relevant turbines at junctions;
- "No access to Unauthorised Personnel" at appropriate locations;
- Speed limits signs at site entrance and junctions;
- "Warning these Premises are alarmed" at appropriate locations;
- "Danger HV" at appropriate locations;

- "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at site entrance;
- "No unauthorised vehicles beyond this point" at specific site entrances; and
- Other operational signage required as per site-specific hazards.

An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the site and providing for access for emergency services at all times.

The components of a wind turbine are designed to last up to 30 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the site's health and safety requirements.

Residual Impact

With the implementation of the above mitigation measures, there will be a long-term, imperceptible residual impact on health and safety during the operational life of the proposed development

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

5.9.3.2 Employment and Investment

The operational phase will present an opportunity for mechanical-electrical contractors and craftspeople to become involved with the maintenance and operation of the wind farm. On a long-term scale, the proposed development will create approximately 2-3 jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

5.9.3.3 Population

The operational phase of the proposed development will have no impact on the population of the area with regards to changes to trends, population density, household size or age structure.

5.9.3.4 Land-use

The footprint of the proposed development site, including turbines, roads etc., will occupy only a small percentage of the total site defined for the purposes of this EIAR. The main land-use of the site is for commercial forestry; and during the operational phase, any commercial forestry activity on the site will continue to co-exist with the wind farm. The proposed development will have no impact on other land-uses within the wider area.

5.9.3.5 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be reasonably concluded that there would be a long-term imperceptible impact from the proposed development.

5.9.3.6 Noise

A baseline assessment of the existing background noise conditions was carried out, the results of which are presented in Chapter 11 of the EIAR. A noise assessment of the operational phase of the proposed development has also been carried out through modelling of the development using noise prediction software. The predicted noise levels for the proposed development have been compared with the existing background noise levels and the best practice guidance levels for noise emissions from wind farms. The existing Garvagh Glebe and Black Banks wind farms are within 2km of the proposed development and have been considered as part of the cumulative noise impact assessment.

Details of the noise assessment carried out by AWN Consulting are presented in Chapter 11 of the EIAR. The noise assessment determined that the predicted operational noise effect at the closest noise sensitive receptors to the site is of a moderate, negative, long-term nature. It is noted that this effect considers the periods of greatest potential effect prior to mitigation, i.e. the worst-case scenario. For the majority of locations assessed, operation of the proposed turbines will have a slight, negative, long-term effect. The noise assessment notes that these effects should be considered in terms that the effect is variable, and that this assessment considers periods of the greatest potential effect.

As stated in the noise assessment in Chapter 11, it has been demonstrated that the relevant national guidance in relation to noise associated with proposed wind turbines can be satisfied, therefore the predicted impact associated with the operational turbines is long term and not significant.

5.9.3.7 Traffic

Two to three service technicians may have to attend to the site of the proposed wind farm during on a weekly basis of operational phase of the project. A Traffic and Transportation Assessment (TTA) of the proposed development has been completed by Alan Lipscombe Traffic and Transport Consultants, the results of which are presented in Section 14.1 of this EIAR. The TTA found that there will be a long-term imperceptible impact on traffic created during the operational phase of the proposed wind farm.

5.9.3.8 Renewable Energy Production and Reduction in Greenhouse Gas Emissions

Emissions from energy production accounted for 19.3% of Ireland's greenhouse gas emissions in 2017 ('*Ireland's Final Greenhouse Gas Emissions 1990 - 2017*', EPA (April 2019), less than the 20.5% recorded in 2016. The National Climate Change Strategy 2007 – 2012 stated that electricity generation from renewable sources provides the most effective way of reducing the contribution of power generation to Ireland's greenhouse gas emissions. The proposed development will offer significant benefits in terms of renewable energy production and reductions in greenhouse gas emissions. In this regard, it will have a long-term siguificant positive impact. The carbon loss and savings due to the proposed development are discussed in Chapter 10 of this EIAR.

5.9.3.9 Tourism and Amenity

Pre-Mitigation Impacts

Currently there are no dedicated amenity walkways within the site of the proposed development. As part of the proposed development design, approximately 3.75km of amenity pathways including walkways and cycleways and a 24-car carpark will be provided. Sections of new site roads will be developed and promoted for walking activities in additional to dedicated amenity walkways. These dedicated areas will provide a safer visitor experience and open the site up to locals, tourists, trail runners etc. Full details of the proposed recreation and amenity infrastructure is included in Section 4.6 of this EIAR.

Proposed Mitigation Impacts

None required.

Residual Impact

The proposed development will have a long-term positive impact on local amenity due to the social and recreational benefits associated with the recreational amenity walkways/ paths.

Significance of Effects

The addition of dedicated recreational and amenity routes for locals and tourists will have a significant positive effect on amenity in the local area.

5.9.3.10 Shadow Flicker

Pre-Mitigation Impacts

Assuming worst-case conditions, a total of 13 properties, as a result of the proposed Croagh Wind Farm may experience daily shadow flicker in excess of the current DoEHLG guideline threshold of 30 minutes per day. The DoEHLG total annual gnideline limit of 30 hours is not predicted to be exceeded at any of the 13 properties when the regional sunshine average of 24% is taken into account.

Proposed Mitigation Measures

Where daily shadow flicker exceedances have been predicted at buildings by the modelling software, a site visit will be undertaken firstly to determine the level of occurrence, existing screening and window orientation. Upon commissioning of the proposed wind farm, the shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to.

1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).*
2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.*
3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.*
4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded.*

Screening Measures

In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including:

- Installation of appropriate window blinds in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.

If agreement can be reached with the homeowner, then it would be arranged for the required mitigation to be implemented in cooperation with the affected party as soon as practically possible and for the full costs to be borne by the wind farm operator.

Wind Turbine Control Measures

If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine control measures will be implemented.

Wind turbines will be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm. The shadow flicker control units will be added to any required turbines and are not cost prohibitive.

A shadow flicker control unit allows a wind farm's turbines to be programmed and controlled using the wind farm's SCADA control system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

All predicted incidents of shadow flicker can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to ensure that shadow flickers occurrences at properties which are not naturally screened or cannot be screened with measures outlined above. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the wind farm site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photocells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. The moving blades of the turbine will require a short period of time to cease rotating and as such there may be a very short period (less than 3 to 5 minutes) during which the blades are slowed to a complete halt. The turbines giving rise to shadow flicker may be turned off on different days to prevent excessive wear and tear on any single turbine. This method of shadow flicker mitigation has been technically well-proven at wind farms in areas outside Ireland that experience significantly longer periods of direct sunlight.

This measure can be utilised at the site of the proposed development to prevent incidences of shadow flicker values at any house. Therefore, the proposed wind farm could be brought in line with the requirements of the Draft Revised Wind Energy Development Guidelines 2019 should they be adopted during the planning application process for this development.

Should a complaint be received within 12 months of commissioning of the wind farm, field investigation/monitoring will be carried out by the wind farm operator at the affected property. With the permission of the homeowner, the wind farm developer will log the date, time and duration of shadow flicker events occurring on at least five different days from within the dwelling. The provided log will be compared with the predicted occurrence of shadow flicker at the residence, and if necessary, a field investigation will be carried out.

Residual Impact

Shadow flicker could potentially have a long-term, slight, negative impact. However, the implementation of the above mitigation measures where an exceedance in the existing daily and annual shadow flicker limits at residential properties up to a distance of 10 rotor diameters from the proposed development, will ensure that there will be no impact from shadow flicker on human beings.

Significance of Effects

Based on the assessment above and the mitigation measures proposed there will be no significant effects related to shadow flicker.

5.9.3.11 Residential Amenity

Pre-Mitigation Impacts

Potential impacts on residential amenity during the operational phase of the proposed wind farm could arise primarily due to noise, shadow flicker, changes to visual amenity or interference with telecommunications. Detailed noise and shadow flicker modelling have been carried out as part of this EIAR, which shows that the proposed development will be capable of meeting all required gnidelines in relation to noise thresholds and the shadow flicker thresholds set out in the 2006 DoEHLG Wind Energy Guidelines.

The visual impact of the proposed development is addressed comprehensively in Chapter 12 of this EIAR. An assessment of roadside screening was carried out for roads within 5 kilometres of the proposed turbine locations, with both the methodology and findings of this described in Section 12.7.3.3.3 of this EIAR. Many of these roads have intermittent/partial and dense screening, and therefore these roads which fall within the ZTV will have more screening and therefore reduced views, rather than the full visibility that the ZTV suggests. Given the separation distance of the residential properties from the proposed turbines, and the level of existing screening in the area, the proposed development will have no significant impact on existing visual amenity at dwellings.

As part of the scoping and consultation exercise undertaken by MKO, the national and regional broadcasters and fixed and mobile phone operators were contacted with regard to potential interference from the proposed wind farm. Full details are provided in Section 2.5 of the EIAR (in Chapter 2: Background to the Proposed Development) and Section 14.2 of the EIAR (in Chapter 14: Material Assets – Telecommunications and Aviation). Copies of scoping replies received are presented in Appendix 2-1 of the EIAR. The proposed wind farm will have no impact on telecommunications.

Proposed Mitigation Measures

As detailed above, there are no turbines proposed within approximately 850 metres of any property. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIAR will be implemented in order to reduce insofar as possible impacts on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route.

Residual Impact

With the implementation of the mitigation measures outlined in relation to noise and vibration, dust, traffic, shadow flicker, telecommunications and visual amenity, the proposed development will have no significant impact on residential amenity..

Significance of Effects

Based on the assessment above there will be no significant effects on residential amenity.

5.9.4 Decommissioning Phase

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of turbines, subject to planning permission being obtained, or the site may be decommissioned fully. Site roads constructed as part of the wind farm development will remain *insitu*. The substation will remain in place as it will be under the ownership of the ESB.

The works required during the decommissioning phase are described in Section 4.11 in Chapter 4 of this EIAR. Any impact and consequential effect that occurs during the decommissioning phase will be similar to that which occurs during the construction phase, however to a lesser extent.

5.9.5 Cumulative Effects

For the assessment of cumulative impacts, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered where they have the potential to generate an in-combination or cumulative impact with the construction and operational phases of the proposed Croagh Wind Farm. Further information on projects considered as part of the cumulative assessment are given in Section 2.8 of this EIAR. The impacts with the potential to have cumulative impacts on human beings, in particular noise, air and climate, shadow flicker, traffic, telecommunications and visual impacts are addressed in their relevant chapters of this EIAR.

5.9.5.1 Health and Safety

The proposed wind farm will have no impacts in terms of health and safety. There is no credible scientific evidence to link wind turbines with adverse health impacts.

5.9.5.2 Employment and Economic Activity

There is one permitted wind farm and 15 no. operational existing wind farms sites located within 20 kilometres of the proposed wind farm site. The proposed development in combination with the permitted project will contribute to short term employment during their construction stages. The proposed development in combination with all the existing and permitted projects will provide the potential for long-term employment resulting from maintenance operations. This results in a long-term moderate positive impact.

The commercial forestry activities on the site of the proposed wind farm provides between 3-6 months of employment, either for harvesting or replanting per year. These activities can continue while the proposed wind farm is under construction and operating, resulting in a long-term moderate positive cumulative impact.

5.9.5.3 Tourism and Amenity

There are no key identified tourist attractions pertaining specifically to the site of the proposed development itself.

It is not considered that the proposed development together with other projects in the area will cumulatively affect any tourism infrastructure in the wider area. As mentioned previously, wind farms are an existing feature in the surrounding landscape, which will assist in the assimilation of the proposed development into this environment.

5.9.5.4 Traffic

All other wind farms, accessed via the same local road network as the proposed development are existing are operational and therefore there is no potential for cumulative impacts on local traffic to occur during the construction of the Croagh Wind Farm development.

5.9.5.5 Property Values

As noted in Section 5.6 above, the conclusions from available international literature indicate that property values are not impacted by the positioning of wind farms near houses. It is on this basis that it can be concluded that there would be a long-term imperceptible cumulative impact from the proposed development and other wind farm developments in the area.

5.9.6 Shadow Flicker

As stated in Section 5.7.5.2 above, the cumulative shadow flicker model results show that there is no cumulative shadow flicker experienced at the 24 no. properties assessed due the existing Garvagh Glebe, Black Banks, and Geevagh Wind Farms in conjunction with the proposed Croagh Wind Farm.

6. BIODIVERSITY

6.1 Introduction

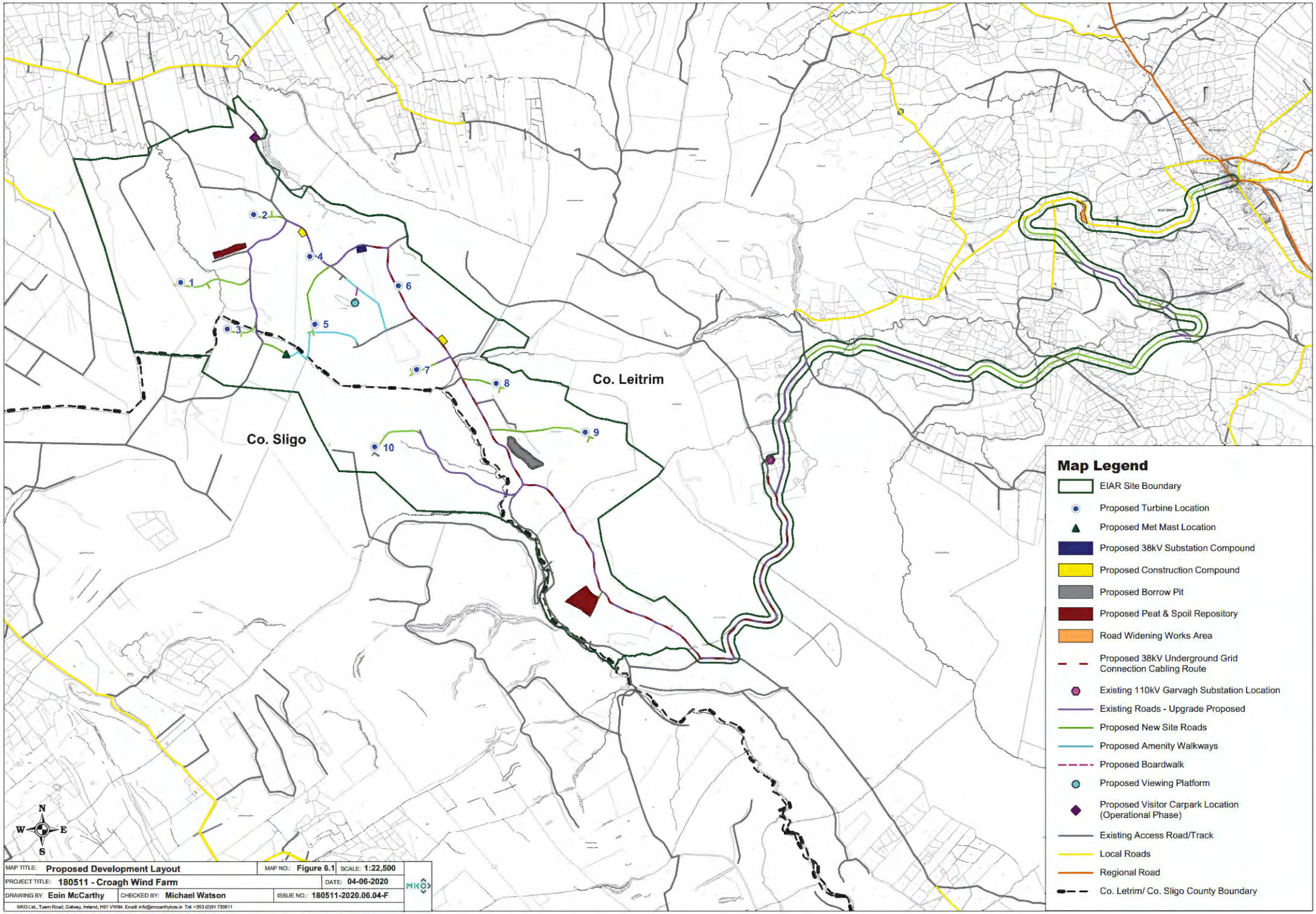
This chapter assesses the likely significant effects (both alone and cumulatively with other plans and projects) that the proposed development may have on Biodiversity, Flora and Fauna and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified. The residual impacts on biodiversity are then assessed. Particular attention has been paid to species and habitats of ecological importance. These include species and habitats with national and international protection under the Wildlife Acts 1976-2012 as amended, EU Habitats Directive 92/43/EEC. Impacts on avian receptors are considered in Chapter Seven of this EIAR. The full description of the proposed development is provided in Chapter 4 of this EIAR.

The chapter is structured as follows

- The Introduction provides a description of the legislation, guidance and policy context applicable to Biodiversity, Flora and Fauna.
- This is followed by a comprehensive description of the ecological survey and impact assessment methodologies that were followed to inform the robust assessment of likely significant effects on ecological receptors.
- A description of the Baseline Ecological Conditions and Receptor Evaluation is then provided.
- This is followed by an Assessment of Effects which are described with regard to each phase of the development: construction phase, operational phase and decommissioning phase. Potential Cumulative effects in combination with other plans and projects are fully assessed.
- Proposed mitigation and best practice measures to avoid, reduce or offset the identified effects are described and discussed. This is followed by an assessment of residual effects taking into consideration the effect of the proposed mitigation and best practice measures.
- The conclusion provides a summary statement on the overall significance of predicted effects on Biodiversity, Flora and Fauna.

The following defined terms are utilised in this chapter:

- For the purposes of this EIAR, the entire project is referred to as the 'Proposed Development'.
- For the purpose of this EIAR chapter, the term 'EIAR Site Boundary'/ 'Site Boundary' refers to the site red line boundary as shown in Fignre 6-1.
- The term 'development footprint' is used to describe the lands that will be subject to the proposed infrastructure and associated construction works.
- "Key Ecological Receptor" (KER) is defined as a species or habitat occurring within the zone of influence of the development upon which likely significant effects are anticipated.
- "Zones of Influence" (ZOI) for individual ecological receptors refers to the zone within which potential effects are anticipated. ZOIs differ depending on the sensitivities of particular habitats and species and were assigned in accordance with best available gnidance and through adoption of a precautionary approach.



MAP TITLE: Proposed Development Layout	MAP NO.: Figure 6.1	SCALE: 1:22,500	
PROJECT TITLE: 180511 - Croagh Wind Farm		DATE: 04-06-2020	
DRAWING BY: Eoin McCarthy	CHECKED BY: Michael Watson	ISSUE NO.: 180511-2020.06.04-F	

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6.2 Requirements for Ecological Impact Assessment

National Legislation

The Wildlife Act, 1976–2012 as amended, is the principal piece of legislation governing protection of wildlife in Ireland. The Wildlife Act provides strict protection for species of conservation value. The Wildlife Act conserves wildlife (including game) and protects certain wild creatures and flora. These species are therefore considered in this report as ecological receptors.

Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) are heritage sites that are designated for the protection of flora, fauna, habitats and geological sites. Only NHAs are designated under the Wildlife (Amendment) Act 2017. These sites do not form part of the Natura 2000 network of European sites and the AA process, or screening for same, does not apply to NHAs or pNHAs. Proposed Natural Heritage Areas (pNHAs) were published on a non-statutory basis in 1995 but have not since been statutorily proposed or designated[1] However, these sites are considered to be of significance for wildlife and habitats as they may form statutory designated sites in the future (NPWS, 2020).

The Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) lists the species, hybrids and/or subspecies of flora protected under Section 21 of the Wildlife Acts. It provides protection to a wide variety of protected plant species in Ireland including vascular plants, mosses, liverworts, lichens and stoneworts. It illegal to cut, pick, collect, uproot or damage, injure or destroy species listed or their flowers, fruits, seeds or spores or wilfully damage, alter, destroy or interfere with their habitat (unless under licence).

National Policy

The National Biodiversity Action Plan 2017-2021 (Department of Culture, Heritage and the Gaeltacht, 2017) (the "**Plan**") demonstrates Ireland's continuing commitment to meeting and acting on its obligations to protect Ireland's biodiversity for the benefit of future generations through a series of targeted strategies and actions. The main objective of the Plan is to bring biodiversity into the mainstream of policy and decision-making. Objective 1 (*Mainstream biodiversity into decision-making across all sectors*) of the Plan identifies the following relevant measures in relation to future developments:

- "Incorporate into legislation the requirement for consideration of impacts on biodiversity to ensure that conservation and sustainable use of biodiversity are taken into account in all relevant plans and programmes and relevant new legislation;
- Public and Private Sector relevant policies will use best practice in SEA, AA and other assessment tools to ensure proper consideration of biodiversity in policies and plans;
- All Public Authorities and private sector bodies move towards no net loss of biodiversity through strategies, planning, mitigation measures, appropriate offsetting and/or investment in Blue-Green infrastructure;
- Strengthen ecological expertise in local authorities and relevant Government Departments and agencies;
- Local Authorities will review and update their Biodiversity and Heritage Action Plans;
- Local Authorities will review and update their Development Plans and policies to include policies and objectives for the protection and restoration of biodiversity;

[1] https://www.npws.ie/protected-sites/nha (accessed 23 January 2020).

- Develop Green Infrastructure at local, regional and national levels and promote the use of nature based solutions for the delivery of a coherent and integrated network;
- Continue to produce guidance on the protection of biodiversity in designated areas, marine and the wider countryside for Local Authorities and relevant sectors;
- Integrate Natura 2000 and Biodiversity financial expenditure tracking into Government Programmes internal paying agency management procedures including linkage to the Prioritised Action Framework and this NBAP;
- Develop a Natural Capital Asset Register and national natural capital accounts by 2020, and integrate these accounts into economic policy and decision-making;
- Initiate natural capital accounting through sectoral and small scale pilot studies, including the integration of environmental and economic statistics using the framework of the UN System of Experimental-Ecosystem Accounting (SEEA);
- Establish a national Business and Biodiversity Platform under the CBD's Global Business Partnership;
- Ensure Origin Green produces tangible benefits for biodiversity with increased emphasis on conservation and restoration of biodiversity;
- Implement actions from Ireland's Biodiversity Climate Change Sectoral Adaptation Plan;
- Identify and take measures to minimise the impact of incentives and subsidies on biodiversity loss, and develop positive incentive measures, where necessary, to assist the conservation of biodiversity;
- Establish and implement mechanisms for the payments of ecosystem services including carbon stocks, to generate increased revenue for biodiversity conservation and restoration;
- Develop and implement a National Biodiversity Finance Plan to set out in detail how the actions and targets of this NBAP will be delivered from 2017 and beyond; and
- Monitor the implementation of the Plan"

Such policies have informed the evaluation of ecological features recorded within the study area and the ecological assessment process.

European Legislation

The EU Habitats Directive (92/43/EEC) (together with the Birds Directive (79/409/EEC), as subsequently codified by Council Directive 2009/147/EC on the conservation of wild birds) forms the cornerstone of Europe's nature conservation within the EU. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. The Habitats Directive protects over 1,000 animal and plant species and over 200 "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance. The Habitats Directive and Birds Directive, which were transposed into Irish law through Part XAB of the Planning and Development Acts 2000-2019 (from a land use planning perspective) recognise the significance of protecting rare and endangered species of flora and fauna, and more importantly, their habitats.

Annex I of the Habitats Directive lists habitat types whose conservation requires the designation of Special Areas of Conservation (SAC). Priority habitats, such as Turloughs, which are in danger of disappearing within the EU territory are also listed in Annex I. Annex II of the Directive lists animal and plant species (e.g. marsh fritillary, Atlantic salmon, and Killarney fern) whose conservation also requires the designation of SAC. Annex IV lists animal and plant species in need of strict protection such as lesser horseshoe bat and otter, and Annex V lists animal and plant species whose taking in the wild and exploitation may be subject to management measures. In Ireland, species listed under Annex V include Irish hare, common frog and pine marten. Species can be listed in more than one Annex, as is the case with otter and lesser horseshoe bat which are listed on both Annex II and Annex IV.

The disturbance of species under Article 12 of the Habitats Directive (and in particular avoidance of deliberate disturbance of Annex IV species, particularly during the period of breeding, rearing,

hibernation and migration and avoidance of deterioration or destruction of breeding sites or resting places) has been specifically assessed in this EIAR.

Council Directive 2009/147/EC on the conservation of wild birds (the "**Birds Directive**") instructs Member States to take measures to maintain populations of all bird species naturally occurring in the wild state in the EU (Article 2). According to Recital 1 of the Birds Directive, Council Directive 79/409/EEC on the conservation of wild birds was substantially amended several times and in the interests of clarity and rationality, the Birds Directive codifies Council Directive 79/409/EEC. Such measures may include the maintenance and/or re-establishment of habitats in order to sustain these bird populations (Article 3). A subset of bird species has been identified in the Directive and are listed in Annex I as requiring special conservation measures in relation to their habitats. These species have been listed on account of inter alia: their risk of extinction; vulnerability to specific changes in their habitat; and/or due to their relatively small population size or restricted distribution. Special Protection Areas (SPAs) are to be identified and classified for these Annex I listed species and for regularly occurring migratory species, paying particular attention to the protection of wetlands (Article 4).

In summary, the species and habitats provided National and International protection under these legislative and policy documents have been considered in this Ecological Impact Assessment. A detailed assessment of the likelihood of the proposed development having either a significant effect or an adverse impact on any relevant European Sites (i.e. SACs, cSACs, SPAs or cSPAs) has been carried out in the Appropriate Assessment Screening Report and Natura Impact Statement. A separate assessment has not been carried out in this chapter, to avoid duplication of assessments. However, the relevant conclusions have been cross-referenced and incorporated.

6.3 Relevant Guidance

The assessment methodology is based primarily upon the National Road Authority (NRA)'s Guidelines for Assessment of Ecological Impacts of National Road Schemes Rev 2 (NRA, 2009) (referred to hereafter as the NRA Ecological Impact Assessment Guidelines), and the survey methodology is based on the NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2009). Although these survey methodologies relate to road schemes, these standard gnidelines are recognised survey methodologies that ensure good practice regardless of the development type.

In addition, the following guidelines were consulted in the preparation of this document to provide the scope, structure and content of the assessment:

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater and Coastal (CIEEM, 2018).
- SNH (2019) '*Bats and onshore wind turbines: survey, Assessment and mitigation*'
- Draft Revised guidelines on the information to be contained in Environmental Impact Statements (EPA, 2017).
- Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. Department of the Environment, Community and Local Government DoEHLG (2013).
- Guidelines for assessment of Ecological Impacts of National Road Schemes, (NRA, 2009).
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (NRA, 2009).
- Environmental Assessment and Construction Guidelines (NRA, 2006).
- Advice Notes on Current Practice (in preparation of Environmental Impact Statements) (Environmental Protection Agency (EPA), 2003).
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2002).

- European Commission Guidance on the preparation of the Environmental Impact Assessment Report (2017)
- Environmental Protection Agency (EPA) '*Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports*' (August 2017)

This assessment has been carried out in accordance with the Environmental Impact Assessment guidance as outlined in Chapter 1 of the EIAR.

In addition to the above, the following legislation applies with respect to habitats, fauna and water quality in Ireland and has been considered in the preparation of this report:

- The International Convention on Wetlands of International Importance especially Waterfowl Habitat (Concluded at Ramsar, Iran on 2 February 1971)
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations 2003 which give further effect to EU Water Framework Directive (2000/60/EC).

The following legislation applies with respect to non-native species:

- Regulation 49 and 50 of European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477 of 2011).

This assessment has been prepared with respect to the various planning policies and strategy guidance documents listed below:

- Leitrim County Development Plan 2015 – 2021.
- Natura Impact Assessment Report on the Leitrim County Development Plan, Leitrim County Council, (2015).
- Sligo County Development Plan 2017-2023
- Natura Impact Assessment Report on the Sligo County Development Plan 2017-2023, Sligo County Council, (2017).
- Roscommon County Development Plan 2014 – 2020
- Roscommon Co. Co. 2017, Screening for Appropriate Assessment Report, Proposed Variation No. 1 to the Roscommon County Development Plan 2014-2020.

6.3.1 Statement of Authority

This report has been prepared by David McNicholas (BSc., MSc., MCIEEM) and Pat Roberts (B.Sc. Environmental Science, MCIEEM). David McNicholas has over 9 years' professional ecological consultancy experience and is a full member of the Chartered Institute of Ecology and Environmental Management. Pat Roberts has over 14 years' experience in ecological management and assessment. The baseline ecological surveys were undertaken by James Owens (BSc., MSc.), David McNicholas, Dr. Úna Nealon, Laoise Kelly (B.Sc), Julie O'Sullivan (BSc, MSc). James has over 4 years' consultancy experience and is a competent expert in undertaking ecological surveys. Úna Nealon's primary expertise lies in bat ecology. She completed her PhD with the Centre for Irish Bat Research, examining the impacts of wind farms on Irish bat species. Laoise Kelly, Julie O'Sullivan, all assisted in the gathering of baseline data at the proposed development site. They have relevant academic qualifications and are competent experts in undertaking the ecological surveys in which they were involved.

6.4 Methodology

Assessing the impacts of any project and associated activities requires an understanding of the ecological baseline conditions prior to and at the time of the project proceeding. Ecological baseline conditions are those existing in the absence of proposed activities (CIEEM, 2018).

The following sections outline the methodologies utilised to establish the baseline ecological condition of the proposed development site.

6.4.1 Desk Study

The desk study undertaken for this assessment included a thorough review of available ecological data including the following:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), EPA (Envision), Water Framework Directive (WFD), Geological Survey of Ireland (GSI) & Inland Fisheries Ireland (IFI).
- Review of Bird Atlases: (Sharrock, 1976; Lack, 1986; Gibbons *et al.*, 1993; Balmer *et al.*, 2013).
- Review of the Bat Conservation Ireland (BCI) Private Database.
- Review of the publicly available National Biodiversity Data Centre (NBDC) web-mapper.
- Data on potential occurrence of protected bryophytes – as per NPWS online map viewer; Flora Protection Order Map Viewer – Bryophytes[2].
- Inland Fisheries Ireland (IFI) Reports.
- Records from the National Parks and Wildlife Services ('NPWS') WS web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectad in which the Proposed Development is located.
- Review of NPWS Article 17 Metadata and GIS Database Files

6.4.2 Scoping and Consultation

MKO undertook a scoping exercise during preparation of this EIAR, as described in Chapter 2, Section 2.6 of this EIAR.

Copies of all scoping responses are included in Appendix 2-1 of this EIAR. The recommendations of the consultees have informed the EIAR preparation process and the contents of this chapter. Table 2.4 in Chapter 2 of this EIAR describes where the comments raised in the scoping responses received have been addressed in this assessment.

provides a list of the organisations consulted with regard to biodiversity during the scoping process.

Table 6-1 Organisations consulted with regard to biodiversity

Consultee	Response
Department of Culture, Heritage and the Gaeltacht	The scoping response provides a number of recommendations and a summary of the main points is provided below: 'in order to assess impacts on biodiversity, fauna, flora and habitats an ecological survey should be carried out of the proposed

[2] *NPWS, 2020, Online map viewer; Flora Protection Order Map Viewer – Bryophytes. Online, Available at: http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Accessed: 24/03/2020.*

	development site including the route of any access roads, pipelines or cables etc. to survey the habitats and species present'. 'Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive. These species could include otters (*Lutra lutra*). which are protected under the Wildlife Acts and listed on Annexes II and IV of the Habitats Directive, salmon (*Salmo salar*) and Lamprey species listed on Annex II of the Habitats Directive'. 'The EIAR should also address the issue of invasive alien plant and animal species such as Japanese Knotweed or piri piri burr, and detail the methods required to ensure they are not accidentally Introduced or spread during survey and/or construction'. Recommendations for the preparation of a Construction Management Plan were also provided along with guidance on cumulative impacts and post-construction monitoring.
Inland Fisheries Ireland - Shannon Region & Western Region	The scoping response provides a number of recommendations and a summary of the main points is provided below: In general, requirements regarding items to be addressed in surveys & assessment, in relation to the protection of aquatic habitat. 'All watercourses that will receive drainage from the construction sites of the turbines or the access roads must be assessed in terms of aquatic biodiversity with particular emphasis on fish, the food of fish, spawning grounds and fish habitat in general'. 'Electrofishing surveys will be required for all waters. Quantitative data in relation to all fish species should be compiled'. 'A drainage plan should be produced during both the construction phase and the operational phase'. 'The number and extent of watercourse crossings should be kept to a minimum'. 'An invasive species survey should be carried out and where species are identified a management plan must be drawn up'.
Irish Peatland Conservation Council	The scoping response provides a number of recommendations and a summary of the main points is provided below: Assess 'the effects of the construction and operation of a wind farm at Croagh will have on water quality be fully investigated'. 'Any development planned on or near peatland should have a management plan in place to eliminate the risk of alien species and protect Ireland's native biodiversity through not only the construction phase but also the operational stage'.

	In addition, concerns were raised in relation to the possible loss of blanket bog, impacts on designated sites and peat stability.
Roscommon County Council - Heritage	No comment received.
Leitrim County Council – Heritage	No comment received.
Sligo County Council – Heritage	The scoping response provides a number of recommendations and a summary of the main points is provided below: Require for the assessment of 'cumulative effect from the proposed wind fam in combination with all existing and permitted wind farms within 20 km of the site'. Bat surveys should be undertaken as part of the EIAR. A 'Construction Environmental Management Plan shall include details of Ecological Clerk of Works'. The EIAR shall address; flora protections species and that the 'standard methodology for habitat survey and mapping in Ireland shall be to Fossitt Level 3'.

In addition, a data request was sent to the National Parks and Wildlife Service, scientific data unit, and a response was received on the 9th of April 2019. The feedback is provided in Section 6.5.1 of the EIAR.

6.4.3 Field Surveys

A comprehensive survey of the biodiversity of the entire site was undertaken on various dates throughout 2017, 2019 and 2020. The following sections fully describe the ecological surveys that have been undertaken and provide details of the methodologies, dates of survey and guidance followed.

6.4.3.1 Multi-disciplinary Walkover Surveys (as per NRA Guidelines, 2009)

Multidisciplinary walkover surveys were undertaken within the site of the proposed development on the following dates;

- 14th June 2017
- 25th September 2017
- 24th April 2019
- 26th April 2019
- 24th June 2019
- 5th July 2019
- 14th August 2019
- 19th August 2019
- 21st August 2019
- 30th August 2019
- 13th September 2019
- 31st January 2020

All surveys of vegetation were completed within the optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith *et al.*, 2011). A comprehensive walkover of the entire EIAR primary study area was completed. Surveys undertaken outside of this period were not used to evaluate habitats.

The walkover surveys were also designed to detect the presence, or likely presence, of a range of protected species. The survey included a search for badger setts and areas of suitable habitat, potential features likely to be of significance to bats and additional habitat features for the full range of other protected species that are likely to occur in the vicinity of the proposed development (e.g. otter etc.). In addition, an inventory of other species of local biodiversity interest was compiled including invertebrates (butterflies, dragonflies, damselflies, beetles), plants, fungi etc.

The multi-disciplinary walkover surveys comprehensively covered the entire EIAR primary study area for features and locations of ecological significance. Based on the multi-disciplinary walkover survey findings, further detailed targeted surveys were carried out during follow-up species specific survey visits. These are described in detail below. These surveys were carried out in accordance with NRA *Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna* on National Road Schemes (NRA, 2009).

During the multidisciplinary surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted.

Other targeted survey methodologies undertaken at the site are described in the following subsections.

6.4.3.2 Dedicated Habitat and Vegetation Composition Surveys

Habitats within the site were classified according to the guidelines set out in 'A Guide to Habitats in Ireland" (Fossitt, 2000), which classifies habitats based on the vegetation present and management history. Vegetation was sampled by taking botanical quadrats/Relevés within representative habitat areas of the site. This allowed for accurate habitat classification. The location of each of the quadrats and the quadrat data is provided in Appendix 6-1, of the EIAR. The extent of each habitat on site was mapped on site using aerial photography, hand held GPS and smartphone technology. A representative photograph was also taken for each of the habitats recorded on site, including all relevés.

Habitats, such as peatlands recorded within the site, likely to correspond to EU Habitats Directive Annex I habitat types have been described and assessed in accordance with NPWS guidance from the relevant national Annex I habitat surveys/ Irish Wildlife Manuals. Where applicable, vegetation communities were also classified for habitats, in particular Annex I habitats, according to the Irish Vegetation Classification (IVC) system (Perrin, 2015[3]).

The habitat assessment surveys described in this report, including EU Habitats Directive Annex I classification and condition assessment, have been undertaken with reference to the following guidelines and interpretation documents:

- Perrin, P.M, Martin, J.R., Barron, J.R., Roche & O'Hanrahan, B. (2014) *Guidelines for a national survey and conservation assessment of upland vegetation and habitats in Ireland.* Version 2.0. Irish Wildlife Manuals, No. 79. National Parks and Wildlife Service.
- O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland.

[3] *Perrin, P.M., (2015) The Irish Vegetation Classification – Technical Progress Report No. 1, Online, Available at: http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Irish-Vegetation-Classification_Technical-Progress-Report-No.1-1.pdf Accessed 20.03.2020.*

- Martin, J.R., O'Neill, F.H. & Daly, O.H. (2018) The monitoring and assessment of three EU Habitats Directive Annex I grassland habitats. Irish Wildlife Manuals, No. 102. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.
- NPWS (2019), The Status of EU Protected Habitats and Species in Ireland. Volume 2: *Habitat Assessments*. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill
- NPWS (2013), The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Commission of the European Communities (2007) Interpretation manual of European Union habitats. Eur 27. European Commission DG Environment.

Habitats considered to be of ecological significance and in particular having the potential to correspond to those listed in Annex I of the EU Habitats Directive 92/43/EEC were identified and classified as KERs.

Plant nomenclature for vascular plants follows 'New Flora of the British Isles' (Stace, 2010), while mosses and liverworts nomenclature follows 'Mosses and Liverworts of Britain and Ireland - a field guide' (British Bryological Society, 2010).

6.4.3.3 Terrestrial Fauna Surveys

The results of the desk study, scoping replies and incidental records of protected species recorded during multidisciplinary walkover surveys were all used to inform the scope of targeted ecological surveys required. Based on these findings dedicated surveys for bats, otter and badger were undertaken at the times set out below following the methodologies also provided below. Following the completion of ecological walkover surveys, no requirement for further dedicated faunal surveys was identified. During the multidisciplinary walkover surveys, records of invertebrates including butterflies, damselflies, dragonflies, moths, beetles etc. were recorded. As suitable marsh fritillary habitat was identified following initial site visits and based on records in the wider area following the desk study, dedicated marsh fritillary butterfly surveys were deemed necessary.

6.4.3.3.1 *Badger Survey*

Dedicated badger surveys were conducted on the 14th June 2017, 26th April 2019, 13th September 2019 and 31st January 2020. In addition, records of any badger activity within the study area were also recorded during other faunal and habitat surveys of the site. The badger surveys covered the entire development footprint and surrounding boundary hedgerows/treelines. The site was systematically searched for signs of badger, incidental setts, prints, latrines, foraging signs or sightings. If encountered, setts were classified as per the convention set out in NRA (2009) (i.e. main, annexe, subsidiary, outlier). The badger survey was not constrained by vegetation given the nature of the habitats within the site and the timing of the surveys (NRA 2006a).

The badger survey was conducted adhering to best practice guidance (NRA, 2009) and followed the 'Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes' (NRA, 2006a) and following CIEEM best practice competencies for species surveys (CIEEM, 2013[4]).

6.4.3.3.2 *Otter Survey*

Following a review of the initial site walkover ecological surveys for constraints identification and the results of the multi-disciplinary walkover survey; areas identified as providing potential habitat for otter were subject to specialist targeted survey. The otter survey of watercourses was conducted on the 14th

[4] *CIEEM, 2013, Technical Guidance Series – Competencies for Species Survey, Online, Available at: https://cieem.net/resource/competencies-for-species-survey-css/ Accessed: 20.06.2019*

June and 25th September 2017, 5th July and 14th August 2019 and 31st January 2020. Additional otter surveys were undertaken during a fisheries assessment of the watercourses both within and downstream of the study area between the 19th and 21st August 2019.

The otter surveys were conducted as per NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes). This involved a search for all otter signs e.g. spraints, scat, prints, slides, trails, couches and holts. In addition to the width of the rivers/watercourses, a 10m riparian buffer (both banks) was considered to comprise part of the otter habitat (NPWS 2009). The dedicated otter surveys also followed the guidance as set out in NRA (2008) 'Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes' and following CIEEM best practice competencies for species surveys (CIEEM, 2013).

6.4.3.3.3 Bats

A detailed bat survey report is provided in Appendix 6-2 of this EIAR. This document provides a detailed description of survey methodologies undertaken at the site during the survey period 2018-2019. Full details of the survey times and dates and the methodologies followed are provided in Appendix 6-2 along with details of all the surveyors.

Survey design and effort in 2018 was created in accordance with the best practice guidelines available at the time, '*Bat Surveys: Good Practice Guidelines'* prepared by the Bat Conservation Trust (Hundt, 2012). Surveys undertaken in 2019 were undertaken in strict accordance with those prescribed in SNH (2019) '*Bats and onshore wind turbines: survey, Assessment and mitigation*'. This is in line with standard best practice industry guidelines.

6.4.3.3.4 Marsh fritillary surveys

Following the identification of suitable habitat for marsh fritillary within the site during habitat surveys, targeted surveys for the species were undertaken on 14th June and 22nd September 2017. The survey methodology followed that described in the NRA (2009) best practice guidance document. This involved walked surveys to identify suitable areas of marsh fritillary habitat within or adjacent to the development footprint. Where suitable habitat did occur, detailed surveys to locate larval webs were undertaken. In addition, habitat suitability assessments were undertaken within areas of suitable habitat for the species following those developed by the NBDC[5].

6.4.3.3.5 Aquatic surveys

Following initial site visits and based on records in the wider area following a desk study, habitat suitability for protected aquatic species of conservation interest, known or suspected to occur within the study area (e.g. fish species, otter etc.), were conducted. Aquatic habitats and species were assessed during the multi-disciplinary walkover surveys and where appropriate dedicated aquatic habitat and fisheries surveys were undertaken. A dedicated fisheries assessment was undertaken at the site for targeted species groups including salmon, trout and lamprey on the 19th August, 20th and 21st August 2019. A full description of the survey methodologies is provided in the standalone report available in Appendix 6-3 of the EIAR. Aquatic plant species protected under Flora (Protection) Order, 2015 (S.I. No. 356 of 2015) were searched for during all aquatic surveys.

6.4.3.3.6 Invasive species survey

[5] *NBDC, 2020, Habitat Condition Assessment for Marsh Fritillary, Online, Available at: http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Marsh-Fritillary-Habitat-Condition-Form.pdf, Accessed, 20 March 2020*

During the multi-disciplinary walkover surveys, a search for non-native invasive species was undertaken. The survey focused on the identification of invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (As Amended) (S.I. 477 of 2015).

6.4.4 Methodology for Assessment of Impacts and Effects

6.4.4.1 Identification of Target Receptors and Key Ecological Receptors

The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ecological Receptors (KERs). Following a comprehensive desk study, site visits were undertaken on the dates listed in Section 6.4.3.1 (not including bat surveys and stakeholder consultation), "Target receptors" likely to occur in the zone of influence of the development were identified. The target receptors included habitats and species that were protected under the following legislation:

- Annexes of the EU Habitats Directive
- Qualifying Interests (QI) of Special Areas of Conservation (SAC) within the likely zone of impact.
- Species protected under the Wildlife Acts 1976-2019
- Species protected under the Flora Protection Order 2015

6.4.4.2 Determining Importance of Ecological Receptors

The importance of the ecological features identified within the study area was determined with reference to a defined geographical context. This was undertaken following a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular receptor is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The Guidelines clearly set out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of any importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna. Specific criteria for assigning each of the other levels of importance are set out in the guidelines and have been followed in this assessment. Where appropriate, the geographic frame of reference set out above was adapted to suit local circumstances. In addition, and where appropriate, the conservation status of habitats and species is considered when determining the significance of ecological receptors.

Any ecological receptors that are determined to be of National or International, County or Local importance (Higher Value) following the criteria set out in NRA (2009) are considered to be Key Ecological Receptors (KERs) for the purposes of ecological impact assessment if there is a pathway for

effects thereon. Any receptors that are determined to be of Local Importance (Lower Value) are not considered to be Key Ecological Receptors.

6.4.4.3 Characterisation of Impacts and Effects

The proposed development will result in a number of impacts. The ecological effects of these impacts are characterised as per the CIEEM 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (2018). These guidelines are the industry standard for the completion of Ecological Impact Assessment in the UK and Ireland. This chapter has also been prepared in accordance with the corresponding EPA guidance (EPA 2017). The headings under which the impacts are characterised follow those listed in the guidance document and are applied where relevant. A summary of the impact characteristics considered in the assessment is provided below:

- **Positive or Negative.** Assessment of whether the proposed development results in a positive or negative effect on the ecological receptor.
- **Extent.** Description of the spatial area over which the effect has the potential to occur.
- **Magnitude** Refers to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. the amount of habitat lost, percentage change to habitat area, percentage decline in a species population.
- **Duration** is defined in relation to ecological characteristics (such as the lifecycle of a species) as well as human timeframes. For example, five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species.
- **Frequency and Timing.** This relates to the number of times that an impact occurs and its frequency. A small-scale impact can have a significant effect if it is repeated on numerous occasions over a long period.
- **Reversibility.** This is a consideration of whether an effect is reversible within a 'reasonable' timescale. What is considered to be a reasonable timescale can vary between receptors and is justified where appropriate in the impact assessment section of this report.

6.4.4.4 Determining the Significance of Effects

The ecological siguificance of the effects of the proposed development are determined following the precautionary principle and in accordance with the methodology set out in Section 5 of CIEEM (2018).

For the purpose of Ecological Impact Assessment (EcIA), 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local (CIEEM, 2018).

When determining siguificance, consideration is given to whether:

- Any processes or key characteristics of key ecological receptors will be removed or changed
- There will be an effect on the nature, extent, structure and function of important ecological features
- There is an effect on the average population size and viability of ecologically important species.
- There is an effect on the conservation status of important ecological habitats and species.

The EPA draft Guidelines on information to be included in Environmental Impact Assessment Reports (EPA, 2017) and the *Guidelines for assessment of Ecological Impacts of National Road Schemes*, (NRA, 2009) were also considered when determining significance and the assessment is in accordance with those gnidelines.

The terminology used in the determination of significance follows the suggested langnage set out in the Draft EPA Guidelines (2017) as shown in Table 6-2.

Table 6-2 Criteria for determining significance of effect, based on (EPA, 2017) guidelines

Effect Magnitude	Definition
No change	No discernible change in the ecology of the affected feature.
Imperceptible effect	An effect capable of measurement but without noticeable consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effect	An effect that alters the character of the environment that is consistent with existing and emerging trends.
Significant effect	An effect which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effect	An effect which obliterates sensitive characteristics.

As per TII (NRA, 2009) and CIEEM (2018) best practice guidelines, the following key elements should also be examined when determining the significance of effects:

- The likely effects on 'integrity' should be used as a rueasure to determine whether an impact on a site is likely to be significant (NRA, 2009).
- A 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives (CIEEM, 2018).

Integrity

In the context of EcIA, 'integrity' refers to the coherence of the ecological structure and function, across the entirety of a site, that enables it to sustain all of the ecological resources for which it has been valued (NRA, 2009). Impacts resulting in adverse changes to the nature, extent, structure and function of component habitats and effects on the average population size and viability of component species, would affect the integrity of a site, if it changes the condition of the ecosystem to unfavourable.

Conservation status

An impact on the conservation status of a habitat or species is considered to be siguificant if it will result in a change in conservation status. According to CIEEM (2018) gnidelines the definition for conservation status in relation to habitats and species are as follows:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area

- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

As defined in the EU Habitats Directive 92/43/EEC, the conservation of a habitat is favourable when:

- Its natural range, and areas it covers within that range, are stable or increasing
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future
- The conservation status of its typical species is favourable.

The conservation of a species is favourable when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future
- There is and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

According to the NRA/CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international).

6.4.4.5 Incorporation of Mitigation

Section 6.7 of this EIAR assesses the potential effects of the proposed development to ensure that all effects on Key Ecological Receptors (KERs) are adequately addressed. Where significant effects on Key Ecological Receptors are predicted, mitigation is incorporated into the project design or layout to address such impacts. The implemented mitigation measures avoid or reduce or offset potential significant residual effects, post mitigation.

6.4.4.6 Limitations

The information provided in this assessment accurately and comprehensively describes the baseline ecological environment following surveys on numerous dates during all seasons and over 3 years; provides an accurate prediction of the likely ecological effects of the proposed development; prescribes best practice and mitigation as necessary; and, describes the residual ecological impacts.

The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

The habitats and species on the site were readily identifiable and comprehensive assessments were made during the field visit. No significant limitations in the scope, scale or context of the assessment have been identified.

6.5 Establishing the Ecological Baseline

6.5.1 Desk Study

The following sections describe the results of a survey of published material that was consulted as part of the desk study for the purposes of the ecological assessment. It provides a baseline for the ecology of

the existing environment. Material reviewed includes the Site Synopses for Designated Sites for their conservation importance compiled by the National Parks and Wildlife Service (NPWS) of the Department of Culture, Heritage and the Gaeltacht, bird and plant distribution atlases and other research publications.

6.5.1.1 Designated Sites

6.5.1.1.1 *Identification of the Designated Sites within the Likely Zone of Influence of the Proposed Development*

The potential for the proposed development to impact on sites that are designated for nature conservation was considered in this Ecological Impact Assessment.

Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs) are designated under the EU Habitats Directive and EU Birds Directive, respectively and are collectively known as 'European Sites'. The potential for significant effects and/or adverse impacts on the integrity of European Sites is fully assessed in the AA Screening Report and Natura Impact Statement that accompanies this application. As per EPA draft Guidance 2017, *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement"* but should *"incorporate their key findings as available and appropriate"*. Section 6.7.2 of this EIAR provides a summary of the key assessment findings with regard to European Designated Sites.

Natural Heritage Areas (NHAs) are designated under Section 18 the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this EcIA.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA.

The following methodology was used to establish which sites that are designated for nature conservation have the potential to be impacted by the proposed development:

- Initially the most up to date GIS spatial datasets for European and Nationally designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 20/03/2020. The datasets were utilised to identify Designated Sites which could feasibly be affected by the proposed development.
- All designated sites within a distance of 15km surrounding the development site were identified. In addition, the potential for connectivity with European or Nationally designated sites at distances of greater than 15km from the proposed development was also considered in this initial assessment.
- A map of all the European Sites within 15km is provided in Fignre 6-2. Figure 6-2a shows the site in relation to Ballykenny-Fisherstown Bog SPA and Lough Forbes Complex SAC, located further to the south of the site (as described in Table 6-3). All Nationally designated sites shown in Figure 6-3.
- Table 6-3 provides details of all relevant Nationally designated sites as identified in the preceding steps and assesses which are within the likely Zone of Impact. All relevant European Designated Sites are fully described and assessed in the Screening for Appropriate Assessment and Natura Impact Statement reports submitted as part of this planning application.
- The designation features of these sites, as per the NPWS website (www.npws.ie), were consulted and reviewed at the time of preparing this report 20/03/2020.

Drumcliff Bay SPA
Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC
Cummeen Strand SPA
Coastal04
Ballysadare Bay SPA
Ballysadare Bay SAC
Union Wood SAC
Lough Gill SAC
Corratirrim SAC
Boleybrack Mountain SAC
Garvogue
Cuilcagh - Anierin Uplands SAC
Ballysadare
Shannon
Unshin River SAC
And Cloonacleigha Loughs SAC
igo) SAC
Lough Arrow SAC
Bricklieve Mountains and Keishcorran SAC
Lough Arrow SPA

Map Legend

- Special Protection Area (SPA)
- Special Area of Conservation (SAC)
- EPA mapped watercourses
- River Catchments
- 15km buffer from proposed development
- Proposed turbine location
- EIAR Study Area

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MAP TITLE: Site in relation to EU designated sites	MAP NO.: Figure 6.2	SCALE: 1:140.000
PROJECT TITLE: 180511 - Croagh Wind Farm		DATE: 16-06-2020
DRAWING BY: DMN	CHECKED BY: PR	ISSUE NO.: 180511-2020.04.16-D1

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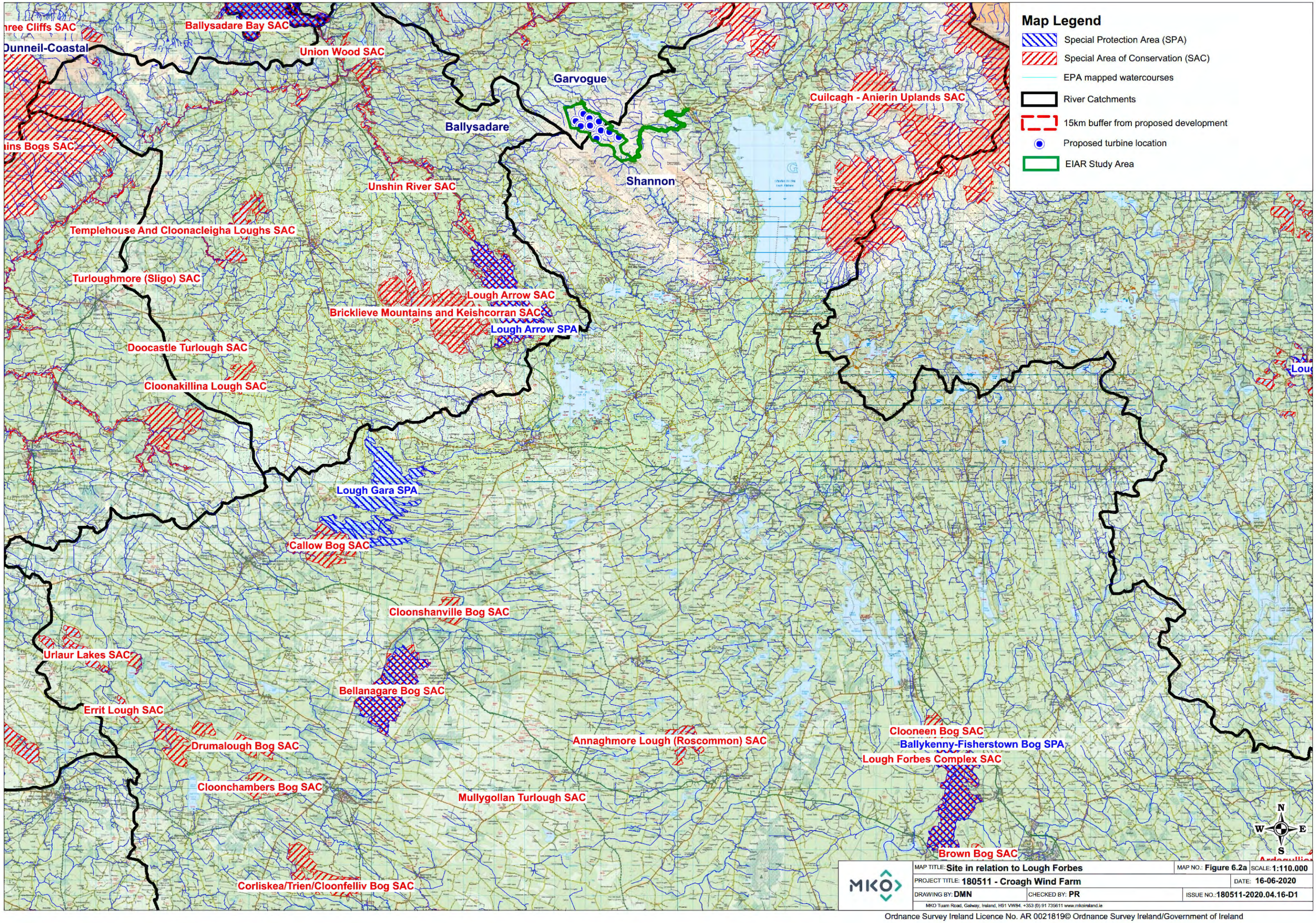

MAP TITLE: **Site in relation to Lough Forbes**		MAP NO.: **Figure 6.2a**	SCALE: **1:110.000**
PROJECT TITLE: **180511 - Croagh Wind Farm**			DATE: **16-06-2020**
DRAWING BY: **DMN**	CHECKED BY: **PR**		ISSUE NO.: **180511-2020.04.16-D1**

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Cummeen Strand/Drumcliff Bay (Sligo Bay)
Crockauns/Keelogyboy Bogs NHA
Dough/Thur Mountains NHA
Lough Macnean Upper
Colgagh Lough
O'Donnell's Rock Wood
Corratirrim
Coastal04
Boleybrack Mountain
Lough Gill
Ballysadare Bay
Union Wood
Lough Dargan
Slieveward Bog NHA
Garvogue
Knockmullin Fen
Owengar Wood
Kilgarriff Marsh
Ballysadare
Unshin River
Fin And Riskeen Loughs
Meharth Lough
Carrane Hill Bog NHA
Shannon
Cuilcagh - Anierin Uplands
Corry Mountain Bog NHA
Lough Allen, South End and Parts
Kilronan Mountain Bog NHA
Cromlin Bridge Wo
Feenagh And Bunnamuck Loughs
Lough Arrow
Bricklieve Mountains & Keishcorran
Carrickaport Lough
Corrigeenroe Marsh
Hog's Island (Lough Key)
Drumhierny Wood
Drum Bridge (Lough Key)

Map Legend

- Proposed Natural Heritage Area (pNHA)
- Natural Heritage Area (NHA)
- EPA mapped watercourses
- River Catchments
- 15km buffer from proposed development
- Proposed turbine location
- EIAR Study Area

MAP TITLE: Site in relation to Nationally designated sites		MAP NO.: Figure 6.3	SCALE: 1:140.000
PROJECT TITLE: 180511 - Croagh Wind Farm			DATE: 16-06-2020
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Where potential pathways for Significant Effect are identified, the site is included within the Likely Zone of Impact and further assessment is required.

Table 6-3 Designated sites in the Zone of Influence

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Special Areas of Conservation (SAC)		
Lough Gill SAC (001976)	4.4	As described in Chapter 9 'Water' of the EIAR, hydrological connectivity has been identified between the proposed development and Lough Gill SAC via watercourses within the west of the site boundary. **The SAC is considered to be within the Likely Zone of Impact and further assessment is required with regard to the relevant QIs of the SAC.**
Boleybrack Mountain SAC (002032)	4.9	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. These SACs are within a separate water catchment with no hydrological connectivity to the proposed development site. No pathway for indirect effects on the terrestrial habitats for which the SAC has been designated exists. The SACs are therefore not within the Likely Zone of Impact.
Unshin River SAC (001898)	8.5	
Cuilcagh - Anierin Uplands SAC (000584)	9.2	
Lough Arrow SAC (001673)	10.1	
Bricklieve Mountains and Keishcorran SAC (001656)	12.7	
Union Wood SAC (000638)	14.6	
Special Protection Area (SPA)		
Lough Arrow SPA (004050)	9.3	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. This SPA is in a separate water catchment with no hydrological connectivity to the development site. The site is not within the core foraging range of the SCI species for which the SPA has been designated (SHN, 2016). No pathways for significant effect on the European Site was identified. Thus it can be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the European site, that the proposed development, individually or in combination with other plans and projects, would therefore not have a significant effect on this European Site.
Natural Heritage Areas (NHA)		

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Corry Mountain Bog NHA (002321)	0	This designated Site is located adjacent to the proposed development . **From a precautionary perspective, it is included within the Likely Zone of Impact.**
Carrane Hill Bog NHA (002415)	0.28	The development footprint is located over 280 metres from the NHA and no part of the proposed development site is located inside the NHA. Therefore, there is no potential for direct effects. No direct or indirect hydrological connectivity has been identified between the proposed development site and the NHA. No pathway for indirect effects on the terrestrial habitats for which the NHA has been designated exists. **This NHA is therefore not within the Likely Zone of Impact.**
Lough Gill NHA (001976)	4.4	No pathway for direct or indirect effects on the terrestrial habitats for which the NHA has been designated exists. As described in Chapter 9 'Water' of the EIAR, hydrological connectivity has been identified between the proposed development and Lough Gill NHA via watercourses within the west of the site boundary. **The NHA is therefore within the Likely Zone of Impact and further assessment is required.**
Kilronan Mountain Bog NHA (000617)	5.5	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the NHA has been designated exists. No direct or indirect hydrological connectivity has been identified between the proposed development site and the NHA due to differences in topography and separation in distance. This NHA is therefore not within the Likely Zone of Impact.
Crockauns/Keelogyboy Bogs NHA (002435)	14.06	This NHA is in a separate water catchment with no direct or indirect hydrological connectivity to the development site. No pathway for indirect effects on the terrestrial habitats for which the NHA has been designated exists. It is not within the Likely Zone of Impact.
Proposed Natural Heritage Areas (pNHA)		

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
Owengar Wood (001419)	0.046	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the pNHA has been designated exists. However, as this designated Site is located adjacent to the proposed development site. **From a precautionary perspective, it is included within the Likely Zone of Impact and further assessment is required.**
Kilgarriff Marsh (000426)	5.6	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the pNHA has been designated exists. Hydrological connectivity has been identified between the proposed development site and this pNHA via watercourses that connect to Lough Allen. **This pNHA is therefore within the Likely Zone of Impact and further assessment is required.**
Lough Gill (001976)	5.8	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. As described in Chapter 9 'Water' of the EIAR, hydrological connectivity has been identified between the proposed development and Lough Gill pNHA via watercourses within the site boundary. For this reason, potential for impact on the aquatic features of the pNHA has been identified and further assessment is required. No potential for indirect effects has been identified on the terrestrial habitats for which the pNHA has been designated. **It is within the Likely Zone of Impact and further assessment is required**.
Lough Allen, South End and Parts (000427)	7.5	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. N As described in Chapter 9 'Water' of the EIAR, hydrological connectivity has been identified between the proposed development and this pNHA via watercourses within the site boundary which

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
		discharge to Lough Allen. No potential for indirect effects has been identified on the terrestrial habitats for which the pNHA has been designated. **It is within the Likely Zone of Impact and further assessment is required.**
Meharth Lough (001900)	8.4	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. These pNHAs are located within a separate water catchment and thus no hydrological connectivity exists. This site is not within the Zone of Likely Impact.
Unshin River (001898)	8.48	
Cuilcagh - Anierin Uplands (000584)	8.7	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the pNHA has been designated exists. While this pNHA is within the same catchment as the proposed development. No hydrological connectivity to the proposed development site exists. This site is not within the Zone of Likely Impact.
Lough Arrow (001673)	10.17	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. This pNHA is in a separate water catchment with no hydrological connectivity to the proposed development site. It is not within the Zone of Likely Impact.
Boleybrack Mountain (002032)	9.2	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. While this pNHA is within the same catchment as the proposed development, no hydrological connectivity to the proposed development site was identified. No potential for indirect effects has been identified on the terrestrial habitats for which the pNHA has been designated. This site is not within the Zone of Likely Impact.
Lough Dargan (001906)	10.17	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. This pNHA is in a separate water catchment with no hydrological connectivity to the proposed

Designated Site	Distance from Proposed Development (km)	Likely Zone of Impact Determination
		development site. It is not within the Zone of Likely Impact.
O'Donnell's Rock Wood (001418)	10.4	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the pNHA has been designated exists. While this pNHA is within the same catchment as the proposed development, no direct or indirect hydrological connectivity to the proposed development site. This site is not within the Zone of Likely Impact.
Bricklieve Mountains & Keishcorran (001656)	10.8	There is no potential for direct or indirect effects on the terrestrial habitats for which the site has been identified as the proposed development is located entirely outside of this designated site. These pNHAs are in a separate water catchment with no direct or indirect hydrological connectivity to the proposed development site. This site is not within the Zone of Likely Impact.
Corrigeenroe Marsh (000596)	12.69	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. No pathway for indirect effects on the terrestrial habitats for which the pNHA has been designated exists. While this pNHA is within the same catchment as the proposed development, no direct or indirect hydrological connectivity to the proposed development site exists. This site is not within the Zone of Likely Impact.
Ballygawley Lough (001909)	12.9	There is no potential for direct effects as the proposed development is located entirely outside of this designated site. These pNHAs are in a separate water catchment with no direct or indirect hydrological connectivity to the proposed development site exists. They are not within the Zone of Likely Impact.
Colgagh Lough (001658)	13.3	
Union Wood (000638)	14.2	

Potential for effects on European sites is summarised in this report and is fully addressed in the Natura Impact Statement submitted as part of the statutory consent process.

Where a nationally designated site (NHA), overlaps with the boundary of a European designated site, i.e. (SAC/SPA), the potential for impacts has been considered under the European designation.

Corry Mountain Bog NHA (002321) and Owengar Wood pNHA (001419) are located adjacent to the proposed development site. On a precautionary basis, these sites have been included within the Likely Zone of Impact for further assessment.

Surface water connectivity was identified between the proposed development Lough Allen, South End and Parts (000427), Kilgarriff Marsh (000426) and Lough Gill pNHA, NHA and SAC approximately 4.4km downstream. As this pNHA has also been designated a SAC, impacts on this designated site are fully considered under the European designation within the NIS. This is further described in Section 6.7.2 of this Chapter.

The AA Screening that accompanies this application identifies the following European Sites as being within the Likely Zone of Impact:

- Lough Gill SAC [001976]
- Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)
- Cummeen Strand SPA (004035).

6.5.1.2 NPWS Article 17 Reporting

A review of the Irish Reports for Article 17 of the Habitats Directive (92/42/EEC), including the Heath, Bogs and Mires, Irish Semi-Natural Grassland Survey datasets, National Survey of Native Woodlands and Ancient and Long-Established Woodland datasets were conducted prior to undertaking the multi-disciplinary walkover survey.

In a search of the NPWS Article 17 datasets[6], was undertaken as part of the desk study. Small areas of Blanket bog [7130], Wet Heath [4010] and Dry heath [4030] were mapped within or immediately adjacent to the site boundary, see Figure 6-4. An area of *Molinia* meadows [6410] was identified outside the west of the site boundary. Following a review of the database, a small area of Oak-ash-hazel woodland (WN2), not conforming to any EU Annex I habitat, occurs outside the site and to the south of the proposed haul route at Glassait Woods, upstream of the proposed infrastructure. As shown in Figure 6-4, only a small fragment of Article 17 mapped blanket bog, along the site access road to T1, occurs within the proposed development footprint. Where Article 17 datasets occur along the grid connection route, these will not be impacted, as the proposed infrastructure will be located within the existing road.

6.5.1.3 Vascular plants

A search was made in the New Atlas of the British and Irish Flora (Preston *et al*, 2002) to investigate whether any rare or unusual plant species listed under Annex I of the EU Habitats Directive, The Irish Red Data Book, 1, Vascular Plants (Curtis, 1988) or the Flora (Protection) Order (1999, as amended 2015) had been recorded in the relevant 10km squares in which the study site is situated (G82). Each hectad contains 100 whole one kilometre squares containing terrestrial habitats. Species of conservation concern are given in Table 6-4.

Table 6-4 Species listed designated under the Flora Protection Order or the Irish Red Data Book within Hectad G82

Common Name	Scientific Name	Hectad	Status
Corn Marigold	*Chrysanthemum segetum*	G82	Red List (NT)
Prostrate Broom	*Cytisus scoparius*	G82	Red List (VU)

[6] *Including bog 2012 and 2019 datasets, Online, Available at: https://www.npws.ie/publications/article-17-reports*

Map Legend

- Molinia meadows [6410]
- Blanket bog [7130]
- Northern Atlantic wet heaths [4010]
- European dry heath [4030]
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Proposed 38kV Underground Grid Connection Cabling Route
- Proposed Amenity Walkway
- Proposed Boardwalk
- Proposed 38kV Substation Compound
- EIAR Site Boundary
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Existing Access Road/Track
- Proposed Viewing Platform
- Proposed Visitor Carpark Location (Operational Phase)
- Proposed Met Mast Location
- Proposed Turbine Location

1 2 3 4 5 6 7 8 9 10

N W E S

MAP TITLE: **Distribution of relevant Article 17 habitat records**		MAP NO.: **Figure 6.4**	SCALE: **25,000**
PROJECT TITLE: **180511 - Croagh Wind Farm**			DATE: **30-06-2020**
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Alpine Meadow-grass	*Poa alpina*	G82	Red List (EN)
Irish Sorrel	*Rumex acetosa*	G82	Red List (NT)

6.5.1.4 Bryophytes

A search of the NPWS online database for bryophytes (non-vascular land plants comprising of mosses, hornworts and liverworts) was also undertaken with no protected bryophytes recorded within or adjacent to the proposal (NPWS, 2020).

6.5.1.5 National Biodiversity Data Centre (NBDC) Records

A search of the National Biodiversity Data Centre (NBDC) records for the relevant hectad, G82, provided records on a number of fauna species of conservation concern, excluding marine species and bird species. These are provided in Table 6-5. Records on species of conservation concern recorded from the area are also provided and outlined in Table 6-6.

Table 6-5 NBDC Records for Species of Conservation Interest in hectad G82

Species	Scientific Name	Red List Status	Habitats Directive
Common frog	*Rana temporaria*	LC	Annex V
Badger	*Meles meles*	LC	WA
Red fox	*Vulpes vulpes*	LC	
Red deer	*Cervus elaphus*		WA
Red squirrel	*Sciurus vulgaris*	LC	WA
Fallow deer	*Dama dama*	LC	WA
Irish hare	*Lepus timidus subsp. Hibernicus*	LC	
Hedgehog	*Erinaceus europaeus*	LC	WA
Marsh fritillary	*Euphydryas aurinia*	VU	Annex II, WA
Daubenton's bat	*Myotis daubentonii*	LC	Annex IV
Leisler's bat	*Nyctalus leisleri*	NT	Annex IV
Pine marten	*Martes martes*	LC	Annex V
Soprano pipistrelle	*Pipistrellus pygmaeus*	LC	Annex IV

Annex II, Annex IV, Annex V – Of EU Habitats Directive, WA - Wildlife Acts – Irish Wildlife Acts (1976, 2017), LC – Least concern, NT – Near threatened, VU - Vulnerable.

6.5.1.6 NPWS

National Parks and Wildlife Service (NPWS) online records were searched to see if any rare or protected species of flora or fauna have been recorded from hectad G82. An information request was also sent to the NPWS requesting records from the Rare and Protected Species Database. Table 6-6 lists rare and protected species records obtained from NPWS, as received on the 9th of April 2019, as well as those recorded available through the online NPWS map viewer.

Table 6-6 National Parks and Wildlife Service Map Viewer Records

Common name	Scientific name	Red List Status	Flora Protection Order/Red List	Habitats Directive/Birds Directive/Wildlife Act
Freshwater crayfish	*Austropotamobius pallipes*	-	-	Annex II, V, WA
Sika deer	*Cervus nippon*	-	-	WA
Cladonia lichen	*Cladonia ciliata*	-	-	Annex V
Reindeer moss	*Cladonia portentosa*	-	-	Annex V
Hedgehog	*Erinaceus europaeus*	LC	-	WA
Viviparous lizard	*Lacerta vivipara*	LC	-	WA
Irish hare	*Lepus timidus subsp. hibernicus*	LC	-	Annex V, WA
Pine marten	*Martes martes*	LC	-	Annex V
Badger	*Meles meles*	LC	-	WA

6.5.1.7 Bat Records

The National Bat Database of Ireland was searched for records of bat activity within hectad G82 on 20/03/2020. A number of observations have been recorded (Table 6-7). At least three of Ireland's nine resident bat species were recorded within 10 km of the proposed works including soprano pipistrelle, Leisler's bat and Daubenton's bat. The results of the database search are provided in Table 6-7.

Table 6-7 National Bat Database of Ireland records within 10km square G82

Species	Record Count	Latest Record	Dataset
Daubenton's Bat (*Myotis daubentonii*)	1	26/09/2009	National Bat Database of Ireland
Leisler's bat (*Nyctalus leisleri*)	1	26/08/2009	National Bat Database of Ireland
Soprano pipistrelle (*Pipistrellus pygmaeus*)	3	26/09/2009	National Bat Database of Ireland

6.5.1.8 Marsh fritillary (*Euphydryas aurinia*)

The closest NBDC records for marsh fritillary were located outside the north of the site in the townland of Corglancy. The most recent record was from 26/06/2019.

6.5.1.9 Inland Fisheries Ireland (IFI) Data

The IFI online database was reviewed for fish species records within the catchments downstream of the EIAR study area boundary. The Croagh wind farm development encompasses numerous small streams and rivers in north Leitrim, primarily on the Killanummery, Argina, Tullynascreen and Owengar river sub-catchments. Fisheries data for the Killanummery, Argina, Tullynascreen and Owengar river sub-catchments was largely lacking.

A range of fish species including Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel, stone loach (*Barbatula barbatula*), minnow (*Phoxinus phoxinus*), *Lampetra* spp., perch (*Perca fluviatilis*), gudgeon (*Gobio gobio*), three-spined stickleback (*Gasterosteus aculeatus*), roach (*Rutilus rutilus*) and pike (*Esox lucius*) are known from the wider Bonet catchment, to which the Killanummery adjoins (IFI, 2016; Kelly et al., 2011). The Owengar River is known locally to support a stock of brown trout. Fisheries data was not available for the Argina and Tullynascreen channels (Triturus, 2019). Table 6-8 provides a summary of the available ouline data[7].

Table 6-8 Fish data available from IFI National Research Survey Programme

Waterbody Name & Site Code	Species	Species Richness	Draft Fish Ecological Status
Bonet River Site code: 35B060600A	Brown trout; European eel; Gudgeon; Lamprey sp.; Minnow; Perch; Salmon; Stone loach; Three-spined stickleback	9	Moderate
Lough Allen Site code: SH_26_716	Bream; Brown trout; European eel; Perch; Pike; Pollan; Roach; Roach x Bream hybrid	7	Good
Lough Gill WE_35_158	Bream; Brown trout; European eel; Perch; Pike; Roach; Roach x Bream hybrid	6	Good

[7] *IFI National Research Survey Programme, Online, Available at:* https://ifigis.maps.arcgis.com/apps/webappviewer/index.html?id=9a31fedb077c4fb2991184842b7ef025

Garavoge Estuary	Common goby; European eel; Five-bearded rockling; Flounder; Gadoid; Lesser spotted dogfish; Long-spined sea scorpion; Pogge; Pollack; Sand goby; Three-spined stickleback; Two-spotted goby	12	Good

6.5.1.10 Invasive Species

The NBDC database also contains records of invasive species identified within the relevant hectad. Records of invasive species for hectad G82 are provided in Table 6-9.

Table 6-9 NBDC records for Invasive Species

Common Name	Scientific Name
Butterfly-bush	*Buddleja davidii*
Cherry laurel	*Prunus laurocerasus*
Indian balsam	*Impatiens glandulifera*
Japanese knotweed	*Fallopia japonica*
Rhododendron	*Rhododendron ponticum*
Jenkins' spire snail	*Potamopyrgus antipodarum*
American mink	*Mustela vison*
Fallow deer	*Dama dama*

6.5.1.11 Local Hydrology and Hydrogeology

The following description has been summarised from Chapter 9 '*Water*' of the EIAR and provides a baseline of the local watercourses within and downstream of the site of the proposed development.

In terms of regional hydrology, the Proposed Development is located in 2 no. river basins and 3 no. regional surface water catchments. The southern half of the wind farm site is located in the Shannon River surface water catchment within the Shannon International River Basin District (SHIRBD). The northern half of the wind farm site is located in the Sligo Bay & Drowse surface water catchment.

In terms of turbine distribution, 4 no. are located in the Shannon River surface water catchment and 6 no. are located in the Sligo Bay & Drowse surface water catchment.

The Garvagh Windfarm grid connection option, which runs to the southeast of the site, passes through the Shannon River surface water catchment (for 6.4km) and the Garvogue River surface water catchment (for 0.7km).

In terms of local hydrology, the southern half of the EIAR Site boundary is located in the Arigua River surface water catchment. The Arigua River flows into Lough Allen approximately 16km downstream of

the site. The north half of the windfarm site is located in the Bonet River surface water catchment. The Bonet River flows into Lough Gill approximately 15km downstream of the site. The site is connected to the River Bonet via two upper tributaries; the Tullynascreen Stream and the Killanummery stream.

6.5.1.12 Water Quality

River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The online EPA Envision map viewer provides access to water quality information at individual waterbody status for all the River Basin Districts in Ireland. The EPA Envision map viewer was consulted, most recently, on 30th February 2020 regarding the water quality status of the rivers which run within and directly adjacent to the Study Area. The WFD River Waterbody Status 2013 – 2018 for the watercourses which flow through the site have been assessed in Table 6-10.

Table 6-10 Watercourses on site with relevant water quality statuses

Name	Location	Status	Risk
Arigna	Flows in a North-West to South-Easterly direction through the majority of the site	Good	Not at Risk
Killanummary, tributary of the Bonet Rvier.	Flows in a South-East to North-Westerly direction at the Northern portion of the site	Good	At risk

Status– WFD River Waterbody Status 2010-2015 Risk – WFD River Waterbodies Risk

6.5.2 Conclusions of the Desk Study

The desktop study has provided information about the existing environment in hectad G82, within which the proposed development is located. The mammal species recorded within the relevant hectad have widespread range and distributions in Ireland and are likely to be recorded frequently throughout Ireland (Marnell et al, 2009[8]). Bat records within 10km of the proposed development site revealed that the wider area has been studied for bats. This suggests that the area offers potential for foraging and commuting bat species.

As part of the desk study, a small area of Habitats Directive Annex I habitats 'Wet Heath [4010]' and Dry heath [4030] were mapped within the site boundary, while Blanket bog [7130] was recorded adjacent to the site boundary. However, no Habitats Directive Annex I habitats have been recorded within or immediately adjacent to the proposed development footprint, as per NPWS records consulted and other ecology survey reports reviewed.

A number of watercourses that drain the study area, lead to the following downstream EU Designated Sites, and are further considered in the Natura Impact Statement prepared for the proposed development:

- Lough Gill SAC [001976]
- Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)
- Cummeen Strand SPA (004035)

Corry Mountain Bog NHA (002321) and Owengar Wood pNHA (001419) are located adjacent to the proposed development site. On a precautionary basis, these sites have been included within the Likely Zone of Impact for further assessment.

[8] *Marnell, F., Kingston, N. & Looney, D. (2009) Ireland Red List No. 3: Terrestrial Mammals, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.*

The desk study identified that a variety of protected faunal species are known to occur within the study area, including bats, marsh fritillary, otter, freshwater white-clawed crayfish, Atlantic salmon, badger and red squirrel. The mammal species recorded during the desk study informed the survey methodologies undertaken during the site visits. The desk study also provided useful information to inform the ecological surveys undertaken on site as well as the identification of pathways for potential impact on sensitive ecological receptors.

6.6 Description of the Existing Environment

6.6.1 Description of Habitats

The habitat classifications and codes correspond to those described in '*A Guide to Habitats in Ireland*' (Fossitt 2000). A total of fourteen habitats were recorded within the development site (Table 6.11). Peatland and grassland habitats have also been categorised to plant communities from the National Survey of Upland Habitats (Perrin et al. 2014) and the Irish Vegetation Classification. Detailed botanical data from relevés recorded in peatland and grassland habitats are provided in Appendix 6-1 of this report. A habitat map of the site is provided in Figure 6-5

. This also shows the smaller areas of peatland habitat within the site as an insert. A habitat map is also provided with the proposed infrastructure footprint overlain in Figure 6-6.

Table 6-11 Habitats recorded on the proposed development

Habitat Name	Fossitt Code
Wet grassland	GS4
Conifer plantation	WD4
Scrub	WS1
Wet willow-alder-ash woodland	WN6
Oak-ash-hazel woodland	WN2
Buildings and artificial surfaces	BL3
Recolonising bare ground	ED3
Spoil and bare ground	ED2
Eroding/upland rivers	FW1
Drainage ditches	FW4
Dystrophic lakes	FL1
Upland blanket bog	PB2
Poor fen and flush	PF2
Transition mire and quaking bog	PF3

Map Legend

Habitat legend

- Buildings and Artificial Surfaces (BL3)
- Dystrophic Lakes (FL1)
- Improved Agricultural Grassland (GA1)
- Wet Grassland (GS4)
- Upland Blanket Bog (PB2)
- Poor Fen and Flush (PF2)
- Transition Mire and Quaking Bog (PF3)
- Conifer Plantation (WD4)
- Scrub (WS1)
- EPA mapped watercourses

Proposed development legend

- Proposed Met Mast Location
- Existing 110kV Garvagh Substation Location
- Proposed Turbine Location
- Proposed New Site Roads
- Proposed 38kV Underground Grid Connection Cabling Route
- Proposed Amenity Walkway
- Proposed Boardwalk
- Existing Roads - Upgrade Proposed
- Existing Access Road/Track
- Proposed 38kV Substation Compound
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Proposed Viewing Platform
- Proposed Visitor Carpark Location (Operational Phase)
- EIAR Site Boundary

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MAP TITLE: **Habitat map with infrastructure overlain** | MAP NO.: **Figure 6.6** | SCALE: **30,000**

PROJECT TITLE: **180511 - Croagh Wind Farm** | DATE: **30-06-2020**

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Map Legend

Habitat legend

- Buildings and Artificial Surfaces (BL3)
- Dystrophic Lakes (FL1)
- Improved Agricultural Grassland (GA1)
- Wet Grassland (GS4)
- Upland Blanket Bog (PB2)
- Poor Fen and Flush (PF2)
- Transition Mire and Quaking Bog (PF3)
- Conifer Plantation (WD4)
- Scrub (WS1)
- EPA mapped watercourses

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MAP TITLE: **Habitat map**		MAP NO.: **Figure 6.5**	SCALE: **21,000**
PROJECT TITLE: **180511 - Croagh Wind Farm**			DATE: **30-06-2020**
DRAWING BY: **DMN**	CHECKED BY: **PR**	ISSUE NO.: **180511-2020.06.30-D1**	

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6.6.1.1 Habitats within the EIAR Study Area Boundary

The majority of the study area (580 hectares/86.3% of the study area) is dominated by plantation forestry, comprising mainly of Sitka spruce (*Picea sitchenis*) and Lodgepole pine (*Pinus contorta*). The site is accessible via a network of existing forestry access tracks and forestry rides. The remainder of the wind farm infrastructure site is dominated by degraded Upland blanket bog (PB2). The haul route to the east of the site primarily traverses areas of Wet grassland (GS4), Scrub (WS1), Conifer plantation (WD4) and existing roads.

Conifer plantation (WD4)

In total, approximately 86.3% of the study area (580 hectares) comprises of coniferous plantation forestry (Plate 6-1 and Plate 6-2). This includes forestry (WD4) of various ages (including clear-felled areas, semi-mature and mature stands, along with immature pre-thicket areas of both first and second rotation. Sitka spruce and Lodgepole pine are the dominant species, typically 8-10m tall. Mature conifer plantation is interspersed with immature stands. The understorey is typically species-poor in forestry plantations and vegetation normally restricted to a few bryophytes and ferns which include, hard fern (*Blechnum spicant*) and *Thuidium tamariscum*.

As the forestry was originally planted on peatland habitats, forestry rides or areas where forestry failed to achieve closed canopy are dominated by ling heather (*Calluna vulgaris*), heath rush (*Juncus squarrosus*), purple moor-grass (*Molinia caerulea*) and *Sphagnum palustre*. These areas make up a very small area of the overall forestry plantation.

The majority of the proposed wind farm infrastructure (88.75%) is located within Conifer plantation (WD4) habitat which includes Turbines 2-10, temporary construction compounds, borrow pits, substation, met mast, part of the access road to T1, new site roads to other turbines and part of the turbine haul route.



Plate 6-1 Example of Conifer plantation (WD4) within the study area



Plate 6-2 Example of recently felled and replanted Conifer plantation (WD4) within the study area.

Upland Blanket Bog (PB2)

Upland blanket bog (PB2) habitat occurs within the west of the site, as well as a small pocket in the centre of the site. This habitat is typically degraded where it occurs within the site boundary associated with historic and more recent turbary. Only Turbine 1, and part of the associated access road, is located within Upland blanket bog (PB2) habitat. This represents 0.55% of the habitat loss to the development footprint. This area is surrounded by bog that has been cutover in the past and shows evidence of drying-out.

T1 is located immediately adjacent to a relatively recent cutover area which has revegetated and is dominated by a short sward comprising of ling heather and hare's-tail cottongrass (*Eriophorum vaginatum*). The peatland habitat within the infrastructure footprint was dominated by dense leggy ling heather which was relatively dry underfoot (Plate 6-3). In addition, some of the area around proposed TI footprint had been recently disturbed (Plate 6-4). Other species included hare's-tail cotton grass and bilberry (*Vaccinium myrtlus*). Although *Sphagnum capillifollium* was present, it was in low abundance and the dominant bryophytes comprise of species typical of dryer peatland habitats, including *Rhytidiadelphus loreus*, *Hylcomium splendens* and *Hypnum jutlandicum*. Purple moor-grass (*Molinia caerulea*) cover was generally sparse. Although the vegetation was characteristic of a grade between wet and dry heath, the peat depths in this area were well in excess of 50cm, and as such the habitat was categorised as Upland blanket bog (PB2). Some of this peatland was classified as inactive where *Sphagnums* were absent. In wetter areas, the peatland habitat formed a mosaic with Poor fen and flush (PF2) and Transition mire and quaking bog (PF3) which are described in the sections below.

The Upland blanket bog (PB2) habitat within the proposed development footprint at Turbine 1 was classified to communities using the Irish Vegetation Classification (IVC) following analysis using ERICA[9]. The Upland blanket bog (PB2) recorded on site was identified as confirming to the *Calluna vulgaris* - *Eriophorum vaginatum* (HE3F) and *Calluna vulgaris* - *Hylocomium splendens* (HE3A)

[9] *Engine for Relevés to Irish Communities Assignment (ERICA)*

communities. The *Calluna vulgaris - Eriophorum vaginatum* (HE3F) is a heathy bog community where ling heather forms dense cover. It is a high-altitude bog community which is usually found upper mountain slopes over 450m. However, the altitude where it is located at the study site is between 270-280m (Perrin, 2017[10]). The *Calluna vulgaris - Hylocomium splendens* (HE3A) community is a heath community (Perrin, 2017[11]) and is normally found higher altitudes also, over 450m. The high abundance of ling heather is likely to be an indicator of drying-out and past degradation and turbary activity is present in the surrounding area. Although the *Calluna vulgaris - Hylocomium splendens* (HE3A) is considered a dry heath community, as peat depths across the peatland were between 1.0-2.2m, the habitat is considered to be blanket bog.



Plate 6-3 Degraded Upland blanket bog (PB2) along proposed access road to T1

[10] *Perrin, P., 2017, IVC - Calluna vulgaris – Eriophorum vaginatum heathy bog (HE3F), Available at: https://www.biodiversityireland.ie/wordpress/wp-content/uploads/HE3F.pdf, Accessed, 24.03.2020*

[11] *Perrin, P., 2017, IVC* - Calluna vulgaris - Hylocomium splendens *(HE3A) https://www.biodiversityireland.ie/wordpress/wp-content/uploads/HE2B.pdf, Accessed, 24.03.2020*



Plate 6-4 Degraded Upland blanket bog (PB2) within T1 footprint

Poor fen and flush (PF2)

Poor fen and flush (PF2) habitat was recorded within the Upland blanket bog (PB2) within a low lying area and subsequent movement of ground and surface water through this area of peatland (Plate 6-5). This habitat was also recorded occurring within an intimate mosaic with Transition mire and quaking bog (PF3). Poor fen and flush (PF2) generally formed linear features and was characterised by species which were indicative of higher nutrients than the surrounding bog, such as soft rush (*Juncus effusus*), Yorkshire fog (*Holcus lanatus*), wavy hair-grass (*Deschampsia flexuosa*), sweet vernal grass (*Anthoxanthum odoratum*), sharp-flowered rush (*Juncus acutiflorus*), sorrel (*Rumex acetosa*) *Polytrichum commune* and *Spagnum palustre*.

ERICA analysis of the quadrat data within this habitat assigned the quadrats to *Agrostis canina/vinealis - Rhytidiadelphus squarrosus* (GL4D) community. This community is an intermediate between the upland acid grassland and wet grassland. The presence of *Sphagnum fallax*, *Sphagnum palustre* and *Polytrichum commune* characterise this habitat as poor fen and flush.



Plate 6-5 Poor fen and flush (PF2) at T1 location

Transition mire and quaking bog (PF3)

Transition mire and quaking bog (PF3) was recorded in an intimate mosaic with Poor fen and flush (PF2) within the north-west corner of the EIAR Site boundary and was also recorded along the southern shore of Lough Nacroagh within the centre of the site.

Where it occurred in association with Poor fen and flush (PF2) within the peatland complex in the north-west of the site, it was found as small linear features where there was movement of ground and surface water (Plate 6-6). A much larger area of the habitat (0.46ha) was recorded in association with Lough Nacroagh, along its southern shore (Plate 6-7). The transition mire habitat is encroaching on the lake as a *Sphagnum* lawn. The species composition of Transition mire and quaking bog (PF3) habitat primarily consisted of bottle sedge (*Carex rostrate*), bogbean (*Menyanthes trifoliata*), common cottongrass (*Eriophorum angustifolium*), *Sphagnum fallax* and *Sphagnum palustre*. The access road to Turbine 1 will cross a small area of this Transition mire and quaking bog (PF3) habitat. However, there is no wind farm infrastructure proposed within or adjacent to the habitat where it exists adjacent to Lough Nacroagh.

Quadrats recorded within this habitat were assigned to the IVC community *Menyanthes trifoliata* – *Sphagnum recurvum* agg. mire (FE2E) following ERICA analysis.



Plate 6-6 Transition mire and quaking bog (PF3) along proposed access road to T1



Plate 6-7 Transition mire and quaking bog (PF3) adjacent to Lough Nacroagh

Dystrophic lakes (FL1)

Lough Nacroagh in the centre of the proposed windfarm site was categorised as a Dystrophic lake (FL1) (see Plate 6-7 andPlate 6-8). The lake is relatively small and is being encroached by Transition mire and quaking bog (PF3) habitat to the south, as described previously. The lake is surrounded by coniferous forestry (WD4) along its northern shore and where there is a small gap in tree cover, purple moor-grass and ling heather occur up to the water edge. The lake did not contain any emergent vegetation during the site visits.



Plate 6-8 Lough Nacroagh categorised as a Dystrophic lake (FL1)

Spoil and bare ground (ED2)

Unbound forestry tracks throughout the site were categorised as Spoil and bare ground (ED2). The access track verges across much of the site contained of wet grassland or surrounding peatland habitats (Plate 6-9). Species recorded comprised mainly of sweet vernal grass (*Anthoxanthum odoratum*), daisy (*Bellis perennis*), dandelion (*Taraxacum officinale* agg.), colt's-foot (*Tussilago farfara*), soft rush (*Juncus effusus*), purple moor-grass, *Carex* ssp, crested dogs-tail (*Cynosurus cristatus*) and heather (*Calluna vulgaris*). Upgrading of existing forestry tracks is proposed across the site, as shown in Figure 4-1, Chapter 4 of the EIAR.



Plate 6-9 Example of existing unbound forestry tracks categorised as Spoil and bare ground (ED2)

Eroding/upland rivers (FW1)

A number of watercourses drain the site windfarm site with the watercourses draining the northern part of the site including the Killanummery River and Tullynascreen stream, which flow into the River Bonet further north, and those draining the southern part of the site forming the Arigna River. The streams within the windfarm site were generally small, up to a metre wide, high-energy and with boulder and cobble substrate. Most of the streams were surrounded by forestry and did not contain aquatic macrophytes or where forestry cover was absent, they were bordered by heath or wet grassland vegetation such as ling, soft rush, heath bedstraw (*Galium saxatile*) and Yorkshire fog (*Holcus lanatus*) (Plate 6-10).

The Gowlaunrevagh and Tinnybeg Rivers will be crossed as part of the proposed haul road located to the southeast of the site of the proposed development. These rivers enter the Owengar River located within a steep valley to the north of the haul road. An example of the Gowlaunrevagh River crossing location is provided in Plate 6-11.



Plate 6-10 Tullynascreen stream (FW1) flowing through the north-west of the windfarm site



Plate 6-11 The Gowlaunrevagh River (FW1) - The image shows the approximate location of the proposed haul route to the east of the proposed windfarm site

6.6.1.2 Habitats Along the Haul Route

The proposed haul road is shown in Figure 4-1, Chapter 4 of the EIAR. Starting in Drumkeeran, the route passes through a farm yard, mapped as Buildings and artificial surfaces (BL3). It then crosses wet grassland dominated by soft rush before joining the local road network (L4282). The proposed route then utilises a large section of existing forestry (WD4) and associated access tracks (Plate 6-12), categorised as Buildings and artificial surfaces (BL3), before moving west through Conifer plantation (WD4) forestry of varying ages (Plate 6-13). Where forestry rides occur within the development footprint, these are dominated by species-poor Wet grassland (GS4) see Plate 6-14, dominated by soft rush and Yorkshire fog and areas Scrub (WS1) (Plate 6-15). Scrub (WS1) consisted of willow (Salix sp.), gorse (*Ulex europaeus*) and bramble (*Rubus fruticosus* agg.).

The river channels occurring along the proposed haul road were categorised as Eroding/upland rivers (FW1) (Plate 6-11). Wet willow-alder-ash woodland (WN6) was recorded both upstream and downstream of the proposed haul road (Plate 6-15). This immature woodland was dominated by willow (*Salix* sp.) and bramble and also contained some naturally regenerating Sitka spruce.



Plate 6-12 Example of existing forestry track (ED2) within the proposed haul road



Plate 6-13 Example of second rotation forestry (WD4) occurring within the proposed haul road, with mature forestry in the background.



Plate 6-14 Example of fragmented wet grassland (GS4) occurring within forestry rides along the site haul road



Plate 6-15 Example of willow dominated scrub (WS1) occurring along the proposed haul road between plantation forestry blocks.

The proposed haul route will continue to follow the existing road (BL3) south until it enters the wind farm site through Conifer plantation (WD4) and on to existing forestry tracks (ED2). The existing road is bordered by Conifer plantation (WD4), soft rush dominated Wet grassland (GS4) and Upland blanket bog (PB2) along its length to the windfarm site.

6.6.1.3 Habitats on the Grid Connection Route

The proposed grid connection route will leave the on-site substation south through the proposed windfarm site, following existing forestry tracks categorised as Spoil and bare ground (ED2). On exiting the windfarm site the grid connection will follow the existing local road, categorised as Buildings and artificial surfaces north for approximately 1.8km and will then follow the existing unbound access road (ED2) for approximately 300m into the Garvagh substation.

6.6.1.4 Habitats at the site of the Met Mast, Amenity Car Park, Amenity Paths and Site Access Road

The proposed met mast is located within Conifer plantation forestry (WD4) within the site boundary, located southwest of T5. The area is dominated by sitka spruce and is generally of low ecological significance (Plate 6-16). Similarly, the proposed amenity car park, amenity trail and the majority of the site access track new roads are located within Conifer plantation forestry (WD4) of low ecological value. This is a highly modified habitat and subject to ongoing forestry activity.



Plate 6-16 Existing access track classified as Recolonising bare ground (ED3) leading north to Conifer plantation (WD4) where the met mast will be located

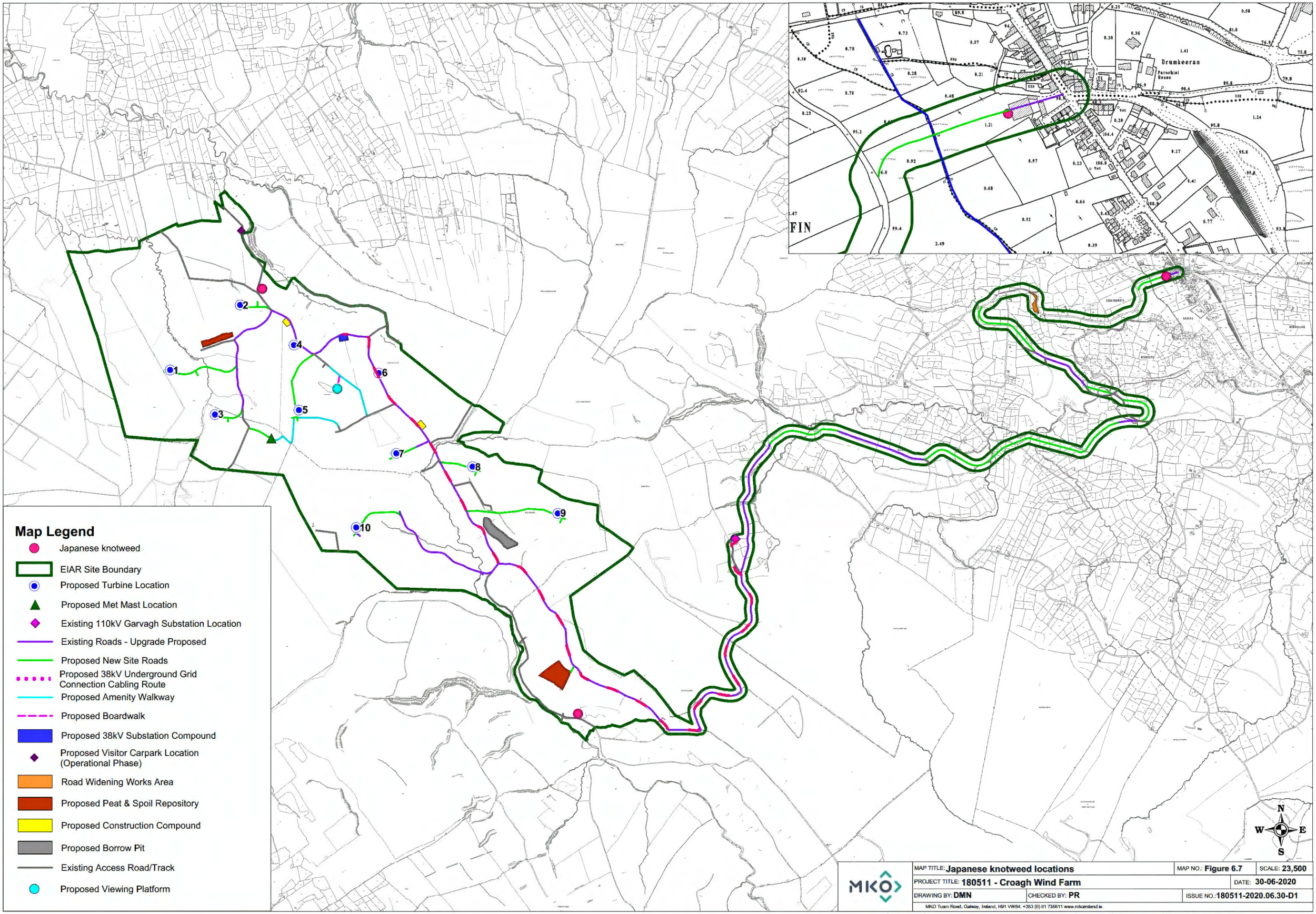
6.6.2 Protected Flora

No botanical species listed under the Flora (protection) Order (1999, as amended 2015), listed in the EU Habitats Directive (92/43/EEC), or listed in the Irish Red Data Books were recorded on the site. All species recorded are common in the Irish landscape. No rare and protected plant species recorded in the desk study, including those obtained from NPWS data request (see Table 6-6), were recorded within the study area.

6.6.3 Invasive species

During field surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted. A number of Japanese knotweed (*Fallopia japonica*) plants were recorded adjacent to an existing forestry road, approximately 200m east of Turbine 2 (Grid Ref: E184107 N324067) and in close proximity to the proposed access road, by existing farm buildings to the east of the site (Grid Ref: E 190620 N 324296). The location of the Japanese knotweed stands are shown in Figure 6-7.

No additional species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations, 2011 were recorded during the survey.



Map Legend

- Japanese knotweed
- EIAR Site Boundary
- Proposed Turbine Location
- Proposed Met Mast Location
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Proposed 38kV Underground Grid Connection Cabling Route
- Proposed Amenity Walkway
- Proposed Boardwalk
- Proposed 38kV Substation Compound
- Proposed Visitor Carpark Location (Operational Phase)
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Existing Access Road/Track
- Proposed Viewing Platform

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MAP TITLE: **Japanese knotweed locations**	MAP NO.: **Figure 6.7**	SCALE: **23,500**
PROJECT TITLE: **180511 - Croagh Wind Farm**		DATE: **30-06-2020**
DRAWING BY: **DMN**	CHECKED BY: **PR**	ISSUE NO.:**180511-2020.06.30-D1**

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6.6.4 Fauna in the Existing Environment

Dedicated faunal walkover surveys were undertaken at the site on the following dates:

- 14th June 2017
- 25th September 2017
- 24th April 2019
- 26th April 2019
- 24th June 2019
- 5th July 2019
- 14th August 2019
- 19th August 2019
- 21st August 2019
- 30th August 2019
- 13th September 2019
- 31st January 2020

In addition to the above targeted surveys, additional faunal signs/sightings were also recorded during other surveys including habitat assessments, bat surveys and bird surveys. The site was also visited on numerous additional occasions during the undertaking of bat surveys throughout 2017, 2018 and 2019.

The walkover survey was designed to detect the presence, or likely presence, of a range of protected species, including birds, bats, otter and badger. Potential suitable habitats were investigated for signs of animal presence. The following subsections provide a breakdown of the species recorded within the proposed development boundary during the site visit and assessment.

6.6.4.1 Badger

Dedicated surveys for this species were undertaken on the above dates between 2017, 2019 and 2020, in addition to incidental records recorded during other species-specific surveys. During dedicated badger surveys of the site, signs of badger i.e. badger foraging signs, latrines etc. were searched for. A single main sett (comprising numerous entrances) and one outlier sett was recorded within and adjacent to the study area. The location of all badger setts are shown on Figure 6-8, Confidential Appendix 6-4[12] of this EIAR. In addition, badger foraging signs and latrines were also recorded within the study area. An example of the main sett (showing two of the entrances) recorded within the study area is provided in Plate 6-17.

[12] *Following standard best practice, the location of breeding or resting places of protected species should be provided as a confidential appendix for review by the competent authority and not made available to the public in order to avoid potential for persecution.*



Plate 6-17 Example of main badger sett recorded within the study area.

6.6.4.2 Otter

No otter signs were recorded during the dedicated otter surveys of the watercourses within the site. Three otter spraints were recorded on the Killanummery Stream and Rathgeean River outside the north and northwest of the site during the dedicated fisheries assessment or kick sampling of the watercourses surrounding the study area, see Appendix 6-3 of the EIAR (Triturus Environmental Ltd, 2019). The main watercourses were assessed as providing suitable commuting and foraging habitat for the species and otter may occur within the EIAR Site boundary, at least on occasion. Following assessment, the fisheries potential of the upper reaches of watercourses within the site is poor (Triturus Environmental Ltd, 2019) and therefore otter are more likely to utilise the lower reaches of the watercourses, downstream of the proposed development site.

6.6.4.3 Red Squirrel

Dedicated red squirrel (*Sciurus vulgaris*) surveys were undertaken, including walked transects through coniferous plantation forestry (WD4). Feeding signs were present throughout the forestry, however no dreys were recorded within the proposed development footprint during the surveys.

6.6.4.4 Bats

Bat surveys undertaken in 2019, in accordance with Scottish Natural Heritage Guidance (SNH 2019), form the core dataset for the assessment of effects on bats at the proposed development site. Bat surveys included roost survey, manual transect surveys and ground-level static surveys.

Roost surveys

One structure located within the south of the site at grid reference E186351 N321105 was surveyed for evidence of roosting bats. The building was assessed as providing suitable roosting features and was subject detailed inspections of the exterior to assess for evidence of bat use. No evidence of bat use was recorded during the roost assessments (Collins, 2016). In addition, no bats were recorded during a dedicated roost survey undertaken by two surveyors on the 7th May 2019. Following this emergence survey it was concluded that the building was not suitable for roosting bats and no further surveys were deemed necessary. No other structures within the site were identified as being, within 200m of a turbine location, or as providing roosting bat features and thus further surveys were not deemed necessary.

The surrounding habitats were assessed as low suitability for roosting bats. No potential tree roosts were identified during the roost surveys and no evidence of bat use was recorded elsewhere during the roost assessment.

Manual transects 2019

Manual transects were undertaken in spring, summer and autumn 2019. Bat activity was recorded on all surveys. Bat activity was low with 68 bat passes in total recorded across all survey nights. Activity was particularly low during the summer transect where only 2 bat passes were recorded in total. In general, Leisler's bat was recorded most frequently. This activity was largely concentrated in the spring season. Common and soprano pipistrelle were also frequently recorded, particularly in autumn. *Myotis* sp. and brown long-eared bat were less frequently encountered. Species composition and activity levels varied significantly between surveys. Figure 4-4, Section 4.5 '*Manual Transects*' of the standalone 'bat report', provided in Appendix 6-2 of the EIAR, presents results for individual species per survey period.

Ground-level Static Surveys 2019

SNH Guidance (2019) requires static detector surveys at turbine bases and the results of those surveys are provided below. The location of all static detectors is provided in Table 3.2 of the Bat report Appendix 6-2 of this EIAR. In total, 21,214 bat passes were recorded across all deployments. In general, Leisler's bat (n= 7,699), common pipistrelle (n=6,384) and soprano pipistrelle (n=6,628) occurred most frequently, while instances of *Myotis* sp. (n=456) and brown long-eared bat (n=47) were significantly less.

Leisler's bat activity was significantly higher than all other species (see Figure 4-7, Appendix 6-2 of the EIAR). During the summer and autumn seasons, Leisler's bat activity reduced while coruuon and soprano pipistrelles were more prevalent during the summer and autumn seasons. Activity was variable between survey nights. Therefore, the median Nightly Pass Rate, including absences, was used as the most appropriate measure of bat activity (Lintott & Mathews, 2018). Results for each species can be found in Section 4.6 of the detailed bat report, provided in Appendix 6-2 of the EIAR.

6.6.4.5 Reptiles and Amphibians

Common frog (*Rana temporaria*) was recorded in the area of peatland within the site. The species is likely to breed in wet habitats within the study area. Common lizard (*Zootoca vivipara*) and smooth newt (*Lissotriton vulgaris*), while not recorded during the site visits, are likely to occur within the study area.

The proposed development will not result in a significant loss of suitable habitat for reptiles and amphibians. It is considered that suitable habitat is extremely widespread in the study area and beyond.

6.6.4.6 Fisheries and Aquatic Fauna

In order to collate baseline fisheries information, Triturus Environmental Ltd. were contracted by MKO to undertake both a catchment-wide electro-fishing, white-clawed crayfish and Q-sampling survey of watercourses within the footprint of the proposed wind farm development study area. A detailed *Aquatic and fisheries assessment* has been prepared for the project and is provided in Appendix 6-3 of the EIAR. A total number of 12 (n=21) sites were electro-fished across the Killanummery, Argina, Tullynascreena and Owengar rivers as well as numerous unnamed tributaries over the course of Monday 19th – Wednesday 21st August 2019. Biological water quality was analysed (via Q-sampling) at n=13 sites. The location of all survey sites referred to in the below subsections is provided in Figure 1.1 of the *Aquatic and fisheries assessment*, Appendix 6-3 of the EIAR.

A total of n=112 fish across five species were recorded via electro-fishing. Brown trout were the dominant species overall accounting for 92% of the total catch, followed by small numbers of Atlantic salmon, stone loach and minnow. Only one site (A7, Killanummery Stream, see location in Figure 1.1 of the *Aquatic and fisheries assessment*, Appendix 6-3 of the EIAR) produced species other than brown trout and this was the only site to support Atlantic salmon at the time of survey. European eel was not recorded from any site.

Lamprey (*Lampetra* spp.) were not recorded during the survey, with all bar one site (A7) considered generally unsuitable for the species in terms of both nursery and spawning habitat. Typically, survey sites were too high-energy to support lamprey larvae or adult spawning.

A total of n=12 (57%) electro-fishing sites did not support resident fish (any species) at the time of survey. These sites were located in more upland areas and invariably featured high-energy flows exposed to regular spate conditions, often flowing over moderate to steep gradients. Upstream fish access for salmonids was difficult or blocked entirely due to such physical characteristics in several cases e.g. sites A1, A2, A3, C1, C2 etc. Some did offer some low suitability for European eel, however, despite their absence at the time of survey.

No white-clawed crayfish were recorded via trapping or sweep netting surveys across a total of n=24 sites in the footprint of Croagh wind farm. However, crayfish remains were recorded in otter spraint under bridges at sites A7 on the Killanummery Stream and site D3 on the Rathgeean River. The majority of sites were considered unstainable for the species.

Overall, the watercourses with the highest value for fish species were the lower survey reaches of the Killanummery, Argina, Tullynascreena and Owengar rivers. Over half of the survey sites were on upland, eroding watercourses and featured higher gradients and higher flows not conducive to supporting resident salmonids, European eel, lamprey or white-clawed crayfish.

6.6.4.7 Marsh Fritillary

The desk study identified that marsh fritillary is known to occur in the wider area surrounding the proposed development.

Dedicated surveys were undertaken within the study area to identify areas of suitable marsh fritillary habitat. Suitable habitat was recorded in small areas within the northwest of the study area as shown in Figure 6-9. The suitable habitat was maiuly associated with areas where stone material has been brought into the site for the construction of site access tracks, where peat had been cutaway or within areas of degraded blanket bog.

During dedicated larval web surveys of the study area in 2017 and 2018, no marsh fritillary larval webs were recorded. None of the potentially suitable marsh fritillary habitat recorded within the proposed development site occur within the proposed infrastructure footprint. In addition, best practice suggests that two consecutive years of surveys be undertaken within suitable habitat, and if not found then no

Map Legend

- Suitable marsh fritillary habitat
- Primary marsh fritillary study area
- Proposed Turbine Location
- Proposed Met Mast Location
- Existing 110kV Garvagh Substation Location
- Existing Roads - Upgrade Proposed
- Proposed New Site Roads
- Proposed 38kV Underground Grid Connection Cabling Route
- Proposed Amenity Walkway
- Proposed Boardwalk
- Proposed 38kV Substation Compound
- Proposed Visitor Carpark Location (Operational Phase)
- Road Widening Works Area
- Proposed Peat & Spoil Repository
- Proposed Construction Compound
- Proposed Borrow Pit
- Existing Access Road/Track
- Proposed Viewing Platform
- EIAR Site Boundary

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MKO

MAP TITLE: **Mapped distribution of marsh fritillary habitat** | MAP NO.: **Figure 6.9** | SCALE: **23,500**

PROJECT TITLE: **180511 - Croagh Wind Farm** | DATE: **30-06-2020**

DRAWING BY: **DMN** | CHECKED BY: **PR** | ISSUE NO.: **180511-2020.06.30-D1**

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MAP TITLE: **Mapped distribution of marsh fritillary habitat** | MAP NO.: **Figure 6.9** | SCALE: **23,500**

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further surveys required. In addition, TII (2009) guidelines also state generally that 'In the vast majority of situations, surveys over successive years will not be required'. For this reason, no additional dedicated surveys were undertaken. As described above, an example of the fragmented areas of suitable marsh fritillary habitat recorded at the site is shown in Plate 6-18.



Plate 6-18 Example of linear strip of wet grassland occurring between forestry and cutover raised bog providing suitable habitat (containing devils-bit scabious) for marsh fritillary.

In addition to the larval web searches, habitat suitability assessments were undertaken during larval web searches within areas of suitable habitat for the species. This followed methods set out in National Biodiversity Data Centre (NBDC[13]) best practice guidance. The results of the condition assessment were focused on assessing the quality of the marsh fritillary habitat identified on site during the initial walkover surveys. Only areas identified as providing suitable marsh fritillary supporting habitat i.e. containing sufficient abundance of devils-bit scabious, were subject to the condition assessment.

6.6.4.8 Other species

Irish hare (*Lepus timidus ssp. hibernicus*) was observed on occasion within the site boundary. Mustelid scats were recorded within the forestry and are presumed to be pine marten (*Martes martes*). The scats of fox (*Vulpes vulpes*) were also recorded in a number of areas within the site. Red deer (*Cervus elaphus*) was observed during the site walkover surveys and numerous deer droppings and wallows were found throughout the site.

[13] *NBDC, 2019, Habitat Condition Assessment for Marsh Fritillary, Online, Available at: http://www.biodiversityireland.ie/wordpress/wp-content/uploads/Marsh-Fritillary-Habitat-Condition-Form.pdf, Accessed, 20 March 2020*

No significant areas of suitable habitat for other taxa including invertebrates or amphibians, species listed in Annex II or IV of the EU Habitats Directive, or other species of conservation concern was identified within the boundaries of the proposed development site.

6.6.5 Importance of Ecological Receptors

Table 6-12 lists all identified receptors and assigns them an ecological importance in accordance with the Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009). This table also provides the rationale for this determination and identifies the habitats that are Key Ecological Receptors. These ecological receptors are considered in Section 6.7 of this report and mitigation/ measures will be incorporated into the proposed development where required, to avoid potential significant impacts on the features.

Table 6-12 Key Ecological Receptors identified during the assessment

Ecological feature or species	Reason for inclusion as a KER	KER
Designated sites	**Nationally Designated Sites** The following Nationally designated site is located downstream of the proposed development and has been identified as being within the likely Zone of Impact: › Corry Mountain Bog NHA (002321) › Owengar Wood pNHA (001419) › Kilgarriff Marsh pNHA (000426)	Yes
	European Designated Sites The following Special Areas of Conservation are identified in the AA Screening as being within the Likely Zone of Impact and are assessed fully in the NIS that accompanies this application: › Lough Gill SAC [001976] › Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627) These sites are assigned **International** importance and included as a KER as there is potential for indirect effects on them via water pollution. **Note: SPAs within the Likely Zone of Impact are considered in Chapter 7, Ornithology and in the NIS.**	Yes
Aquatic Habitats and related species	**Eroding/upland rivers (FW1)** A number of natural watercourses and large rivers were located within the site boundary. These watercourses include: › River Bonet via the Killanummery Stream, Argina, Tullynascreen and Owengar Rivers as well as several unnamed channels. These Rivers and Streams have been assigned **Local importance (Higher Value)** as they are of high biodiversity value and connect to downstream waterbodies in the local area. They also provide a conduit to downstream SACs of international importance.	Yes

Ecological feature or species	Reason for inclusion as a KER	KER
	Dystrophic lakes (FL1) The site of the proposed development includes a Dystrophic lake (FL1), Lough Nacroagh. There is a small area of Rich Fen and Flush, which is included as a wetland for the purposes of this assessment. These areas have been assigned County Importance in that they conform to EU Habitats Directive habitats that are of high biodiversity, although small in scale.	Yes
	Aquatic and Fisheries Species The aquatic species that are associated with the rivers that are located within and surrounding the site assigned **Local Importance (Higher Value)** in that they have a high biodiversity value in the local context. The downstream watercourses and fauna within them have been assigned as of Local Importance (Higher Value) due to the known populations of salmon, trout and lamprey species along with otter. There is potential for indirect effect on these features as a result of impacts on water quality. These species include salmonid, trout, lamprey species, white clawed crayfish, European eel, aquatic invertebrates and other aquatic species. Fish and other aquatic species are therefore included as a KER for further assessment along with Upland eroding rivers.	Yes
Conifer plantation (WD4)	The majority of the proposed windfarm infrastructure is located within Conifer Plantation (WD4). This is a highly modified habitat with a low biodiversity value. This is classified as Local Importance (Lower Value). For these reasons, this habitat has not been identified as a KER.	No
Peatlands and associated habitats	**Upland Blanket Bog (PB2)** This habitat is assigned County Importance as, although the habitat occurring within the site has been degraded as a result of forestry and turbary activities, the areas of upland blanket bog conform to EU Habitats Directive Annex I habitat Blanket Bog [7130] and is of high biodiversity. The footprint of the proposed development has the potential to result in direct and indirect effects on the receptors and they are included as a KER for further assessment.	Yes
	Transition mire and quaking bog (PF3) This habitat is assigned County Importance as it conforms to the EU Habitats Directive habitat Transition mires [7140] as well as occurring in close association with upland blanket bog (PB2) habitat and Dystrophic lakes (FL1). The footprint of the proposed development has the potential to result in direct and indirect effects on the receptors and they are included as a KER for further assessment.	Yes
	Poor fen and flush (PF2) The Poor fen and flush (PF2) habitat has no affinity with habitats listed under Annex I of the EU Habitats Directive, however, this habitat does form part of the wider Upland blanket bog (PB2) habitat that does conform to EU Habitats Directive Annex I Blanket bogs [7130].Therefore, this habitat has been assessed as of local importance (higher value). Impacts on this habitat are therefore assessed under potential impacts on upland	Yes

Ecological feature or species	Reason for inclusion as a KER	KER
	blanket bog habitat. From a precautionary point of view this habitat has been included as a KER.	
Spoil and bare ground (ED2)	The habitat is common and widespread in the wider area. The habitat has been assessed as of Local Importance (lower value) as it is largely associated with artificial site access tracks and is of low biodiversity value. For this reason, it has not been identified for further assessment and is not a KER.	No
Wet grassland (GS4)	Wet grassland (GS4) has been assessed as of local importance (lower value) as where this habitat occurs within the proposed development footprint, it is generally of low biodiversity value primarily due to fragmentation, abandonment and scrub encroachment associated with the surrounding afforestation of the landscape. However, the habitat is of some local importance to local wildlife (NRA, 2009). As such, the habitat has been assessed as of Local Importance (lower value).	No
Scrub (WD1)	The habitat that is of some local importance to local wildlife (NRA, 2009). However, the habitat is common and widespread in the wider area. As such, the habitat has been assessed as of Local Importance (lower value).	No
Wet willow-alder-ash woodland (WN6)	This habitat occurs as linear strips of woodland along the larger watercourses that occur on site. This habitat occurs as narrow strips of treelined along the narrow upland watercourses. It is located between stands of plantation woodland and has been assessed as of local importance (higher value) as they are of high local biodiversity value. The proposed development footprint will not result in the loss of Wet willow-alder-ash woodland (WN6) recorded on site and has therefore been excluded as a KER.	No
Oak-ash-hazel woodland (WN2)	Wet willow-alder-ash woodland (WN6) has been assigned Local Importance (higher value) as it is of high local biodiversity value. This habitat occurs outside of the proposed development footprint and upstream of any of the proposed infrastructure. As such, it will not be affected.	No
Badger	Badger as an ecological receptor has been assigned Local Importance (Higher value) on the basis that the habitats within and adjacent to the study area are likely to be utilised by a locally occurring badger population of Local Importance. Direct impacts on badger are not anticipated. There will be no loss of resting or breeding places associated with the development. The proposed development has the potential to result in indirect effects on the receptor and it is therefore included as a KER for further assessment.	Yes
Otter	No evidence of otter was recorded within the red line boundary; however, three spraints were recorded on the Killanummery Stream and Rathgeean River outside the north and northwest of the site during detailed fisheries assessments. Based on the absence of otter records within the site, the low number of otter records in the wider study area and the low suitability of the aquatic habitats to support fish species, otter has been assessed as of Local Importance (Higher value). No evidence of a more ecologically important population was recorded during any of the site surveys undertaken. The proposed development has the potential to result in indirect effects on the receptor (as a result of deterioration in habitat or disturbance during construction/ decommissioning) and it is therefore included as a KER and requires further assessment.	Yes

Ecological feature or species	Reason for inclusion as a KER	KER
Red squirrel	Although evidence of red squirrel was recorded within the study area, no evidence of populations of squirrel being significant at more than a local level was recorded. Based on the low number of squirrel records for the site, squirrel has been assessed as of Local Importance (Higher value). The proposed development footprint has the potential to result in direct and indirect effects on this receptor. However, given the extent of suitable habitat in the area for the species, the small footprint of the proposed infrastructure and the fact that the proposal will not result in any fragmentation of red squirrel habitat, red squirrel has not been included as a KER.	No
Marsh fritillary	Based on the desk study, marsh fritillary has been recorded outside the site, as recently as 2019. However, although small areas of suitable habitat for the species does occur within the site boundary, no evidence of the species was recorded during dedicated surveys for the species undertaken in 2017 and 2018. In addition, the proposed development footprint avoids areas identified as potentially suitable for the species and as such, no potential for impact on the species is predicted. For this reason, the species has not been considered for further assessment in this report.	No
Bats	The habitats within and surrounding the proposed development site are likely to be utilised by a bat population of Local Importance (higher value). All bat species in Ireland are protected under both national legislation – (Wildlife Act, 1976, as amended in 2017) and European legislation – (Habitats Directive (92/43/EEC). Bats are likely to forage and commute within the vicinity of the proposed development. No potential bat roosting features were identified within or adjacent to the development footprint. The proposed development has the potential to result in direct and indirect effects on the receptor. Therefore, bats are included as a KER for further assessment.	Yes
Reptiles and Amphibians	It is considered that the proposed development will not result in a significant loss of suitable habitat for reptiles and amphibians. No evidence of populations of amphibians being significant at more than a local level was recorded. No likely significant effects on these species are anticipated and therefore further survey/ assessment was not deemed necessary. Based on the low number of amphibian records for the site and the highly afforested nature of the study area, amphibians have been assessed as of Local Importance (lower value).	No
Invasive species	Japanese knotweed was recorded along the site access route to the east of the site.	Yes
Additional protected fauna (e.g. Irish hare, pine marten, fox etc).	The recorded evidence suggests that the study area is not utilised by populations of higher than local significance and no potential for significantly effects have been identified at the population level. Due to the small footprint and nature of the proposed development, they are unlikely to be significantly affected by the proposed development. For this reason, other faunal species are not considered further in this EIAR. Significant effects are not anticipated.	No

6.7 Ecological Impact Assessment

6.7.1 Do-Nothing Effect

If the proposed development were not to proceed, the majority of the lands within the site would continue to be managed as commercial forestry. This would continue to involve the harvesting of timber as it matures, followed by the coniferous forestry replanting. The other habitats identified within the EIAR study area, including peatlands and associated habitats, would likely remain in a similar condition. In some drier areas of the peatland habitat, scrub is likely to develop and in time, this may undergo succession to small areas of woodland. The general biodiversity on the site, as described in this chapter, would likely remain similar to its current state as activity levels and land use would not change significantly.

6.7.2 Effects on Designated Sites

None of the elements of the proposed development are located within the boundaries of any Nationally or European designated sites. There will be no direct effects on any designated site as a result of the construction, operation and decommissioning the wind farm project including the haul route, substation and grid connection.

Three nationally designated sites were identified as being within the zone of influence and as KERs. These are listed below:

- Corry Mountain Bog NHA (002321)
- Owengar Wood pNHA (001419)
- Kilgarriff Marsh (000426)

NHAs or pNHAs that are also designated as European Sites have been assessed as those designations within the Appropriate Assessment Screening Report and NIS, with the relevant conclusions are recorded and referenced in this chapter.

In relation to European sites, an Appropriate Assessment Screening Report and Natura Impact Statement (NIS) have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the Proposed development in compliance with Article 6(3) of the Habitats Directive.

As per the aforementioned EPA draft Guidance (2017), *"a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement"* but should *"incorporate their key findings as available and appropriate"*. This section provides a summary of the key assessment findings with regard to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs).

The Screening for Appropriate Assessment concluded as follows:

> *'it cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would be likely to have a significant effect on the following sites:*
>
> - *Lough Gill SAC [001976]*
> - *Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)*
> - *Cummeen Strand SPA (004035)*
>
> *As a result, an Appropriate Assessment is required, and a Natura Impact Statement has been prepared in respect of the proposed development in order to assess whether the proposed development will adversely impact the integrity of these European Sites'.*

The findings presented in the NIS are that, '*in the light of the best scientific knowledge in the field, all aspects of the proposed development which, by itself, or in combination with other plans or projects, which may affect the relevant European Sites have been considered. The NIS contains information which the competent authority, may consider in making its own complete, precise and definitive findings and conclusions and upon which it is capable of determining that all reasonable scientific doubt has been removed as to the effects of the proposed development on the integrity of the relevant Natura 2000 sites'.*

6.7.3 Likely Significant Effects During Construction Phase

6.7.3.1 Effects on Habitats During Construction

Table 6-13below provides details of the extent of the recorded habitats on the site, the extent of the habitat that will be lost to facilitate the proposed development and the percentage of the total area of that habitat in the EIAR study area that it represents.

Table 6-13 Extent of habitat lost to the proposed development and the percentage of the total area of that habitat on site

Habitat	Total area on the site	Area to be lost to development footprint	Percentage of total to be lost
Conifer plantation (WD4)	580.9	30.46	5.24
Upland Blanket Bog (PB2)	61.97	0.91	1.47
Poor fen and flush (PF2)	1.22	0.19	15.57
Transition mire and quaking bog (PF3)	0.68	0.02	2.94
Wet grassland (GS4)	20.5	0.47	2.29
Scrub (WS1)	0.33	0.01	3.03
Buildings and artificial surfaces (BL3)	7.0	2.26	32.29
Total	**672.6**	**34.32**	**5.10%**

The proposed development will result in the loss of areas of habitat that are of Local Importance (Lower Value) and are not identified as KERs. This mainly involves the loss of coniferous plantation forestry (WD4) and has been assessed as of low ecological value. Other habitats assessed as of local importance (lower value) include; Wet grassland (GS4), Buildings and artificial surfaces (BL3), Recolonising bare ground (ED3) and Spoil and bare ground (ED2). Any direct or indirect impacts on these habitats are not significant.

The effects on habitats that are identified as KERs are described in the below tables.

6.7.3.1.1 Assessment of Potential Effects on Rivers and Streams, Open Waterbodies and Sensitive Aquatic Faunal Species

Table 6-14 Potential for impact on rivers, streams, Open Waterbodies and Sensitive Aquatic Species

Description of Effect	The footprint of the proposed development has been specifically designed to avoid the large waterbodies and watercourses within the study area, see Sections 4.2 & 4.7 of the EIAR. The location of new watercourse crossings has been specifically chosen to facilitate the use of clear-span bridges, see Section 4.9.3 of the EIAR, thereby minimising potential for impact on the receiving environment. However, the proposed internal road network and proposed haul route cross a number of watercourses. In some locations, site access tracks will utilise existing bridges with no instream works proposed. As no instream works are proposed, there will be no direct effects on these habitats or the species that are associated with them. There is no potential for the proposed development to result in any barrier to the movement of aquatic species. There is potential for the construction activity to result in the run off of silt, nutrients and other pollutants such as hydrocarbons and cementitious material into these watercourses. This could result from the removal of scrub and woodland, culverting of drainage ditches, minor movement of peat (associated with T1) or the use of concrete and other construction materials. The proposed development will cross a number of small drainage ditches, which are not themselves ecologically sensitive but do provide connectivity to the larger watercourses that surround the site. The construction phase of the proposed watercourse crossings represents a potential indirect effect on the identified aquatic receptors in the form of habitat degradation through water pollution. These effects on water quality are fully described in Chapter 9 'Water' of this EIAR and are described here in relation specifically to ecology. The proposed amenity boardwalk has also been specifically designed to be set back from Lough Nacroagh as well as being constructed in the form of a raised boardwalk, further reducing potential for any deterioration in water quality. **Note: Whilst this impact assessment is in the habitats section, it also assesses the impact on the proposed development on aquatic species including salmonids, lamprey, white-clawed crayfish, European eel, aquatic invertebrates and other aquatic species. The proposed development will have no direct impact on the aquatic habitat of these species and there is no potential for disturbance. The only pathway for effect to occur is as a result of water pollution and this is discussed in this section in relation to habitats and species.**
Characterisation of unmitigated effect	In the absence of mitigation, the indirect effect of water pollution on aquatic receptors during construction has the potential be a short-term reversible impact on watercourses which act as a conduit to downstream habitats. The magnitude of any such impact is likely to be at worst moderate, given that the all major infrastructure such as turbine bases, site compound etc. are located over 50 metres from any significant watercourse.
Assessment of Significance prior to mitigation	In the absence of mitigation and following the precautionary principle, there is potential for the proposed development to result in significant indirect effects on the identified aquatic habitats and species at a local geographic scale in the form of pollution during the construction phase of the proposed development.
Mitigation	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7.11 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development. In addition to this, specific mitigation is provided in relation to water quality in Chapter 9: 'Water' of this EIAR. In addition, the Construction Environmental Management Plan (CEMP) that is provided as Appendix 4-3 of the EIAR, provides the details of exactly how the measures will be implemented during construction.

	In relation to watercourse crossings, Inland Fisheries Ireland (IFI) will be consulted a minimum of four weeks in advance of the installation of clear-span bridges.
Residual Effect following Mitigation	Following the implementation of mitigation, there will be no significant residual effect on aquatic habitats or species as a result of the proposed development.

6.7.3.1.2 Assessment of Potential Effects on Peatlands and Associated Habitats

Table 6-15 Loss of peatlands and associated habitats

Description of Effect	The construction of the proposed windfarm and associated infrastructure will result in the direct loss of approximately 0.91 hectares (1.47%) of the total study area, of Upland blanket bog (PB2) as a result of the proposed Turbine 1 and associated site access track. This area of blanket bog also forms an intimate mosaic with small areas of Transition mire and quaking bog (PF3) and Poor fen and flush (PF2). As described in Section 4.6.1.2 of the EIAR 'a wooden boardwalk will extend for approximately 90m from the amenity walkway north of Lough Nacroagh and will terminate at a viewing platform on the shores of the lake'. As the proposed boardwalk has been designed to utilise existing forestry rides and will be constructed as a raised boardwalk, there will be no associated loss of peatland habitats. The remaining area of peatland habitats (61.06 ha) have been entirely avoided in the design of the project with no potential for any effect thereon. There is the potential to result in indirect effects on the habitat immediately adjoining the footprint through drainage.
Characterisation of unmitigated effect	This is a permanent and irreversible impact on habitats of County Importance. The magnitude of this impact is Slight as it only affects a small percentage of the overall habitat type, which is widespread in the surrounding landscape.
Assessment of Significance prior to mitigation	The loss or degradation of Upland blanket bog (PB2) habitats has been assessed as a permanent significant negative effect on a very small area of a receptor of County importance, in the absence of mitigation. The impact is restricted to a small percentage of the overall habitat within the site. In addition, the proposed infrastructure layout has been designed to deliberately avoid the other areas of Upland blanket bog (PB2) within the site boundary.
Mitigation	The proposed development has been deliberately designed to minimise loss of Upland blanket bog (PB2). Where the development footprint does occur on this habitat, at Turbine 1, the proposed development provides for the replacement of peatland habitat through the restoration of forestry (WD4) back to peatland, located adjacent to Turbine no. 7. This is fully described in the site-specific Biodiversity Management Plan (BMP), provided in Appendix 6-5 of the EIAR. The BMP aims to ensure that there will be no net loss of peatland habitat associated with the proposed development. This has been further developed by the inclusion of an additional peatland enhancement area comprising of degraded Upland blanket bog (PB2) located to the north of Turbine no. 7. It is proposed to undertaken enhancement of this area of peatland, covering an area of 3.74 hectares, through drain blocking and the removal of encroaching conifers (establishing as a result of natural seed dispersal). The location and extent of the habitat replacement and enhancement areas located adjacent to T7 are mapped in the Biodiversity Management Plan, Appendix 6-5 of the EIAR.
Residual Effect following Mitigation	Following the implementation of mitigation and the arising effect of the mitigation measures, there will be no significant residual effect on these Upland blanket bog (PB2). There may be a short-term slight negative effect in the early stages of implementation of the Biodiversity Management Plan in the form of habitat loss.

6.7.3.2 Effects on Protected Fauna During Construction

The proposed development has the potential to result in habitat loss and disturbance impacts on faunal species that were recorded on the site but were not included as KERs, see Table 6-13. Given the extensive area of habitat that will remain undisturbed throughout the site and the avoidance of the most significant areas of faunal habitat (wetlands, natural woodlands and watercourses), no significant effects on non-KER faunal biodiversity is anticipated as a result of the proposed development. Therefore, these species were excluded from further assessment.

The potential for significant effects on aquatic species is restricted to indirect effects on their habitat resulting from water pollution. This has been assessed in Section 6.7.3.1.1 above and is not repeated below.

6.7.3.2.1 *Assessment of Potential Effects on Badger*

Table 6-16 Assessment of Potential Impacts on Badger

Description of Effect	Whilst badger setts and foraging activity were recorded within the study area, the proposed development has been specifically designed to avoid all identified setts. There is some potential for small scale loss of foraging habitat to facilitate the construction footprint. In addition, the proposed haul roads will pass close (over 35 metres) to an identified badger sett located within the north-eastern section of the study area (see Figure 6-8, confidential Appendix 6-4). In the absence of mitigation/best practice, this has the potential to result in disturbance/displacement, and potentially mortality, during the construction phase of the proposed development. In addition, construction works in close proximity to the sett could prevent badgers from occupying the sett.
Characterisation of unmitigated effect	Given the small scale of the development footprint in comparison to the size of the study area, the loss of foraging habitat to the footprint of the proposed development constitutes a Permanent Slight Negative Effect. This would not be reversible as it is within the construction footprint. The proposed development will not result in any fragmentation of badger habitat, as there will be no barriers to movement throughout the site as a result of the proposed works. Although the works that are proposed close to the badger sett involve only the construction of an access track, following the precautionary approach, there is potential for short term slight negative effects on the local badger population in terms of disturbance, displacement and potentially mortality.
Assessment of Significance prior to mitigation	There is no potential for significant loss of badger habitat as a result of the proposed development at any geographic scale. In the absence of mitigation, there is potential for significant disturbance/displacement and/or mortality on the local badger population as a result of the proposed development. There is no potential for significant effects at a county, national or international scale.

Mitigation	The following measures will be undertaken for the avoidance of disturbance/displacement and direct mortality and will be implemented during the construction phase of the proposed development: › From a precautionary basis, a pre-commencement badger survey will be undertaken in accordance with standard best practice guidance (TII, 2005) prior to the commencement of site works to confirm the conditions predicted in this EIAR. If a badger sett is identified within or immediately adjacent to the proposed development footprint, a badger sett disturbance licence will be sought from the National Parks and Wildlife Service. › An exclusion zone will be put in place along the section of haul road during the construction phase to ensure works are not undertaken within 30 metres of a known badger sett on site (known to be approx. 40 metres from the proposed footprint). › All of the above works will be undertaken or supervised by an appropriately qualified ecologist. To protect individual badgers during the construction phase of the proposed development, all open excavations on site will be covered when not in use and backfilled as soon as possible. Excavations will also be covered at night and any deep excavations left open will have appropriate egress ramps in place to allow mammals to safely exit excavations should they fall in.
Residual Effect following Mitigation	Following the implementation of the mitigation as described above, there is no potential for any significant negative effect on badger at any geographic scale.

6.7.3.2.2 Assessment of Potential Effects on Otter

Table 6-17 Assessment of Potential Impacts on Otter

Description of Effect	As described above in relation to aquatic habitats and species, the proposed development has been deliberately designed such that all major infrastructure, i.e. turbine bases and hardstands, avoid significant watercourses and wetland habitats. No instream works are proposed within watercourses that occur. There is therefore no potential for direct effect on habitat that is significant for otter. The dystrophic lake recorded on site has been entirely avoided by the proposed site infrastructure. Infrastructure such as the haul roads and site access tracks will require a number of watercourse crossings. The construction of these watercourse crossings has the potential for indirect effects in the form of disturbance to otter. The proposed development also has the potential to result in indirect effects on otter habitat in the form of water pollution resulting from construction activity as described above.
Characterisation of unmitigated effect	There is no potential for direct loss or fragmentation of significant otter habitat. Given that the site is at present in active afforestation of different ages and all major proposed infrastructure is located over 50 metres from any significant watercourse, any potential disturbance to otter will be a short-term, slight negative effect associated with the installation of the proposed watercourse crossings. In the absence of mitigation, the indirect effect of water pollution on otter during construction has the potential to be a short-term reversible impact. The magnitude of any such impact is likely to be at worst moderate, given that the all major infrastructure such

	as turbine bases and construction compounds are located over 50 metres from any significant watercourse.
Assessment of Significance prior to mitigation	There is no potential for the construction phase of the proposed development to result in significant disturbance, displacement or habitat fragmentation for otter. In the absence of mitigation and following the precautionary principle, there is potential for the proposed development to result in significant indirect effects on otter at a local geographic scale in the form of habitat deterioration resulting from pollution.
Mitigation	A detailed drainage maintenance plan for the proposed development is provided in Section 4.7 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development. In addition to this, specific mitigation is provided in relation to water quality in Chapter 9: 'Water' of this EIAR. In addition, the Construction Environmental Management Plan (CEMP) that is provided as Appendix 4-4 of the EIAR provides the details of exactly how the measures will be implemented during construction. Prior to the commencement of construction works associated with the installation of watercourse crossings, the following measures will be undertaken for the avoidance of disturbance/displacement and direct mortality and to ensure that no otter holts/breeding sites have been established since the original surveys undertaken (TII, 2007): › From a precautionary basis, a pre-commencement otter survey will be undertaken in accordance with standard best practice guidance prior to the commencement of site works. In the unlikely event that an otter holt is identified within or immediately adjacent to the proposed development footprint, consultation will be undertaken with the National Parks and Wildlife Service and a derogation licence applied for. › All conditions of a derogation licence will be implemented in full. › No works should be undertaken within 150m of any holts at which breeding females or cubs are present. › No wheeled or tracked vehicles (of any kind) should be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance should also not take place within 15m of such holts, except under licence (TII, 2006[14]). › All of the above works will be undertaken or supervised by an appropriately qualified ecologist.
Residual Effect following Mitigation	Following the implementation of mitigation, there will be no significant residual effect on otter as a result of the proposed development.

[14] *NRA, 2006. Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes. Dublin: Transport Infrastructure Ireland. Available at: www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Otters-prior-to-the-Construction-of-National-Road-Schemes.pdf*

6.7.3.2.3 Assessment of Potential Effects on Bats

Table 6-18 Assessment of Potential Impacts on Bats

Description of Effect	Whilst the study area was utilised by foraging and commuting bats, the proposed development will not result in any significant reduction or loss of the available habitat on the site given the size of the site and nature and small scale of the habitats that will be lost. No bat roosts were identified in close proximity to the construction footprint of the proposed development and there is no potential for significant bat roosts to be disturbed by increased human presence and increased noise during construction. No built structures within the site were identified as being, within 200m of a turbine location, or as providing roosting bat features and thus further surveys were not deemed necessary. The potential for bats to be killed during removal of trees or structures was considered in this assessment. However, no buildings or other structures with the potential to support bat roosts will be demolished to facilitate the proposed development. In addition, the trees occurring within the development footprint were assessed as not providing suitable cavities to support any significant bat roosts. The coniferous woodland does not provide suitable cavities due to the nature and age of the species recorded, while the scrub habitat occurring within the infrastructure footprint comprises largely of immature downy birch and willows.
Characterisation of unmitigated effect	The construction of the proposed development has the potential to result in Short-Term Imperceptible Negative effects on the local bat populations in the form of habitat loss, disturbance or direct mortality.
Assessment of Significance prior to mitigation	There is no potential for the construction of the proposed development to result in Significant effects on the local bat population at any geographic scale as no roosts were recorded close to the infrastructure, habitat loss and disturbance are only likely to result in imperceptible effects on the local population. The bat survey report, which is included in Appendix 6-2 provides further detail and analysis with regard to the effects on bat species.
Mitigation	Whilst no significant effects on bat species have been identified, the following potential positive effects are noted. The felling of plantation forestry (WD4) within the site, to facilitate site access roads and turbine locations, will result in the creation of more woodland edge habitat and as such benefit feeding and commuting bat species locally. In addition, the following construction best practice will be employed to minimise general noise and disturbance potential. Plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).
Residual Effect following Mitigation	There is no potential for the construction of the proposed development to result in Significant effects on the local bat population at any geographic scale. There will be no significant effect on the conservation status of any bat species as defined in '*The Status of Protected Habitats and Species in Ireland*' (NPWS, 2019)

6.7.3.3 Potential Introduction or Spread of Invasive Alien Plant Species

6.7.3.3.1 Pre-Mitigation Impacts

The Third Schedule invasive species Japanese knotweed was recorded along the proposed site access route. From a precautionary perspective, a pre-construction invasive species survey will be undertaken a part of the proposed project. This will provide updated data in advance of any construction given the

intervention time period between the original survey work and any future grant of permission/ construction. Measures will be in place to prevent the spread of these species during the proposed works. In addition, all necessary precautions will be taken to prevent the introduction of invasive species to the site from elsewhere.

6.7.3.3.2 Proposed Mitigation Measures

Best practice measures in relation to invasive species are described below:

- All earthworks machinery will be thoroughly pressure-washed prior to arrival on site and prior to their further use elsewhere.
- Care will be taken not to disturb or cause the movement of invasive species fragments, either intentionally or accidentally.
- Stands of Knotweed will be clearly demarcated by temporary fencing and tracking within them will be strictly avoided. A minimum buffer of seven metres will be applied to avoid disturbance of lateral Knotweed rhizomes.
- Where works occur within 7m of a Knotweed stand these will be carried out under the supervision of a suitably qualified ecologist.
- Should removal of Knotweed off site be required this will be done so under the supervision of an ecologist in line with NPWS licencing.
- The machinery must be thoroughly cleaned down under supervision of an ecologist prior to moving away from the Knotweed contaminated area.
- All contractors and staff will be briefed about the presence, identification and significance of Knotweed before commencement of works.
- Good construction site hygiene will be employed to prevent the spread of these species with vehicles thoroughly cleaned down prior to leaving any site with the potential to have supported invasive species. All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down on site to prevent the spread of invasive plant species such as Knotweed. All clean down must be undertaken in areas with no potential to result in the spread of invasive species.
- When working at locations in proximity to natural watercourses, a suitable barrier will be erected between the watercourse and the stand of invasive species. This will assist in preventing the spread of any invasive species into the watercourse during their removal.
- Any material that is imported onto any site will be verified by a suitably qualified ecologist to be free from any invasive species listed on the 'Third Schedule' of Regulations 49 & 50 of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regnlations 2011 (S.I. 477 of 2011). This will be carried out by searching for rhizomes and plant material.
- Any soils or subsoils contaminated with invasive species will sent for disposal to an authorized waste facility under licence from NPWS.

The treatment and control of invasive alien species will follow guidelines issued by the National Roads Authority - *The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (NRA 2010) and Irish Water (2016) *Information and Guidance Document on Japanese Knotweed.*

6.7.3.3.3 Residual Impact

No impact.

6.7.3.3.4 Significance of Effects

With the above mitigation in place there will be no significant effect with regard to Third Schedule invasive species as a result of the proposed works.

6.7.4 Likely Significant Effects During Operational Phase

6.7.4.1 Effects on Habitats during Operation

The operation of the proposed development will not result in any additional land take or loss of revegetated peatland habitats and as such there is no potential for any significant effects in this regard. These habitats are not considered to be a KER in the context of the operation of the proposed development. However, the proposed development has the potential to result in enhancement of the surrounding areas through habitat rehabilitation management (as described in the Biodiversity Management Plan) that will be implemented during the construction phase of the proposed development and maintained during the operational phase. Details of the management that will be undertaken are provided in the Biodiversity Management Plan in Appendix 6-5.

Potential for effects on rivers, streams, open waterbodies and sensitive aquatic species remains a KER during operation and is assessed in detail in the following subsection.

6.7.4.1.1 *Effects on Rivers and Streams, open waterbodies and sensitive aquatic faunal species.*

Table 6-19 Assessment of Potential Impacts on Rivers, Streams, Open Waterbodies and Sensitive Aquatic Faunal Species

Description of Effect	The increased amount of hard standing associated with the windfarm infrastructure has the potential to result in faster run off of water from the site to the surrounding watercourses. This may have the indirect effect of causing erosion, which could lead to deterioration of surface water and supporting habitat quality. Additionally, there is the potential for the faster run off of any pollutants that may be associated with vehicular usage on the site. These impacts on water quality are fully described in Chapter 9: '*Water*' of this EIAR and are described here in relation specifically to biodiversity. **Note: Whilst this impact assessment is in the habitats section, it also assesses the impact on the proposed development on aquatic species including salmonids, lamprey, white-clawed crayfish, European eel, aquatic invertebrates and other aquatic species. The proposed development will have no direct impact on the aquatic habitat of these species and there is no potential for disturbance. The only pathway for effect to occur is as a result of water pollution and this is discussed in this section in relation to habitats and species.**
Characterisation of unmitigated effect	Impact on water quality during the operational phase of the proposed development has been assessed as a permanent negative effect in the absence of mitigation. The magnitude of this impact is slight because all major infrastructure will be located over 50 metres from any significant watercourse (those mapped by the EPA[15] and downloaded to GIS) and the footprint of the proposed development will be minimal when compared to the overall size of the site. The closest turbine to an EPA mapped watercourse is Turbine no. 3, located approx. 90 metres to the east of the watercourse.
Assessment of Significance prior to mitigation	Significant effects on water quality are not anticipated at any geographic scale during the operation of the proposed development.
Mitigation	Whilst no significant effects on water quality are anticipated, potential for effects on water quality associated with the operational phase drainage of the site has been fully mitigated through appropriate design and mitigation as fully described in Section 9.4.4 of Chapter 9: 'Water' and Section 3.2 of the CEMP.

[15] *EPA, 2020, Online Map viewer. Available at: https://gis.epa.ie/EPAMaps/*

Residual Effect following Mitigation	Following the implementation of the mitigation measures outlined above, no potential for significant effect has been identified at any geographic scale as a result of the proposed development.

6.7.4.2 Effects on Fauna during Operation

The operation of the proposed development will not result in any additional habitat loss or deterioration, nor will it result in a significant increase in anthropogenic activity due to its location and scale.

The implementation of the Biodiversity Management Plan will ensure that any Upland blanket bog habitat that is lost to facilitate the proposed infrastructure will be replaced within the site. The Biodiversity Management Plan will also incorporate drain blocking and the removal of encroaching conifers from an existing area of Upland blanket bog, as fully described in Appendix 6-5, and will result in the establishment of habitats of higher value for local faunal species. As such the operation of the proposed development will not result in a significant impact at any geographic scale. Such measures will have positive effects on the non-volant terrestrial fauna at the site of the proposed development. There is no potential for significant negative effects on non-volant terrestrial fauna including badger and otter that were identified as KERs during the construction phase of the development.

It should be noted that no significant habitat for salmonids, lamprey, white-clawed crayfish, European eel, aquatic invertebrates or other aquatic species was recorded within the footprint of the proposed development and all major infrastructure such as turbine bases are located over 50 metres from the watercourses and wetlands within the site. The potential for significant effects on the above aquatic species is restricted to indirect effects on their habitat resulting from water pollution. This has been assessed in Section 6.7.4.1.1 and is not repeated below.

Potential for significant effects on bat species resulting from the operation of the proposed development were identified and therefore, these are identified as KERs during the operational phase.

6.7.4.2.1 *Assessment of Potential Effects on Bats during operation*

Table 6-20 Assessment of Potential Impacts on Bats

Description of Effect	There is no potential for loss or fragmentation of foraging or roosting habitat for bat species during the operational phase of the proposed windfarm as there will be no additional loss of any habitats following construction. The bat survey report that is provided in Appendix 6-2, found bat species composition and abundance to be typical of the geographic location and largely afforested upland nature of the site.
Characterisation of unmitigated effect	The operation of the proposed wind farm has the potential to result in a long-term effect on Pipistrelle and Leisler's bat species as a result of mortality due to collision. The magnitude of this effect in the absence of mitigation is moderate on the basis that no significant roosts were identified in the immediate vicinity of the turbines and the median level of activity is considered moderate (on a precautionary basis). It is noted in the SNH (2019) guidelines that bat activity on windfarm sites is highly liable to change following construction of a wind farm due to the changes in habitat that occur to facilitate construction. Therefore, continued monitoring of operational wind farms for three years' post construction is recommended in the guidelines and will be undertaken at this site, to determine the actual, post construction effects on the local bat populations.

Assessment of Significance prior to mitigation	Following the precautionary principle, there is potential for the operation of the proposed development to result in Significant effects on the local bat population.
Mitigation	In order to reduce the value of the habitat for bat species in the areas surrounding the turbines, a buffer of at least 50m between the tip of the blade and any trees or other tall vegetation that could provide high quality foraging habitat for bat species will be implemented. Details of this mitigation and how it is calculated is provided in Appendix 6-2. In addition to this, ongoing monitoring of bat activity will be undertaken for at least 3 years' post construction of the wind farm. This will provide data and information on the actual recorded impact of the wind turbines on the local bat populations. Full details of the proposed monitoring programme are provided in Appendix 6-2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions. If, following monitoring, there are significant effects recorded, a range of measures are proposed to ensure that any such effects are fully mitigated. These measures include blade feathering, curtailment of turbines during certain conditions and increase of buffers surrounding the turbines. Any or all of the above measures may be employed following actual monitoring of the impact of the operating turbines on bats to ensure that no potential for significant effects on bat species remains.
Residual Effect following Mitigation	Following the implementation of the monitoring and mitigation described above, there is no potential for significant residual effects on bat species.

6.7.5 Likely Significant Effects During Decommissioning phase

There will be no additional habitat loss associated with the decommissioning of the proposed development and therefore there will be no significant effects in this regard. In addition, the removal of the infrastructure will involve similar operations to those involved in construction but without the large-scale earth moving or excavations as the turbine bases and roads etc. will be left in place. These works would therefore be of a smaller scale but would have similar impacts on ecology to those experienced during construction. There would be no additional or ancillary impacts associated with the decommissioning phase.

The same mitigation to prevent significant impacts on water quality and associated aquatic fauna and other terrestrial fauna during construction will be applicable to the decommissioning phase. An outline decommissioning plan is contained in the CEMP, Appendix 4-4 of the EIAR. The CEMP for the project provides the details of the mitigation and best practice that will be employed to avoid any potential for significant residual effects on biodiversity during decommissioning of the proposed wind farm. In addition, the measures incorporated into the construction phase, in Section 4.7.11 of this EIAR, including specific mitigation provided in relation to water quality in Chapter 9: 'Water', will be implemented during decommissioning.

6.8 Cumulative impact

The proposed development was considered in combination with other plans and projects in the area that could result in cumulative impacts on the Key Ecological Receptors (KERs) identified in Section 6.6.5 of this report, including European Sites, Nationally designated sites. This included a review of

online Planning Registers and served to identify past, present and future plans and projects, their activities and their predicted environmental effects. The projects considered are listed in Chapter 2: Background of the Proposed Development.

6.8.1 Assessment of Plans

The following development plans have been reviewed and taken into consideration as part of this assessment:

- Leitrim County Development Plan 2015-2021
- Sligo County Development Plan 2017–2023
- Roscommon County Development Plan 2014-2020
- National Biodiversity Action Plan 2017-2021

The review focused on policies and objectives that relate to designated sites for nature conservation, biodiversity and protected species. Policies and objectives relating to the conservation of peatlands and sustainable land use were also reviewed, particularly where the policies relate to the preservation of surface water quality. An overview of the search results with regard to plans is provided in Table 6-21.

European sites are considered in the Natura Impact Statement that accompanies this application.

Table 6-21 Assessment of Plans

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
Leitrim County Development Plan 2015-2021	**Peatlands** Objective 74 It is an objective of the Council to conserve peatlands and protect peatland landscapes within the County. Objective 75 It is an objective of the Council to seek hydrological reports for significant developments within and close to peatlands, in order to assess potential impacts on the integrity of the peatland ecosystems. **Trees, woodlands & Hedgerows** Policy 83 It is the Council's policy to ensure the preservation of sound deciduous trees, woodlands and native hedgerows, without excessively inhibiting development. **NHA/pNHA** Policy 79 It is the policy of the Council to protect NHA sites. The Council acknowledges that not all sites of ecological importance have been identified and will protect any such site of significance, proposed as an NHA. Objective 66	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the biodiversity, protected species and designated sites. The proposed development has been designed in order to avoid peatland habitats where possible and where some loss has been identified; appropriate mitigation and compensation measures have been incorporated into the proposed project through a Biodiversity Management Plan. The proposed development is located outside of any Nationally designated sites, as described in Section 6.5.1. No potential for negative cumulative impacts when considered in conjunction with the current proposal were identified. No developments or projects identified within the Development Plan were found to occur in the wider area surrounding the proposed development.

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	It is an objective of the Council to protect all Natural Heritage Areas and those proposed for designation either before or during the lifetime of this plan so as to recognise that the process of designation of such sites is ongoing, with new sites being added and boundaries of existing sites being adjusted, as better information becomes available. Objective 67 It is an objective of the Council to protect the following proposed Natural Heritage Areas and all others as they become proposed during the lifetime of this plan.	
Sligo County Development Plan 2017–2023	**Natural heritage –Policies** It is the policy of Sligo County Council to: **P-NH-1** Protect, sustainably manage and enhance the natural heritage, biodiversity, geological heritage, landscape and environment of County Sligo in recognition of its importance for nature conservation and biodiversity, and as a non-renewable resource, in association with all stakeholders. **P-NH-2** Promote increased understanding and awareness of the natural heritage and biodiversity of the county. **P-NH-3** Protect and, where possible, enhance the plant and animal species and their habitats that have been identified under the EU Habitats Directive, EU Birds Directive, the Wildlife Act and the Flora Protection Order. **P-NH-4** Take full account of the precautionary principle where uncertainty exists regarding the potential impact of a proposed development on the natural heritage resource. **Designated sites for nature conservation – Policies and objective**	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the biodiversity, protected species and designated sites. The proposed development has been designed in order to avoid peatland habitats where possible and where some loss has been identified; appropriate mitigation and compensation measures have been incorporated into the proposed project through a Biodiversity Management Plan. The proposed development is located outside of any Nationally designated sites, as described in Section 6.5.1. No potential for negative cumulative impacts when considered in conjunction with the current proposal were identified.

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	P-DSNC-1 Protect and maintain the favourable conservation status and conservation value of all-natural heritage sites designated or proposed for designation in accordance with European and national legislation and agreements. These include Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), Ramsar Sites, Statutory Nature Reserves. In addition, the Council will identify, maintain and develop non-designated areas of high nature conservation value which serve as linkages or 'stepping stones' between protected sites in accordance with Article 10 of the Habitats Directive. **P-DSNC-4** Consider development within, or with the potential to affect, Natural Heritage Areas or proposed Natural Heritage Areas, where it is shown that such development, activities or works will not have significant negative impacts on such sites or features, or in circumstances where impacts can be appropriately mitigated. **Protected plant and animal species - Policies and objective** **P-PPAS-1** Ensure that development does not have a significant adverse impact, incapable of satisfactory mitigation on plant, animal or bird species protected by law. **Nature conservation outside designated sites – policies** **P-NCODS-1** Minimise the impact of new development on habitats of natural value that are key features of the County's ecological network. Developments likely to have an adverse effect on recognised sites of local nature conservation importance will be required to demonstrate the impacts on the ecological value of the site and will not be approved unless it can be clearly demonstrated that there are reasons for the development that outweigh the need to safeguard the nature conservation value of the site.	No developments or projects identified within the Development Plan were found to occur in the wider area surrounding the proposed development.

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	P-NCODS-3 Ensure that proposals for development protect and enhance biodiversity, wherever possible, by minimising adverse impacts on existing habitats and by including mitigation and/or compensation measures, as appropriate, which ensure that biodiversity is enhanced. **P-NCODS-4** Apply the precautionary principle in relation to development proposals with potential to impact on County Biodiversity Sites or on local nature conservation interest by requiring an ecological impact assessment (EcIA) to ensure that any proposed development will not affect the integrity and conservation value of the site. **Inland waters - policies & Objectives** **P-INW-1** Protect rivers, streams and other water courses and their associated Core Riparian Zones (CRZs) from inappropriate development and maintain them in an open state, capable of providing suitable habitats for fauna and flora. Structures (e.g. bridges) crossing fisheries waters shall be clear-span and shall be designed and built in consultation with Inland Fisheries Ireland. **O- INW-1** Consult with prescribed bodies prior to undertaking, approving or authorising any works or development that may impact on rivers, streams and watercourses. **O- INW-2** Require that runoff from a developed area does not result in deterioration of downstream watercourses or habitats, and that pollution generated by a development is treated within the development area prior to discharge to local watercourses.	
Roscommon County Development Plan 2014 - 2020 -	**Core Policy 2.10:** To identify and recognise the potential, in economic and social terms, of the county's natural resources such as its arable agricultural land, clean environment, lands with forestry potential, aggregate reserves and tourism opportunities. To support the utilisation of alternative energy provision in a sustainable and harmonious way in terms of impacts on landscapes and habitats over the broad spectrum of its potential sources, including wind, solar and alternative fuel sources. Any such development will be cognisant of the need to protect, conserve and enhance the county's	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the biodiversity, protected species and designated sites. The proposed development has been designed in order to avoid peatland habitats where possible and where some loss has been identified; appropriate mitigation and

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
Core Strategy and Settlement Policy	biodiversity and the requirement for screening to determine if a full Appropriate Assessment of the likely impact on integrity on Natura 2000 sites is required.	compensation measures have been incorporated into the proposed project through a Biodiversity Management Plan. No potential for negative cumulative impacts when considered in conjunction with the current proposal were identified. No developments or projects identified within the Development Plan were found to occur in the wider area surrounding the proposed development.
National Biodiversity Action Plan 2017-2021	**Objective 1** Mainstream biodiversity into decision-making across all sectors Developments in the area of Green Infrastructure are being initiated at the local and regional level. Green Infrastructure is a strategically planned network of natural and semi natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation. **Objective 4** - Conserve and restore biodiversity and ecosystem services in the wider countryside **Target 6.2** - Sufficiency, coherence, connectivity, and resilience of the protected areas network substantially enhanced by 2020.	The Development plan was comprehensively reviewed, with particular reference to Policies and Objectives that relate to the biodiversity, protected species and designated sites. The proposed development has been designed in order to avoid any potential fragmentation of habitats or commuting corridors. No potential for negative cumulative impacts when considered in conjunction with the current proposal were identified.
The Regional Planning Guidelines for the West 2010-2022	**EAP13:** To support the protection of Natural Heritage Areas, Special Protection Areas, Special Areas of Conservation, Nature Reserves, Ramsar Sites (Wetlands), Wildfowl Sanctuaries, National Parks, Nature Reserves and the biodiversity designated under the Habitats Directive, Birds Directive, Wildlife Act, Flora Protection Order and other designated or future designated sites.	The proposed development will not result in significant effects on habitat and features of ecological importance. The proposed development has been designed in order to avoid and minimise impacts on sensitive habitats and species.

Plans	Key Policies and Objectives directly related to European Sites and Biodiversity in the Zone of Influence	Assessment of Potential Impact on European Sites
	EAO18: Support the achievement of favourable conservation status of Annex I habitats, Annex II species, Annex I bird species and other regularly occurring migratory bird species and their habitats in the region.	No potential for negative cumulative impacts when considered in conjunction with the current proposal were identified

6.8.2 Assessment of Projects

As described in Section 2.2 of the EIAR, relevant projects have been assessed in-combination with the proposed wind farm development and include planning applications in the vicinity of the site, within the zone of influence of all habitats and species considered in this report, and include other wind energy applications within the wider area. These have not been repeated here to reduce the duplication of information within this EIAR. However, they have been fully considered in the assessment with further detail provided below. In addition, Section 6.8.4 concludes on their potential for impact on biodiversity.

For the purposes of this cumulative assessment wind farms within a 10-kilometre radius of the proposed development area were considered in further detail below. Windfarms occurring at greater distances were considered, however, given the nature of the KERs identified within the EIAR study area and that no significant residual effects were identified, further detailed analysis is not provided below.

Black Banks, Co. Leitrim (Ref. 97/13602)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Black Banks wind farm, which is located to south-east of the proposed project, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Black Banks wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Garvagh Glebe, Co. Leitrim (Ref. 03/257, 08/602)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Garvagh Glebe wind farm, which is located to the east of the site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Garvagh Glebe wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Carrane Hill, Co. Sligo (Ref. 98/533)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Carrane Hill wind farm, which is located 600m from the wind farm site, was considered. The planning file was reviewed on the Sligo County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Carrane Hill wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Geevagh, Co. Sligo (Ref. 98/861)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Geevagh wind farm, which is located 1km from the wind farm site, was considered. The planning file was reviewed on the Sligo County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Geevagh wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Moneenatieve, Co. Leitrim (Ref. 00/7)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Moneenatieve wind farm, which is located 1.8km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Moneenatieve wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Corrie Mountain, Co. Leitrim (Ref. 96/12794)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Corrie Mountain wind farm, which is located 2.3km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Corrie Mountain wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Spion Kop, Co. Leitrim (Ref. 95/12501)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Spion Kop wind farm, which is located 3.2km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Spion Kop wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial

photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Altagowlan, Co. Roscommon (Ref. 00/1979)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Altagowlan wind farm, which is located 3.2km from the wind farm site, was considered. The planning file was reviewed on the **Roscommon** County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Altagowlan wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Derrysallagh, Co. Sligo (Ref. 12/133)

Derrysallagh is the next closest wind farm to the proposed development, located approximately 3.7km to the south. The development was not located within any designated sites for nature conservation. Not all of the EIAR submitted for the application was available online during the search. Therefore, it was not possible to review the entire Ecological Impact Assessment. However, given the location of the wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Garvagh Tullyhaw, Co. Roscommon (Ref. 03/1486)

Garvagh Tullyhaw is the next closest wind farm to the proposed development, located approximately 4.3km to the south-east. The EIS was consulted to determine whether cumulative impacts are likely to result. The EIS concluded that the windfarm will not have a significant effect on the receiving flora and fauna. No significant residual effects on biodiversity receptors were identified.

Based on the information available in the Garvagh Tullyhaw EIS, significant cumulative impacts are not anticipated.

Seltannaveeny, Co. Sligo (Ref. 02/1094)

Seltannaveeny is the next closest wind farm to the proposed development, located approximately 5.7km to the south-east. A compilation of a formal EIS was not mandatory as the proposed development was below the statutory threshold (5 turbines or 5MW). The scope of the EIA to be carried out did not include any ecology section. However, given the location of the Seltannaveeny wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Tullynamoyle, Co. Leitrim (Ref. 03/331)

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Tullynamoyle wind farm, which is located 7.5km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the Tullynamoyle wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

Tullynamoyle Extension, Co Leitrim (Ref. 15/164)

The planning file was reviewed on the Leitrim Connty Council Planning Register and no information regarding potential effects on biodiversity was available. However, given the location of the wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts biodiversity associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the absence of any significant residual effect identified for the proposed Croagh Wind Farm, significant cumulative effects on the KERs identified with regard to direct habitat loss, disturbance/displacement or mortality are not anticipated.

6.8.3 Existing Habitats and Land Uses

The potential for the proposed development to result in a cumulative loss or deterioration of habitats, or impact on the KER species identified, was considered in relation to the existing land uses in the area.

The wind farm is primarily located in forestry habitats, which generally provide low value habitats for faunal species. In addition, due to the nature of the plantation forestry, this habitat is of low biodiversity value locally. The proposed development will not result in any significant loss of valuable habitats e.g. upland peatland or grassland. The minor loss of peatland habitat that will be affected, will be fully mitigated through habitat enhancement and restoration proposed as part of this development. The wind farm will not contribute to any overall loss of high value habitat, it has been deliberately designed to be located on habitats of low value for faunal species.

6.8.4 Assessment of Cumulative Effects

The residual construction, operational and decommissioning impacts of the proposed development are considered cumulatively with other plans and projects as described in Sections 6.8.1 & 6.8.2. Particular focus has been placed on those plans and projects that are in closest proximity to the proposed development and those that could be potentially affected via downstream surface water.

Following the detailed surveys undertaken and impact assessment provided in Section 6.7, it is concluded that there will be no significant residual habitat loss, disturbance, deterioration of water quality etc., associated with the wind farm project and therefore it cannot contribute to any cumulative effect when considered in combination with other plans and projects. The other wind farms in the area

were considered (among other projects) but the proposed development has been deliberately designed to minimise the effects on biodiversity through the siting of the wind farm on habitats of low ecological value (conifer plantation). The project also includes a biodiversity management plan, which further minimises / offsets any potential for individual or cumulative negative effects on biodiversity.

No significant effects as a result of the proposed development in relation to disturbance, displacement or mortality of faunal species has been identified. Therefore, there is no potential for the proposed development to contribute to any cumulative effect in this regard.

The proposed development will not result in any significant residual effects on biodiversity and will not contribute to any cumulative effect when considered in combination with other plans and projects.

In the review of the projects and plans that was undertaken, no connection that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the proposed development.

6.9 Conclusion

The site is located primarily within a large plantation coniferous forestry (WD4) of varying ages that has been assessed as of low ecological value. Consequently, any potentially significant effects on the Key Ecological Receptors identified in this report have been avoided through their avoidance during the project design or by the implementation of mitigation measures as detailed in Section 6.7 of this chapter; including all references made to mitigation specified in other Chapters and appendices of the EIAR.

A small area of fragmented Upland blanket bog (PB2) also occurs within the northwest of the site. This area of peatland and associated habitats have been assessed as corresponding to those listed in Annex I of the EU Habitats Directive and were therefore identified as of County importance. The proposed development has been designed in order to avoid peatland habitats where possible and where some loss has been identified; appropriate mitigation and compensation measures have been incorporated into the proposed project through a Biodiversity Management Plan.

Faunal species records within the EIAR study area, during detailed ecological surveys undertaken between 2017 and 2020, were found to be common and widespread in the wider area, and in a National context. Protected species such as badger were identified within the site boundary. The badger setts recorded have been fully avoided by the proposed development footprint. In addition. a number of standard best practice measures have been incorporated into the project for the avoidance of impact on badger as a result of disturbance/displacement. The implementation of these measures in full will ensure compliance with the Wildlife Act.

Taking the above information into consideration and having regard to the precautionary principle, the proposed development will not result in a residual loss of peatland habitat of high ecological significance and will not have any significant impacts on the ecology of the wider area.
Provided that the proposed development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant impacts on ecology are not anticipated at any geographic scale.

7. ORNITHOLOGY

7.1 Introduction

This chapter assesses the likely significant effects that the Croagh Wind Farm development (the 'Proposed Development') may have on avian receptors. Particular attention has been paid to species of ornithological importance. These include species with national and international protection under the Wildlife Acts 1979-2012 as amended and the EU Birds Directive 2009/147/EC among other relevant legislation. Where potential effects are identified, mitigation is described and residual impacts on avian receptors are assessed.

This chapter is supported by Technical Appendices 7-1 to 7-7 which contain data from the surveys undertaken including full details of the survey times, weather conditions, and other relevant information together with the bird records themselves. Appendix 7-6 contains the CRA document which illustrates how the Collision Risk Modelling was undertaken for this site. Appendix 7-7 contains the Birds Monitoring Programme. The proposed development area and survey radii are provided in Figures 7-1-7-6.

The chapter is structured as follows:

- The Introduction provides a description of the Proposed Development and the relevant legislation, gnidance and policy context regarding ornithology.
- This is followed by a comprehensive description of the ornithological surveys and impact assessment methodologies that were followed to inform the robust assessment of likely significant effects on avian receptors.
- A description of the Baseline Ornithological Conditions and Receptor Evaluation is then provided. This is followed by an Assessment of Effects, which as per SNH Guidance (2017), includes direct habitat loss, displacement and death from collision. Effects are described with regard to each phase of the Proposed Development: construction, operational and decommissioning. Potential cumulative effects in combination with other projects are fully assessed.
- Proposed mitigation and best practice measures to ameliorate the identified effects are described and discussed. This is followed by an assessment of residual effects taking into consideration the effect of the proposed mitigation and best practice measures.
- The conclusion provides a summary statement on the overall significance of predicted effects on ornithology.

The following list defines the meaning of the technical terms used in this chapter:

- "Key Ornithological Receptor" (KOR) is defined as a species occurring within the zone of influence of the development upon which likely significant effects are anticipated and assessed.
- "Zones of Influence" (ZOI) for individual ornithological receptors refers to the zone within which potential effects are anticipated ZOIs were assigned following best available guidance (SNH 2016 and McGuinness et.al 2015).

7.1.1 Description of the Proposed Development

The full development description is provided in Chapter 4 of the EIAR. The proposed development comprises 10 no. turbines with an overall blade tip height of up to 170 metres, a substation that will connect by underground cable to the existing Garvagh substation, a borrow pit, 2 no. peat repository

areas, new access road from the regional road, replacement lands and all ancillary infrastructure. A detailed description of the Proposed Development is included in Chapter 4 of this EIAR.

The Proposed Development will have an operational life of 30 years from the date of commissioning of the wind farm.

7.1.2 Legislation, Guidance and Policy Context

This EIAR is prepared in accordance with the requirements of the 2011 EIA Directive as amended by EIA Directive 2014/52/EU.

The following are the key legislative provisions applicable to habitats and fauna in Ireland:

- Irish Wildlife Acts 1976 to 2012 as amended.
- The European Communities (Birds and Natural Habitats) Regulations 2011 (transposes EU Birds Directive 2009/147/EC and EU Habitats Directive 92/43/EC).
- The International Convention on Wetlands of International Importance 1971.

In the absence of specific National Irish Ornithological Survey Guidance, the guidance documents published by Scottish Natural Heritage (SNH) have been followed to inform this assessment:

- SNH (2017). *Recommended bird survey methods to inform impact assessment of onshore wind farms.* Scottish Natural Heritage.
- SNH (2018) *Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model.* Scottish Natural Heritage, Edinburgh, UK. http://www.snh.gov.uk/docs/B721137.pdf.
- SNH (2016). *Assessing Connectivity with Special Protection Areas (SPAs).* Scottish Natural Heritage.
- SNH (2012). *Assessing the Cumulative Impact of Onshore Wind Energy Developments.* Scottish Natural Heritage.
- SNH (2006). *Assessing Significance of Impacts from Onshore Windfarms on Birds with Designated Sites.* Scottish Natural Heritage.
- SNH (2009). *Monitoring the impact of onshore wind farms on birds.* Scottish Natural Heritage.
- SNH (2000). *Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action.* SNH Guidance Note.

The following Irish Guidance documents were also consulted:

- Percival, S.M. (2003). *Birds and wind farms in Ireland: A review of potential issues and impact assessment.* Ecological Consulting.
- McGuinness, D., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). *Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland.* Guidance Document. Birdwatch Ireland.
- Birds of Conservation Concern in Ireland 2014-2019 (Colhoun, K. and Cummins, S. 2013).

This assessment has been prepared with respect to the various planning policies and strategy guidance documents listed below:

- Planning and Development Acts 2000 – 2018.
- Leitrim County Council (2015). Leitrim County Development Plan 2015-2021.
- Sligo County Council (2017). Sligo County Development Plan 2017-2023.

- EPA (2017) Guidelines on the Information to be contained in Environmental Impact Assessment Reports – Draft August 2017'.
- EPA (2015) 'Revised Guidelines on the Information to be contained in Environmental Impact Statements – Draft September 2015'
- EPA (2015) 'Advice Notes for Preparing Environmental Impact Statements – Draft September 2015'.
- EPA (2003)'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'
- EPA (2002) 'Guidelines on the Information to be contained in Environmental Impact Statements'
- DoEHLG (2013). *Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment.* Department of the Environment, Community and Local Government (where relevant).
- The European Commission also published a number of guidance documents in December 2017 in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU as amended by 2014/52/EU) including '*Guidance on Screening*', '*Guidance on Scoping*' and '*Guidance on the preparation of the Environmental Impact Assessment Report*'.
- NRA (2009). *Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2).* National Roads Authority.
- European Commission (2002). *Assessment of plans and projects significantly affecting Natura 2000 sites.*

7.1.3 Statement of Authority and Competence

This ornithology chapter has been prepared by Senior Ornithologist, Mr. Padraig Cregg (BSc., MSc.) with the assistance of Ecologist, Mr David Naughton (BSc.), of McCarthy Keville O'Sullivan Ltd. (MKO). Both are suitably qualified, competent, professional ecologists with extensive experience of completing avifaunal assessments and are competent experts for the purposes of the preparation of this EIAR. The scope of works and survey methodology was devised by Senior Ornithologist, Mr. Alex Ash (BSc.) and is fully compliant with recent SNH guidance. The chapter has been reviewed by Pat Roberts (B.Sc. Environmental Science) who has over 14 years' experience in management and ecological assessment.

Field surveys were undertaken by Lee Dark (BSc., MSc.), Rob Wheeldon (BSc., MSc.), Shay Fennelly (BSc.), Jack Kennedy (BSc.), Eric Dempsey (www.birdsireland.com), John Curtin (BSc.), Andrew O'Donoghue (BSc.), Chris Peppiatt (PhD), Declan Manley (BTO C license, BTO Trainer license & Irish Ringing License from NPWS) Padraig Webb (3rd Year BSc.) and Athena Michaelides (BSc.) All of the above surveyors are competent experts for the purposes of the preparation of this EIAR and suitably qualified.

7.2 Assessment Approach and Methodology

7.2.1 Desk Study

A comprehensive desk study was undertaken to search for any relevant information on species of conservation concern which may potentially make use of the study area. The assessment included a thorough review of the available ornithological data including:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), National Biodiversity Data Centre (NBDC), Irish Wetland Bird Survey I-WeBS.
- Review of Bird Atlases: (Sharrock, 1976; Lack, 1986; Gibbons et al., 1993; Balmer et al., 2013).

- Review of Birds of Conservation Concern (BoCCI) in Ireland 2014-2019 (Colhoun & Cummins, 2013).
- Review of specially requested records from the NPWS Rare and Protected Species Database.
- Review of impact assessments associated with nearby developments including wind farms.

7.2.2 Consultation

7.2.2.1 Scoping and Consultation

Consultation was undertaken with the relevant statutory and non-statutory organisations as part of the EIAR scoping to inform the current assessment. Full details can be found in Section 2.5 of Chapter 2.

Table 7-1 provides a list of the organisations consulted with regard to Ornithology during the scoping process and notes where scoping responses were received.

Copies of all scoping responses are included in Appendix 2.1 of this EIAR. The recommendations of the consultees have informed the EIAR preparation process and the contents of this chapter. Table 2.3 in Chapter 2 of this EIAR describes where the comments raised in the scoping responses received have been addressed in this assessment.

Table 7-1 Consultation Responses

	Consultee	Response
01	An Taisce	Response received on 05th April 2019. Comment: Address cumulative effects, impacts on birds since construction of other wind farms in the area
02	BirdWatch Ireland	Response received on 14th December 2018. Comment: Acknowledgement email - has forwarded to Policy & Advocacy officer for comment. No further comment received to date.
03	Department of Agriculture, Food and the Marine	Response received on 22nd January 2019. Comment: Felling licence requirements, felling impacts to be assessed
04	Department of Culture, Heritage, and the Gaeltacht	Response received on 30th January 2019. Comment: Requirements re ecological surveys on biodiversity, flora, fauna (incl birds, bats), habitats (incl aquatic), Construction Management Plan, cumulative impacts, post-construction monitoring
05	Irish Peatland Conservation Council	Response received on 21st January 2019. Comment: Concerns re loss of blanket bog, impacts on designated sites, birds (Curlew), water quality, peat stability, visual amenity/views

	Consultee	Response
06	Irish Red Grouse Association	No response to date
07	Irish Raptor Study Group	No response to date
08	Irish Wildlife Trust	No response to date
09	Leitrim County Council - Env.	No response to date. However, a meeting was held with Leitrim County Council on the 10th June 2019 and 15th of May 2020.
10	Leitrim County Council – Heritage	No response to date. However, a meeting was held with Leitrim County Council on the 10th June 2019
11	Roscommon County Council - Env.	Response received on 28th February 2019. Comment: Env section has no comments to make
12	Roscommon County Council - Heritage	No response to date
13	Sligo County Council - Env.	No response to date. However, a meeting was held with Sligo County Council on the 21st June 2019 and 21st of May 2020.
14	Sligo County Council – Heritage	No response to date. However, a meeting was held with Sligo County Council on the 21st June 2019

7.2.3 Identification of Target Species and Key Ornithological Receptors

This section of the report describes the criteria used for the selection of target species. The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ornithological Receptors. Following a comprehensive desk study, initial site visits and consultation, a list of "Target species" likely to occur in the zone of influence of the Proposed Development was derived. The observation/survey work carried out on the site was specifically designed to survey for these identified target species in accordance with SNH guidance (2017). The target species list (see Appendix 6-1) was drawn from:

- Annex I of the EU Birds Directive.
- Special Conservation Interests (SCI) of Special Protection Areas (SPA) within the zone of likely significant effects.
- Species protected under the fourth schedule of the Wildlife Acts 1976-2012 as amended.
- Red and Amber listed birds of Conservation Concern.

Following analysis of the collated bird survey data, it was possible to refine the list of Target species to identify "Key Ornithological Receptors" and exclude species which were not recorded during the extensive surveys and those for which pathways for significant effect could not be identified.

7.2.4 Field Surveys

Field surveys were undertaken during the survey period September 2017 - September 2019. The data provided in this report is robust and allows clear, precise and definitive conclusions to be made on the avian receptors identified within the subject site. Field survey methodologies have been devised to survey for the bird species composition and assemblages that occur within the study area. The study area/ area surveyed for each type of survey is discussed in the methodology section below. The survey radii mentioned below are discussed in relation to the proposed development area, that is the area within the development boundary where all onsite infrastructure is sited, with the exception of the access road. The survey of the access road is discussed in Section 7.2.4.2.8 below.

7.2.4.1 Initial Site Assessment

Based on the results of the desk study, consultation and reconnaissance site visits, the likely importance of the study area for bird species was ascertained. Based on the collated information available from the above preliminary assessment and adopting a precautionary approach, a site-specific scope for the ornithological survey was developed.

7.2.4.2 Survey Methodologies

The survey work undertaken between September 2017 and September 2019 forms the core dataset for the assessment of effects on ornithology.

In the absence of specific national bird survey guidelines, the ornithological surveys were designed and undertaken in full accordance with '*Recommended bird survey methods to inform impact assessment of onshore wind farms*' (SNH, 2017).

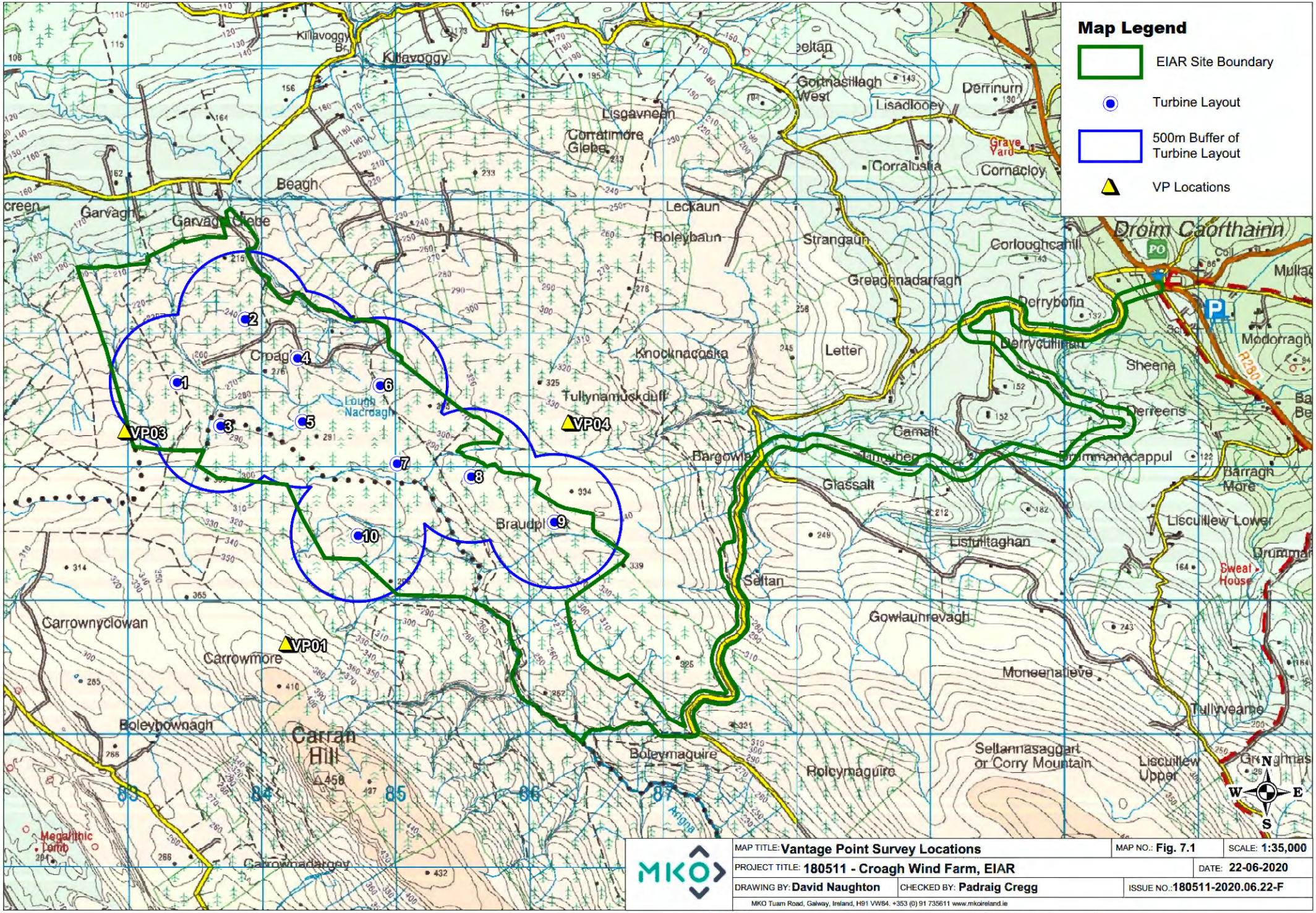
The various survey types undertaken are described below.

7.2.4.2.1 *Vantage Point Surveys*

Vantage point surveys were undertaken in accordance with SNH guidance from September 2017 to September 2019. Surveys were conducted monthly throughout this survey period from four fixed point vantage points (VP1, VP2, VP3 and VP4) to allow comprehensive coverage of the 500m study area surrounding the proposed turbines. The vantage point locations were selected by undertaking a viewshed analysis, as described below, and confirmed by a recce visit and initial field surveys in September 2017. Data collected from VP02 has been excluded from the core dataset and CRM as it is no longer proposed to site any turbines within its view shed. The proposed turbine layout is entirely covered from three fixed VPs (VP1, VP3 & VP4). In the interests of transparency, data gathered from VP2 is provided in Appendix 7-5 but is not discussed in detail in this report. Figure 7-1 shows the locations of all vantage points relative to the development site.

Viewshed Analysis

Viewshed analysis was carried out to inform coverage of the study area from fixed vantage point locations (i.e. VPs 1, 3 and 4). Viewsheds were calculated using Resoft Wind Farm ZTV (Zone of Theoretical Visibility) software in combination with Mapinfo Professional (Version 10.0) using a notional layer suspended at 30m, which is representative of the minimum height considered for the Potential Collision Risk Area based on a worst-case scenario turbine model. While the relevance of being able to view as much of the site to ground level is acknowledged, the SNH guidance emphasizes the importance of visibility of the 'collision risk volume' when the data is to be used to estimate the risk of collision with turbines by birds.



MAP TITLE: **Vantage Point Survey Locations**		MAP NO.: **Fig. 7.1**	SCALE: **1:35,000**
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The viewshed analysis involved testing each VP location for its visibility coverage by creating a viewshed point 1.5 meters in height (to represent the height of observer) on a map using 10 metre contours terrain data. The relative height of forestry and its effects on visibility is also accounted for. Using the ZTV software, a viewshed of 360 degrees was produced calculating an area 30 metres from ground level up to a 2km radius. The resulting viewshed image was then cropped to 180 degrees to give the viewshed from each VP location in line with SNH (2017). A 500m buffer was applied to the outer most turbines of the proposed wind farm development in line with SNH (2017). The aim of the viewshed analysis is to identify the visible airspace of the turbine rotor swept area, using the fewest VPs. The visible view sheds at 30m are presented on Figure 7-2.

Data Recording and Digitisation

Data on bird observations and flight activity was collected from a scanning arc of 180° and a 2km radius by an observer at each fixed location for six hours per month. Due to weather constraints, some surveys ended early but were continued at a later date in the month to ensure that six hours of surveys were conducted per month in accordance with SNH guidance (2017). Surveys were scheduled to provide a spread over the full daylight period including dawn and dusk watches to coincide with the highest periods of bird activity. Target species were as per listed in Table 1-1 of Appendix 7-1.

Survey effort for vantage point watches is presented in Appendix 7-2, Table 1-1. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Table 7-2 below shows a summary of the VP survey work undertaken.

Table 7-2 Vantage Point Survey Effort

Survey Season	Months	Minimum Effort per VP
2017/2018 Non-Breeding Season (4VPs)	Sep - Mar	42 hours/VP
2018 Breeding Season (4VPs)	Apr - Sep	36 hours/VP
2018/2019 Non-Breeding Season (4VPs)	Oct - Mar	36 hours/VP
2019 Breeding Season (4VPs)	Apr - Sep	36 hours/VP

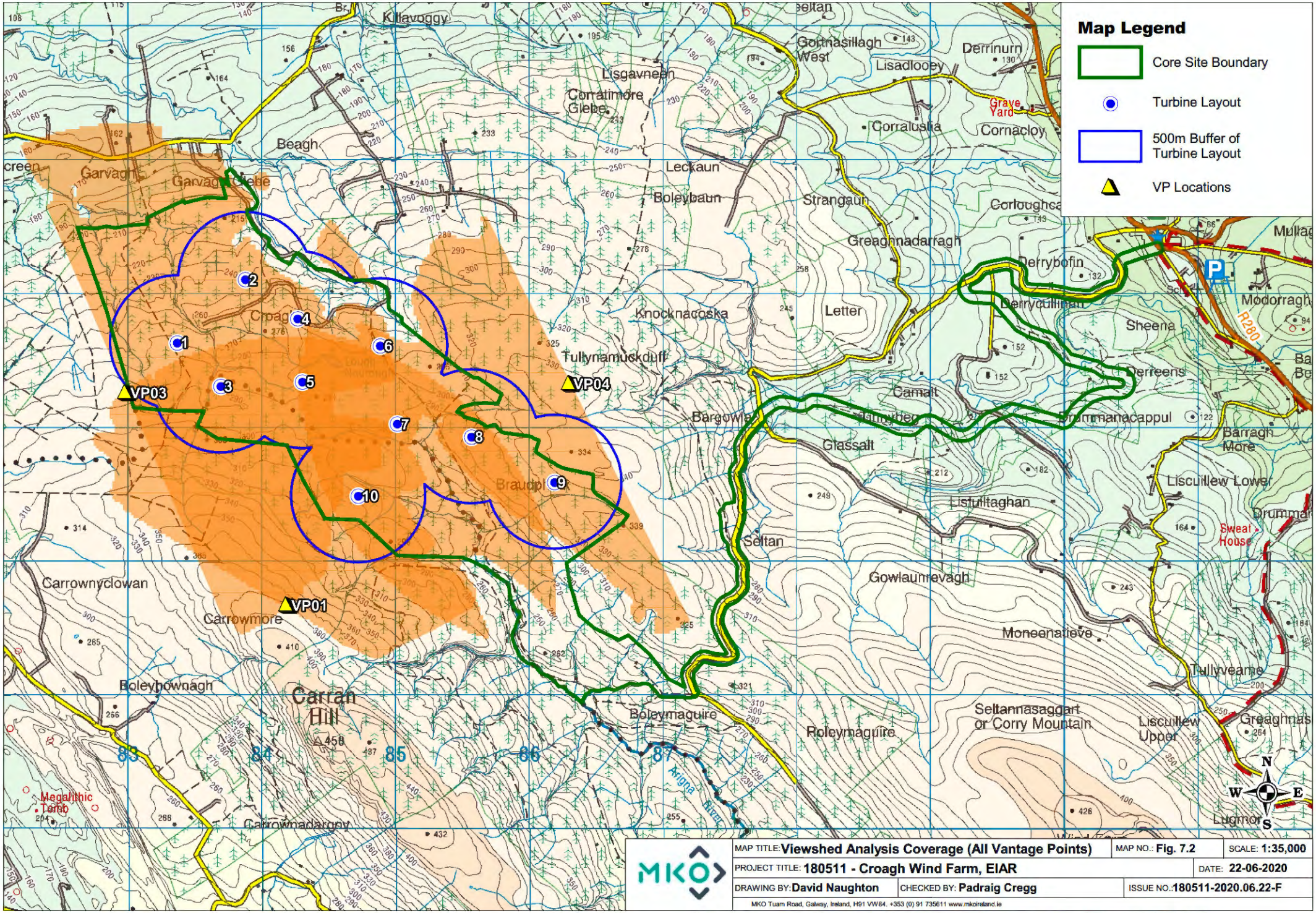
Observed flight activity was recorded as per defined flight bands which were chosen in relation to the dimensions of potential turbine models for the site. Bands were split into 0-10m, 10-25m, 25m-175m and 175m+. All flight activity within the height band 25-175m is considered to be within the Potential Collision Height (PCH) with regard to the turbine swept area.

Each flight observation was assigned a unique identifier when mapped in the field and subsequently digitised using GIS software.

7.2.4.2.2 *Breeding Bird Surveys (Adapted Brown & Shepherd Survey)*

Breeding walkover surveys were undertaken to determine the presence of bird species of high conservation concern and identify areas of possible, probable or confirmed breeding territories for bird species observed within the study area. The survey methodology followed the Adapted Brown and Shepherd method for upland sites as outlined in Gilbert et al. (1998) and SNH (2017) ('adapted Brown and Shepherd surveys'). Heavily forested areas and non-Coillte land holdings around the margins of the proposed development area, were surveyed from areas where public access was permitted i.e. public roads, or from areas within Coillte property.

Transect routes were devised to ensure coverage of different habitat complexes between vantage point locations within the study area. Transects were selected in order to survey every area of suitable breeding/ foraging habitat, in areas where access was not an issue. Target species were waders, raptors,



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MAP TITLE: **Viewshed Analysis Coverage (All Vantage Points)**		MAP NO.: **Fig. 7.2**	SCALE: **1:35,000**
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waterbirds, gulls and other birds of conservation concern. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Walkover surveys were carried out between daylight hours during the core breeding season months of April, May, June and July (2018 and 2019), with the site being visited four days per month on each occasion. The timing of visits followed the recommendations of Calladine et al. (2009). Following all survey visits, the field maps were analysed to determine the number and location of breeding territories. All non-breeding individuals and species encountered were also recorded.

Survey effort is presented in Appendix 7-2, Table 1-2. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 7-3 in shows the transect routes surveyed.

7.2.4.2.3 Breeding Raptor Surveys

Breeding raptor surveys (i.e. birds of prey and owls) were undertaken within the study area and its immediate surrounds. Survey methodology was as outlined in Hardey et al. (2013). Following guidance from NPWS, informed by research carried out by University College Cork (Wilson et al. 2015), the Breeding Raptor Survey area extended to 5km from the wind farm site boundary rather than the 2km given by SNH (2017), in order to account for foraging distance recorded for hen harrier in Ireland. All areas of suitable habitat within 5km of the site boundary were surveyed for the presence of hen harrier, merlin, peregrine, red kite, goshawk and other more abundant raptor species.

Raptor surveys, in the form of short VP watches, were conducted within and up to 5km outside the site boundary on a monthly basis during the core breeding season (April – July 2018 & 2019). The aim of these surveys was to identify occupied territories or successful breeding attempts by any raptor species. Surveys from a number of alternate locations were carried out during the 2018 breeding season, in order to ensure that the most suitable areas of breeding raptor habitat were covered. These locations were further refined for the 2019 breeding season as the best raptor VP locations were continued from the 2019 breeding season.

Survey effort details are provided in Appendix 7-2, Table 1-3. Figure 7-4 shows the areas surveyed.

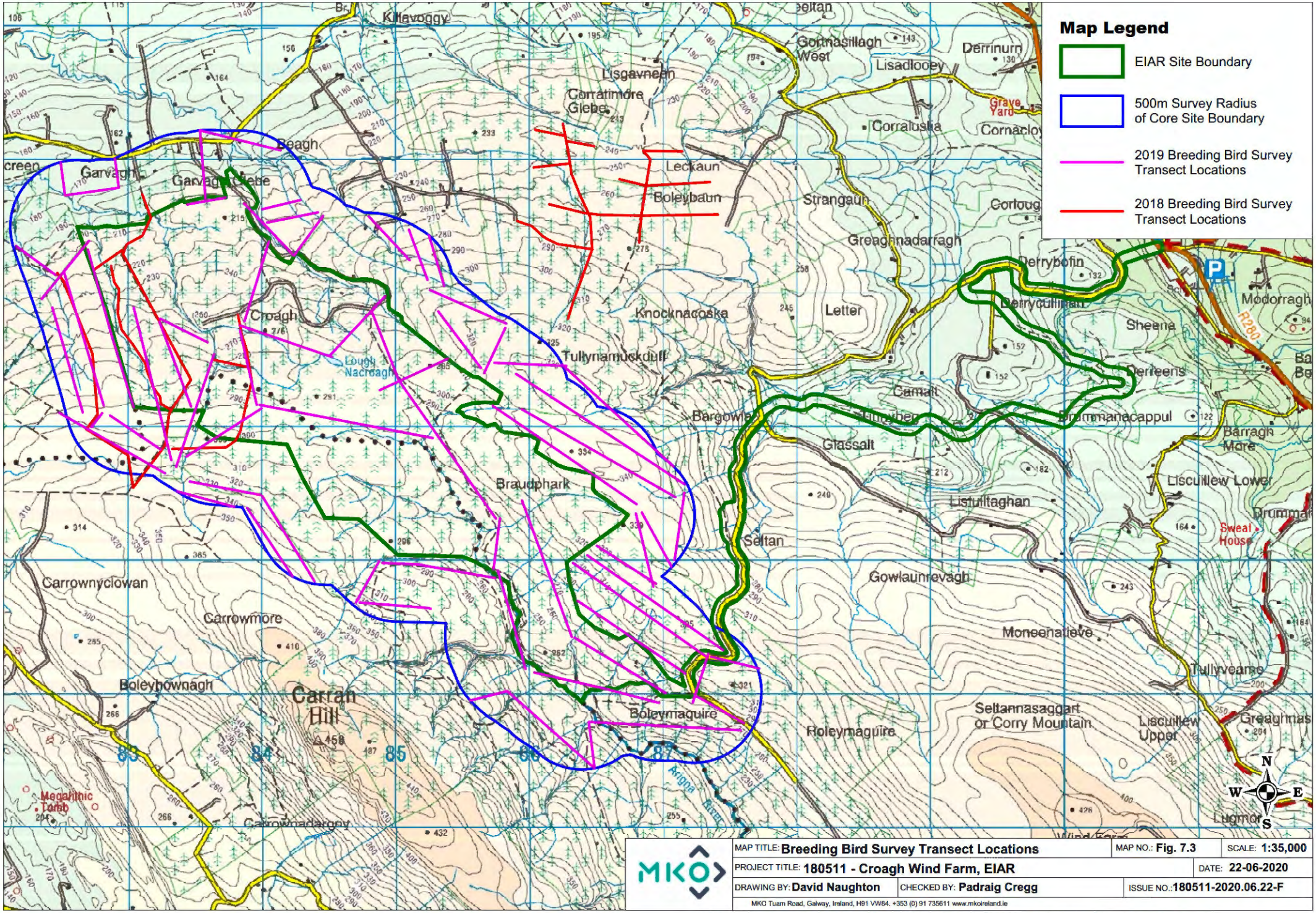
7.2.4.2.4 Breeding Woodcock Surveys

Breeding woodcock surveys were undertaken in accordance with Gilbert et.al (1998). Four dusk surveys were undertaken in areas of suitable breeding habitat (i.e. forestry/woodland) during June 2018 and six dusk surveys between May and June 2019. Surveys commenced one hour before sunset and continued for one hour after sunset or until it was too dark to see. Transects were slowly walked through areas of suitable woodland habitat within the survey area and all observations of woodcock (as well as the areas covered) were recorded. The aim of the survey was to record the presence of roding (displaying) male woodcock and thereby establish the distribution and abundance of the species in the study area. This survey method also allowed the observer to survey for owls, i.e. barn owls and long-eared owls.

Survey effort is presented in Appendix 7-2, Table 1-4. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 7-5 in shows the transect routes surveyed.

7.2.4.2.5 Red Grouse Surveys

Red Grouse surveys were undertaken during (March) 2018 and (March) 2019. The methodology used was derived from that described in Bibby et al. (2000) and the survey methods for the most recent national Red Grouse survey (2006/2007 to 2007/2008) coordinated by BirdWatch Ireland and submitted to the NPWS (Murray et al., 2013). The survey targeted areas of suitable habitat (i.e. open moorland and areas of heather). Areas of forestry were not surveyed as they do not have potential to support red



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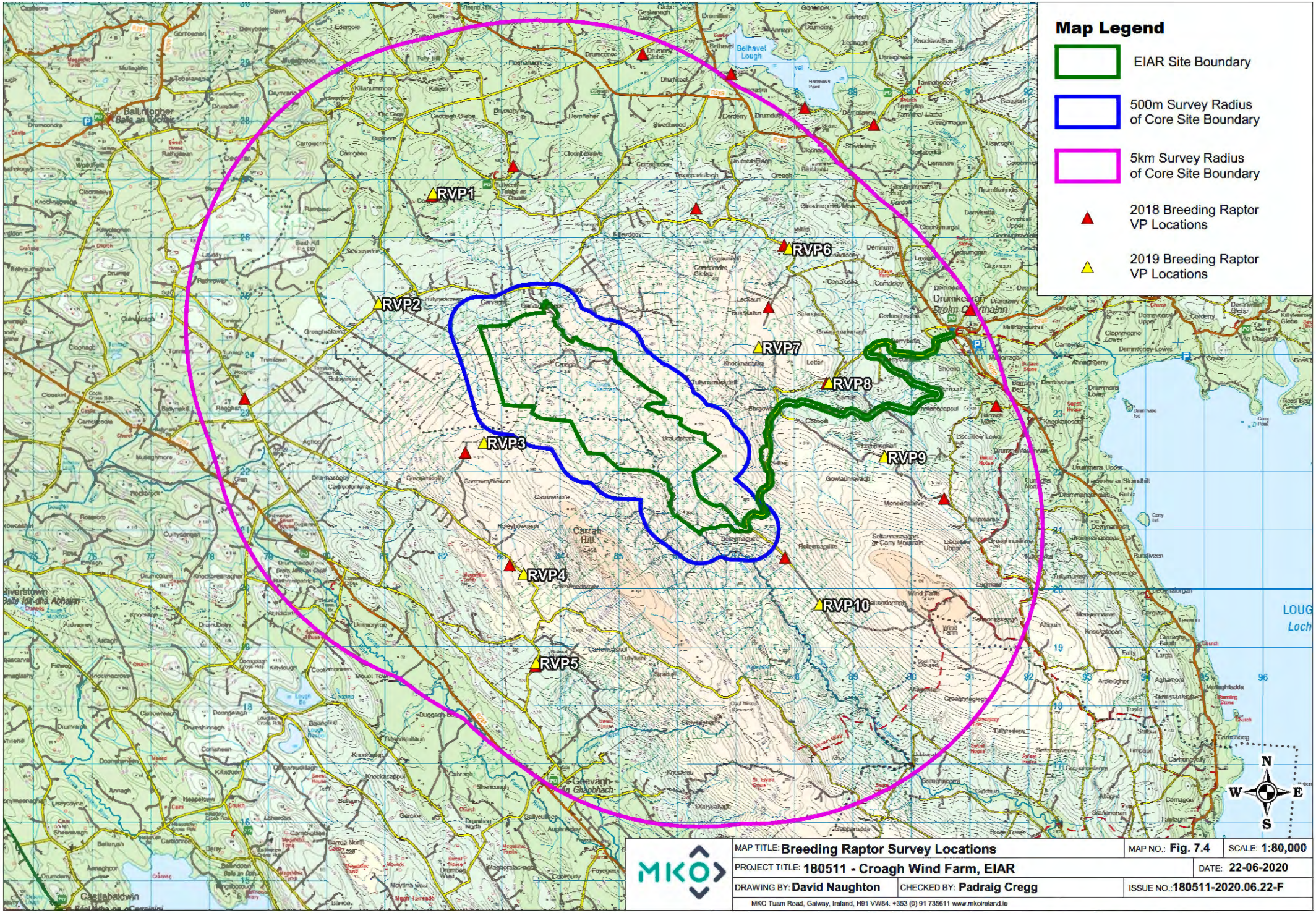

MAP TITLE: **Breeding Raptor Survey Locations** | MAP NO.: **Fig. 7.4** | SCALE: **1:80,000**

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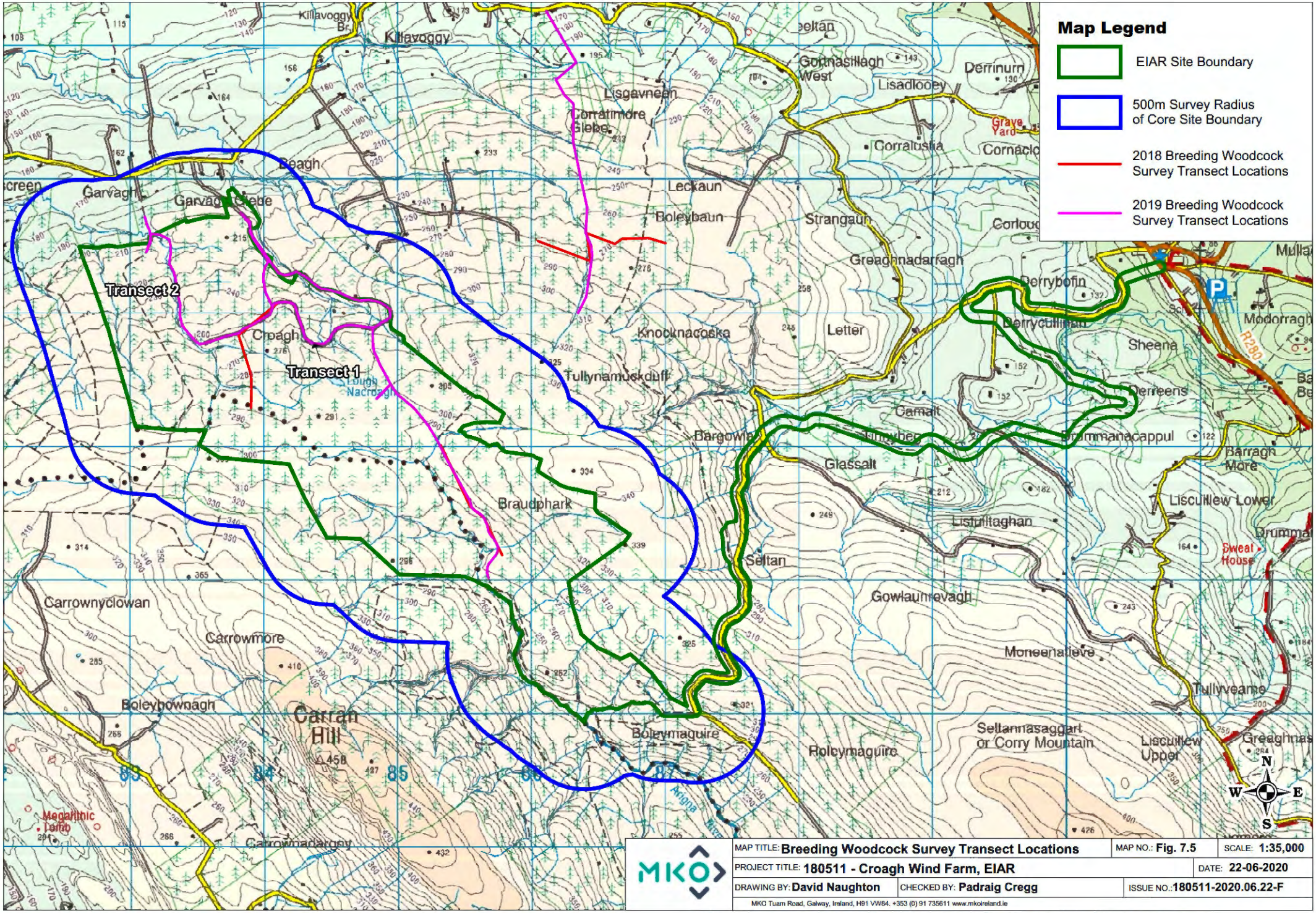

MAP TITLE: **Breeding Woodcock Survey Transect Locations**	MAP NO.: **Fig. 7.5**	SCALE: **1:35,000**
PROJECT TITLE: **180511 - Croagh Wind Farm, EIAR**		DATE: **22-06-2020**
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grouse populations. The survey consisted of tape luring transects. Survey details are provided in Appendix 7-2, Table 1-5. Figure 7-6 shows the areas surveyed.

The work was carried out under NPWS Licence Numbers 013/2018 & 17/2019.

7.2.4.2.6 *Hen Harrier Roost Surveys*

Suitable habitat for roosting hen harrier within 2km of the proposed development area (as per SNH 2017) were surveyed for the presence of hen harrier during the winter season. Survey work was undertaken in accordance with the methodology devised by Gilbert et al. (1998) and the 'Irish Hen Harrier Winter Roost Survey' (unpublished document coordinated by members of NPWS). Surveys were carried out throughout the entirety of both non-breeding seasons (October 2017 - March 2018 & Oct 2018 – Mar 2019). Full details of survey effort are provided in Appendix 7-2 Table 1-6. Figure 7-7 shows the locations of Hen Harrier Roost Survey VP locations.

7.2.4.2.7 *Winter Transect Surveys*

Winter transect surveys were conducted to determine the presence of bird species of high conservation concern within areas of potential suitable habitat in the study area.

Transect routes were devised to ensure coverage of different habitat complexes between vantage point locations within the study area, during winter months. Methodology was broadly based on methods described in Bibby et al. (2000). Target species were raptors, waterbirds, gulls and ground birds of conservation interest. Along with target species, all additional species observed were recorded to inform the evaluation of supporting habitat.

Survey effort, including details of survey duration and weather condition, is presented in Appendix 7-2, Table 7. Figure 7-8 shows the surveyed area.

7.2.4.2.8 *Access Road Survey*

On the 14th of August 2019 and the 29th January 2020, the access road was subject to a multi-disciplinary ecological survey. In addition, the area surveyed for the breeding raptor survey overlaps with the route of the access road. Three breeding raptor vantage points: RVP7, RVP8 and RVP9, are all sited in close proximity to the access road route as can be seen in Figure 7.4. The aim of these surveys was to identify occupied territories or successful breeding attempts by any raptor species.

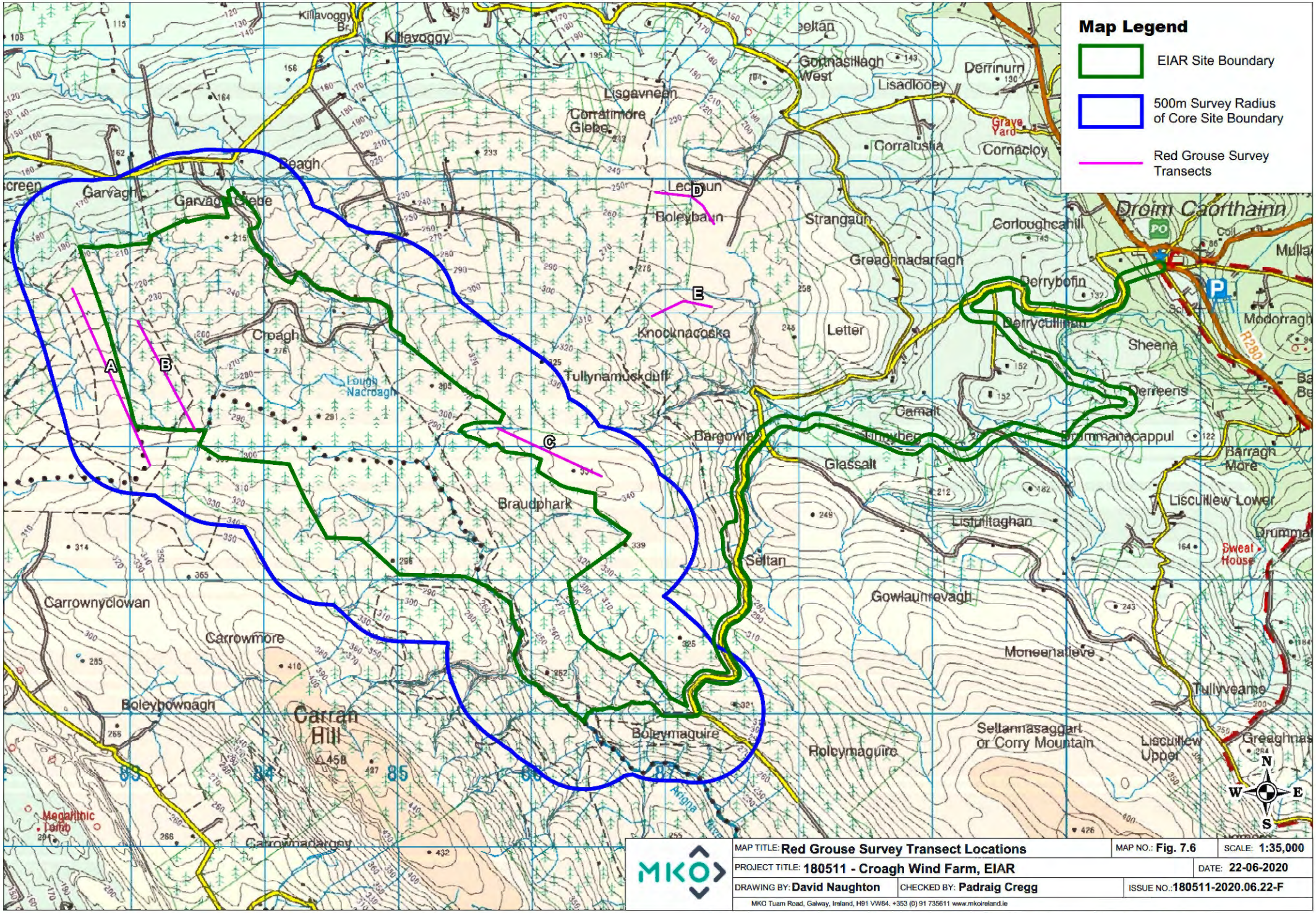
7.2.5 Ornithological Evaluation Criteria and Impact Assessment Methodology

7.2.5.1 Potential Effects Associated with Proposed Development

As per SNH Guidance, wind farms present three potential risks to birds (Drewitt & Langston 2006, 2008; Band et al. 2007):

- **Direct habitat loss** through construction of wind farm infrastructure;
- **Displacement** (sometimes called indirect habitat loss) if birds avoid the wind farm and its surrounding area due to turbine construction and operation. Displacement may also include barrier effects in which birds are deterred from using normal routes to feeding or roosting grounds;
- Death through **Collision** or interaction with turbine blades and other infrastructure.

For each of these three risks, the detailed knowledge of bird distribution and flight activity within and surrounding the site has been utilised to predict the potential effects of the Proposed Development on



MAP TITLE: **Red Grouse Survey Transect Locations** | MAP NO.: **Fig. 7.6** | SCALE: **1:35,000**

PROJECT TITLE: **180511 - Croagh Wind Farm, EIAR** | DATE: **22-06-2020**

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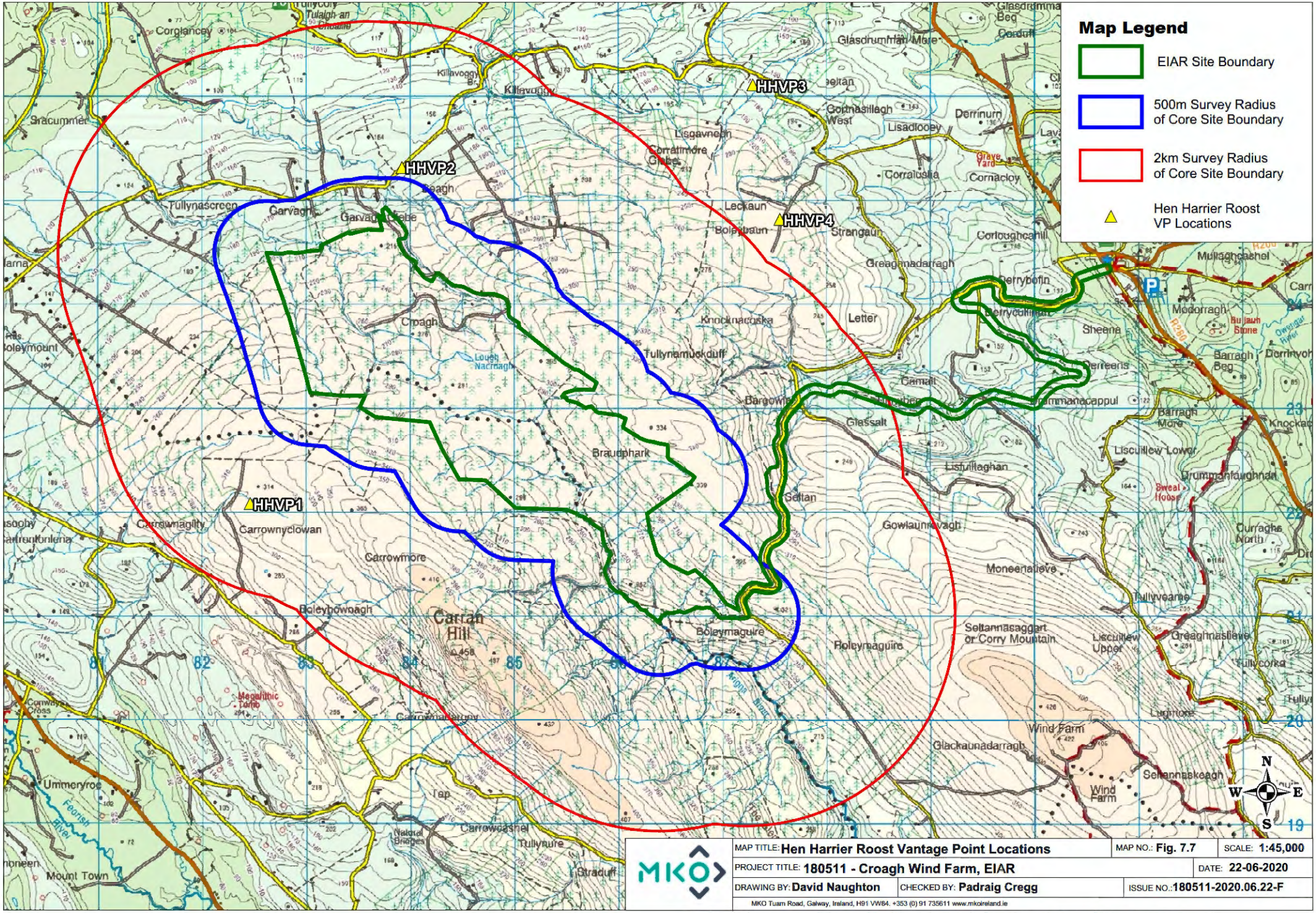

MAP TITLE: **Hen Harrier Roost Vantage Point Locations**		MAP NO.: **Fig. 7.7**	SCALE: **1:45,000**
PROJECT TITLE: **180511 - Croagh Wind Farm, EIAR**			DATE: **22-06-2020**
DRAWING BY: **David Naughton**	CHECKED BY: **Padraig Cregg**		ISSUE NO.: **180511-2020.06.22-F**

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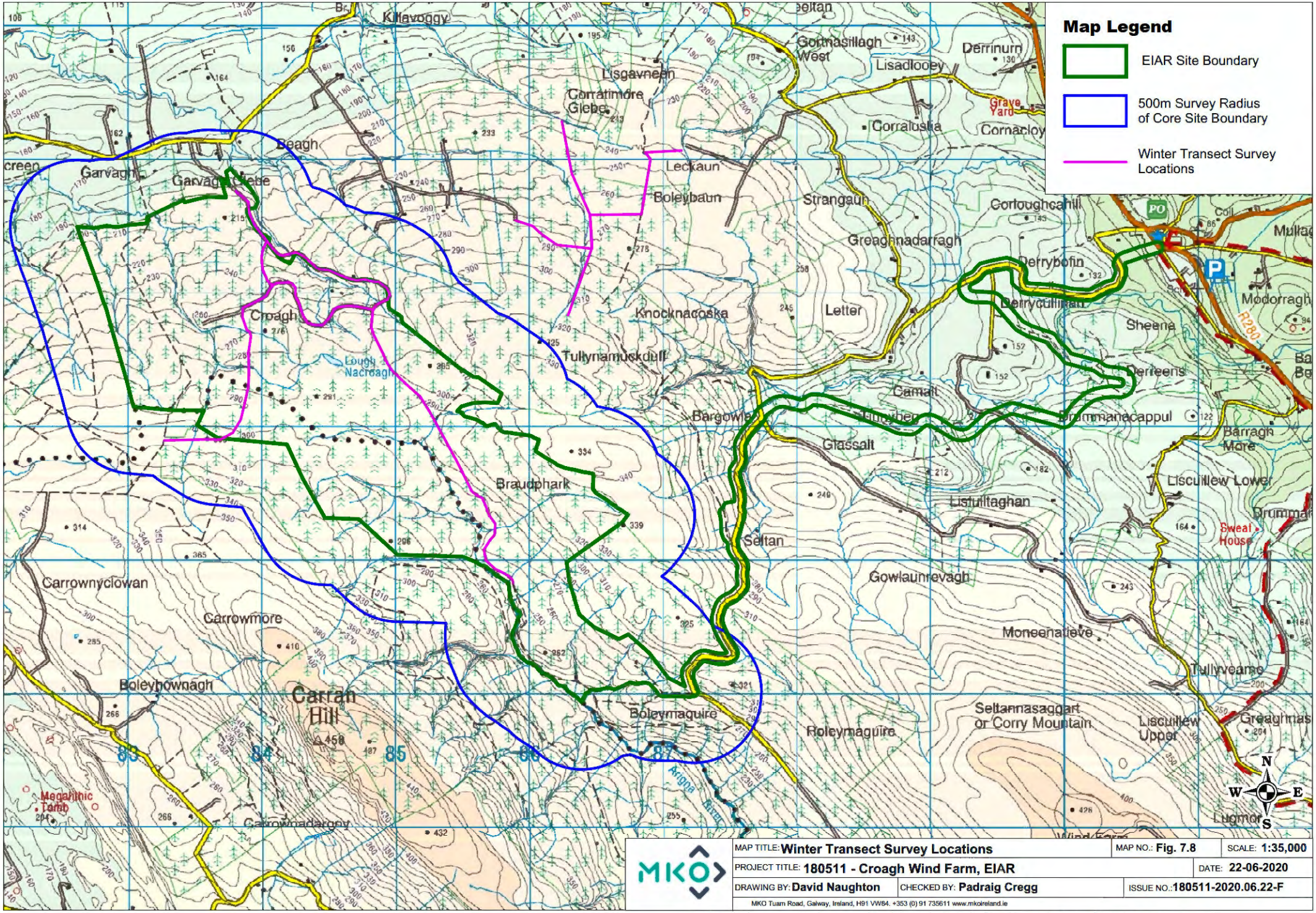

MAP TITLE: **Winter Transect Survey Locations**		MAP NO.: **Fig. 7.8**	SCALE: **1:35,000**
PROJECT TITLE: **180511 - Croagh Wind Farm, EIAR**			DATE: **22-06-2020**
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birds. Effects are assessed with regard to the construction phase, the operational phase and the decommissioning phase. They are also assessed cumulatively with other projects and plans.

7.2.5.2 Geographical Framework

Guidance on Ecological Impact Assessment (CIEEM 2018) recommends categories of ornithological or nature conservation value that relate to a geographical framework (e.g. international, through to local). This assessment utilises the geographical framework described in Guidelines for Assessment of Ecological Impact of National Road Schemes (NRA 2009). The guidelines provide a basis for determination of whether a site is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of importance only in the local area. Internationally Important sites are designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna.

7.2.5.3 Receptor Evaluation and Impact Assessment (Percival 2003)

Percival's (2003) methodology for assessing the effects of wind farms on birds has been applied to assess the sensitivity of a species to the development type, the magnitude of the effect and the significance of the potential impact. The following tables (Table 7-3 - Sensitivity,
Table *7-4* – Magnitude of effect,
Table *7-5* – Determination of significance) outline the assessment criteria for each stage.

Table 7-3 Evaluation of Sensitivity for Birds (Percival 2003)

Sensitivity	Determining Factor
Very High	Species that form the cited interest of SPA's and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
High	Species that contribute to the integrity of an SPA but which are not cited as a species for which the site is designated. Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, red necked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% Irish population)
Medium	Species on Annex 1 of the EU Birds Directive. Species present in regionally important numbers (>1% regional (county) population). Other species on BirdWatch Ireland's red list of Birds of Conservation Concern
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

Table 7-4 Determination of Magnitude of Effects (Percival 2003)

Sensitivity	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. Guide: < 20% of population / habitat remains
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. Guide: 20-80% of population/ habitat lost
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. Guide: 5-20% of population/ habitat lost
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. Guide: 1-5% of population/ habitat lost
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. Guide: < 1% population/ habitat lost

Table 7-5 Significance matrix: combining magnitude and sensitivity to assess significance (Percival 2003)

Significance		Sensitivity			
		Very High	High	Medium	Low
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Very Low
	Low	Medium	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low

7.2.5.4 Impact Assessment – EPA Criteria (2017 Draft)

Effects identified as per the Percival 2003 criteria have been equated with EPA impact assessment criteria described below in Table 7-6 and Table 7-7.

The following terms were utilised when quantifying duration and frequency of effects:

- Momentary – effects lasting from seconds to minutes
- Brief – effects lasting less than a day
- Temporary – effects lasting less than a year
- Short-term – effects lasting 1 to 7 years
- Medium term – effects lasting 7 to 15 years
- Long term – effects lasting 15 to 60 years
- Permanent – effects lasting over 60 years
- Reversible – effects that can be undone, for example through remediation or restoration
- Frequency – How often the effect will occur. (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)

Table 7-6 Criteria for assessing impact significance based on (EPA, 2017)

Impact Magnitude	Definition
Imperceptible Effect	An effect capable of measurement but without significant consequences
Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight Effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effect	An effect that alters the character of the environment that is consistent with existing and emerging baseline trends
Significant Effect	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment
Profound Effect	An effect which obliterates sensitive characteristics

Table 7-7 Criteria for assessing impact quality based on (EPA, 2017)

Impact Type	Criteria
Positive	A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities
Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
Negative	A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance)

7.2.5.5 Collision Risk Assessment

Collision risk is calculated using a mathematical model to predict the nnmbers of individual birds, of a particular species, that may be killed by collision with moving wind turbine rotor blades. The modelling

method used in this collision risk calculation follows Scottish Natural Heritage (SNH) guidance which is sometimes referred to as the Band Model (Band et al. (2007).

Two stages are involved in the model:

- Stage 1: Determination of the number of birds or flights passing through the air space swept by the rotor blades of the wind turbines.
- Stage 2: Calculation of the probability of a bird strike occurring.

Please see Appendix 7-6 for full details on the collision risk modelling method.

7.2.6 Survey Justification

A comprehensive suite of bird surveys has been undertaken at the Proposed Development site between September 2017 and September 2019.

Results are derived from a continuous two years of surveying undertaken in line with SNH Guidance. These are the results that are analysed to inform this assessment.

The surveys undertaken provide the information necessary to allow a complete, comprehensive and robust assessment of the potential impacts of the Proposed Development on avian receptors.

7.2.6.1 Mitigation

The development has been designed to specifically avoid, reduce and minimise effects on all Ornithological Receptors. Where potential effects on KORs are predicted, mitigation has been prescribed to avoid, reduce and remove such effects.

Proposed best practice design and mitigation measures are specifically set out and are realistic in terms of cost and practicality. They have been subject to detailed design and will effectively address the effects on the identified KORs.

The potential effects of the Proposed Development were considered and assessed to ensure that all effects on KORs are adequately addressed and no significant residual effects are likely to remain following the implementation of mitigation measures / best practice measures. As discussed in further detail in Section 7.16.

7.2.6.2 Limitations

The information provided in this EIAR chapter accurately and comprehensively describes the baseline environment; provides an accurate prediction of the likely effects of the Proposed Development; prescribes mitigation as necessary; and describes the predicted residual impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

No significant limitations in the scope, scale or context of the assessment have been identified.

7.4 Baseline Conditions and Receptor Evaluation

7.4.1 Identification of Designated Sites within the Likely Zone of Influence of the Development

A screening assessment and Natura Impact Statement were prepared to provide the competent authority with the information necessary to complete an Appropriate Assessment for the Proposed Development in compliance with Article 6(3) of the Habitats Directive.

As per EPA draft Guidance 2017, "a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement" but should "incorporate their key findings as available and appropriate". This section provides a summary of the key screening assessment findings with regard to Special Protection Areas. A summary of key assessment findings with regard to Special Areas of Conservation is provided in Chapter 6 of this EIAR.

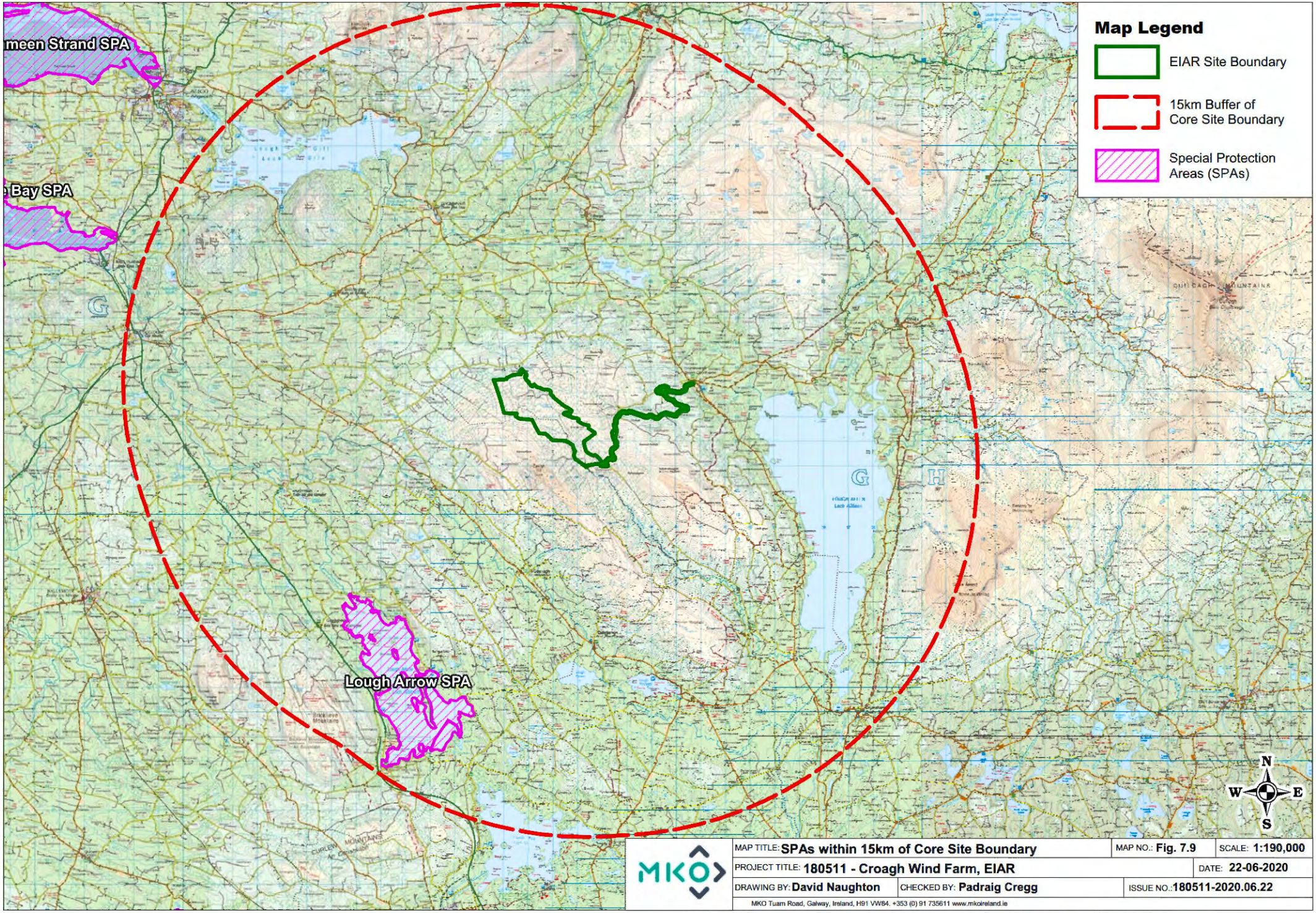
Using GIS software, sites designated for nature conservation within the potential ZOI of the Proposed Development were identified. The ZOI was derived utilising a precautionary approach. Initially, sites within a 15-kilometre radius of the proposed works were identified. Then designated sites located outside the 15km buffer zone were taken into account and assessed. In this case, no potential for direct or indirect impacts for species listed as Special Conservation Interest of SPAs more than 15km from the development site was identified.

None of the pNHAs or NHAs within the ZOI were considered as KORs in their own right for the following reasons:

- Distance/buffer from the proposed development.
- Nature of the conservation sites (e.g. qualifying interest)

In addition, and in the absence of any specific European or Irish guidance, the Scottish Natural Heritage (SNH) Guidance, 'Assessing Connectivity with Special Protection Areas (SPA)' (2016) was consulted. This document provides guidance in relation to the identification of connectivity between Proposed Development and Special Protection Areas. The guidance takes into consideration the distances some species may travel beyond the boundary of their SPAs and outlines information on dispersal and foraging ranges of bird species which are frequently encountered when considering projects. Potential effects on wetlands and supporting habitats associated with Special Protection Areas and indirect potential pathways in the form of surface water pollution are considered in the Appropriate Assessment Screening Report and Natura Impact Statement of this application.

Only one SPA was located within the Likely Zone of Influence of the development, which is listed below in Table 7-8 and illustrated on Figure 7-9.



MAP TITLE: **SPAs within 15km of Core Site Boundary** | MAP NO.: **Fig. 7.9** | SCALE: **1:190,000**

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Table 7-8 Designated Sites in the Zone of Influence

European Sites and distance from proposed development	Qualify Interests/Special Conservation Interests for which the European site has been designated (Sourced from NPWS online Conservation Objectives, www.npws.ie on the 03/07/2020	Conservation Objectives	Likely Zone of Impact Determination	Possibility of Significant Effects? (If Yes Progress To Stage 2 Of AA Process)
Special Protection Area				
Lough Arrow SPA [004050] **Distance:** 9.3km	› Little Grebe (*Tachybaptus ruficollis*) [A004] › Tufted Duck (*Aythya fuligula*) [A061] › Wetland and Waterbirds [A999]	This site has the generic conservation objective: '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA*'." (NPWS Generic version 6.0, 2018) This site has a second conservation objective: 'To maintain or restore the favourable conservation condition of the wetland habitat at Lough Arrow SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.'	There will be no direct effects as the project footprint is located entirely outside the designated site. The European Site is located in a separate hydrological catchment than the proposed development and therefore no potential pathways for surface water impacts on SCI's exist. These SCI species are strongly associated with the waterbodies and located over 9km from the SPA. It is also located outside the zone of sensitivity of any species that is listed as particularly sensitive to wind energy development in Mc Guinness et.al (2015).	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

			No pathways for significant effect on the European Site was identified. Thus it can be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the European site, that the proposed development, individually or in combination with other plans and projects, would therefore not have a significant effect on this European Site.	
Cummeen Strand SPA (004035) **Distance:** 18.1km (approximately 29.1km surface water distance)	› Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] › Oystercatcher (*Haematopus ostralegus*) [A130] › Redshank (*Tringa totanus)* [A162] › Wetland and Waterbirds [A999]	Detailed conservation objectives for this site (Version 1, September 2013) were reviewed as part of the assessment and are available at www.npws.ie	There will be no direct effects as the project footprint is located entirely outside the designated site. Hydrological connectivity with the SPA has been identified via the Killanummery River that joins the River Bonet further downstream. The River Bonet enters into Lough Gill before entering the SPA at Drumcliff Bay, via the Garavogue River, located over 29 km hydrological distance downstream of the proposed development. Therefore, taking a precautionary approach the potential for	Yes – Potential for significant effect has been identified and there is a need to progress to Stage 2 of the Appropriate Assessment process.

			deterioration of surface water quality affecting the supporting habitat of SCI species has been identified. The potential effect requires further assessment and will be considered under the Wetland and Waterbird [A999] conservation objective. The proposed development site does not offer suitable supporting habitat for the SCI species for which the SPA is designated. In addition, the site is located over 18km from the proposed development, significantly outside the core foraging range of the SCI species for which the SPA has been designated (SNH, 2016). Therefore, disturbance/displacement related effects on SCI species have been excluded. **This site is considered to be within the Likely Zone of Impact and further assessment will be provided in a Natura Impact Statement.**	
Ballykenny-Fisherstown Bog SPA (004101) **Distance:** 43.1 km (approximately 61.0km surface water distance)	Greenland White-fronted Goose (*Anser albifrons flavirostris*) [A395]	This site has the generic conservation objective: '*To maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests of this SPA*'." (NPWS Generic version 6.0, 2018)	There will be no direct effects as the project footprint is located entirely outside the designated site.	No – Potential for significant effect has been excluded and there is no need to progress to Stage 2 of the Appropriate Assessment process.

			Surface water connectivity between the proposed development site and the SPA exists via the Arigna River and River Shannon. However, any potential pollutants would have to travel over 60km via rivers and pass through a number of large waterbodies including Lough Allen, Lough Corry, Lough Nanoge, Lough Tap, Lough Boderg and Lough Bofin. Given the nature of the watercourses on the site, the attenuation effect of the intervening waterbodies as listed and the distance to the European Site, in the absence of any mitigation there is no potential for the proposed works to result in any significant effect thereon. This conclusion is confirmed in the detailed hydrological assessment that is provided in Chapter 9 of the EIAR with the relevant section from that chapter included in Section 3.1.1 below. The proposed development site is located over 43.1 km from the EU designated site and is located significantly outside the foraging range (5-8km) of the SCI species (SNH, 2016). Additionally, the SPA is not designated for Wetland and Waterbirds. There	

			is therefore no potential for significant effects as a result of the proposed development. ***No pathways for significant effect on the European Site was identified. Thus it can be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the European site, that the proposed development, individually or in combination with other plans and projects, would therefore not have a significant effect on this European Site.*** **development to result in effects on this European Site was identified.**	
Nationally Designated Sites				
Other than sites, which are encompassed by the above listed SPAs, no nationally designated sites of ornithological significance occur within the potential ZOI.				

7.4.2 Breeding and Wintering Bird Atlas Records

Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland' (Balmer et al., 2013) is the most recent comprehensive work on wintering and breeding birds in Ireland.

Previous Bird Atlases have been the primary source of information on the distribution and abundance of British and Irish birds prior to Bird Atlas 2007–11. The three previously published atlases were:

- Sharrock, J.T.R. (1976) The atlas of breeding birds in Britain and Ireland.
- Lack, P.C. (1986) The atlas of wintering birds in Britain and Ireland.
- Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The new atlas of breeding birds in Britain and Ireland: 1988-1991.

The entire development site lies within hectad G82. Table 7-9 presents a list of species of conservation interest species recorded from the relevant hectads:

Table 7-9 Breeding Bird Atlas Data (Hectad G82)

Species Name	Breeding Atlas 68-72 (G82)	Breeding Atlas 88-91 (G82)	Breeding Atlas 07-11 (G82)	Conservation Status
Hen Harrier *(Circus cyaneus)*	Possible	-	Probable	Annex I EU Birds Directive
Peregrine *(Falco peregrinus)*	-	-	Present	Annex I EU Birds Directive
Corncrake *(Crex crex)*	Probable	-	-	Annex I EU Birds Directive
Common Tern *(Sterna hirundo)*	Possible	-	-	Annex I EU Birds Directive
Red Grouse *(Lagopus lagopus)*	Possible	-	-	BOCCI Red Listed
Black-headed Gull *(Larus ridibundus)*	Confirmed	-	-	BOCCI Red Listed
Woodcock *(Scolopax rusticola)*	Probable	-	Possible	BOCCI Red Listed
Curlew *(Numenius arquata)*	Probable	Breeding	Probable	BOCCI Red Listed
Redshank *(Tringa totanus)*	Confirmed	-	-	BOCCI Red Listed
Tufted Duck *(Aythya fuligula)*	Confirmed	-	-	BOCCI Red Listed
Meadow Pipit *(Anthus pratensis)*	Confirmed	Breeding	Confirmed	BOCCI Red Listed

Species Name	Breeding Atlas 68-72 (G82)	Breeding Atlas 88-91 (G82)	Breeding Atlas 07-11 (G82)	Conservation Status
Grey Wagtail *(Motacilla cinerea)*	Confirmed	Breeding	Probable	BOCCI Red Listed
Yellowhammer *(Emberiza citrinella)*	Probable	-	-	BOCCI Red Listed

Seen = recorded; Possible = possible breeding; Probable = probable breeding; Confirmed = confirmed breeding; - = not-recorded

Table 7-10 shows those species recorded in the relevant hectad (G82) in the wintering birds' atlases that are also protected under the EU Birds Directive or mentioned on the Birds of Conservation Concern in Ireland (BoCCI) red list.

Table 7-10 Wintering Bird Atlas Data (Hectad G82)

Species Name	Wintering Atlas 81-84 (G82)	Wintering Atlas 07-11 (G82)	Conservation Status
Hen Harrier *(Circus cyaneus)*	-	Present	Annex I EU Birds Directive
Whooper Swan *(Cygnus cygnus)*	Present	Present	Annex I EU Birds Directive
Peregrine *(Falco peregrinus)*	-	Present	Annex I EU Birds Directive
Black-headed Gull *(Larus ridibundus)*	Present	-	BOCCI Red Listed
Woodcock *(Scolopax rusticola)*	Present	Present	BOCCI Red Listed
Curlew *(Numenius arquata)*	Present	-	BOCCI Red Listed
Lapwing *(Vanellus vanellus)*	Present	-	BOCCI Red Listed
Tufted Duck *(Aythya fuligula)*	Present	Present	BOCCI Red Listed
Wigeon *(Anas penelope)*	-	Present	BOCCI Red Listed
Meadow Pipit *(Anthus pratensis)*	Present	Present	BOCCI Red Listed

Present = recorded; - = not-recorded

7.4.3 Bird Sensitivity Mapping Tool

A Bird Sensitivity Mapping Tool for wind energy development was developed by BirdWatch Ireland and provides a measured spatial indication of where protected birds are likely to be sensitive to wind energy developments. The tool can be accessed via the National Biodiversity Data Centre Website (www.biodiversityireland.ie) and is accompanied by a guidance document (McGuiness et al. (2015). The criteria for estimating a zone of sensitivity (i.e. 'low', 'medium', 'high' and 'highest') is based on a review of the behavioural, ecological and distributional data available for each species.

The majority of the development site is not located within a bird sensitivity zone. However, a small section (in the north of the development area) is located within a zone of *Low* sensitivity to windfarm development.

7.4.4 Irish Wetland Bird Survey (I-WeBS) Records

The study area is not covered by an I-WeBS site and the nearest site is located approximately 6.5km from the development site boundary. The development site lies on the border for County Leitrim and County Sligo. Data from I-WeBS sites in both County Leitrim and County Sligo has been used to estimate wintering populations of waterbirds identified as KORs. Datasets for the following sites were downloaded from www.birdwatchireland.ie and reviewed:

Leitrim I-WeBS Sites

- Acres Lake (Drumshanbo)
- Ballinamore Lakes
- Ballinamore/Ballyconnell Canal
- Beaghmore Lough
- Clooncose Lough
- Drowes River Bundrowes Bridge
- Drumshanbo Lough
- Eslin River
- Fearglass Lough
- Glencar Lough
- Gortermone Lough
- Gulladoo Lough
- Keeldra Lough
- Killylea Lough
- Kilmaddaroe Lough
- Lough MacNean (Upper)
- Lough Nabelwy
- Lough Sallagh
- North West Leitrim Mountain Lakes
- Rinn Lough Wetlands
- River Shannon Upper (Drumsna – Carrick-on-Shannon)

Sligo I-WeBS Sites

- Ballysadare Bay
- Drumcliff Bay Estuary
- Garvogue River
- Inishmurray
- Lough Arrow
- Lough Gara
- Lough Gill
- Sligo Harbour

7.4.5 NPWS Rare and Protected Species Dataset

An information request was sent to the NPWS requesting records from the Rare and Protected Species Database. The sections below provide the records obtained from the NPWS (9th April 2019) regarding rare and protected bird species. The NPWS were contacted via email on the 25/07/2019, prior to finalising this EIAR chapter, and it was confirmed that no new records were available. The NPWS were again contacted on the 26th of September 2019 to request information on the extent of the Leitrim Uplands non-designated regionally important area for hen harrier.

Hen Harrier

Table 7-11 below provides the NPWS records for Hen Harrier to defined radii (km) of the development site.

Table 7-11 NPWS Hen Harrier Records (April 2019)

Year	Within Site Boundary	0-1km from site boundary	1-3km from site boundary	3-5km from site boundary
2015	1 record of possible breeding	No Records	No Records	No Records
2010	No Records	No Records	No Records	No Records
2005	No Records	No Records	No Records	No Records
1998-2004	No Records	No Records	No Records	No Records

On the 7th of October 2019, NPWS confirmed that the Leitrim Uplands non-designated regionally important area for hen harrier does not overlap with the proposed development area and at its nearest point is located 7km from the national grid squares in which the site is located (G72 and G82).

Curlew

The NPWS identified one confirmed breeding curlew site within the wider surroundings of the site. The observation was recorded during a survey in 2014, approximately one kilometre north of the development site.

Red Grouse

The NPWS identified that several Red grouse observations were recorded within four kilometres of the development site during the National Red Grouse Survey 2006-2008. However, the nearest records of red grouse were approximately 1.5km southwest of the development site at Carran Hill.

7.5 Additional Boleybaun Surveys (offsite)

Surveying between September 2017 and September 2019 included an area c.2km to the northeast of the proposed development site (Boleybaun), which consists predominantly of conifer plantation with small fragmented areas of upland blanket bog, dry heath and wet grassland. This area was surveyed from VP2, as well as during Breeding Bird Surveys and Winter Transect Surveys. The following target species were recorded in the area during the breeding season, hen harrier, merlin, red grouse, buzzard, sparrowhawk and kestrel. During the winter months golden plover, hen harrier and kestrel were the only species of note recorded here. No evidence of breeding or roosting activity for any species was recorded during surveys in the area.

Whilst it is no longer proposed to site any infrastructure in this location, the results of surveys from the Boleybaun area provide information on the distribution and abundance of key receptor species in the wider surroundings of the proposed development area.

Figures showing flightlines during VP surveys as well as observations during distribution and abundance surveys can be found in Appendix 7-5.

7.6 Field Survey Results

A comprehensive list of all bird species recorded during surveys is provided in Table 1-1 of Appendix 7-1. The target species listed below were recorded within the zone of influence of the Proposed Development during the ornithological surveys. The list is ordered in accordance with conservation significance: Annex I species, SCIs of designated sites, Red listed species and raptors.

- Whooper Swan (Annex I species)
- Golden Plover (Annex I species)
- Hen Harrier (Annex I species)
- Merlin (Annex I species)
- Peregrine (Annex I species)
- Red Grouse (Red listed with regard to Breeding populations)
- Woodcock (Red listed with regard to Breeding populations)
- Curlew (Red listed with regard to Breeding & Wintering populations)
- Buzzard (Raptor, Schedule IV of the Wildlife Act; 1976)
- Sparrowhawk (Raptor, Schedule IV of the Wildlife Act; 1976)
- Kestrel (Raptor, Schedule IV of the Wildlife Act; 1976)
- Snipe (Amber listed with regard to Breeding & Wintering populations)

The following sections describe the observations of each target species under the individual survey headings. Survey data and mapping for each target species is provided in the technical appendices. Appendix 7-3 presents results summary tables including:

- Summary of seasonal Vantage Point Survey Effort.
- Summary of the monthly distribution of flight activity recorded for the target species during the vantage point watches.
- Summary of observations at Potential Collision Height for target species during vantage point watches.
- Summary of the monthly distribution of flight activity recorded for the non-target species during the vantage point watches.
- Summary of monthly distribution of target species during Breeding Bird Surveys.
- Summary of monthly distribution of non-target species during Breeding Bird Surveys.
- Summary of monthly distribution of Breeding Raptor Survey results.
- Summary of monthly distribution of target species during Winter Transect Surveys.
- Summary of monthly distribution of non-target species during Winter Transect Surveys.

7.6.1 Whooper Swan

Raw Survey data for Whooper Swan is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Whooper swan were only recorded on four occasions during Vantage Point Surveys. (see Appendix 7-4, Fignre 7.1.1). All four observations occurred during the 2018/2019 winter season, between October 2018 and March 2019. All four observations occurred within 500m of the proposed turbine layout. Flock sizes ranged from 4 – 20 birds. Two observations occurred in October and one observation in late March 2019. All three of these observations were noted by the surveyors as likely migrating flocks. A flock of four birds was observed on the 3rd of December 2018 travelling over the development site.

Incidental Observations

There was one incidental observation of whooper swan during a Hen Harrier Roost Survey on the 26th of October 2018 (see Figure 7.10.1, Appendix 7-4). A flock of 23 birds were seen flying from north to south over the development site, presumed to be on migration. The flight occurred within 500m of the proposed turbine layout.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.2 Golden Plover

Raw Survey data for Golden Plover is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Golden plover were recorded on 32 occasions during Vantage Point Surveys (see Appendix 7-4, Figure 7.1.2). 28 of these were observed in flight, while four observations were of birds heard calling but not seen in November 2017. There were 14 observations of birds in flight within the 500m of the proposed turbine layout.

All observations of this species occurred during winter months. Only five of the 28 flights were recorded during the 2017/2018 winter season, with flocks between 5 and 37 birds recorded in flight and landing/emerging from loafing areas on heath and upland blanket bog. The remaining 23 flights were recorded during the 2018/2019 winter season (October – March). Observations ranged from an individual to a flock of 270 birds. Flocks were seen flying, calling and landing/emerging from loafing/roosting areas on heath, wet grassland and upland blanket bog. Flocks of greater than 40 birds were only recorded on four dates during the vantage point surveys.

Winter Transect Surveys

Golden plover were only recorded twice during Winter Transect Surveys (see Appendix 7-4, Figure 7.8.1). Both observations occurred during the 2018/2019 season. A flock of 40 birds were recorded in flight on the 16th of October 2018, while on the 8th of January 2019 a flock of 30 birds were recorded travelling over conifer plantation. Both flights occurred within the development site and within 500m of the proposed turbine layout. No flocks of greater than 40 birds were recorded during these surveys.

Incidental Observations

There were four incidental observations of golden plover between September 2017 and September 2019. On the 10th of November 2017 a flock of six birds were flushed from heather by the surveyor as he walked off site after concluding a VP survey. A flock 50 - 60 golden plover were flushed by the surveyor on the 25th of January 2019 as he walked off site after a VP survey.

On the 17th of May 2018 during a breeding raptor survey a single golden plover was heard calling from an area of dense heather, approximately 1km from the development site. This was noted as a possible breeding territory, the location of which can be found on Figure 7.10.2 in Appendix 7-4.

On the 13th of March 2019 a flock of 26 golden plover was flushed from an area of heather, approximately 200m east of the proposed development site, during a red grouse survey. The location of all incidental golden plover observations can be seen on Figure 7.10.2 in Appendix 7-4.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.3 Hen Harrier

Raw Survey data for Hen Harrier is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Hen harrier were recorded on eight occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.3). There were four observations of birds in flight within 500m of the proposed turbine layout. All eight observations were of individual birds in hunting flights over areas of heath and upland blanket bog. Six of the eight observations were recorded during the 2018 breeding season, four of which occurred during late August. In addition, there was a single observation in December 2018 of a male hen harrier in a hunting flight. On the 7th of August 2019 a male hen harrier was seen travelling in a low flight before circling low over an area and dropping out of view. This area was identified by the surveyor as a possible roost site and further surveys were undertaken to determine its significance. No further roosting activity was recorded on subsequent watches at this vantage point and it is not considered to be a regular roost for the species.

Breeding Bird Surveys

Hen harrier were only observed once during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.1). On the 25th of June 2019 an adult male was seen foraging an area of bog and conifer plantation, approximately 200m northwest of the development site.

Breeding Raptor Surveys

Hen harrier were only recorded on two occasions during Breeding Raptor Surveys (see Appendix 7-4, Figure 7.4.1). On the 7th of May 2018 an adult male was seen in a short flight before landing in an area of dense wet grassland and heather, approximately 2.5km northwest of the development site. On the 23rd of July 2019 a male hen harrier was observed hunting over areas of dry meadows and grassy verges, approximately 50m north of the development site.

Hen Harrier Roost Surveys

Hen harrier were only recorded twice during Hen Harrier Roost Surveys (see Appendix 7-4, Figure 7.7.1). Both flights were recorded in the same area approximately one kilometre west of the proposed development site. On the 25th of March 2018 an adult male was seen flying low over heather moorland before flying in to roost, approximately one kilometre west of the proposed development site. This area was identified by the surveyor as a possible roost site and further surveys were undertaken to determine its significance. No further roosting activity was recorded on subsequent watches and it is not considered to be a regular roost for the species. On the 26th of October 2018 an adult male was seen flying low over an area of upland blanket bog in the same area as the identified roost site from the previous winter period, though no evidence of roosting was recorded.

7.6.4 Merlin

Raw Survey data for Merlin is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Merlin were only recorded once during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.4). The observation occurred on the 17th of September

2019 as an individual bird was seen hunting over bog, within the proposed development site and approximately 400m south-west of the closest turbine.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.5 Peregrine

Raw Survey data for Peregrine is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Breeding Raptor Surveys

Peregrine were only recorded once during Breeding Raptor Surveys (see Appendix 7-4, Figure 7.4.2). On the 17th of July 2018 an adult female was seen in a short flight, approximately 1.8km southwest of the development site.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.6 Red Grouse

Raw Survey data for Red Grouse is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Red Grouse were recorded in flight on five occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.5). All five observations occurred outside of the proposed development site and more than 500m away from the nearest turbine location, in areas of suitable heath and blanket bog to the west of the site. On the 12th of December 2017 three red grouse were recorded in a short flight. Individuals were recorded in flight in the same area on the 2nd of May 2018 and the 15th of January 2019. On the 5th of September 2019 a pair of red grouse were recorded in a short flight on two occasions during the VP survey in the same area as before. All flight activity was less than 10m above ground level (i.e. below PCH).

There were a further 23 observations of red grouse heard calling from areas of heather, but not seen during VP surveys.

Breeding Bird Surveys

Red grouse were only observed twice during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.2). On the 10th of July 2018 an adult male was flushed from an area of bog, approximately 400m west of the development site. On the 25th of June 2019 a male red grouse was recorded in a brief low flight, approximately 300m east of the development site.

Red Grouse Surveys

Red Grouse were only recorded twice during dedicated Red Grouse Surveys (see Appendix 7-4, Figure 7.6.1). One observation occurred during the 2018 breeding surveys and one during the 2019 breeding surveys. Both observations occurred in the same area, approximately 300-400m west of the development site. Both observations were of adult males calling in response to the tape lure. These observations indicate that red grouse held a breeding territory in this area, within 500m of the development site, during both the 2018 and 2019 breeding seasons.

Winter Transect Surveys

Red grouse were only recorded once during Winter Transect Surveys (see Appendix 7-4, Figure 7.8.2). On the 16th of October 2018 an individual bird was flushed from an area of upland blanket bog, approximately 200m east of the development site.

Incidental Observations

There were ten incidental observations of red grouse between September 2017 and September 2019 (see Figure 7.10.3, Appendix 7-4). Five of these occurred either before or after Vantage Point Surveys, as red grouse were either flushed from heather or heard calling by the surveyor on his walk to or from the VP locations. Two more observations occurred during Hen Harrier Roost Surveys as red grouse were recorded during surveys several hundred meters from the development site.

There were three incidental observations of red grouse during Breeding Raptor Surveys. All three observations occurred in May 2019 as individual birds were heard calling from areas of dry heath and wet grassland. Two observations were recorded on the 9th of May 2019 in the same area, approximately 750m west of the development site. The remaining observation occurred more than 1.5km southeast of the development site on the 7th of May 2019.

7.6.7 Woodcock

Raw Survey data for woodcock is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Woodcock were only recorded once during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.6). The observation occurred on the 29th of April 2019, an adult male was recorded in a roding (displaying) flight, within 500m of the nearest turbines.

Breeding Woodcock Surveys

Woodcock were only recorded twice during dedicated Breeding Woodcock Surveys (see Appendix 7-4, Figure 7.5.1). Both observations occurred on the 4th of June 2019, a roding male was recorded in flight on two occasionsc.10 minutes apart in the same area, near Lough Nacroagh, within the development site.

Incidental Observations

There were twelve incidental observations of woodcock between September 2017 and September 2019. All twelve observations were recorded during winter months when the populations of native breeding woodcock are greatly supplemented by wintering birds from Eastern Europe. Eight of the twelve observations occurred either before or after Vantage Point Surveys, as woodcock were flushed or seen in flight by the surveyor on his walk to or from the VP locations. The remaining four observations occurred during Hen Harrier Roost Surveys, with birds recorded during surveys several hundred meters from the development site.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.8 Curlew

Raw Survey data for Curlew is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Curlew were only recorded on a single day of Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.7). There were six observations of curlew during a survey at VP4 on the 29th of April 2018. Only one of these observations was of a bird in flight; a bird was recorded flying over conifers, approximately 750m east of the development site. The remaining five observations were of an individual heard calling between 05:28 and 7:53am. The approximate location of where this calling bird was heard can be found on Figure 7.1.7.1 in Appendix 7-4. Due to the nature of the records and time of year these observations have been noted as a possible breeding territory.

Incidental Observations

There were two incidental observations of curlew during a Hen Harrier Roost Survey on the 25th of March 2018 more than 1km west of the development site. Both observations were of an individual bird heard calling and bubbling but not seen. Due to the nature of the records and time of year these observations have been noted as a possible breeding territory. However, on subsequent visits to this location during breeding raptor surveys (April to July inclusive) no evidence of territory occupancy was recorded.

The location of this territory as well the breeding territory identified during the Vantage Point Surveys can both be found on Figure 7.7.2 in Appendix 7-4.

7.6.9 Buzzard

Raw Survey data for Buzzard is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Buzzard were observed on ten occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.8). All observations were of individual birds, in flight or soaring on thermals over nearby ridges. Five observations occurred during winter months and five during the breeding season months.

Breeding Bird Surveys

Buzzard were only observed twice during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.3). On the 18th of April 2019 a single buzzard was heard calling, but not seen, from an area of forestry within the development site and 500m of the turbine layout. On the 26th of June 2019 an individual adult was recorded soaring, approximately 400m south of the development site.

Breeding Raptor Surveys

Buzzard were recorded on nine occasions during Breeding Raptor Surveys (see Appendix 7-4, Figure 7.4.3). Four observations occurred during the 2018 breeding season, while the remaining five observations occurred during the 2019 breeding season. Eight of the nine observations were recorded more than 2km away from the development site during surveys for breeding hen harrier out to 5km.

These observations were further away than the core foraging range for this species (i.e. 2km) as detailed in Hardey et al (2013).

Incidental Observations

There was one incidental observation of buzzard on the 9th of May 2019. The surveyor spotted a buzzard in flight in proximity of VP3 while driving off site after concluding a breeding raptor survey.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.10 Sparrowhawk

Raw Survey data for Sparrowhawk is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Sparrowhawk were only recorded on three occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.9). Only one of these observations occurred within the proposed development site. On the 13th of August 2018 an individual bird was briefly recorded hunting around conifers, approximately 650m east of the nearest turbine. On the 23rd of October 2018 a female was recorded hunting and perched along the edge of conifer plantation, approximately 650m west of the nearest turbine. On the 13th of June 2019 an individual was recorded soaring over conifer plantation within the development site.

Breeding Bird Surveys

Sparrowhawk were only observed twice during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.4). On the 18th of April 2019 a single sparrowhawk was flushed from an area of scrub at the very northern most edge of the development site, before seen in a brief flight north and out of view. On the 24th of June 2019 an adult male was seen flying from a *Sitka spruce* tree, approximately 700m east of the development site. This was noted by the surveyor as a possible nest location.

Breeding Raptor Surveys

Sparrowhawk were recorded on 13 occasions during Breeding Raptor Surveys (see Appendix 7-4, Figure 7.4.4). Nine observations occurred during the 2018 breeding season, while the remaining four observations occurred during the 2019 breeding season. Only seven of the 13 observations were recorded within 2km of the development while the remaining six observations occurred between 2 – 5km away during surveys for breeding hen harrier out to a 5km radius of the proposed development area.

Incidental Observations

There were four incidental observation of sparrowhawk during surveys between September 2017 and September 2019. Two observations occurred before or after VP survey as the surveyor made his way from the survey location. There was incidental observation of a sparrowhawk in flight after a breeding walkover on the 16th of July 2019. The remaining observation was of a sparrowhawk hunting a blackbird during a Hen Harrier Roost Survey on the 8th of January 2019.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.11 Kestrel

Raw Survey data for kestrel is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Kestrel were observed on 17 occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.10). All observations were of individual birds in hunting flights. Thirteen observations occurred during the 2018 breeding season, while there were only two observations during the 2018/19 winter season and two observations during the 2019 breeding season. Thirteen of the 17 observations occurred within 500m of the proposed turbine layout. Flight activity was primarily associated with areas of heath and bog in the northwest of the development site around Turbines 1 and 3.

Breeding Bird Surveys

Kestrel were observed on six occasions during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.5). Only one observation occurred during the 2018 breeding season while the remaining five observations occurred during the 2019 breeding season.

Breeding Raptor Surveys

Kestrel were recorded on 13 occasions during Breeding Raptor Surveys (see Appendix 7-4, Figure 7.4.5). Eleven observations occurred during the 2018 breeding season, while the remaining two observations occurred during the 2019 breeding season. Only four of the 13 observations were recorded within 2km of the development while the remaining nine observations occurred between 2 – 5km away during surveys for breeding hen harrier out to 5km. A possible kestrel breeding territory was recorded 2.5km to the north of the proposed development area.

Incidental Observations

There were four incidental observations of Kestrel during Hen Harrier Roost surveys between September 2017 and September 2019. All four observations occurred during the 2018/19 winter season as individuals were seen in hunting flights.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.12 Snipe

Raw Survey data for Snipe is provided in Appendix 7-4. Results summary tables are present in Appendix 7-3.

Vantage Point Surveys

Snipe were observed in flight on eleven occasions during Vantage Point Surveys between September 2017 and September 2019 (see Appendix 7-4, Figure 7.1.11). Only four of these observations occurred in winter months while the remaining seven observations occurred during the 2019 breeding season. All seven observations of snipe during the breeding season were of displaying birds (i.e. drumming or chipping while in flight). The majority of the flight activity occurred more than 500m west of the proposed turbine layout in areas of confirmed breeding.

Furthermore, there were a further 15 observations of snipe heard calling or drumming during VP surveys but not seen. Six of these observations occurred during the 2018 breeding season while the remaining nine observations occurred during the 2019 breeding season. The location of all breeding territories can be found on Figure 7.11 in Appendix 7-4.

Breeding Bird Surveys

Snipe were observed on nine occasions during Breeding Bird Surveys (see Appendix 7-4, Figure 7.3.6). Only three observations occurred during the 2018 breeding season while the remaining six observations occurred during the 2019 breeding season. Drumming snipe were heard on two occasions on the 21st of May 2019. The locations of breeding territories identified during this survey and all other surveys can be found on Figure 7.11 in Appendix 7-4.

Incidental Observations

There were 39 incidental observations of snipe during surveys between September 2017 and September 2019 (see Figure 7.10.5, Appendix 7-4). Twenty-two observations occurred during breeding raptor surveys, several hundred meters from the development site. A further five observations occurred during Hen Harrier Roost Surveys within 2km of the development site. There were eleven incidental observations of snipe flushed or heard calling or drumming as the survey made his way to and from his VP surveys. The remaining observation was of a snipe heard drumming, but not seen, during a breeding woodcock survey on the 13th of June 2019.

There were no additional observations of this species during any of the other comprehensive surveys.

7.6.13 Passerines (Red Listed)

The BoCCI Red listed species meadow pipit, grey wagtail and whinchat was recorded during the surveys undertaken. Whinchat were only recorded once during surveys undertaken between September 2017 and September 2019. A single female was seen during a breeding bird survey on the 18th of April 2019, approximately 300m west of the development site. There were no further observations of this species.

7.7 Evaluation

A determination of population importance of birds within the likely zone of influence is provided in the sections below following criteria described in Section 7.2.5. Estimates of National population sizes were obtained from the NPWS Article 12 Reporting (2008-2012) which details the status and trends of Irelands Bird species. The development site lies on the border for County Leitrim and County Sligo. Where relevant, estimates for mean county populations has been derived following a review of I-WeBS sites in County Leitrim and County Sligo.

7.7.1 Whooper Swan

Wintering

As per the latest national wintering estimates provided in Burke et al (2018), the national wintering population of Whooper Swan in the Republic of Ireland is 11,852. Using these latest I-WeBS figures, 1% of the National population of Whooper Swans is 119. Therefore, as per NRA 2009, a regularly occurring population of 119 Whooper Swans is required for classification as Nationally Important.

The Swan Census 2015 (Crowe et. al., 2015) was consulted regarding the population data for Whooper Swans in Counties Leitrim and Sligo. Based on the 2015 Swan Census data, in January 2015 the County Leitrim population was 302 individuals, while the County Sligo population was 198 individuals. Based on the above, a population of 2-3 Whooper Swans is required for County Importance classification in the Sligo-Leitrim area. This EIAR utilises the lower threshold figure of 198 birds as a baseline for County population on a highly precautionary basis.

During the 2017-2019 surveys, whooper swan flocks of county importance, as per NRA criteria Crowe et al. (2015), were observed on five occasions. Four of the five flights were described as birds likely to be on migration over the site due to the time of the observations. No evidence of feeding or roosting activity was recorded within the proposed windfarm site. The recorded evidence and random flight distribution do not suggest that the proposed development is located on a defined migratory corridor for the species, although the potential for displacement and collision requires further assessment.

The flocks recorded flying over the development site were assigued **County Importance** on a precautionary basis. This species was not recorded to regularly occur at the site.

Breeding

The species is not dependent of the development site for breeding.

7.7.2 Golden Plover

Wintering

The estimated national wintering population of Golden Plover in Ireland is 80,707 for the Republic of Ireland (ROI) (Burke et al. 2018). 1% of the ROI National wintering population of Golden Plover is 807 birds. As per NRA 2009, a regularly occurring population of 807 Golden Plover is required for classification as Nationally Important. The maximum number of birds recorded from the winter season was 270 birds. This maximum number does not correspond with the classification criteria for National or International Importance (Burke et al. 2018).

Estimating population of County Importance

Typically to estimate the county population, a review of I-WeBS sites in both County Leitrim and County Sligo would be undertaken. However, I-WeBS counts are acknowledged to underestimate the numbers of certain species, e.g. golden plover (Burke et al. 2018). I-WeBS surveys focus on wetland sites, whereas golden plover regularly foraging in terrestrial habitats (e.g. agricultural grassland). In the present case, no golden plover were recorded at Leitrim I-WeBS sites and no golden plover were recorded at non-coastal Sligo I-WeBS sites. Given that golden plover were recorded on the site during the surveys undertaken, a population estimate of zero based on I-WeBS data would clearly be inaccurate.

As a result, an alternative method to provide an estimate of the size of the population that is important at the County scale has been undertaken based on the average wintering population density for the species. This methodology is described below. The data used for this estimation is taken from the Bird Atlas survey (2007-11) (Balmer et al., 2013). It should be noted that this is very much an estimation that provides a guide against which to assess the ecological importance of the populations of golden plover at the wind farm site.

The population density for wintering golden plover in Ireland from Bird Atlas survey data (2007-11) (Balmer et al., 2013) is 11.9 birds per tetrad (i.e. 4km^2). This means that the average population density of wintering golden plover in Ireland is 2.975 birds per square kilometre.

For the purposes of the assessment, it is assumed that the number of golden plover in any given County is three times the number of square kilometres in that county. In this case, the wind farm is located in both Co. Leitrim and Co. Sligo and the land area of both these Counties is provided below in square kilometres:

- Co. Sligo = 1,838 square kilometres
- Co. Leitrim = 1,590 square kilometres

Following a precautionary approach, the assumptions are based on the county with the smaller land area and smaller estimated population (Co. Leitrim). The estimated county population of golden plover for Co. Leitrim is 4,770 birds.

Therefore, a regularly occurring population of 48 birds (1% of the County population) is considered of County Importance in the context of the development site. Such flocks of **County** Importance were only recorded on five dates during the extensive surveys undertaken.

Estimating population of Local importance

The core foraging range of golden plover during the winter months is 12km (Gillings and Fuller, 1999). The total area within a 12km radius of the proposed development area is approximately 612km^2. When the average population density (i.e. 3 birds per km^2) was applied to this area, a rough estimate of the local population is 1,836 individuals.

Therefore, a regularly occurring population of 18 birds (1% of the local population) is considered of Local Importance in the context of the development site. Flocks of 18 birds or greater were recorded on 11 dates during the survey period.

Evaluation of importance of wintering golden plover on the wind farm site

The site is utilised on a regular basis by a wintering population that is estimated to be of **Local** importance as evidenced during the surveys undertaken. This population was recorded loafing and roosting in the open areas of the site and flying over the entire site, including the forestry. Flocks that

are estimated to be of **County** importance were recorded occasionally (on only 5 dates) primarily flying over the site.

Breeding

This species was only observed once during the breeding season. A single bird was heard calling from an area of dense heather, approximately 1km from the proposed development site. No evidence of breeding was recorded. There were no further observations of this species during the breeding season.

The species is not dependent on the development site for breeding.

7.7.3 Hen Harrier

Wintering

The estimated national wintering population of Hen Harrier in Ireland is 269-349 therefore 1% of the ROI National wintering population is 2-3 birds. As per NRA 2009, a regularly occurring wintering population of 2-3 Hen Harrier is required for classification as Nationally/Internationally Importance.

Taking a precautionary approach, it is assumed that the individuals recorded during the winter season are associated with a **Nationally/Internationally** important wintering population.

Breeding

Based on the latest Breeding Hen Harrier Survey (NPWS 2015), the ROI National breeding population is in the range of 108-157 pairs. Therefore, a single breeding pair in Ireland conforms to National/International Importance as per NRA criteria.

This species was infrequently recorded during the breeding season, i.e. hen harrier were recorded on nine occasions during the breeding season. The majority of these observations were recorded in August, which is considered to be outside the core breeding season of April to July. No indication of breeding behaviour was observed either on site or within 5km of same.

Taking a precautionary approach, it is likely that the individuals recorded outside the core breeding season are associated with a **Nationally/Internationally** important population from the wider area.

7.7.4 Merlin

As per the latest NPWS Article 12 reporting document, the estimated population of Merlin is between 200 – 400 pairs based on Hardy et al (2009).

The species was only recorded once within 500m of the turbine layout. Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)**.

7.7.5 Peregrine

The development site is not of significance to this species and numbers of ecological significance were not recorded on or near the site. Ouly one record of this species occurred with an adult female recorded in flight approximately 2km away from the development site.

The development site is not of significance to the species.

7.7.6 Red Grouse

Red Grouse is BOCCI Red Listed during the breeding season in Ireland. The European population of the species is identified as Secure. The species is Red Listed in Ireland with regard to breeding populations. As per the latest NPWS Article 12 reporting document, the estimated population of red grouse in Ireland is 1,898 breeding pairs. Therefore 1% of the ROI National breeding population is 19 breeding pairs. As per NRA 2009, a regularly occurring breeding population of 19 red grouse pairs is required for classification as Nationally Important. The population recorded at Croagh does not correspond to national importance and falls well below the threshold of 19 breeding pairs with ouly five breeding territories identified during surveys, of which only two were within 500m of the development site and none within the site itself. The most recent national survey for red grouse, estimates the population for the northwest to number 2,038 individuals (Cummins 2010).

Taking a precautionary approach, the population recorded was assigned **County Importance** on the basis of a resident/regularly occurring population assessed to be important at the county level.

7.7.7 Woodcock

Woodcock is Red listed during the breeding season in Ireland. The species is not Red listed with regard to wintering populations.

This species was only recorded on three occasions during breeding season bird surveys at Croagh Windfarm between September and September 2019. Two separate roding woodcock was recorded during the core-breeding season.

Taking a precautionary approach, the population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident breeding population assessed to be important at the local level.

7.7.8 Curlew

Curlew is Red listed during both the breeding and wintering seasons in Ireland.

This species was only recorded on two survey dates during the extensive 25-months of bird surveys at Croagh Windfarm between September 2017 and September 2019. Both observations occurred during the 2018 breeding season. A single bird was heard calling from an area of heather on the 25th of March, approximately 1km west of the development site during the 2018 breeding season. A single bird was heard calling from an area of heather on the 29th of April, approximately 200m east of the development site during the 2018 breeding season. Both observations were initially noted as possible breeding, on a highly precautionary basis, despite only an individual bird being recorded on both occasions.

The individual recorded 1km to the north of the proposed development can be excluded from further consideration, given the zone of sensitivity for curlew is referenced as 800m from windfarm developments (Pearce-Higgins et al. 2012; McGuinness et al. 2015). Therefore, disturbance displacement impacts are not predicted for this individual as this bird was recorded beyond the likely zone of sensitivity for this species.

The individual that was recorded on a single occasion within 200m of the proposed development, was not subsequently recorded despite a concerted survey effort in this location. The location of this April curlew observation fell within the view shed of VP4 and was surveyed for a total 30 hours between March and July 2018. Had a curlew pair bred in this area it would have been observed from VP4, particularly given the conspicuous display flights of this species.

It can be assumed that both the observation in late March and late April, was of an individual male prospecting various areas within the wider surroundings of the development site in search of a mate,

before ultimately moving on from the area. In addition, the NPWS provided records on breeding curlew which identified a confirmed nest site from 2014, approximately one kilometre north of the development site.

As previously stated, the zone of sensitivity for Curlew is referenced as 800m from windfarm developments (Pearce-Higgins et al. 2012; McGuinness et al. 2015). The confirmed historic territory from 2014, submitted by the NPWS is beyond the likely zone of sensitivity for this species, while the observations from surveys at the site in 2018 indicate a male bird prospecting potential breeding areas, but ultimately there were no breeding attempts occurring within 2km of the development site in either 2018 or 2019.

The development site is not of significance to the species.

7.7.9 Buzzard

Buzzard is not listed on Annex I of the Birds Directive. The species is Green listed in Ireland (BoCCI). The population recorded across the seasons was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.7.10 Sparrowhawk

Sparrowhawk is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during the breeding season only. The population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.7.11 Kestrel

Kestrel is not listed on Annex I of the Birds Directive. The species is Amber listed in Ireland (BoCCI) during the breeding season only. The population recorded was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.7.12 Snipe

Snipe are amber listed in Ireland during both the breeding and winter seasons (BoCCI). The population recorded within the development site was assigned **Local Importance (Higher Value)** on the basis of a resident/regularly occurring population assessed to be important at the local level.

7.7.13 Passerines (Red Listed)

Meadow pipit, grey wagtail and whinchat are Red listed in Ireland during the breeding season. Whinchat were ouly recorded once during surveys undertaken between September 2017 and September 2019. Populations recorded were deemed to be of no greater than Local Importance (Lower Value).

7.8 Identification of Key Ornithological Receptors

Table 7-12 Avifaunal Receptor Evaluation and Selection Criteria Rational

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
Whooper Swan	Annex I; EU Birds Directive	**Wintering** Flocks of County Importance recorded	This species was not recorded utilising habitats within the site boundary for foraging or roosting. There is no potential for direct habitat loss. Birds were recorded flying over the development site and within 500m of the turbine layout. Taking a precautionary approach, **the potential for displacement exists.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Golden Plover	Annex I, EU Birds Directive; BoCCI Red List & Irish Wildlife Act.	**Wintering** Flocks of County Importance recorded	This species was occasionally recorded loafing/roosting within the development site and within 500m of same during winter months. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
		Breeding	This species was not recorded on site or in the wider areas during the 2019 breeding season. There was only one observation of a single bird heard calling, more than 1km from the development site, during the 2018 breeding season in May. There was no evidence of breeding activity recorded. There is	**No**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
		No population of ecological significance recorded	no evidence to suggest that the development site is of significance to this species during the breeding season. There is no potential for direct habitat loss or displacement. On the basis of the separation distance between the observation and the proposed development, no pathways for significant direct or indirect effects were identified.	
Hen Harrier	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** National/International Importance recorded	There was no evidence of breeding activity recorded during either the 2018 or 2019 breeding seasons. This species was occasionally recorded in flight within the development site. The potential for direct habitat loss cannot be excluded. **An assessment of direct habitat loss is required.** Birds were recorded within the development site boundary. Taking a precautionary approach, **the potential for displacement exists**. This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**
Merlin	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	This species was only recorded once within 500m of the turbine layout during surveys between September 2017 and September 2019. No evidence of breeding or roosting activity was recorded. There is no potential for direct habitat loss. This species was only recorded once within 500m of the turbine layout during surveys between September 2017 and September 2019. Taking a highly precautionary approach, **an assessment of displacement effects is required.** This species was recorded flying over the development site within the potential collision risk zone. **A collision risk assessment is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
Peregrine	Annex I, EU Birds Directive; BoCCI Green List & Irish Wildlife Act.	**All Seasons** No population of ecological significance recorded	This species was not recorded within the development site. Only one record of this species occurred with an individual bird recorded in flight approximately 1.8km away from the development site. There is no evidence to suggest that the development site is of significance to this species. There is no potential for direct habitat loss or displacement. No pathways for significant direct or indirect effects were identified. No flights were recorded during VP surveys. Collision risk modelling cannot therefore be carried out, with the available data	**No**
Red Grouse	BoCCI Red Listed (Breeding Populations)	**All Seasons** County Importance	The development site is dominated by conifer plantation, this habitat is not utilised by foraging or breeding red grouse. The majority of observations occurred in areas of suitable breeding habitat, predominantly to the west of the development site. There is no evidence to suggest that the development site is of significance to this species. While birds were not recorded within the development site itself, there were a number of observations within 500m of same. Taking a precautionary approach, **an assessment of displacement effects is required.** No flights were recorded at PCH during VP surveys. Collision risk modelling cannot therefore be carried out, based on survey results.	**Yes**
Woodcock	BoCCI Red Listed (Breeding Populations)	**Breeding** Local Importance (Higher Value)	This species was recorded within the development site on three occasions during the 2019 breeding season. All three observations were of roding males, which occurred in two distinct locations, indicating breeding locally. The potential for habitat loss cannot be excluded. **An assessment of direct habitat loss is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
			Birds were recorded within the development site boundary and within 500m of the proposed turbine layout. Taking a precautionary approach, **the potential for displacement exists**. No flights were recorded within PCH during VP surveys. Collision risk modelling cannot therefore he carried out, with the available data.	
Curlew	BoCCI Red List (breeding and wintering) & Irish Wildlife Act	**All Seasons** No population of ecological significance recorded	Curlew was not recorded within the development site. The development site is dominated by conifer plantation. There is no evidence to suggest that the development site is of significance to this species. There is no potential for direct habitat loss. This species was only recorded on two survey dates during the extensive 25-months of bird surveys. Both observations were of a single individual, believed to be a male, prospecting potential breeding habitat in search of a mate during the early part of the 2018 breeding season. Only one record occurred within the zone of sensitivity for this species, i.e. within 800m of the development site. There were no subsequent observations of this species throughout the extensive suite of breeding season surveys. There were no observations of curlew during the 2019 breeding season. Significant displacement effects are not anticipated particularly given the low levels of activity recorded. No flights were recorded during VP surveys within the Potential Collision Height (PCH). Collision risk modelling cannot therefore be carried out, with the available data.	**No**
Buzzard	Irish Wildlife Act	**All Seasons**	The potential for habitat loss, while minimal, cannot be excluded. **An assessment of direct habitat loss is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
		Local Importance (Higher Value)	The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. A **collision risk assessment is required.**	
Sparrowhawk	BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. A **collision risk assessment is required.**	**Yes**
Kestrel	BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.** This species was recorded flying over the site within the potential collision risk zone. A **collision risk assessment is required.**	**Yes**
Snipe	BoCCI Amber List & Irish Wildlife Act.	**All Seasons** Local Importance (Higher Value)	The potential for habitat loss, while minimal, cannot be excluded. **An assessment of direct habitat loss is required.** The species was recorded within the site boundary. **An assessment of displacement effect is required.**	**Yes**

Species	Conservation Status	NRA Evaluation (NRA, 2009)	Rational for inclusion/exclusion as KOR	KOR Yes/No
			This species was recorded flying over the site within the potential collision risk zone. **A collision risk assessment is required.**	
Passerines (Red Listed)	Irish Wildlife Act	**All Seasons** Local Importance (Lower Value)	As per SNH guidance, it is generally considered that passerine species are not significantly impacted by wind farms.	**No**

7.9 KOR Sensitivity Determination

Criteria developed by Percival (2003) is presented in Table 7-3 (Section 7.2.5.3) for assessing bird sensitivity within the study area. There were no **Very High** sensitivity KORs as there were no bird populations recorded which were likely to be associated with SPA populations.

High Sensitivity KORs include:

- Hen Harrier (Ecologically sensitive species)

Medium Sensitivity KORs include:

- Whooper Swan (Annex I; EU Birds Directive)
- Golden Plover (Annex I; EU Birds Directive)
- Merlin (Annex I; EU Birds Directive)
- Red Grouse (BoCCI; Red Listed)
- Woodcock (BoCCI; Red Listed)

The remaining KORs identified in the study area were classified as **Low Sensitivity**:

- Buzzard
- Sparrowhawk
- Kestrel
- Snipe

7.10 Likely and Significant Effects

This section of the assessment of effects is structured as follows:

- Assessment of 'Do nothing' Effect.
- Assessment of effects in relation to sites designated for nature conservation.
- Assessment of effects in relation to Key Ornithological Receptors.
- Summary of potential effects associated with proposed development.

All elements of the Proposed Development have been considered in assessing effects on ecological receptors, including:

1. *Construction of 10 No. wind turbines with a maximum overall blade tip height of up to 170 metres, and associated hardstand areas;*
2. *1 no. 38kV permanent electrical substation including a control building with welfare facilities, all associated electrical plant and equipment, security fencing, all associated underground cabling, waste water holding tank and all ancillary works;*
3. *1 no. permanent Meteorological Mast with a maximum height of up to 100 metres;*
4. *All associated underground electrical and communications cabling connecting the turbines to the proposed wind farm substation;*
5. *All works associated with the connection of the proposed wind farm to the national electricity grid, via underground cabling to the existing Garvagh substation;*
6. *Upgrade of existing tracks and roads, provision of new site access roads and hardstand areas;*
7. *The partial demolition and alteration of two agricultural buildings in the townlands of Sheena and associated junction access and road works to the existing yard, agricultural buildings and agricultural lands in the townlands of Sheena and Derrybofin to provide a link road primarily for construction traffic off the R280. This link road will be used for*

the delivery of abnormal loads to the site during the construction period and may be used during the operational period if necessary or to facilitate the decommissioning of the wind farm. Following construction, access to the link road will be closed off and the yard/agricultural building will revert to its use for agricultural purposes except if and when required for delivery of abnormal loads during the operational period of the windfarm or to facilitate the decommissioning of the wind farm;

8. *1 no. borrow pit;*
9. *2 no. peat and spoil repository areas*
10. *2 no. temporary construction compounds;*
11. *Recreation and amenity works, including marked trails, boardwalk and viewing area provision of a permanent amenity car park, and associated recreation and amenity signage*
12. *Site Drainage;*
13. *Permanent Signage;*
14. *Ancillary Forestry Felling to facilitate construction and operation of the proposed development; and*
15. *All associated site development works*

This application seeks a ten-year planning permission and 30-year operational life from the date of commissioning of the entire wind farm.

7.10.1 Do-Nothing Effect

The land that forms the study area is dominated by conifer plantation, with small areas in the surrounding landscape of wet grassland, heath and degraded peatland.

If the proposed development for which this EIAR has been prepared does not go ahead, the site would continue to be managed for the existing commercial forestry that has been present for approx. the past 40 years. The biodiversity on the site would likely remain similar to its current state as activity levels and land use would not change significantly.

7.10.2 Effects on Key Ornithological Receptors during Construction and Operation

7.10.2.1 Whooper Swan (*Wintering*)

Table 7-13 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was not recorded utilising habitats within the site boundary. The development site is dominated by conifer plantation. Observations of this species were predominantly recorded during periods of migration (i.e. spring and autumn). The development site and surrounding areas provide very limited potential to support wintering whooper swan populations in terms of suitable habitat. Significant effects with regard to direct habitat loss are not anticipated at any geographical scale.	**No Effect**	**No Effect**
Displacement & Barrier Effect	As per McGuinness et al (2015) the zone of sensitivity for the species is 600m. This species was recorded in flight within 600m of the development site on four occasions. Numbers recorded ranged from individuals to a flock of 23 birds. A study undertaken by Rees (2005) in relation to Whooper Swan behavioural responses to human activity suggests that swans become less sensitive to disturbance if the frequency of daily disturbance is high. Rees et al. (2006) conducted a study at Black Cart Special SPA near Glasgow in relation to Whooper Swan behavioural and disturbance responses to different types of	The magnitude of the effect is assessed as *Negligible*. The cross tablature of a *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Short-term Slight Negative Effect**

	human activity. The study was undertaken over three winters (from 1997/98 to 1999/00) at agricultural lands used by Whooper Swan. The study found that activities relating to cars, tractors, bicycles, farm workers on foot and cattle (livestock) exhibited the least disturbance to Whooper Swan flocks (within 100m disturbance distance bands). The development site is subject to regular forestry activity and the construction will require works similar to those described in the Rees assessment. Significant disturbance to Whooper Swan is therefore not anticipated as the populations are expected to become habituated to the levels of disturbance. Very few transits of commuting birds were recorded and there is no evidence to suggest that the development site lies on an important commuting or migratory route for the species. Significant displacement effects are not anticipated at any geographical scale.		
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated at any geographical scale.	**No Effect**	**No Effect**
Displacement & Barrier Effect	As per McGuinness et al (2015) the zone of sensitivity for the species is 600m. This species was recorded in flight within 600m of the development site on four occasions. Numbers recorded ranged from individuals to a flock of 23 birds. Observations of whooper swan non-breeding activity from 8 European studies have given a mean minimum avoidance distance of 150 m from the base of wind turbines (Hötker et al. 2006). Only three of the observed flights of whooper swan were recorded within 150m of the proposed turbine layout. This few transits across the site limits the potential for significant impact to result.	The magnitude of the effect is assessed as *Negligible*. The cross tablature of a *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**

	Very few transits of commuting birds were recorded and there is no evidence to suggest that the development site lies on an important commuting or migratory route for the species. Significant displacement effects are not anticipated at any geographical scale.		
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.220 collisions per year or one bird every 4.5 years. Annual mortality of adult whooper swan has been calculated at 20% per annum (Brazil, 2003). If 0.220 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the annual mortality of the county population (i.e. 198) by 0.56%. The predicted collision risk is therefore negligible in the context of the county population. No significant effects are anticipated regarding collision risk at any geographical scale.	The magnitude of the effect is assessed as *Negligible*. The cross tablature of a *Medium* Sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Imperceptible Effect**

7.10.2.2 Golden Plover (*Wintering*)

Table 7-14 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Flocks deemed to be of Local Importance were recorded flying, calling and landing/emerging from loafing/roosting areas on heath, wet grassland and upland blanket bog. Larger flocks of County importance were also occasionally recorded at the site. Observations occurred regularly throughout	The magnitude of the effect is assessed as *low*.	**Long-term Slight Negative Effect**

	both winter seasons surveyed and occurred on-site and within 500m of the proposed turbine layout. The development site is dominated by conifer plantation and does not provide significant areas of suitable habitat for wintering populations. Golden plover activity occurred predominantly offsite and around the northwest and southeast margins of the development area. Significant effects with regard to direct habitat loss are not anticipated at any geographical scale.	The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	
Displacement	As per McGuinness et al (2015) the zone of sensitivity for the species is 800m during the breeding season only. The species is not identified as being particularly sensitive to wind farm developments during the wintering period. Taking a highly precautionary approach, all observations of birds within 800m of the development site were deemed to be sensitive to displacement effects for wintering populations also. There were 30 observations of golden plover within 800m of the development site during surveys between September 2017 and September 2019. However, disturbance during construction is unlikely to discourage flight activity over the site. Furthermore, given the majority of the site is dominated by coniferous plantation significant impacts are not predicted at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	A study by (Pearce-Higgins et al. 2009) found reduced use of habitat surrounding operating turbines, to within 200 m of the turbine base. A review of 29 other studies suggests Golden Plover will approach wind turbines to an average distance of 175 m in non-breeding season (Hötker et al. 2006). There	The magnitude of the effect is assessed as *low*.	**Long-term Slight Negative Effect**

	were 14 observations of golden plover within 200m of the proposed turbine layout during surveys between September 2017 and September 2019. Furthermore, post-construction monitoring at 15 upland wind farms showed no significant decline in populations post construction (Pearce-Higgins et al. 2012). In addition, the character of onsite habitats (e.g. dominated by forestry) limits the potential for ecologically significant displacement impacts to result. In the event of displacement, there are extensive areas of suitable habitat in the wider area. This would likely render such an effect inconsequential. There is no evidence to suggest that the development site lies on a migratory/ regular commuting route for the species therefore barrier effect is not anticipated. Significant displacement effects are not anticipated at any geographical scale.	The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	
Collision	Collision risk for waders is generally deemed to be low, due to a relatively low cursory flight path, coupled with high flight manoeuvrability (McGuinness et.al 2015). A review of pan-European collision assessments revealed much lower Golden Plover collision records than other species, though this was not controlled for survey effort or corpse recovery rates (Hötker et al. 2006). The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk assessment has followed a precautionary approach and utilises flight observations recorded across all seasons and includes flights several hundred meters from the proposed turbine layout. Therefore, the assessment provided below is highly conservative. The collision risk has been calculated at a rate of 22 collisions per year. Annual mortality of adult golden plover has been calculated at 27% per annum	The magnitude of the effect is assessed as *medium*. The cross tablature of a *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

	(Sandercock, 2003). If 22 collisions were to occur per year, it would mean that the losses at the proposed wind farm would increase the estimated annual mortality of the County population (i.e. 4,770 birds, please see Section 7.5.2 for further details) by 1.7%. The predicted collision risk is therefore low in the context of the County population. No significant effects at the International, National or County scale.		

7.10.2.3 Hen Harrier (*All Seasons*)

Table 7-15 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The Proposed Development site is dominated by mature conifer plantation, is considered sub-optimal for breeding or wintering hen harrier. No breeding or regular roosting sites were recorded within the study area between September 2017 and September 2019. The unfavourable nature of onsite habitats (i.e. dominated by mature forestry) limits the potential for construction activities to result in ecologically significant habitat loss for hen harrier.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	A recent assessment of the effects of a wind farm on an existing population of breeding hen harriers reported regular flights at close proximity to turbine bases (Madden & Porter 2007). This report also revealed that, although reductions in flight activity around turbines were observed during the construction phase, the activity of bird populations quickly returned to pre-construction levels. Aside from collision risk, turbine avoidance by Hen Harriers observed at one wind farm installation extended to within 250 m of turbines (Pearce-Higgins et al. 2009). This study predicted a 52% reduction in	The magnitude of the effect is assessed as *Low* The cross tablature of a *High* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**

	breeding population within 500 m of a wind energy array but found no significant modification in flight height near turbines. However, in relation to the current proposal, no territorial and/or breeding behaviours indicative of nesting were recorded at or within the 2km survey radius of the development site boundary. The development site does not form part of the core territory for any known Hen Harrier breeding pair. The species was not found to be dependent on the development site for foraging at any time of the year. Therefore, based on the core dataset there is no potential for significant displacement effects given that hen harrier were not dependent on the habitats within the study area for roosting, foraging or breeding.		
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	In relation to the current proposal, no territorial and/or breeding behaviours indicative of nesting were recorded at or within the 2km survey radius of the development site boundary. The development site does not form part of the core territory for any known Hen Harrier breeding pair. The species was not found to be dependent on the development site for foraging at any time of the year. Therefore, based on the core dataset there is no potential for significant displacement effects given that hen harrier were not dependent on the habitats within the study area for roosting, foraging or breeding.	The magnitude of the effect is assessed as *low*. The cross tablature of a *High* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.002 collisions per year, or one bird every 434 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of a *High* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

7.10.2.4 Merlin (*All Seasons*)

Table 7-16 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was not recorded utilising habitat within the site boundary for roosting or breeding. Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	No breeding sites were recorded within the study area. Disturbance during construction is unlikely to discourage flight activity or foraging in the vicinity of the Proposed Development particularly given the low levels of activity recorded. Significant displacement effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Significant effects are not anticipated particularly given the low levels of activity recorded. Extensive areas of suitable foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding	The magnitude of the effect is assessed as *negligible*.	**Long-term Slight Negative Effect**

	area. Disturbance during operation is unlikely to discourage flight activity or foraging in the vicinity of the Proposed Development.	The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	
Collision	The species was recorded flying within the potential collision risk zone on one occasion during VP surveys. A "Random" collision risk analysis has been undertaken on a precautionary basis and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.0009 collisions per year, or approximately one bird every 1,100 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

7.10.2.5 Red Grouse (*All Seasons*)

Table 7-17 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The development site is dominated by conifer plantation and does not provide significant areas of suitable habitat for red grouse. This species was not recorded utilising habitat within the site boundary for breeding. Extensive areas of suitable breeding and foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Medium* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

Displacement	No breeding territories were recorded within the study area with the nearest observations less than 100m from the development site boundary and approximately 400m from the proposed turbine layout. As per McGuinness et al (2015) a zone of sensitivity of 500m applies for breeding red grouse territories. There is potential for temporary displacement of grouse during construction, however, the magnitude of this impacts will be limited as the majority of observations occurred in excess of 500m to the west of the proposed development site and turbine layout. Furthermore, studies of red grouse have found that population densities recover within one year after disturbance caused by construction of wind farms (Pearce-Higgins et al. 2012). Significant effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Red grouse show a high degree of site fidelity in Ireland (Watson and Moss 2008). Disturbance displacement can result in a significant impact if it reduces the availability of resources for red grouse. However, in the case of red grouse, operating turbines are not considered to result in significant levels of displacement (Douglas et.al 2011). In the unlikely event displacement does occur, there are extensive areas of suitable habitat in the wider area, to render this potential impact inconsequential.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**

Collision	This species was not recorded flying at the potential collision risk height during the extensive VP survey work undertaken. Collision risk is not likely to significantly impact this species based on available data.	**No Effect**	**No Effect**

7.10.2.6 Woodcock (*Breeding*)

Table 7-18 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Roding woodcock were recorded on two separate occasions within the development site. These observations indicate that woodcock bred within the development site. The site is dominated by conifer plantation which provides suitable breeding habitat for woodcock. Extensive areas of suitable breeding and foraging habitat will remain post construction and there is an abundance of suitable habitat in the surrounding area. Significant effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	Roding woodcock were recorded on two separate occasions within the development site. These observations indicate that woodcock bred within the development site. The site is dominated by conifer plantation which provides suitable breeding habitat for woodcock. Construction in forested areas could potentially cause displacement of breeding woodcock. However, two records of roding woodcock is not considered to be indicative of a site hosting a significant number of breeding woodcock. Should any potential displacement occur, this will be rendered inconsequential given the wider area contains extensive areas of forestry suitable for breeding woodcock.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Short-term Slight Negative Effect**

Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The site is dominated by conifer plantation which provides suitable breeding habitat for woodcock. However, roding woodcock were only recorded on two separate occasions within the development site. The number of roding woodcock recorded onsite is considered to be low. There are sufficiently extensive areas of suitable habitat in the wider area, to render any potential displacement effect inconsequential. Significant impacts are not predicted at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Medium* sensitivity species and *Low* Impact corresponds to a ***Low*** effect significance	**Long-term Slight Negative Effect**
Collision	This species was not recorded flying at the potential collision risk height during the extensive VP survey work undertaken. Collision risk is not likely to significantly impact this species based on available data.	**No Effect**	**No Effect**

7.10.2.7 Buzzard (*All Seasons*)

Table 7-19 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	This species was infrequently recorded within the development site during the breeding and winter seasons. No evidence of breeding activity was recorded within the development site or 2km of the same. Significant areas of suitable nesting and foraging habitat will continue to exist within the development site.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low*	**Long-term Slight Negative Effect**

	Substantial areas of undisturbed suitable nesting and foraging habitat will remain beyond the development footprint.	Impact corresponds to a ***Very Low*** effect significance	
Displacement	Construction in forestry areas could potentially cause displacement of breeding Buzzard. There was no evidence of breeding activity within the development site or within 2km of same during either the 2018 or 2019 breeding seasons. Given the availability of potential nesting and foraging habitat in the wider area, no significant effects are anticipated. Overall, disturbance during construction is unlikely to discourage flight activity, foraging or breeding attempts in the vicinity of the Proposed Development. particularly given the low levels of activity recorded. Significant displacement effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	The development footprint is dominated by commercial conifer plantation. Pearce Higgins (2009) describes that buzzard has been found to show significant turbine avoidance extending to at least 500m. However, this species was infrequently recorded within the development site during the breeding and winter seasons. There was no evidence of breeding activity within the development site or 2km of same during either the 2018 or 2019 breeding seasons. Extensive areas of suitable breeding and foraging habitat exist and will remain in the wider area (i.e. outside the 500m buffer zone). Significant displacement effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.119 collisions per year, or one bird every 8.4 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.10.2.8 Sparrowhawk (*All Seasons*)

Table 7-20 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The proposed development area is dominated by mature forestry, this could provide breeding and foraging habitat for sparrowhawk. This species was only observed within the development site on two occasions throughout the extensive 25-month survey period. Both observations occurred during the 2019 breeding season. No evidence of breeding was recorded within the development site. Whilst felling of forestry will occur onsite, significant areas of suitable nesting habitat will continue to exist within the development site. Significant displacement effects are not anticipated, particularly given the low levels of activity recorded.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Displacement	No evidence of breeding was recorded within the development site. A possible nest site was identified in June 2019, approximately 750m east of the development site. Construction in forested areas could potentially cause displacement of breeding Sparrowhawk. However, the only nest recorded in	The magnitude of the effect is assessed as *low*.	**Short-term Slight Negative Effect**

	the vicinity of the proposed development is unlikely to be impacted due to the c. 700m separation distance between it and any potential source of disturbance. Furthermore, the wider surroundings contain extensive areas of similar suitable habitat in the unlikely event that any disturbance occurs. Overall, disturbance during construction is unlikely to discourage flight activity, foraging or breeding attempts in the vicinity of the Proposed Development, particularly given the low levels of activity recorded. Significant displacement effects are not anticipated at any geographical scale.	The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Significant effects are not anticipated particularly given the low levels of activity recorded. Disturbance from operation is unlikely to discourage breeding attempts and the species is expected to habituate to the operation of the development.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.009 collisions per year, or one bird every 107 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Imperceptible Negative Effect**

7.10.2.10 Kestrel (*All Seasons*)

Table 7-21 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	The Proposed Development site is dominated by conifer plantation, with small areas of potential foraging habitat around the margins of the site. Direct loss of breeding and foraging habitat will be minimal. There will be minimal reduction in the distribution and availability of potential nesting sites and minimal loss of potential foraging area. Substantial areas of undisturbed suitable breeding and foraging habitat will remain, both within the development site and the wider area. Significant effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**
Displacement	Construction in forestry areas could potentially cause displacement of breeding kestrel. However, given the availability of extensive areas of alternative nesting sites in the wider area no significant effects are anticipated. Overall, disturbance during construction is unlikely to discourage flight activity, foraging or breeding attempts in the vicinity of the Proposed Development. Significant displacement effects are not anticipated at any geographical scale.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *low* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**

Displacement	Significant effects are not anticipated at any geographical scale. Extensive areas of suitable foraging and breeding habitat will remain post construction. Disturbance from operation is unlikely to discourage breeding attempts and the species is expected to habituate to the operation of the development.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**
Collision	The species was recorded flying within the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. The collision risk has been calculated at a ratio of 0.118 collisions per year, equating to one bird every 8.5 years. The predicted collision risk is insignificant in the context of the county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.10.2.11 Snipe (*All Seasons*)

Table 7-22 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development	Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase		
Direct Habitat Loss	The Proposed Development area is dominated by conifer plantation, this habitat type is not favoured by snipe. Direct loss of breeding and foraging habitat will therefore be minimal. Snipe were regularly recorded during VP surveys, with observations primarily of drumming or calling snipe during the breeding season. There were five breeding territories identified through these observations of calling and	The magnitude of the effect is assessed as *low*. The cross tablature of a *Low* sensitivity species and a *Low* Impact corresponds to a ***Very Low*** effect significance.	**Long-term Slight Negative Effect**

	drumming snipe. Of these five breeding territories, only three were located within 500m of the development site, while only one breeding territory was located within 500m of the proposed turbine layout. There will be minimal reduction in the distribution and availability of potential nesting sites and minimal loss of potential foraging area. Significant impacts are therefore not predicted at any geographical scale.		
Displacement	The Proposed Development site is dominated by conifer plantation, with small areas of open habitat suitable for snipe is present in the margins of the site. There were five breeding territories identified through these observations of calling and drumming snipe. Of these five breeding territories, only three were located within 500m of the development site, while only one breeding territory was located within 500m of the proposed turbine layout. Overall, the numbers recorded were considered to be low and restricted to the margins of the site. Should any potential displacement effects occur, there are extensive areas of suitable habitat in the wider area, to render this potential impact inconsequential.	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Short-term Slight Negative Effect**
Operational Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	Pearce Higgins et. al (2009), found that breeding snipe showed significant avoidance of turbines extending to a distance of 400m. There were five breeding territories identified through these observations of calling and drumming snipe. Of these five breeding territories, only three were located within 500m of the development site, while only one breeding territory was located within 500m of the proposed turbine layout. However, given the overall numbers recorded were low, the distance of the observed breeding territories from the proposed development site and the	The magnitude of the effect is assessed as *low*. The cross tablature of *Low* sensitivity species and *Low* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

	availability of potential alternative breeding and foraging habitat in the wider area, significant effects are not anticipated at any geographical scale.		
Collision	The species was recorded flying with the potential collision risk zone during VP surveys. A "Random" collision risk analysis has been undertaken and full details are provided in Appendix 7-6. It is acknowledged that Snipe are primarily crepuscular in their flight activity and the vantage point surveys are primarily diurnal. Flight activity has the potential to be under recorded and this has been taken into account in this assessment The collision risk has been calculated at a ratio of 0.097 collisions per year, or one bird every 10.3 years. Even allowing for any potential for under recording of flight activity, the predicted collision risk is insignificant in the context of the local, county, national and international population.	The magnitude of the effect is assessed as *negligible*. The cross tablature of *Low* sensitivity species and *Negligible* Impact corresponds to a ***Very Low*** effect significance	**Long-term Slight Negative Effect**

7.10.3 Effects on Key Ornithological Receptors during Decommissioning

7.10.3.1 All Species

Table 7-23 Impact Characterisation for Ecological Receptors based on Percival (2003) & EPA (2017)).

Analysis of potential effects during construction and operational phases of the Proposed Development		Magnitude and Significance of potential effect (Percival 2003)	Significance of potential effect (EPA 2017)
Construction Phase			
Direct Habitat Loss	Direct or indirect effects are not anticipated	**No Effect**	**No Effect**
Displacement	As above for construction phase for each species listed as a KOR.	As above for construction phase for each KOR	As above for construction phase for each KOR

7.11 Effect Associated with the Grid Connection and Access Road Route

The site of the proposed development is currently accessed, from the R280 to the west, via the local road network. This application includes for the construction of:

- a link road between the R280 in the village of Drumkeeran and the L4282 in the townland of Derryboffin. The road will be constructed through agricultural land and will be left in place and the embankments of the road will be seeded or be allowed to revegetate; and,
- a construction phase access road between the L4282 at Derrycullinan and the same local road at Bargowla. From the proposed construction phase site entrance in the townland of Derrycullinan, the construction access road will comprise a combination of proposed new roads and the upgrade of existing forestry roads.

The cabling routes, assessed as part of this EIAR, will originate at the proposed onsite substation and will run east along the existing site roads and local access roads, within Coillte property, to the existing Garvagh Electricity Substation, located within the site in the townland of Seltan.

The potential for the grid connection and access road route to impact birds is discussed below.

The existing habitats (e.g. existing roads, forestry fire breaks and agricultural land) have the potential to support species of conservation interest in the area. On a precautionary basis it is assumed that some habitat loss and temporary displacement may occur during construction works. However, given the extent of suitable habitat in the wider area; significant habitat loss and displacement effects are not predicted.

As per Percival (2003) the magnitude of the effect on KOR is assessed as ***Negligible.*** The cross tablature of a *High* sensitivity species (e.g. hen harrier) and *Negligible* Impact corresponds to a ***Very Low*** effect significance. Hen harrier was used as an example as it is the highest sensitivity species identified as a KOR at this site. The significance of the potential impact is classed as a Long-term slight negative effect following EPA criteria (2017).

7.12 Effects on Designated Areas

The Proposed Development is not located within the boundaries of any European or Nationally designated sites important for nature conservation (Figure 6.X). There will be no direct effects on any designated site as a result of the construction, operation and decommissioning of the Proposed Development.

In relation to European sites, an AA Screening Assessment and Natura Impact Statement have been prepared to provide the competent authorities with the information necessary to complete an Appropriate Assessment for the proposed development in compliance with Article 6(3) of the Habitats Directive.

As per EPA draft Guidance 2017, "a biodiversity section of an EIAR, should not repeat the detailed assessment of potential effects on European sites contained in a Natura Impact Statement" but should "incorporate their key findings as available and appropriate". This section provides a summary of the key assessment findings with regard to Special Protection Areas . A summary of key assessment findings with regard to Special Areas of Conservation is provided in Chapter 6.

The Screening for Appropriate Assessment concluded as follows:

'it cannot be excluded beyond reasonable scientific doubt, in view of best scientific knowledge, on the basis of objective information and in light of the conservation objectives of the relevant European sites, that the proposed development, individually or in combination with other plans and projects, would be likely to have a significant effect on the following sites:

- Lough Gill SAC [001976]
- Cummeen Strand/Drumcliff Bay (Sligo Bay) SAC (000627)
- Cummeen Strand SPA (004035)'

As a result, an Appropriate Assessment of the proposed development is required, and a Natura Impact Statement has been prepared in respect of the proposed development. The Natura Impact Assessment concludes as follows:

For the reasons set out in detail in this NIS, in the light of the best scientific knowledge in the field, all aspects of the proposed development which, by itself, or in combination with other plans or projects, which may affect the relevant European Sites have been considered. The NIS contains information which the competent authority, may consider in making its own complete, precise and definitive findings and conclusions and upon which it is capable of determining that all reasonable scientific doubt has been removed as to the effects of the proposed development on the integrity of the relevant Natura 2000 sites.

In conclusion, in the light of the conclusions of the assessment which it shall conduct on the implications for the European sites concerned, the competent authority is enabled to ascertain that the proposed development will not adversely affect the integrity of any of the European sites concerned.

7.13 Mitigation and Best Practice Measures

This section describes the measures that are in place to mitigate adverse negative effects associated with the Proposed Development on avian receptors. Effects on avian receptors have been addressed in two ways:

- Design of the Proposed Development.
- Management of the development phases.

7.13.1 Mitigation by Design

The project design has followed the basic principles outlined below to eliminate the potential for significant effects on avian receptors:

- Hard standing areas have been designed to the minimum size necessary to accommodate the turbine model that is selected.
- The grid connection route, internal roads and access road has been selected to utilise built infrastructure for the majority of its length (i.e. cables to be laid within public roads). Cables will be laid underground to avoid effects on roadside hedgerows and disturbance to nesting birds.

7.13.2 Mitigation During Construction, Operation and Decommissioning

The following section describe the mitigation measures to be implemented during each phase of the Proposed Development.

7.13.2.1 Construction Phase Mitigation

The following measures are proposed for the construction phase:

- A Construction and Environmental Management Plan (CEMP) has been prepared. The CEMP will be in place prior to the start of the construction phase. Best practice measures which form part of the design of the project are included in Chapter 4 of the EIAR. The CEMP is included as an Appendix to Chapter 4.
- All removal of woody vegetation will be undertaken in accordance with Section 40 of the Wildlife Act 1976 as amended.
- During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds.
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation.
- An Ecological Clerk of Works (ECoW) will be appointed. Duties will include:
    - Undertake a pre-construction transect/walkover bird survey to confirm the conditions predicted in this EIAR and ensure that significant effects on breeding birds will be avoided.
    - Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site.
    - Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise.
    - Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.
    - Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.

7.13.2.2 Operational Phase Mitigation

No operational phase impacts requiring mitigation were identified.

7.13.2.3 Decommissioning Phase Mitigation

The following measures are proposed for the decommissioning phase:

- During the decommissioning phase, disturbance limitation measures will be as per the construction phase, e.g. commencing works outside the bird nesting season (1st of March to 31st of August inclusive).
- Plant machinery will be turned off when not in use.
- All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).

7.14 Enhancement

It is proposed to provide ecological benefits in the form of a peatland restoration strategy. The plan objective is to pre-maturely fell an area of forestry adjacent, and to the west of turbine T7 and instate restoration measures e.g. drain blocking. This area would otherwise continue to be managed for commercial forestry. In addition to this pre-mature felling, an area of degraded peatland adjacent, and to the north of turbine T7 will be enhanced. Enhancement measures will include drain blocking and removal of self-sown conifer seedlings from adjacent forestry. The proposed enhancement area is

approximately 3.74 hectares. These two areas abut one another and will result in a significant increase in the amount of contiguous open habitat present onsite. Details in full are provided in Appendix 6.4.

This newly created open habitat would be maintained as such for the duration of the operational phase of the wind farm. The proposed peatland and biodiversity restoration area will provide significant benefits to the local avian community.

7.15 Monitoring

7.15.1 Commencement and Pre-Construction Monitoring

Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive). Pre-commencement surveys will be undertaken prior to the initiation of works at the wind farm.

A breeding bird survey will be undertaken between April and July. Monitoring will be undertaken by a suitably qualified ornithologist. The survey will include a thorough walkover survey to a 500m radius of the development footprint and/or all works areas, where access allows. If breeding activity of birds of high conservation concern is identified, the nest site will be located, and earmarked for monitoring at the beginning of the first breeding season of the construction phase. If it is found to be active during the construction phase no works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) in line with best practise. No works shall be permitted within the buffer until it can be demonstrated that the nest is no longer occupied.

7.15.2 Post Construction Monitoring

A detailed post-construction Bird Monitoring Programme has been prepared for the operational phase of the Proposed Development, please refer to Appendix 7.7 for further details. The programme of works will monitor parameters associated with collision, displacement/barrier effects and habituation and these surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 & 15 of the life-time of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009). The following individual components are proposed for monitoring years:

- Monthly flight activity surveys: vantage point surveys
- Distribution and abundance surveys: breeding wader to a 500m radius of the development area, breeding hen harrier surveys and winter hen harrier roost surveys to a 2km radius of the development area.
- Targeted bird collision surveys (corpse searches) will be undertaken with training dogs. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust.

7.17 Residual Effects

The following species were identified as KORs and were subject to detailed impact assessment:

- Whooper Swan
- Golden Plover
- Hen Harrier
- Merlin
- Buzzard
- Sparrowhawk
- Kestrel
- Snipe

As per Percival 2003 criteria, effect significance of greater than ***Low*** was not identified for any KOR.

As per EPA 2017 criteria, effect significance of greater than ***Slight*** was not identified for any KOR.

Taking into consideration the effect significance levels identified and the proposed best practice and mitigation; significant residual effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

7.18 Assessment of Cumulative Effects

As per SNH guidance on Assessing the Cumulative Impacts of onshore Wind Energy Developments (2012), cumulative effects arising from two or more developments may be:

- **Additive** (i.e. a multiple independent additive model)
- **Antagonistic** (i.e. the sum of impacts are less that in a multiple independent additive model)
- **Synergistic** (i.e. the cumulative impact is greater than the sum of the multiple individual effects)

7.18.1 Other Plans and Projects

Assessment material for this in combination impact assessment was compiled on the relevant developments within the vicinity of the proposed project. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIS/EIAR documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental impacts. The projects considered in relation to the potential for in combination effects and for which all relevant data was reviewed (e.g. individual EISs/EIARs, layouts, drawings etc.) include those listed below.

Forestry Practices

The majority of the lands within the site and the surrounding area are planted with commercial forestry. The forestry works (felling/planting) associated with the forestry in the wider surroundings of the proposed development will be subject to relevant licencing and guidance from the Forestry Service. The management and felling of this surrounding commercial forestry was also considered in this assessment.

7.18.2 Plans Considered in the Cumulative Impact Assessment

The following plans were considered in the cumulative impact assessment:

- Leitrim County Development Plan 2015-2021
- Sligo County Development Plan 2017–2023
- National Biodiversity Action Plan 2017-2021

These policies and objectives of these plans have been taken into account in this cumulative assessment.

7.18.3 Projects Considered in the Cumulative Impact Assessment

A review of the Planning Register for Leitrim and Sligo County Council's show that there has been a number of permitted or existing developments within the vicinity of the proposed development area. A full list of the projects considered in relation to cumulative effects are provided in Section 2.4 of Chapter 2 of this EIAR. Planning applications lodged within the wider surroundings of the proposed development area primarily relate to one-off housing or are agricultural in nature. Owing to the nature and scale of these developments significant cumulative or in-combination effects are not anticipated.

There are a number of previous applications for wind farm development and associated infrastructure. The wind farm projects within a 20-kilometre radius of Croagh Wind Farm proposal are provided in Table 7-22 below and are presented in terms of whether the project is permitted/operational or pending/under appeal. A total of 14 wind farms, and 111 existing/permitted turbines fall within a 20-kilometre radius of the proposal as detailed in Table 7-22.

Table 7-22 Wind Farms within 20km of the development site

Wind Farm	Status	No. of Turbines	Distance from development site (km)
Co. Leitrim			
Spion Kop (Ref. 95/12501)*	Constructed	2	3.2
Corrie Mountain (Ref. 96/12794)	Constructed	8	2.3
Black Banks (Ref. 97/13602)	Constructed	12	Partially within
Moneenatieve (Ref. 00/7)	Constructed	6	1.8
Garvagh Glebe (Ref. 03/257, 08/602)	Constructed	13	Partially within
Tullynamoyle (Ref. 03/331)	Constructed	12	7.5
Tullynamoyle Extension (Ref. 15/164)	Permitted	4	7.6

Wind Farm	Status	No. of Turbines	Distance from development site (km)
Tullynamoyle Extension (Ref. 19/26)	Permitted	4	7.6
Carrickheeney (Ref. 12/152)	Constructed	12	19
Co. Sligo			
Carrane Hill (Ref. 98/533)	Constructed	4	0.6
Geevagh (Ref. 98/861)	Constructed	6	1
Derrysallagh (Ref. 12/133)	Constructed	12	3.7
Co. Roscommon			
Altagowlan (Ref. 00/1979)	Constructed	9	3.2
Seltannaveeny (Ref. 02/1094)	Constructed	2	5.7
Garvagh Tullyhaw (Ref. 03/1486)	Constructed	11	4.3
Kilronan (Ref. 94/582)	Constructed	10	7.4
TOTAL EXISTING		107	
TOTAL PROPOSED		111	

**The recent grant of planning permission for the replacement of the two existing Spion Kop turbines with a single turbine (LCC 19/230) has been considered in the cumulative assessment.*

For the purposes of this cumulative assessment wind farms within a 10-kilometre radius of the proposed development area were considered in further detail below. All of the wind farms included in Table 7-22 are located within 10km of the proposed development with the exception of Carrickheeney wind farm. This wind farm was considered to have been too distant from the proposed development to result in cumulative impacts and was therefore not considered further.

Black Banks, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Black Banks wind farm, which is located partially within the site boundary to the south-east, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Black Banks wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Garvagh Glebe, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Garvagh Glebe wind farm, which is located partially within the site boundary to the east, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Garvagh Glebe wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Carrane Hill, Co. Sligo

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Carrane Hill wind farm, which is located 600m from the wind farm site, was considered. The planning file was reviewed on the Sligo County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Carrane Hill wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Geevagh, Co. Sligo

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Geevagh wind farm, which is located 1km from the wind farm site, was considered. The planning file was reviewed on the Sligo County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Geevagh wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Moneenatieve, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Moneenatieve wind farm, which is located 1.8km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Moneenatieve wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed

Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Corrie Mountain, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Corrie Mountain wind farm, which is located 2.3km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Corrie Mountain wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Spion Kop, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Spion Kop wind farm, which is located 3.2km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Spion Kop wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Altagowlan, Co. Roscommon

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Altagowlan wind farm, which is located 3.2km from the wind farm site, was considered. The planning file was reviewed on the **Roscommon** County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Altagowlan wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Derrysallagh, Co. Sligo

Derrysallagh is the next closest wind farm to the proposed development, located approximately 3.7km to the south. The EIS was consulted to determine whether cumulative impacts are likely to result. The EIS identifies the following Key receptors on site: golden plover, hen harrier, merlin and red grouse. The EIS concluded that "no likely collision impacts have been identified and it is not considered that the presence of other turbines in the general area will contribute to any significant cumulative effect in this regard." This assessment did not identify any likely significant displacement effect on birds of the proposed wind farm, given the existence of large areas of suitable habitat at alternative locations in the vicinity of the study area, for example, for migratory and/or wintering flocks of golden plover. It was concluded that whilst a cumulative displacement effect on non-breeding golden plover or other species from upland areas in the vicinity of these wind farms may occur, it is not considered that this is of significance.

No significant residual effects on avian receptors were identified. Based on the information available in the EIS, significant cumulative impacts are not anticipated.

Garvagh Tullyhaw, Co. Roscommon

Garvagh Tullyhaw is the next closest wind farm to the proposed development, located approximately 4.3km to the south-east. The EIS was consulted to determine whether cumulative impacts are likely to result. The EIS concluded that "taking into account the location of the windfarm, the extent of lands involved, the size of the development, research undertaken elsewhere, available information on bird populations in the area and site visits, there is no strong evidence to indicate that the development will have anything other than a minimal impact on birds."

No significant residual effects on avian receptors were identified.

Based on the information available in the Garvagh Tullyhaw EIS, significant cumulative impacts are not anticipated.

Seltannaveeny, Co. Sligo

Seltannaveeny is the next closest wind farm to the proposed development, located approximately 5.7km to the south-east. A compilation of a formal EIS was not mandatory as the proposed development was below the statutory threshold (5 turbines or 5MW). However, given the location of the Seltannaveeny wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Kilronan, Co. Roscommon

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Kilronan wind farm, which is located 7.4km from the wind farm site, was considered. The planning file was reviewed on the **Roscommon** County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Kilronan wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Tullynamoyle, Co. Leitrim

The potential for the proposed development to result in significant cumulative or in combination effects when assessed alongside Tullynamoyle wind farm, which is located 7.5km from the wind farm site, was considered. The planning file was reviewed on the Leitrim County Council Planning Register and no information regarding potential effects on bird species was available. However, given the location of the Tullynamoyle wind farm, the nature of the habitats on that site (as reviewed on publicly available aerial photography) and the lack of significant residual impacts on bird species associated with the proposed Croagh Wind Farm when considered on its own, significant cumulative or in-combination effects are not anticipated.

Taking into consideration the effect significance levels identified for the proposed Croagh Wind Farm (i.e. no effect significance of greater than ***Low*** (Percival 2003) or ***Slight Negative*** (EPA 2017)), significant cumulative effects on KORs with regard to direct habitat loss, displacement or collision mortality are not anticipated.

Tullynamoyle Extension (Ref. 15/164), Co Leitrim

Tullynamoyle Extension is located approximately 7.6km to the north-east of the proposed development area. The EIS was consulted to determine whether cumulative impacts are likely to result. The EIS stated that "sensitive species known to occur or recorded in the area include red grouse, golden plover, merlin, hen harrier and common gnll." However, the EIS concluded that "the proposed development is not likely to result in significant impacts to these species due to the sub-optimal nature of the habitats occurring within the site for these species and their flight behaviour, which has not been recorded in association with the proposed site and which is unlikely to bring these species into contact with turbine blades."

No significant residual effects on avian receptors were identified. Based on the information available in the Tullynamoyle Extension EIS, significant cumulative impacts are not anticipated.

Tullynamoyle Extension (Ref. 19/26), Co Leitrim

The 2019 Tullynamoyle Extension application is located approximately 7.6km to the north-east of the proposed development area. The EIS was consulted to determine whether cumulative impacts are likely to result. The EIS identifies the following Key receptors on site: hen harrier, kestrel, buzzard, golden plover, red grouse, common snipe, meadow pipit and skylark. This assessment identified only low significant displacement effects on the avian population of the proposed wind farm. Collision risk was identified as being of low significance, or lower, at the proposed wind farm site.

No significant residual effects on avian receptors were identified. Based on the information available in the EIS, significant cumulative impacts are not anticipated.

7.18.3.1 Existing Habitats and Land Uses

The potential for the proposed development to result in a cumulative loss or deterioration of habitats for birds was considered in relation to the existing land uses in the area.

The wind farm is primarily located in forestry habitats, which generally provide low value habitats for bird species. The proposed development will not result in any significant loss of valuable habitats for birds e.g. upland peatland or grassland. The minor loss of peatland habitat that will be affected, will be fully mitigated through habitat enhancement and restoration proposed as part of this development. The

wind farm will not contribute to any overall loss of high value bird habitat, it has been deliberately designed to be located on habitats of low value for bird species.

7.18.3.2 Cumulative Impact Assessment Conclusion

Important migratory routes for any species were not identified in any of the assessments undertaken and no significant short term or daily migrations over the site were identified. There is no potential for the proposed development to result in significant cumulative barrier effect when considered on its own. It cannot therefore contribute to any cumulative barrier effect.

No potentially significant disturbance, displacement or habitat loss effects on any of the KORs has been identified with regard to the development proposal on its own. It cannot therefore contribute to any cumulative disturbance, displacement or habitat loss.

The proposed development does not have the potential to result in significant collision risk on any KOR species when considered on its own. It cannot therefore contribute to any cumulative collision risk when considered in combination with any other development.

No cumulative residual additive, antagonistic or synergistic effects have been identified with regard to habitat loss, displacement or collision mortality for any KOR.

7.19 Conclusion

Following consideration of the residual effects (post mitigation) it is concluded that the Proposed Development will not result in any significant effects on any of the identified KORs. No significant effects on receptors of International, National or County Importance were identified.

Provided that the Proposed Development is constructed, operated and decommissioned in accordance with the design, best practice and mitigation that is described within this application, significant individual or cumulative effects on ornithology are not anticipated at the international, national or county scales or on any of the identified KORs.

8. LAND SOILS AND GEOLOGY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential impacts of a proposed 10 no. turbine wind farm including its grid connection at Croagh, Drumkeeran, Co. Leitrim (the 'Proposed Development') on the land, soil and geological environment.

This report provides a baseline assessment of the environmental setting of the proposed development and all other associated works, as described in Chapter 4 of the EIAR, in terms of land, soils and geology and discusses the potential likely significant, direct,indirect and cumulative effects that the construction, operation and decommissioning of the proposed development will have. Where required, appropriate mitigation measures to avoid any identified effectsto land, soils and geology are recommended and the residual effects of the proposed development post-mitigation are assessed.

8.1.2 Statement of Authority

HES are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience includes soils, subsoils and geology. We routinely complete impact assessments for land soils and geology, hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill and David Broderick.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS for Oweninny WF, Cloncreen WF, and Yellow River WF, Carrownagown WF (SID) and Meenbog WF (SID).

David Broderick (BSc, H Dip Env Eng, MSc) is a hydrogeologist with over 13 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments. David has worked on many wind farm EIAR projects, including Cloncreen WF, Oweninny WF (SID), and Meenbog WF (SID).

Michael and David have worked on over 120 wind farm related projects across Ireland and Northern Ireland over the last 12 years.

8.1.3 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared having regard, where relevant, to the legislation and guidance outlined in Chapter 1: Introduction and the following documents:

- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and,
- University College Dublin (2012) BOGLAND – Protocol for Sustainable Peatland Management in Ireland.

8.2 Schedule of Works

8.2.1 Desk Study

A desk study of the site and the surrounding area was completed in advance of undertaking the walkover survey and site investigations. This involved collecting all relevant geological data for the site and surrounding area. This included consultation of the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 7 (Geology of Sligo - Leitrim). Geological Survey of Ireland (GSI, 1996);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition (www.epa.ie);

8.2.2 Baseline Monitoring and Site Investigations

Detailed walkover surveys, geological mapping and peat/soil augering was undertaken by HES on 3rd and 4th April 2018 with follow up visits carried out on 4th and 11th November 2018, 6th September 2019 and 13th March 2020.

Trial pit investigations (40 no. trial pits over 3 phases – 2017, 2019 and 2020) and bedrock investigation drilling in 2019 was completed by Fehily Timoney and Company - FT formally called AGEC Ltd). Trial pits Phase 1 and Phase 2 were carried out along the internal site access roads and Phase 3 was carried out along the proposed construction access road The trial pits were strategically placed to get an understanding of the soil and bedrock conditions across the proposed development site.

The objectives of the intrusive site investigations included mapping the distribution and depth of blanket peat at the site along with assessing the mineral subsoil / bedrock interface beneath the peat at key development locations (i.e. proposed turbines & met mast, substation, temporary construction compounds, existing and proposed access roads, peat and spoil repository areas and borrow pit location). These thorough investigations allowed the development of an accurate geological conceptual model of the site.

In summary, site investigations to address the land, soil and geology section of the EIAR included the following:

- A total of over 850 no. peat probe depths were carried out by HES, MKO and FT, between 2013 and 2020, to determine the depth and geomorphology of the blanket peat at the site;

- Gouge soil cores were undertaken at each turbine location to investigate peat and mineral subsoil lithology;
- A geotechnical assessment of peat stability by FT (March 2020);
- Logging and supervision of 40no. trial pits across the site (2017, 2019 and 2020 investigations) and laboratory testing of bulk samples from trial pits;
- Drilling of 4 no. bedrock boreholes at the site to investigate potential borrow pit locations and laboratory testing of rock samples from boreholes;
- Logging of bedrock outcrops and subsoil exposures; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

The Peat Stability Assessment report prepared by FT is included as Appendix 8-1 of this EIAR.

8.2.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR. Certain issues and concerns highlighted with respect land, soils and geology are summarised in Table 8-1 below.

Table 8-1 Summary of Scoping Responses Relating to Land, Soils and Geology

Degree/Nature	Description	Addressed in Chapter Section
Health Services Executive (HSE)	• HSE welcomes detailed studies and proposed mitigation measures in relation to peat stability particularly at construction but also at other later stages of the life of the site.	Sections 8.3.8 & 8.5.3.4
Inland Fisheries Ireland (IFI)	• IFI is seriously concerned over the potential for landslides in this area, based on the occurrence of two landslides in close proximity to this site which resulted in significant damage to the fisheries resource and water quality in the Owengar River. The Geological Survey of Ireland have also identified numerous landslides in this area, indicating significant risks from activities involving large scale earth works such as windfarms.	Sections 8.3.8 & 8.5.3.4 Refer also the Water Chapter (Chapter 8) with regard the Owengar River and potential impacts
Irish Peatland Conservation Council (IPCC)	• There is a risk landslide events may occur within the locality of the proposed wind farm. Landsides are disastrous for wildlife (aquatic and terrestrial) . • Most of the footprint of the proposed windfarm is situated on peat soils. Peat is very sensitive to development and will require extra stringent planning procedures	Sections 8.3.8, 8.3.2 & 8.5.3.4

Degree/Nature	Description	Addressed in Chapter Section
	• Planning and construction in, or within close proximity to peatland habitat should adhere to the Environmental Protection Agency funded project BOGLAND (www.ucd.ie/bogland). This project recommends the best practice guidelines to ensure no damage from development occurs on, or affects peat soils and peatlands of conservation/biodiversity value.	
Department of Culture Heritage and Gaeltacht	• In order to assess impacts it may be necessary to obtain hydrological and/or geological data. Any impact on water table levels or groundwater flows may impact on wetland sites some distance away. The EIAR should assess cumulative impacts with other plans or projects if applicable. Where negative impacts are identified suitable mitigation measures should be detailed as appropriate	Section 8.3.2 Refer to Chapter 9 (Hydrology/Hydrogeology)

8.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the land, soil and geological environment within the study area is assessed using the criteria set out in Table 8-2 (NRA, 2008).

Table 8-2-Estimation of Importance of Soil and Geology Criteria (NRA, 2008).

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying attributeis significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2017) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment are those set out in EPA (2017) Glossary of Impacts as shown in Chapter 1 of this EIAR. In addition, the two

impact characteristics proximity and probability are described for each impact and these are defined in Table 8-3.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology[1] of the existing environment, as listed in Table 8-4.

Table 8-3: Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 8-4: Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Geological, Hydrogeological and Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread, permanent impact on: › The extent or morphology of a cSAC. › Regionally important aquifers. › Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread, time dependent impacts on: › The extent or morphology of a cSAC / ecologically important area. › A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). › Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.

[1] *Geological Form or Structure*

Impact Characteristics		Potential Geological, Hydrogeological and Hydrological Impacts
Quality	Significance	
Positive or Negative	Moderate	Local, time dependent impacts on: › The extent or morphology of a cSAC / NHA / ecologically important area. › A minor hydrogeological feature. › Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local, perceptible, time dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

8.3 Existing Environment

8.3.1 Site Description and Topography

The core of the Proposed Development site (EIAR Site Boundary) is located approximately 5 kilometres west of Drumkeeran, Co. Leitrim, however a portion of the construction access road extends out to the village itself. The total study area is approximately 670 ha (~6.7km^2). The site setting is forested upland blanket bog which is owned by Coillte(forestry currently covers approximately 86% of the site). The site is accessible via a network of existing forestry tracks.

Current main access to the site is via a small local road (L4282) which runs from Drumkeeran towards the site. This road then turns south towards Boleymaguire and the southern tip of the site, where access can be gained at various forestry barriers.

The proposed construction access road for the wind farm commences from the R280 at Drumkeeran, approximately 5km to the east of the main site area and traverses private land, public roads and Coillte property (with some short sections in third party lands) before emerging onto the local road where itapproaches the core wind farm site.

The overall elevation of the site ranges between approximately 70m to 330m OD (Ordnance Datum) with the northern section of the site sloping in a northerly direction and the southern section of the site sloping to the southwest.

There is 1 no. proposed grid route, along with 1 no. proposed substation. The proposed substation is located approximately 330 metres east of Turbine No. 4 along an existing access road. From here, the proposed underground grid connection cabling route runs southeast along existing forestry roads for approximately 4.1 km before turning north and following the public road for approximately 1.9km and connecting with the existing Garvagh Glebe 110kV substation.

8.3.2 Soils and Subsoils

The published soils map (www.epa.ie) for the area is attached as Figure 8-1. Blanket peat is the dominant soil type at the site with areas of poorly drained mineral soils with peaty topsoil derived from mainly acidic parent materials (AminPDPT) being present in areas of outcropping bedrock on the northern section of the site and in areas towards the southern and eastern edges of the site. A small area of shallow reasonably drained mineral soil derived from mainly acidic parent materials (AminSRPT) is mapped also. The dominant soil type along the site entrance/turbine delivery road is poorly draining mineral soil (AminPD).

A map of the local subsoil cover is attached as Figure 8-1 (www.gsi.ie). This shows the mapped distribution of subsoil deposits around the site. The map also shows bedrock outcropping on a small area towards the south of the site.

The majority (>80%) of the site is mapped as Blanket peat. An area of the site is mapped as Tills derived from Namurian sandstones and shales (TNSSs), this is mainly along the site construction access road from the R280 and around the banks of the Killanummery Stream and Cashel Stream at the north of the site. A localised area of bedrock outcrop or subcrop is mapped at the very southern end of the site.

A total of over 850 no. peat probes were undertaken by HES, FT and MKO within the Proposed Development footprint area (summary peat depth maps are shown as Figure 8-2 and Figure 8-3).

Peat depths recorded within the proposed infrastructure envelope ranged from 0 to 6.0m with an average of 2.1m. Peat depths recorded at the turbine locations varied from 0.3 to 4.5m with an average depth of 2.0m.

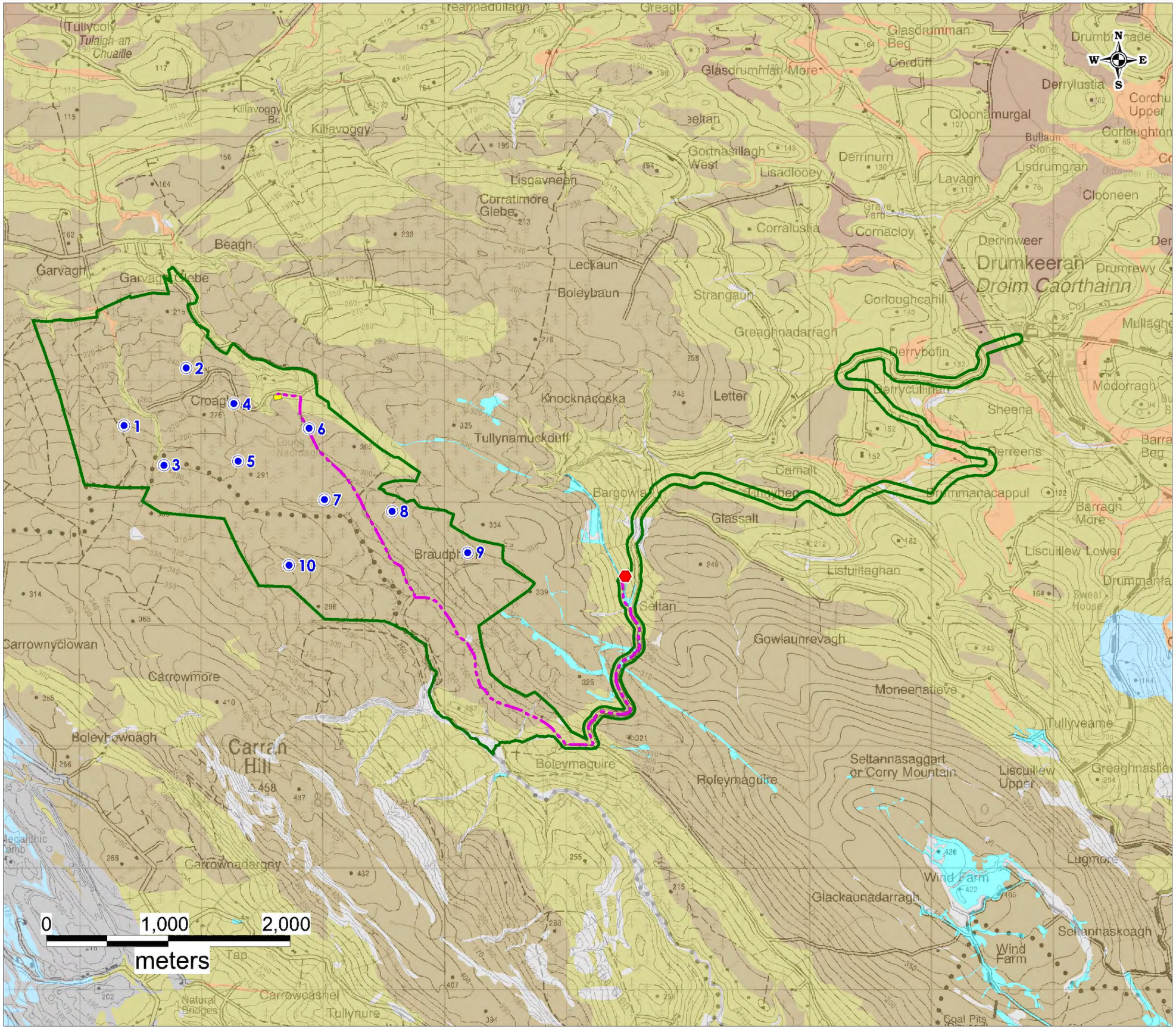
With respect to the existing and proposed access roads, peat depths are typically less than 3m with localised depths of up to 5m. Approximately 10km of existing access roads are present across the site and based on Coillte records have been in operation for a number of years.

Along the proposed construction access road (as described in Section 4.4 of this EIAR), no peat was recorded.

To assess the geological and geotechnical conditions at the turbine locations and other key areas (i.e. substations, construction compounds, met mast, borrow pit and site access roads) a combination of trial pits (were accessible) and soil gouge cores were carried out. A summary of the investigation resnlts are shown in below in Table 8-5.

Table 8-5: Summary of trial pit logs at Key Development Locations

Infrastructure Ref.	Peat Depth (m)	Investigation Location ID	Subsoil Lithology
T1	1.8 – 2.2	TP24A	Firm, locally soft, SILT/CLAY to 2.7m overlying stiff, locally firm, SILT/CLAY
T2	1.8 – 2.8	GC_T2	Soft, dark grey SILT/CLAY
T3	1.9 - 2.8	TP2A	Soft SILT/CLAY in excess of 4.4m
T4	0.5 – 1.0	TP4A	Soft SILT/CLAY to 0.8m overlying firm SILT/CLAY to 1.9m overlying stiff SILT/CLAY to 3.1m overlying very stiff SILT/CLAY



Legend

- EIAR Site Boundary
- Proposed Turbine
- Proposed Substation
- Garvagh Substation
- Proposed Underground Grid Connection Route
- Alluvium
- Blanket Peat
- Made ground
- Kartsified bedrock outcrop or subcrop
- Bedrock outcrop or subcrop
- Till derived from limestones
- Till derived from Namurian sandstones and shales

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Client: MKO	
Job: Croagh WF, Co. Leitrim	
Title: Local Subsoils Map	
Figure No: 8.1	
Drawing No: P1459-0-0620-A3-801-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:30,000	Drawn By: GD
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Infrastructure Ref.	Peat Depth (m)	Investigation Location ID	Subsoil Lithology
T5	0.3 – 1.3	TP25A	Soft SILT/CLAY to 1.1m overlying firm, locally stiff, SILT/CLAY to 2.1m overlying very stiff SILT/CLAY
T6	1.8 - 2.4	TP26A	Soft SILT/CLAY to 1.9m overlying firm, locally stiff, SILT/CLAY to 2.9m overlying stiff SILT/CLAY
T7	2.0 – 2.8	TP12A	Soft SILT/CLAY to 2.8m overlying firm and stiff SILT/CLAY to 3.7m overlying stiff SILT/CLAY
T8	3.3 – 3.9	TP14A	Peat and soft SILT/CLAY to 2.4m overlying firm, locally stiff, SILT/CLAY
T9	2.1 – 4.5	TP16A	Firm SILT/CLAY to 1.9m overlying stiff, locally very stiff, SILT/CLAY
T10	0.8 – 1.0	TP27A	Very soft and soft SILT/CLAY to 1.2m overlying firm SILT/CLAY to 2.0m overlying stiff SILT/CLAY. Material at base of trial pit recovered as residual soil/extremely weathered shale (assumed top of weathered rock)
Substation	0	TP20A	Firm, locally stiff, very gravelly SILT/CLAY to 2.0m overlying Gravels, Cobbles and Boulders with a sandy silt matrix
Compound 1	0.9	TP05A	Very soft to soft sandy clayey SILT to 1.3m over firm to stiff, sandy gravelly Silt/Clay with occasional cobbles to 4.1m
Compound 2	0.4	TP10A	Soft sandy clayey SILT to 0.6m over firm to stiff sandy very gravelly SILT/CLAY to 4.1m
Site construction access road	0	TP-AR1 to TP-AR6	Brown firm CLAY over Stiff dark blue / grey SILT/CLAY, becoming very stiff with depth
Borrow Pit	0.35	TP11	Soft clayey SILT over very gravelly SILT/CLAY. Bedrock met at 2.2m
Peat and Spoil Repository 1	1.0 – 1.5	TP MKO3	Grey sandy clayey SILT to 0.85 over firm blue/grey slightly sandy very gravelly SILT/CLAY to 2.9 over weathered shale at 2.9m
Peat and Spoil Repository 2	0.9 – 1.5	TP3	Soft light grey/brown sandy clayey Silt to 0.7m over firm and stiff grey slightly sandy very gravelly SILT/CLAY with ocaasional cobbles to 2.1m over Stiff grey slightly sandy SILT/CLAY with frequent cobbles to 3.2m

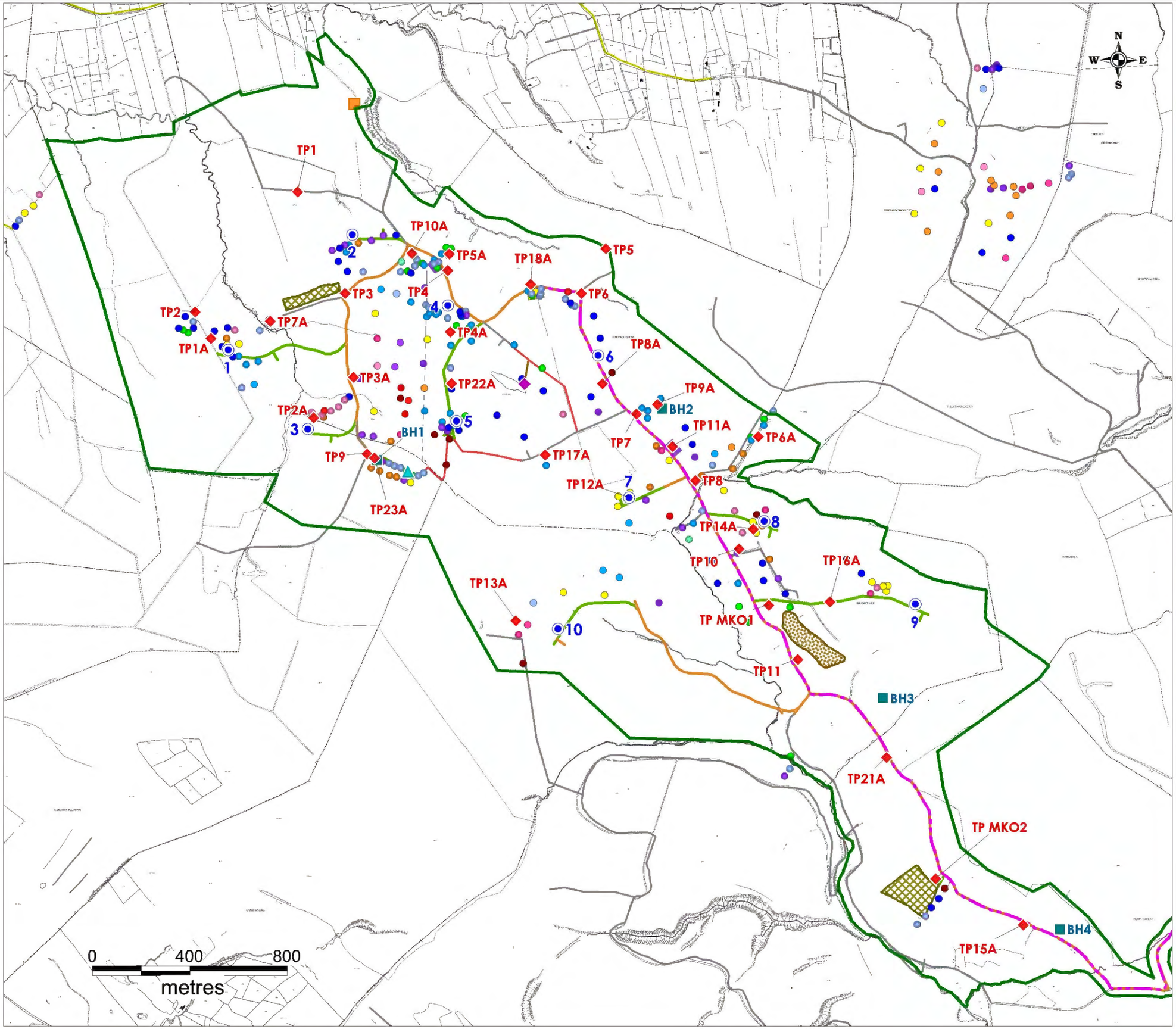
In total 40no. trial pits were undertaken across the overall site. The trial pits typically encountered brown/black amorphous PEAT which was generally spongy and fibrous. Directly underlying the peat there is typically a very soft layer of SILT which is generally less than 0.5m in thickness. Below the SILT, sandy gravelly SILT/CLAY with frequent cobbles and boulders were encountered.

Bedrock at the borrow pit location was met at 2.2m when weathered SHALE was encountered during trial pitting undertaken in September 2019. Bedrock was encountered in 2 no. trial pits)TP9A and TP27A which were undertaken along proposed access roads), where weathered SHALE was encountered at a depth of 3.8 and 3m respectively.

The locations of the trial pits and boreholes are shown on Figure 8-2 and Figure 8-3.

8.3.3 Bedrock Geology

The underlying bedrock at the Proposed Development site is mapped by the GSI as being broadly Namurian shales. The Dergvone Formation encompasses the majority of the site, consisting of four main



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Met Mast
- Proposed Substation
- Proposed Construction Compound
- Proposed Borrow Pit
- Proposed Peat Repository
- Proposed Underground Grid Connection Route
- Garvagh Substation
- Visitor Car Park
- Viewing Platform
- Existing Road Proposed for Upgrade
- Proposed New Road
- Existing Forestry Roads
- Amenity Walkways
- Amenity Boardwalk
- Local Roads
- Trial Pit Locations
- Borehole Locations

Peat Depth Legend

0 - 0.5m	3.0 - 3.5m
0.5 - 1.0m	3.5 - 4.0m
1.0 - 1.5m	4.0 - 4.5m
1.5 - 2.0m	4.5 - 5.0m
2.0 - 2.5m	5.0 - 5.5m
2.5 - 3.0m	5.5 - 6.0m

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Client: MKO

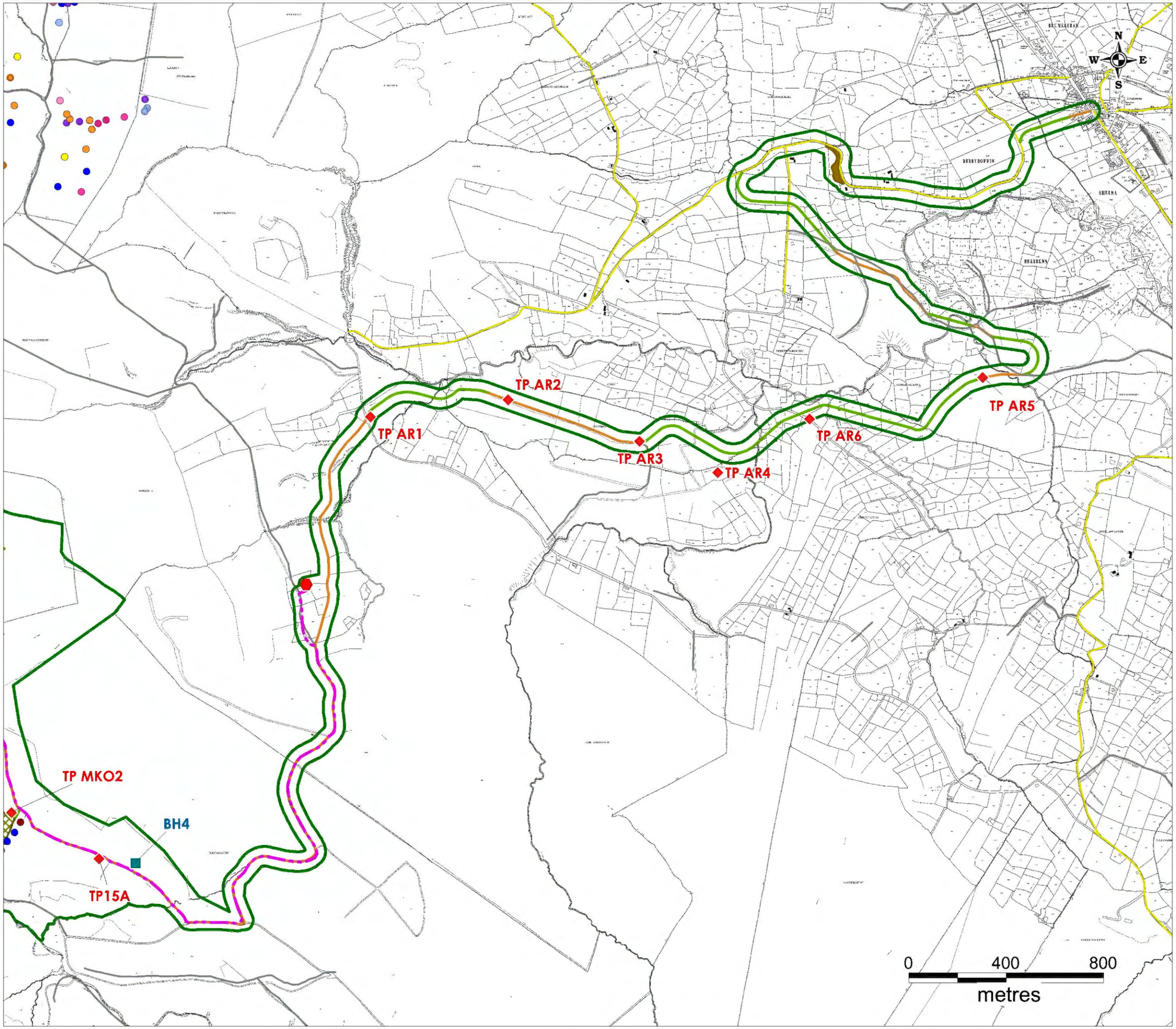
Job: Croagh WF, Leitrim

Title: Peat Depths Map

Figure No: 8.2

Drawing No: P1459-0-0620-A3-802-0A

Sheet Size: A3	Project No: P1459-0
Scale: 1:15,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Met Mast
- Proposed Substation
- Proposed Construction Compound
- Proposed Borrow Pit
- Proposed Peat Repository
- Proposed Underground Grid Connection Route
- Garvagh Substation
- Visitor Car Park
- Viewing Platform
- Existing Road Proposed for Upgrade
- Proposed New Road
- Existing Forestry Roads
- Amenity Walkways
- Amenity Boardwalk
- Local Roads
- Road Widening Works Area
- Trial Pit Location
- Borehole Locations

Peat Depth Legend

0 - 0.5m	3.0 - 3.5m
0.5 - 1.0m	3.5 - 4.0m
1.0 - 1.5m	4.0 - 4.5m
1.5 - 2.0m	4.5 - 5.0m
2.0 - 2.5m	5.0 - 5.5m
2.5 - 3.0m	5.5 - 6.0m

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Client: MKO

Job: Croagh WF, Leitrim

Title: Peat Depths Map

Figure No: 8.3

Drawing No: P1459-0-0620-A3-803-0A

Sheet Size: A3	Project No: P1459-0
Scale: 1:15,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

shale facies S1-S4. S1 is a generally dark pyritic, sometimes calcareous shale which is often fossiliferous, S2 is similar to S1 but generally not fossiliferous. S3 is pyritic and unfossiliferous with sideritic mudstone and nodules. S4 is a micaceous and silty shale with thin beds of ironstone and flaggy sandstone.

The northwestern end of the site is underlain by rocks which are Dinantian in age. They are part of the Carraun Shale Formation consisting of grey to black fossiliferous shales and mudstones with thin subordinate limestones and dolomites.

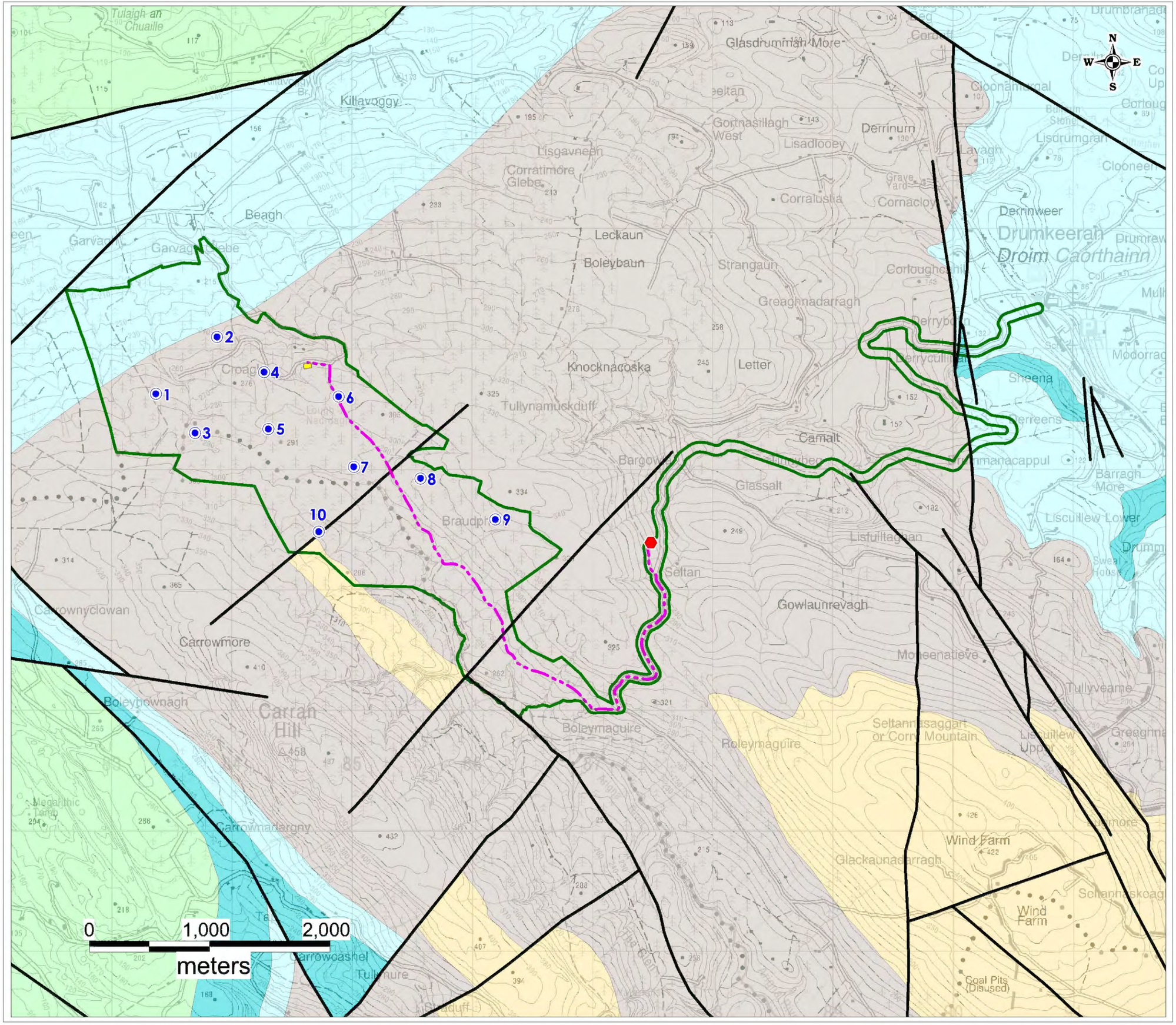
There are numerous mapped faults in the area, which generally trend northeast-southwest or at 90°to this trend. Two northeast-southwest trending faults are mapped within the proposed development site, mapped near the upper reaches of the Arigna River, and further south approximately 0.5km north of the southern tip of the proposed development site. These faults are mapped over a relatively short distance and it is unlikely that there is considerable displacement along them.

A bedrock geology map is shown as Figure 8-4.

Rotary core drilling was undertaken at locations across the site to assess depth of overburden and bedrock lithology/type. A summary of the drillers logs are shown in Table 8-6 below.

Table 8-6: Summary of Borehole Logs

BH no.	Depth (mbgl)	Summary Information (mbgl)
1	30.3	0-4.2 mbgl: No recovery
		4.2–17.4 mbgl: Very stiff dark grey slightly sandy gravelly silty CLAY with cobbles and boulders
		17.4-30.3 mbgl: Medium strong thinly laminated dark blackish grey slightly bioclastic silty fine-grained LIMESTONE
2	30.3	0-4.2 mbgl: No recovery
		4.2-4.8 mbgl: Stiff dark greenish brown SILT
		4.8-30.3 mbgl: Medium strong thinly laminated dark blackish grey slightly bioclastic silty fine-grained LIMESTONE.
3	30.2	0-4.4 mbgl: No recovery
		4.4-10.7 mbgl: Very stiff dark grey slightly sandy gravelly silty CLAY with cobbles.
		10.7–14.9 mbgl: Weathered SILTSTONE rock.
		14.9–30.2 mbgl: Medium strong thinly laminated dark blackish grey calcareous fine-grained SILTSTONE.
4	30.2	0-3.0 mbgl: No recovery
		3.0-6.2 mbgl: Very stiff dark grey slightly sandy gravelly silty CLAY with cobbles
		6.2-9.8 mbgl: Weathered SILTSTONE rock.
		9.8–30.2 mbgl: Medium strong thinly laminated dark blackish grey fissile calcareous fine-grained SILTSTONE



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Substation
- Proposed Underground Grid Connection Route
- Garvagh Substation
- Mapped Faults
- Dinantian Mixed Sandstones, Shales and Limestones
- Dinantian Pure Bedded Limestones
- Dinantian Shales and Limestones
- Namurian Sandstones
- Namurian Shales

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Client: MKO	
Job: Croagh WF, Co. Leitrim	
Title: Local Bedrock Geology Map	
Figure No: 8.4	
Drawing No: P1459-0-0620-A3-804-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:30,000	Drawn By: GD
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BH1 and BH2 encountered dark blackish grey bioclastic, silty LIMESTONE below sandy gravelly silty CLAY and greenish brown SILT respectively.

BH3 and BH4 encountered dark blackish grey fissile SILTSTONE, below weathered siltstone and sandy gravelly silty CLAY. This bedrock type is in line with the bedrock mapped at the site by the GSI and is typical of the Dervgone and Gowlaun Shale Formations.

8.3.4 Geological Resource Importance

There are several ironstone mineral localities mapped in the vicinity of the proposed development site, although no active or inactive quarries have been mapped. This is classified as "Low" importance as it is not likely to economically viable.

The blanket bog and mineral soil at the site are classified as "Low" importance as they are not statutorily designated in this area and are significantly degraded in most places at the site as a result of forestry related drainage and rill ploughing.

Refer to Table 8-1 for criteria.

8.3.5 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within 5km of the proposed development area.

The Proposed Development site is not located within any designated site. However, Corry Mountain Bog NHA runs adjacent to the south-eastern boundary of the site. Also close to the proposed site is Carrane Hill Bog NHA which is located approximately 300m to the southwest of the site. Designated sites further downstream of the site include the Unshin River SAC. Designated sites are assessed in the Water Chapter (Chapter 9) with respect hydrological and hydrogeological impacts.No direct or indirect effects on these designated sites with regard to land, soils or geology are anticipated.

8.3.6 Soil Contamination

There are no known areas of soil contamination on the site of the Proposed Development. During the site walkovers, no areas of contamination concern were identified.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licensed waste facilities on or within the immediate environs of the site of the Proposed Development.

There are no historic mines at or in the immediate vicinity of the site of the Proposed Development that could potentially have contaminated tailings.

8.3.7 Economic Geology

The GSI online Aggregate Potential Mapping Database shows that the Proposed Development site is located within an area mapped as being typically Very Low to Low in terms of crushed rock aggregate potential and with no potential for granular aggregate potential (i.e. potential for gravel reserves).

8.3.8 Peat Stability Assessment

8.3.8.1 Peat Stability Assessment Methodology

This section summarises the report on assessment of peat stability undertaken by Fehily Timoney and Company (FT). The peat stability assessment report is included as Appendix 8-1of this EIAR.

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding (See Table 8-7 below). This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes present on-site where development is proposed.

- The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.
- The drained loading condition applies in the long-term. The condition examines the effect of, in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Table 8-7: Probability Scale for Factor of Safety.

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.19 to 1.11	Probable
5	<1.0	Very Likely

8.3.8.2 Peat Stability Assessment Results

Undrained analysis results are presented inTable 8-8. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

Table 8-8 Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition[2]	
			Condition (1)	Condition (2)
T1	583322	823639	5.22	3.59
T2	583831	824112	6.14	4.53
T3	583648	823314	6.14	4.53
T4	584223	823820	2.95	1.48
T5	584259	823347	13.23	7.48
T6	584841	823616	7.17	5.06
T7	584968	823032	11.16	8.23
T8	585523	822935	2.39	1.9
T9	586144	822595	2.55	2.09
T10	584676	822493	5.77	2.89
Substation	584584	823867	13.69	5.13
Temporary Construction Compound 1	584170	823980	3.84	1.92
Temporary Construction Compound 2	585150	823232	3.87	2.19
Met Mast	583166	823847	20.78	7.79

Drained analysis results are presented in Table 8-9. As outlined above, the drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Table 8-9: Factor of Safety Results (drained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	583322	823639	3.48	5.17

[2] *For the stability analysis two load conditions were examined, namely*

Condition (1): no surcharge loading
Condition (2): surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T2	583831	824112	4.1	6.53
T3	583648	823314	4.1	6.53
T4	584223	823820	1.97	2.08
T5	584259	823347	8.82	10.79
T6	584841	823616	4.78	7.3
T7	584968	823032	7.44	11.88
T8	585523	822935	1.59	2.74
T9	586144	822595	1.69	2.99
T10	584676	822493	3.85	4.14
Substation	584584	823867	9.13	7.39
Temporary Construction Compound 1	584170	823980	2.56	2.74
Temporary Construction Compound 2	585150	823232	2.58	3.13
Met Mast	583166	823847	16.63	13.49

The findings of the peat stability assessment showed that the site has an acceptable margin of safety and is suitable for the proposed wind farm development. The findings include recommendations and specific control rueasures (Section 13 of Appendix 8-1 of this EIAR) for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

An analysis of peat stability was carried out at the turbine locations, roads, substation compound, construction compounds and met mast for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the proposed? peat slopes during construction and operation?.

An undrained analysis was carried out, which applies in the short-term during construction. For the undrained condition, the calculated FoS for load conditions (1) & (2)[3] for the locations analysed, show that all locations have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis would be considered the most critical condition for the peat slopes.

[3] *For the stability analysis two load conditions were examined, namely*

Condition (1): *no surcharge loading*
Condition (2): *surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.*

In addition, an analysis of peat stability was carried out at each infrastructure location (including existing and proposed roads) on site for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes. The findings of the analyses, which involved analysis of 324 no. locations, showed that the site generally has an acceptable margin of safety.

For both the undrained and drained condition, all 324 no. locations showed an acceptable FoS of greater than 1.3 except for 8 no. marginally low FoS's. The locations of the marginally low FoS's are highlighted on the construction and buffer zone plan (Figure 4-3 of Appendix 8-1) and are typically located alongside existing access roads on site which have been in operation for a number of decades for transportation and management of the timber crop through to the second rotation and hence are not considered areas at risk of peat instability. In addition, 2 no. marginally low FoS's are located along the new proposed access road to turbine T9 and coincides with a deeper pocket of peat. This area has an elevated construction risk and is also highlighted on the construction buffer zone plan (Figure 4-3 of Appendix 8-1). This location is subject to additional control and mitigation measures as per the adjacent turbine T9 (these measures are detailed in the peat stability assessment report). The remainder of the locations analysed had acceptable FoS's of greater than 1.3, indicating a low risk of peat instability.

The peat stability risk assessment at each infrastructure location (as listed above) identified a number of specific mitigation/control measures to reduce the potential risk of peat failure. Sections of access roads to the nearest infrastructure element will be subject to the same mitigation/control measures that apply to the nearest infrastructure element.

In summary, the findings of the peat assessment showed that the proposed Croagh wind farm site has an acceptable margin of safety, is suitable for the proposed wind farm development and is at low risk of peat failure. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

8.4 Characteristics of the Proposed Development

The Proposed Development will involve removal of peat, subsoil and bedrock for hardstanding emplacement. Crushed rock for construction will be sourced from 1 no. proposed borrow pit. It is proposed that this borrow pit will be reinstated with peat and spoil excavated as part of the construction phase of the Proposed Development. Excess peat will be stored at 2 no. proposed repository areas.

Estimated volumes of peat, subsoil and bedrock to be removed are shown in Table 8-10 and Table 8-11 respectively. Not all of the peat and soil excavated will be sent to the borrow pit and repository areas for reinstatement, the remaining portion will be cast to one side and used for reinstatement and landscaping works around the site. Any bedrock excavated during cut and fill works will be used for filling along the development footprint. Further details are provided in the Peat and Spoil Management Plan for the works which is included as Appendix 4-2 of this EIAR.

Table 8-10: Estimated Peat and Mineral Soil Excavation Volumes

Development Component	Peat (m^3)	Mineral Soil (m^3)
10 No. Turbines & Hardstands	65,925	48,635
All Access Roads	103,500	93,550
Borrow Pit (1 no.)	14,820	34,580
Repository Areas (2 no.)	15,000[Note]	3,000

Development Component	Peat (m^3)	Mineral Soil (m^3)
Substation	2,810	17,095
Meteorological Mast	425	
Temporary Construction Compounds	7,490	
Totals (m3)	**209,970**	**196,860**
Total Peat and Spoil Volumes (m3)	**406,830**	

Note: Peat is removed from the peat repository areas to reach a founding area for the perimeter stone buttresses.

Table 8-11: Estimated Borrow Pit Rock Resource Volumes

Borrow Pit No.	Volume (m3)
1	372,600

Table 8-12: Peat Storage Locations and Volumes

Location	Volume (m3)
Borrow Pit	298,000
Repository Area 1	82,000
Repository Area 2	18,000
Landscaping	10,000
Total	408,000

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do Nothing Scenario

An alternative land-use option to the development of a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to existing land-use practices. Commercial forestry operations would continue at the site.

Surface water drainage carried out in areas of existing access road and coniferous plantations will continue to function and may be extended in the case of coniferous plantation. Coniferous forestry will be felled as forestry compartments reach maturity. Re-planting of these areas with more coniferous trees is likely to occur. Plantations will be reploughed where necessary to facilitate afforestation.

The land, soils and geology would remain largely unaltered as a result of the Do-Nothing Scenario.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely impacts of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are shown below.

8.5.2.1 Peat, Subsoil Excavation and Bedrock Excavation

Excavation of peat, subsoil and bedrock will be required for site levelling and for the installation of infrastructure and foundations for the access roads and turbines. This will result in a permanent removal of peat, subsoil and bedrock at excavation locations. There is no loss of peat or subsoil, it will just be relocated within the site. Estimated volumes of peat and bedrock to be removed are shown in Table 8-10 and Table 8-11 above.

Mechanism: Extraction/excavation.

Receptor: Peat, subsoil and bedrock

Pre-MitigationPotential Impact: Negative, slight/moderate, direct, likely, permanent impact on peat, subsoil and bedrock due to relocation within the site.

Mitigation Measures:

- Placement of turbines and associated infrastructure in areas with shallow peat during the design phase;
- Use of the existing road network to reduce peat excavation and borrow pit volumes;
- Use of floating roads (where acceptable to do so) to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure;
- No turbines or related infrastructure will be constructed near or on any designated sites such as NHAs or SACs;
- A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design;
- The bedrock at the site is classified as "Medium" importance; and,
- The peat deposits and mineral soil at the site is classified as "Low" importance as the blanket bog is already degraded by forestry works and drainage.

Residual Effect Assessment: The granular soil and peat deposits at the site are classified as of "Low" importance as they are already degraded by forestry and drainage. The overall site area is extensive while the proposed development footprint is approximately 86% of the overall site area. The impact is the disturbance and relocation of c 405,705m^3 of soil and subsoil during construction. All work will be in accordance with the Biodiversity Management Plan. The design measures incorporated into the project as described above in particular the avoidance of deeper peat areas combined with the 'low' importance of the deposits means that the residual effect is- negative, slight, direct, high probability, permanent effect on peat and subsoils due to disturbance and relocation within the site.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are anticipated.

8.5.2.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of peat, subsoils and pollution of the underlying aquifer) on the geological and water environment.

Pathway: Peat, subsoil and underlying bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Pre-Mitigation Potential Impact: Negative, direct, slight, short term, unlikely impact on peat, subsoil and bedrock.

Proposed Mitigation Measures

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station;
- On site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- On site re-fuelling will be undertaken by suitably trained personnel only under a permit to refuel system;
- Fuels stored on site will be minimised. Storage areas located at the temporary compounds where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- All waste tar material arising from the chipping and resurfacing of the public road portion of the temporary construction access road will be removed off-site and taken to licenced waste facility;
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (Appendix 4-4 of this EIAR). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Residual Effect Assessment: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect is considered to be - Negative, imperceptible, direct, short-term, low probability effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are anticipated.

8.5.2.3 Erosion of Exposed Subsoils and Peat During Tree Felling and Construction Work

There is a high likelihood of erosion of peat and spoil during its excavation and during landscaping works. The main impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in Chapter 9.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat and subsoil.

Pre-Mitigation Potential Impact: Negative, slight, direct, short-term, high probability effect on peat and subsoils by erosion and wind action.

Proposed Mitigation Measures:

Peat removed from turbine locations and access roads will be used for landscaping, placed alongside designated access roads, used to reinstate the 1 no. proposed borrow pits or placed in 2 no. repositories. Where possible, the acrotelm shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the borrow pits. Re-seeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the long term. A full Peat and Spoil Management Plan for the development is included as Appendix 4-2.

Any excess temporary mounded peat in storage for long periods will be sealed using the back of an excavator bucket. This will prevent erosion of soil. Silt fences will be installed around stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works.

In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods as defined in the Chapter 9 of this EIAR (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase.

During tree felling, brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

Residual Effect Assessment: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this all excavation works will be completed in accordance with the detailed Peat and Spoil Management Plan, material will be ruoved the least possible distance, and reseeding and planting will be completed to bind landscaped peat and spoil together. Following implementation of these measures the residual effected is considered - Negative, slight, direct, short-term, medium probability effect on peat and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are anticipated.

8.5.2.4 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse impact on the Proposed Development, proposed construction access road and the surrounding environment. Peat failure excludes localised movement of peat that could occur below an access road, creep movement or erosion type events. The consequence of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of access tracks;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by soil particulates;
- Degradation of the environment.

Mechanism: Vehicle movement and excavations.

Receptor: Peat subsoils.

Pre-Mitigation Potential Impact: Negative, significant, direct, low probability permanent effect on peat and subsoils. The findings of the peat stability assessment showed that the proposed Croagh wind farm site has an acceptable margin of safety, is suitable for the proposed wind farm development and is considered to be at low risk of peat failure. The findings include recommendations and control measures which will be implemented for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

Mitigation Measures:

Based on the recommendations and control measures given in the FT Peat Stability Assessment (Appendix 8-1) report being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety, there is a low risk of peat instability/failure at the Proposed Development site.

The risk assessment at each turbine location identified a number of control measures to reduce further? the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine as detailed in the FT Peat Stability Assessment Report.

The following measures which will be implemented during the construction phase of the project will assist in the management of the risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground as detailed in the peat stability assessment report;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Please refer to Appendix 8-1 for proposed turbine specific and road section mitigation measures.

Residual Effects Assessment: A detailed Geotechnical and Peat Stability Assessment has been completed for the development proposal. The findings of that assessment have demonstrated that there is a low risk of peat failure, at the site as a result of the proposed development. With the implementation of the control measures outlined above the residual effect is - Negative, imperceptible, direct, low probability, permanent effect on peat and subsoils.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are anticipated.

8.5.2.5 Proposed Amenity and Recreation Infrastructure

The recreation and amenity proposals include the construction of 1.1km of new amenity walkways (3m wide, floating road construction), 100m of wooden board walk leading to a proposed viewing area next to Lough Nacroagh and a proposed visitor car park located adjacent to an existing access road approximately 540m north of T2. It is proposed that amenity traffic will access the site from the north and that no upgrade is required to the existing junction or access road leading to the car park.

The proposed construction methodology for the amenity walkways is by floating road construction, with no requirement for additional excavation or spoil generation. Walkways and the car park will be created on the existing ground surface by adding crushed stone.

Pathway: Extraction/excavation of peat and soil/subsoils (spoil).

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Impact: Negative, slight, direct, high probability, permanent effect on peat and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section **Error! Reference source not found.**.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section **Error! Reference source not found.** above and measures dealing with soil erosion are dealt with in Section **Error! Reference source not found.**. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.3.2, and the residual effects of soil erosion are assessed in Section **Error! Reference source not found.**.

Residual Effect Assessment: It is proposed to place amenity pathways and car park on top of existing ground. Ground disturbance and peat and spoil relocation during these works will be minimal. As such the residual effects of these works are considered - Negative, imperceptible, direct, high probability, permanent effect on peat and subsoils by covering with 3m wide pathway.

Significance of Effects: For the reasons outlined above, no significant effects on soils and subsoils are anticipated.

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

Very few potential direct impacts are envisaged during the operational phase of the Proposed Development. These may include:

- Some construction vehicles or plant necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil; and,
- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater.

In relation to indirect impacts a small amount of granular material will be required to maintain access tracks during operation which will place intermittent minor demand on local quarries. Please note the on-site borrow pit will have been reinstated with excavated peat and spoil following the construction stage and will not be available to source aggregate during the operational phase.

Mitigation measures for soils and geology during the operational stage include the use of aggregate from authorised quarries for use in road and hardstand maintenance. Oil used in transformers (at the substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on ground/peat and subsoils and groundwater or surface water quality. The substation transformer, and oil storage tanks will be in a concrete bunded capable of holding 110% of the stored oil volume. Turbine transformers are located within the turbines, so any leaks would be contained within the turbine. These mitigation measures are sufficient to reduce risk to ground/peat/soils and subsoils, and groundwater and surface water quality.

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas, and the substation. This will be done by covering hard surfaces with peatland vegetation/scraw or poorly humified peat from the site to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude due to the reduced scale of the works. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH gnidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant. Some of the impacts will be avoided by leaving elements of the proposed development in place including turbine bases which will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant impacts on the soils and geology environment are envisaged during the decommissioning stage of the proposed development.

8.5.5 Cumulative Effects

The geological impact assessment undertaken above in this chapter outlines that significant effects are unlikely due to the localised nature of the construction works. Impacts on land soil and geology will not extend beyond the immediate vicinity of the Proposed Development Site and certainly not beyond the site development boundary. Tree felling has a negligible effects on soils and geology as no significant excavation are required and therefore the surrounding commercial forestry or proposed replanting sites are not expected to contribute to cumulative effects.

Therefore, no cumulative impacts between the Proposed Development, the proposed construction access road and other existing, permitted or proposed projects, listed in Section 2.5 of this EIAR, on land soils and geology are anticipated.

8.5.6 Post Construction Monitoring

None proposed.

8.5.7 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. A wind farm is not a recognized source of pollution and so the potential for effects during the operational phase are negligible. Hydrocarbons will be used onsite during construction however the volumes will be small in the context of the scale of the Proposed Development and will be handled and stored in accordance with best practice mitigation measures. The potential residual impacts associated with soil or ground contamination and subsequent health effects are negligible.

9. WATER

9.1 Introduction

9.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to undertake an assessment of the potential direct, indirect and cumulative effects of the proposed 10 no. turbine, Croagh Wind Farm development (the 'proposed development') on water aspects (hydrology and hydrogeology) of the receiving environment.

The objectives of the assessment are to:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed wind farm development and associated works;
- Identify likely significant effects of the proposed development on surface water and groundwater during construction, operational and decommissioning phases of the development;
- Identify mitigation measures to avoid, reduce or offset significant negative effects;
- Assess significant residual effects; and
- Assess cumulative effects of the proposed development and other local developments.

9.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005, and our office is located in Dungarvan, County Waterford.

Our core areas of expertise and experience include upland hydrology and windfarm drainage design. We routinely complete impact assessments for hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by Michael Gill, David Broderick and Adam Keegan.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Derrinlough WF and Yellow River WF, and over 100 other wind farm-related projects.

David Broderick is a hydrogeologist with over 13 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has worked on the EIS for Oweninny WF, Meenbog WF, Glenmore WF, Yellow River WF, and over 80 other wind farm-related projects.

Adam Keegan is a hydrogeologist with two years of experience in the environmental sector in Ireland. Adam has been involved in Environmental Impact Assessment Reports (EIARs) for numerous projects including wind farms, grid connections, quarries and small housing developments. Adam holds an MSc in Hydrogeology and Water Resource Management. Adam has worked on several wind farm EIAR

projects, including Croagh WF, Lyrenacarriga WF (SID), Cleanrath WF, Carrownagowan WF (SID), and Fossy WF.

9.1.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.6 of this EIAR. Issues and concerns highlighted with respect to the water environment are summarised in

Table 9-1 below.

Table 9-1:Summary of Water Environment Related Scoping Responses

Degree/Nature	Description	Addressed in Section
Inland Fisheries Ireland (IFI)	• IFI is seriously concerned over the potential for landslides in this area, based on the occurrence of two landslides in close proximity to this site which resulted in significant damage to the fisheries resource and water quality in the Owengar River.	Refer to Land, Soils and Geology Chapter (Chapter 8) for a peat stability risk assessment
Geological Survey of Ireland (GSI)	• The Geological Survey of Ireland have also identified numerous landslides in this area, indicating significant risks from activities involving large scale earth works such as windfarms.	
Irish Peatland Conservation Council (IPCC)	• There is a risk landslide events may occur within the locality of the proposed wind farm. Landsides are disastrous for wildlife (aquatic and terrestrial). • Most of the footprint of the proposed windfarm is situated on peat soils. Peat is very sensitive to development and will require extra stringent planning procedures	Refer to Land, Soils and Geology Chapter (Chapter 8) for a peat stability risk assessment and a peat management plan
Department of Culture Heritage and Gaeltacht	• In order to assess impacts it may be necessary to obtain hydrological and/or geological data. Any impact on water table levels or groundwater flows may impact on wetland sites some distance away. The EIAR should assess cumulative impacts with other plans or projects if applicable. Where negative impacts are identified suitable mitigation measures should be detailed as appropriate	Sections: 9.3.4, 9.3.7, 9.3.12 and 9.4.3.9

Degree/Nature	Description	Addressed in Section
Health Services Executive (HSE)	• HSE have particular interest in environmental impact studies, methodologies and proposed mitigation measures in the areas of ground and surface water quality and protection, at construction, operational and decommissioning phases. • Recommendation made that all surface waters and private wells affected be identified and that qualitative analysis of both surface and groundwaters be as current as possible.	Sections: 9.3.17 and 9.4.3
Department of Agriculture, Food and the Marine	• The interaction of these proposed works with the environment locally and more widely, in addition to potential direct and indirect impacts on designated sites and water, is assessed	Sections: 9.3.4, 9.3.7, 9.3.12 and 9.4.3.9
OPW	• The OPW has no records of flooding in this area. • It will be a requirement of the applicant to apply for Section 50 consent for all new and upgraded culverts and bridges	Sections: 9.4.3.8

9.1.4 Relevant Legislation

This chapter of the EIAR is prepared in accordance with the requirements of the Environmental Impact Assessment legislation outlined in Chapter 1: Introduction.

The requirements of the following legislation are complied with:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1994, S.I. No. 101 of 1996, S.I. No. 351 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001, S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act 2000 (as amended), and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 2011/92/EU and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of

water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU ("WFD"). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);

- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 2000/60/EC on the protection of water; S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the "Drinking Water Directive") and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

9.1.5 Relevant Guidance

The Hydrology and Hydrogeology chapter of the EIAR has been completed in accordance with guidance outlined in Chapter 1: Introduction and the guidance contained in the following:

The water section of the EIAR is also carried out in accordance with guidance contained in the following:

- Environmental Protection Agency (2006): Environmental Management in the Extractive Industry;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the preparation of Environmental Impact Statements) where relevant;
- Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;
- National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Coillte (2009): Methodology for Clear Felling Harvesting Operations;
- Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;
- COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Inland Fisheries Ireland (2016): Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);
- PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);
- CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006);

- CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006;
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,

9.2 Methodology

9.2.1 Desk Study & Preliminary Hydrological Assessment

A desk study and preliminary hydrological assessment of the EIAR Site Boundary and the surrounding area was completed in advance of the site investigations. This involved collection of all relevant geological, hydrological, hydrogeological and meteorological data for the study area. This included consultation and review of the following data sources:

- Coillte databases on forestry and drainage;
- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- EPA/Water Framework Directive Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 7 (Geology of Sligo-Leitrim). Geological Survey of Ireland (GSI, 1996);
- Geological Survey of Ireland (2004) – Lough Allen Groundwater Body Initial Characterization Report;
- OPW Flood Hazard Mapping (www.floodinfo.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM flood risk mapping (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

9.2.2 Site Investigations

Detailed walkover surveys, geological mapping and peat/soil augering was undertaken by HES on 3rd and 4th April 2018 with follow up visits carried out on 14th and 20th November 2018, 6th September 2019 and 19th March 2020. Water sampling within local streams was carried out on the 14th and 20th of November 2018, as well as the 6th September 2019 and19th March 2020. Trial pit investigations (3 phases – 2017, 2019 and 2020) and bedrock investigation drilling in 2019 was completed by Fehily Timoney & Company (FT, formally AGEC Ltd).

In summary, site investigations to address the Water Section of the EIAR included the following:

- A total of over 850 no. peat probe depths were carried out by HES, MKO and FT, between 2013 and 2020, to determine the depth and geomorphology of the blanket peat at the site;
- Walkover surveys and drainage mapping of the site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- Field hydrochemistry measurements (electrical conductivity, pH, dissolved oxygen and temperature) were taken to determine the origin and nature of surface water flows;
- Surface water sampling (4 rounds) were undertaken to determine the baseline water quality of the primary surface waters originating from the site and along the grid connection route;
- Surface water flow monitoring of the primary streams passing through the site and along the grid connection route;
- Drilling of 4 no. bedrock boreholes to assess hydrogeological conditions at the proposed borrow pit locations;
- Assessment of bedrock permeability at the proposed borrow pit locations; and,

- Excavation of 40 no. trial pits across the site (2017, 2019 and 2020 investigations) to assess subsoil lithology and depth.

9.2.3 Impact Assessment Methodology

The guideline criteria (EPA, August 2017) for the assessment of likely significant effects require that likely effects are described with respect to their extent, maguitude, type (i.e. negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 9-2 are then used to assess the potential effect that the Proposed Development may have on them.

Table 9-2: Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI gronndwater vulnerability "Extreme" classification and "Regionally" important aquifer

9.3 Receiving Environment

9.3.1 General Site Description

The Proposed Development site (EIAR Site Boundary) is located approximately 1.3 kilometres northeast of Drumkeeran, Co. Leitrim, at its closest point. The total study area is approximately 670 ha (~6.7km^2). The site setting is forested upland blanket bog which is owned by Coillte. The site is accessible from public roads via a network of existing forestry tracks.

The proposed construction access road for the wind farm commences from the R280 at Drumkeeran village, approximately 6km to the east of the main site area and traverses private land, a public road and Coillte property before emerging onto the local road that approaches the core wind farm site.

The overall elevation of the site ranges between approximately 90m to 330m OD (Ordnance Datum) with the northern section of the site sloping in a northerly direction and the southern section of the site sloping to the southwest.

There is 1 no. proposed grid route, along with 1 no. proposed substation. The proposed substation is located approximately 330 metres east of Turbine No. 4 along an existing access road. From here, the proposed underground grid connection cabling route runs southeast along existing forestry roads for ~ 4.1 km before turning north and following the public road for ~ 1.9km and connecting with the existing Garvagh Glebe 110kV substation.

9.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall (1981 - 2010) recorded at Dromahair (Market St), approximately 4 kilometres east of the site, are presented in

Table 9-3. The is the nearest and most appropriate station with respect to topography and elevation.

Table 9-3: Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Dromahair		180600		331500		27		1960		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
125	87	99	66	79	86	89	108	113	129	125	127	1231

The closest synoptic[1] station where the average potential evapotranspiration (PE) is recorded is at Mullingar, approximately 80 kilometres southeast of the site. The long-term average PE for this station is 446mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 423mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

$$\text{Effective rainfall (ER)} = \text{AAR} - \text{AE}$$

$$= 1{,}231\text{mm/yr} - 423\text{mm/yr}$$

$$\text{ER} = 808\text{mm/yr}$$

Based on recharge coefficient estimates from the GSI (www.gsi.ie), an estimate of 5% recharge is taken for the site as an overall average. This value is for "Peat" with a "High" vulnerability rating. Areas where peat is absent may have slightly higher recharge rates, but on this site, these areas are generally on sloping ground. The high stream density in the area would also suggest that recharge rates are very low.

[1] Meteorological station at which observations are made for synoptic meteorology and at the standard synoptic hours of 00:00, 06:00, 12:00, and 18:00.

The lowest value in the available range was chosen to reflect the large coverage of blanket peat and high drainage density. Therefore, annual recharge and runoff rates for the site are estimated to be 40mm/yr and 768mm/yr respectively.

Table 9-4 presents return period rainfall depths for the centre of the Croagh wind farm site. This data is taken from https://www.met.ie/climate/services/rainfall-return-periods and they provide rainfall depths for various storm durations and sample return periods (1-year, 50-year, 100-year). These extreme rainfall data will be used for wind farm drainage design and not the long-term averages.

Table 9-4: Return Period Rainfall Depths for Croagh site

Duration	10-year Return Period	50-Year Return Period	100-Year Return Period
15-min	14.2	22.0	26.4
1-hour	22.7	32.6	38.3
6-hour	39.7	54.4	62
12-hour	49.7	66.3	74.8
24-hour	62.3	80.9	90.1
48-hour	77.2	97.7	107.7

9.3.3 Regional and Local Hydrology

With respect to regional hydrology, the Proposed Development is located in 2 no. river basins and 3 no. regional surface water catchments. The southern half of the wind farm site is located in the Shannon River surface water catchment within the Shannon International River Basin District (SHIRBD). The northern half of the wind farm site is located in the Garvogne River surface water catchment. Both the Garvogue River and the Ballysadare River are located within the North Western International River Basin District (NWIRBD).

In terms of turbine distribution, 4 no. are located in the Shannon River surface water catchment and 6 no. are located in the Garvogue River surface water catchment.

The Garvagh grid connection route, which runs to the southeast of the site, passes through the Shannon River surface water catchment (for 6.4km) and the Garvogue River surface water catchment (for 0.7km). Approximately 8.5km of the construction access road is in the Shannon River catchment.

In terms of local hydrology, the southern half of the windfarm site is located in the Arigna River surface water catchment. The Arigna River flows into Lough Allen approximately 16km downstream of the site. The north half of the windfarm site is located in the Bonet River surface water catchment. The Bonet River flows into Lough Gill approximately 15km downstream of the site. Approximately 6km of the construction access road drains directly to Lough Allen via the Owengar River.

A regional hydrology map is attached as Figure 9-1.

Belhavel Lough

Killanummery River

Owengar River

Douglas River

Arigna River

Lough Allen

0 1,500 3,000

meters

N

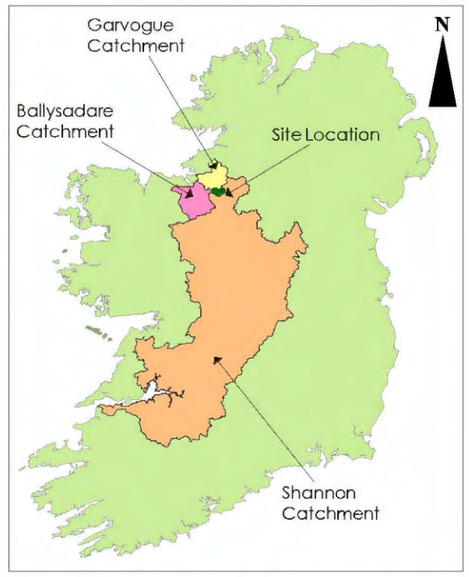
W E

S

Legend

- EIAR Site boundary
- Proposed Underground Grid Connection Route
- Rivers
- River Flow Direction
- Lakes
- Ballysadare Catchment
- Garvogue Catchment
- Shannon Catchment

KEY PLAN



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Client: MKO	
Job: Croagh WF, Leitrim	
Title: Regional Hydrology Map	
Figure No: 9.1	
Drawing No: P1459-0-0620-A3-901-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:50,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

9.3.4 Local & Site Drainage

There are four main rivers which drain the Proposed Development site, namely the upper reaches of the Killanummery River (IE_WE_35K030600) which drains the north-western section of the site. The Killanummery River continues to flow northwest, before meeting the River Bonet just south of Dromahair, approximately 7.5 km north of the site. The smaller Tullynascreen Stream (IE_WE_35K030600) runs parallel to this river, and flows northwest, meeting the Killanummery River approximately 2 km north of the site. The Tullynascreen Stream emanates from Lough Nacroagh, a small lake with an area of ~0.01 km^2.

The Cashel Stream drains the north-eastern section of the proposed site. The Cashel Stream is fed from several smaller streams which converge near Kilavoggy Bridge ~1.5km north of the site. The stream then flows north/northeast, meeting the River Bonet approximately 1 km southeast of Dromahair.

The southern section of the proposed site is drained by the Arigna River. The Arigna River runs south through the site and delineates much of the southwestern boundary of the site. It flows through a steep valley between Carrane Hill and Corry Mountain, and the drainage network suggest it is fed primarily from surface waters draining from the peaked ridge of Carrane Hill, which runs parallel to the river, approximately 1 km southwest of the river. The Arigna River continues to flow south before discharging into the southern tip of Lough Allen, some 3km northwest of Drumshanbo.

The site access road is drained by several headwater streams that flow easterly to form the Owengar River which flows into Lough Allen which is located 2km east of the site entrance.

A local hydrology map is shown as Figure 9-2 and a site drainage map is shown as Figure 9-3.

A summary of the sub-catchments along with relevant Proposed Development infrastructure and significant existing drainage features/routes are shown in

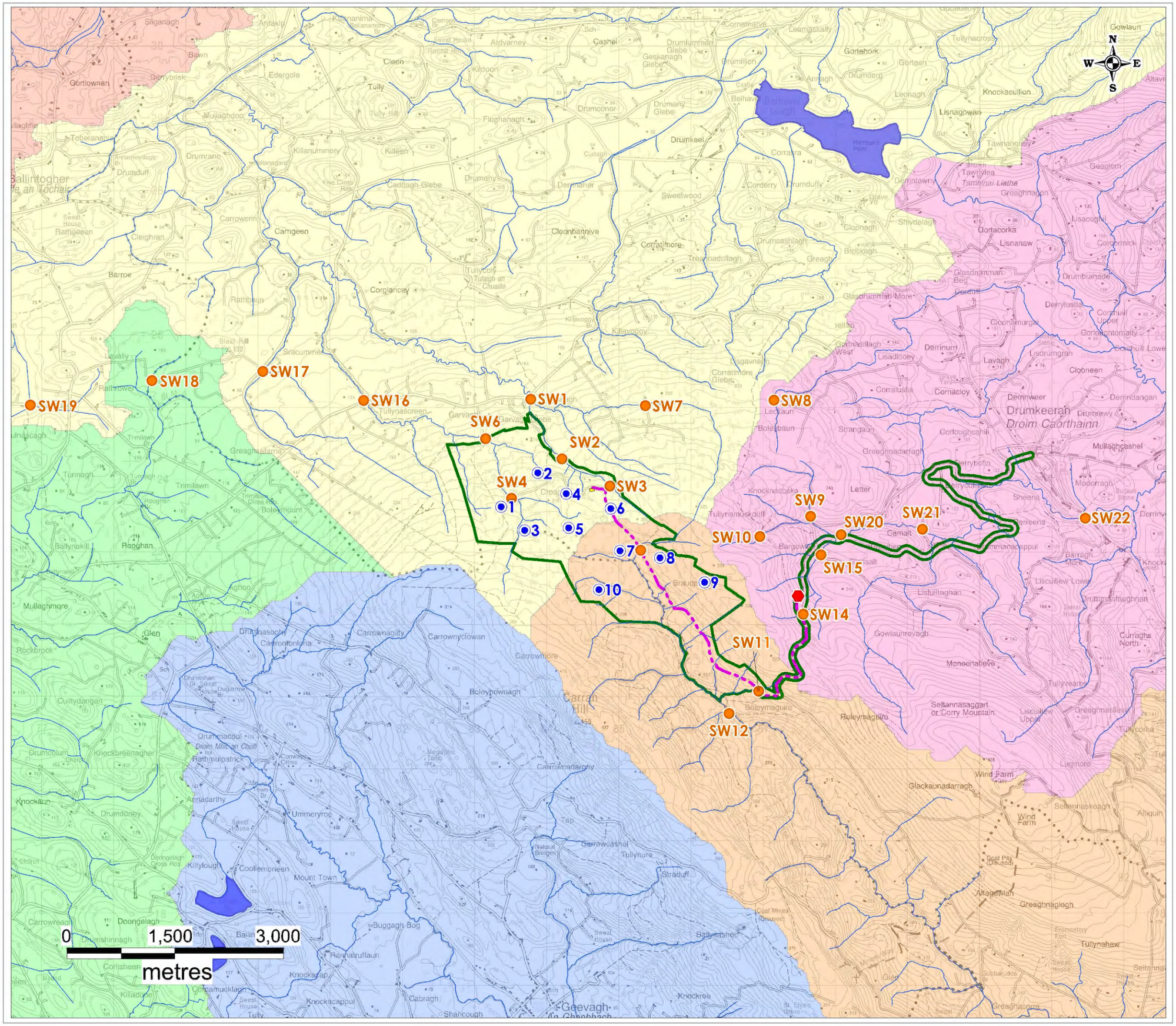
Table 9-5.

Within the Proposed Development site there are numerous manmade drains that are in place predominately to drain the forestry plantations. The current internal forestry drainage pattern is influenced by the topography, peat subsoils, layout of the forest plantation and by the existing road network. The forest plantations, which cover the majority of the site (where clearfelling has occurred forest drains still exist as before, and replanting has generally taken place) are generally drained by a network of mound drains or ploughed ribbons, which typically run perpendicular to the topographic contours of the site and feed into collector drains, which discharge to interceptor drains down-gradient of the plantation.

Mound drains and ploughed ribbon drains are generally spaced approximately every 15m and 2m respectively. As illustrated in Plate 9-1, interceptor drains are generally located up-gradient (cut-off drains) and down-gradient of forestry plantations. Interceptor drains are also located up-gradient of forestry access roads. Culverts are generally located at stream crossings and at low points under access roads which drain runoff onto down-gradient forest plantations. A schematic of a typical standard forestry drainage network and one which is representative of the site drainage network is shown as Plate 9-1.

The forestry drains are the primary drainage routes towards the natural streams on the development site, but the flows in these drains are generally very low. The integration of the existing main drains with the proposed wind farm drainage is a key component of the drainage desigu which is discussed further in Sections 9.4.1 and 9.4.2 below.

Monitoring of stream discharge in the main streams passing through the site, along the grid connection and the construction access road was undertaken in April and November 2018, as well as low flow monitoring in September 2019 and this data is presented in Table 9-6 below. The flows are typical for upland high energy watercourses.



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Substation
- Garvagh Grid Connection
- Garvagh Substation
- Rivers
- Lakes
- SW Sampling Location

- Arigna[Roscommon]_SC_010
- Bonet_SC_020
- Feorish[Ballyfarnon]_SC_010
- Owengar[Leitrim]_SC_010
- Unshin_SC_010

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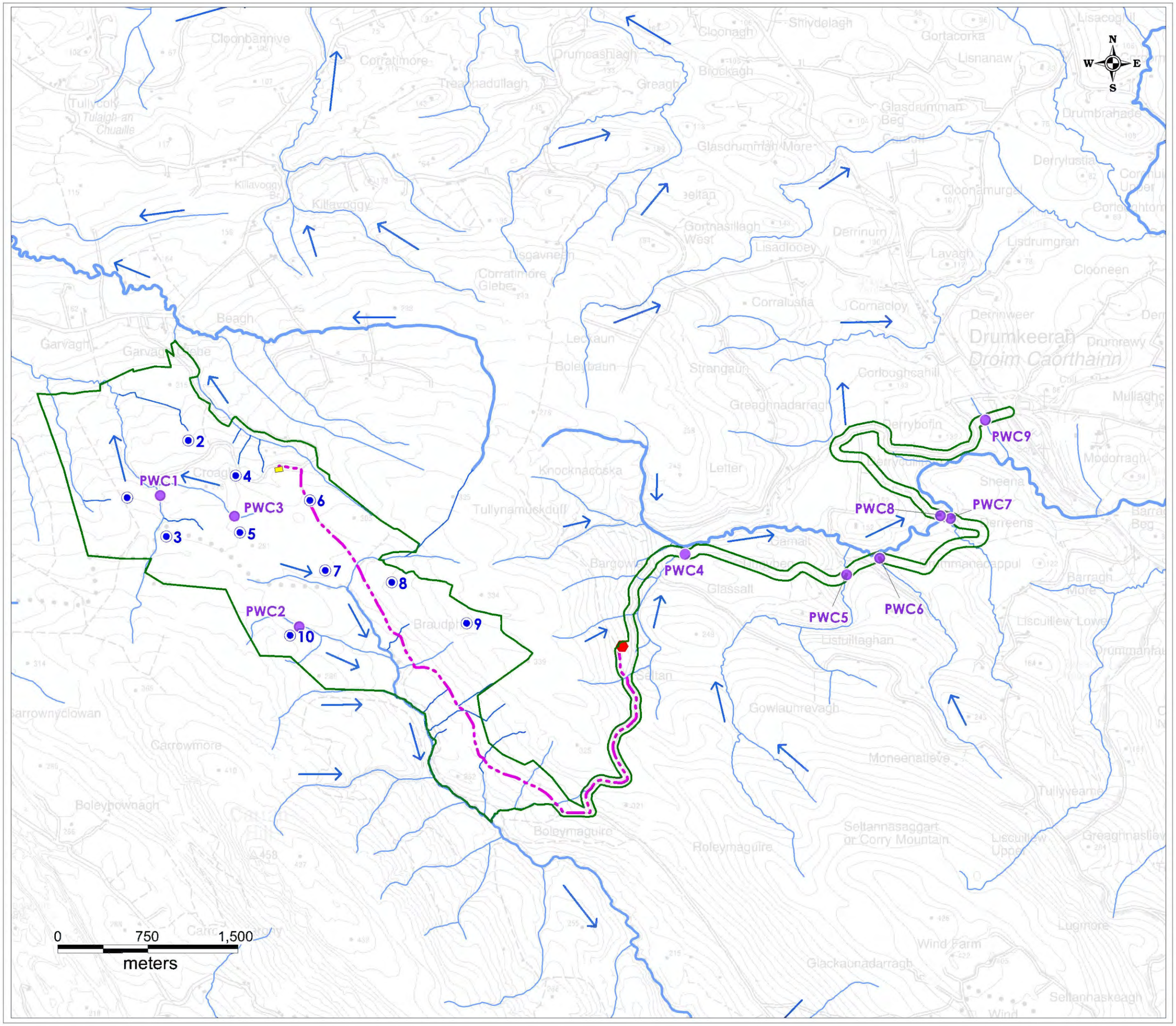
Job: Croagh WF, Leitrim	
Title: Local Hydrology Map	
Figure No: 9.2	
Drawing No: P1459-0-0620-A3-902-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:40,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Substation
- Proposed Underground Grid Connection Route
- Garvagh Substation
- Rivers
- River Flow Direction
- Proposed WC Crossing (PWC)

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Client: MKO	
Job: Croagh WF, Leitrim	
Title: Site Drainage Map	
Figure No: 9.3	
Drawing No: P1459-0-0620-A3-903-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:30,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

Flow duration curves, generated by the EPA HydroTool website, are presented in Plate 9-2 below, and these represent likely volumetric flow variations between dry and wet weather.

The locations of the monitoring points are shown in Figure 9-2.

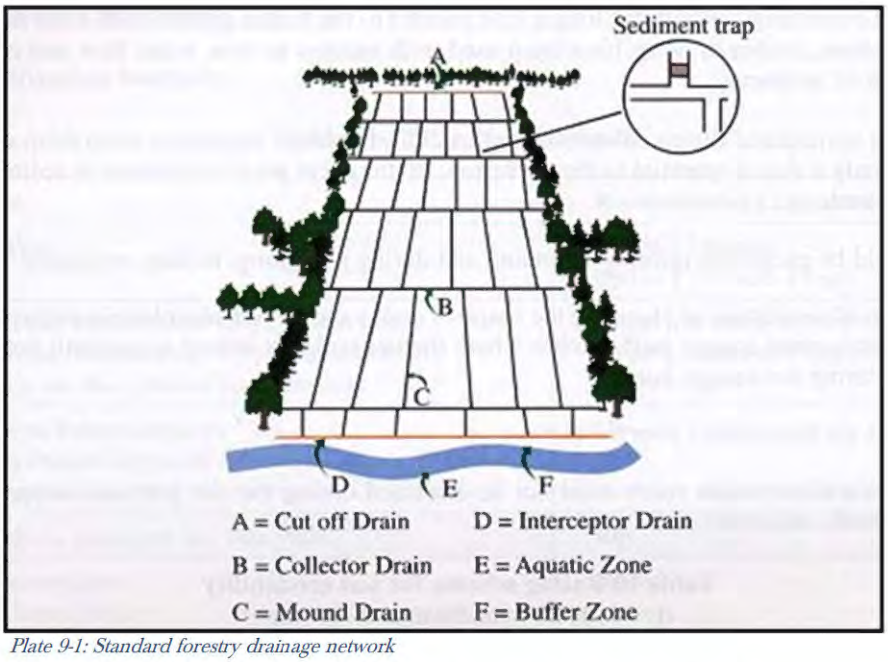


Plate 9-1: Standard forestry drainage network

Table 9-5: Summary of Regional/Local hydrology & Proposed Windfarm Infrastructure

Regional Catchments	Sub-catchment	Main Development Infrastructure	Primary Drainage Features
Shannon	Arigna	4 no. turbines, 1 no. borrow pit, 1 no. peat and spoil repository area,1 no. construction compound and 1.4km of the grid connection route and boardwalk	Arigna River
	Owengar	3.95km of the grid connection route and 8.5km of the construction access road	Owengar River
Garvogne	Bonet	6 no. turbines, substation, 1 no. peat and spoil repository area, 1 no. construction compound, 0.6km of the Garvagh grid connection route and met mast	Killanummery River

Table 9-6: Surface Water Flow Monitoring Data

Location	04/04/2018	14/11/2018	20/11/2018	06/09/2019
	Flow (litres/sec)	**Flow (litres/sec)**	**Flow (litres/sec)**	**Flow (litres/sec)**

Location	04/04/2018	14/11/2018	20/11/2018	06/09/2019
SW1	15	200	20	15
SW2	10	40	10	6
SW3	12	200	15	10
SW4	<10	30	<10	5
SW5	<10	30	<10	5
SW6	22	250	30	15
SW7	<10	100	<10	5
SW8	15	120	20	10
SW9	12	50	15	10
SW10	<10	30	<10	5
SW11	<10	30	<10	5
SW12	90	800	100	80

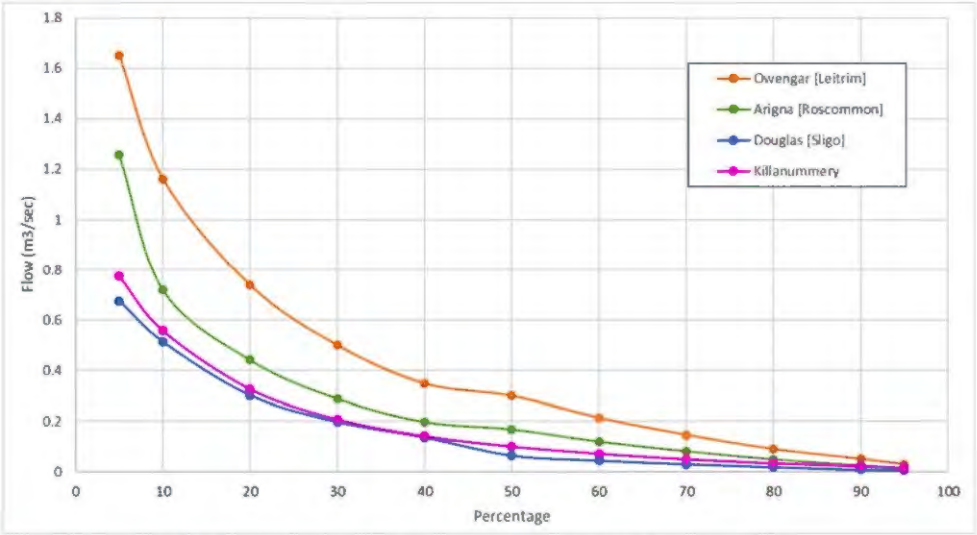


Plate 9-2: Flow Duration Curves for Local Rivers downstream of proposed development [2]

9.3.5 Baseline assessment of site runoff

This section undertakes a long-term water balance assessment and surface water runoff assessment for the baseline conditions at the proposed development site.

[2] http://watermaps.wfdireland.ie/HydroTool/Authentication/Login.aspx?ReturnUrl=%2fHydroTool%2fDefault.aspx

The rainfall depths used in this water balance, long term averages, are not used in the design of the sustainable drainage system for the wind farm. The 100-year rainfall depth will be used for the purpose of drainage design.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 9-7). It represents, therefore, the long-term, average, wettest monthly scenario in terms of volumes of surface water runoff from the site pre-wind farm development. The worst case surface water runoff co-efficient for the site is estimated to be 96% based on the predominant peat coverage (refer to Section 9.3.2).

The highest long-term average monthly rainfall recorded at Dromahair over the period 1987 – present occurred in December, at 128mm. The average monthly evapotranspiration for the synoptic station at Mullingar over the period 1961-1990, for the month of December, was 0mm. The calculation is carried out for the entire study area. The balance indicates that a conservative estimate of surface water runoff for the study area during the highest rainfall month is 814,720m^3/month, which equates to an average of 26,281m^3/day, as outlined in Table 9-8.

Table 9-7: Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.128
Average December Potential Evapotranspiration (PE)	0
Average December Actual Evapotranspiration (AE = PE x 0.95)	0
Effective Rainfall December (ER = R - AE)	0.128
Recharge co-efficient (5% of ER)	0.0064
Runoff (95% of ER)	0.1216

Table 9-8: Baseline Runoff for the Study Area

Approx. Area (ha)	Baseline Runoff per month (m^3)	Baseline Runoff per day (m^3)
670	814,720	26,281

9.3.6 Flood Risk Identification

OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie) and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas as being at risk of flooding.

A site specific Flood Risk Assessment was completed for the Proposed Development and this is attached as Appendix 9-1 of the EIAR. A summary of the FRA is provided in this section.

No recurring flood incidents within the EIAR site boundary were identified from OPW's indicative river and coastal flood map. A recurring flooding incident is mapped downstream of the site at the southern tip of Lough Allen, where the Arigna and Owengar Rivers discharge.

The PFRA mapping shows the extents of the indicative 100-year flood zone which relates to fluvial (i.e. river) and pluvial (i.e. rainfall) flood events. The 100-year fluvial flood zones mapped within the site

boundary generally occur in close proximity to the stream channel itself. All proposed turbine locations, substation, construction compounds, met mast, borrow pit, peat repository areas and access roads (with the exception of stream crossings and road upgrades) are located at least 50m away from streams and are therefore outside of the fluvial indicative 100-year flood zone.

The Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie.) has areas indicated as "fluvial flooding" in the close proximity of streams which pass through the site.

There is no text on local available historical 6" or 25" mapping for the proposed site that identify areas that are "prone to flooding" within the study area or benefitting lands (lands benefitting from the OPW arterial drainage scheme).

It is a key mitigation of the proposed wind farm development to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to diffuse discharge at pre-existing Greenfield rates. As such the mechanism by which downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment section below.

9.3.7 Surface Water Hydrochemistry

9.3.7.1 Proposed Wind Farm Site

Q-rating data for EPA monitoring points on Arigna River are available from a location approximately 3.5km south of the southern site boundary, referred to as Altagowlan School. Most recent data (2004 to present) show that the river has a Q-4 rating (Good Status). A Q-rating point is also located approximately 2.5 km southeast of the Altagowlan school monitoring point. This monitoring point also has a Q-4 rating.

Q ratings are also available along the Owengar river. The river achieved a Q-4 rating at a monitoring point approximately 2 km east of the eastern boundary of the site.

Q ratings for the River Bonet are also available from a monitoring point approximately 3 km north of the site at a bridge along the L4275. The last Q rating at this point was a Q4-5. Q ratings for the Killanummery River are available from a monitoring location at a bridge north of Garvagh Glebe. A Q-4 rating is assigned to the river at this point. A Q rating was also available from the small Cashel Stream which originates at Lough Nacroagh. The monitoring point is located approximately 1km west of the Killanummery River monitoring point. A Q4 rating is reported at this point. These are latest values available from the EPA, please refer to the aquatic section (Chapter 6 of the EIAR) for more contemporary values for the area of the Proposed Development.

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (C°) were taken at locations across the site within surface water courses on 14th and 20th November 2018 and 6th September 2019. The results are listed in Table 9-9 below.

Electrical conductivity (EC) values for surface waters at the site area ranged between 38 and 116µS/cm. This indicates that surface water is derived mainly from rainfall input. Measurement in lower-flow conditions (lower water levels in late summertime) may indicate a higher groundwater flow component (i.e. baseflow - typically signified by 'higher' EC values) contributing to discharge in the Bonet, Owengar and Arigna Rivers.

The pH values, which ranged between 4.7 and 7.2, had an overall average value of 6.32. Slightly acidic values were observed, especially at SW4 and SW6 where values <5 were recorded. This is most likely due to discharge from the small lake Lough Nacroagh, where waters may become relatively acidic due to the residence time within the bog lake.

Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat. In addition, the shale bedrock (and related till subsoils) which underlie the area would have slightly acidic groundwater characteristics which would have some effect on surface water chemistry specifically during dryer periods when baseflow is likely to be more prevalent.

Table 9-9: Summary of Surface Water Chemistry Measurements

Location	EC (µS/cm)			pH			Dissolved Oxygen (mg/L)		
	R1	R2	R3	R1	R2	R3	R1	R2	R3
SW1	58.1	57	57.9	5.93	6.16	6.9	10.82	11.06	10.51
SW2	76.3	67	-	6.33	6.5	-	10.74	10.78	-
SW3	82.7	106	-	6.92	6.81	-	10.72	11.01	-
SW4	37.7	54	-	4.95	6.14	-	10.04	10.38	-
SW5	40.9	39	34.3	5.02	7.11	6.6	10.42	10.84	10.3
SW6	65.6	51	-	4.71	5.85	-	10.71	11.1	-
SW7	54.9	48	54.1	5.88	6.36	6.79	10.48	11.17	10.43
SW8	47.3	54	46.3	5.82	6.85	6.55	10.7	11.09	10.62
SW9	58.1	116	94.9	6.82	7.22	7.39	10.79	10.97	10.48
SW10	51.3	42	-	6.09	6.83	-	10.8	11.34	-
SW11	59.6	72	-	6.84	7.13	-	10.69	11.37	-
SW12	57.4	60	-	6.22	7.21	-	10.62	11.42	-

R1 (Round 1) – 14/11/2018, R1 (Round 2) – 20/11/2018, R3 (Round 3) – 06/09/2019

Two rounds of surface water sampling were completed on 6 no. of the wind farm downstream monitoring locations (See Table 9-10 and (+) *S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations*
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9-11 below for the locations sampled) on the 14th November and 20th November 2018. These 6 no. sampling locations are situated downstream of the key proposed infrastructure locations.

Sampling was carried out along the grid connection option on 3rd and 4th April 2019 (refer to

Table 9-14 and (+) *S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations*
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9-15). Further sampling was carried out at points within the proposed wind farm site boundary and along the grid route (Table 9-12) on the 6th September 2019. The sampling results for the wind farm and grid route are discussed separately below.

Results of analysis are shown alongside relevant water quality regulations. In addition, relevant Environmental Objectives Surface Water Regulations (S.I. 272 of 2009) threshold values are shown in Table 9-13 below. Laboratory reports are shown as Appendix 9-2.

Table 9-10: Analytical Results of Surface Water Samples (Wind farm Round 1)

Parameter	EQS	Sample ID					
		SW1	SW3	SW6	SW8	SW10	SW12
Total Suspended Solids (mg/L)	25(+)	17	17	27	<5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.04	0.04	0.05	0.02	0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrogen (mg/L)	-	<1.0	<1.0	1.0	<1.0	<1.0	<1.0
Phosphorus (mg/L)	-	0.14	0.1	0.1	<0.1	<0.1	<0.1
Chloride (mg/L)	-	11	12.6	12.6	9	9.6	10.4
BOD	≤ 1.3 to ≤ 1.5(*)	<2	5	<2	<2	<2	2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9-11: Analytical Results of Surface Water Samples (Wind farm Round 2)

Parameter	EQS	Sample ID					
		SW1	SW3	SW6	SW8	SW10	SW12
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5	<5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.03	0.03	0.08	0.02	0.03	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	0.03	0.02	0.04	0.02	0.03	0.03
Nitrate - NO_3 (mg/L)	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrogen (mg/L)	-	5.7	7.6	5.5	7.2	2.2	4.1
Phosphorus (mg/L)	-	<0.1	<0.1	0.11	<0.1	<0.1	0.11
Chloride (mg/L)	-	9.8	12.1	12.9	9.9	9.7	9.8
BOD	≤ 1.3 to ≤ 1.5(*)	2	<2	2	<2	3	2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9-12: Analytical Results of Surface Water Samples (Wind Farm/Grid Route(s) Round 3)

Parameter	EQS	Sample ID									
		SW1	SW5	SW6	SW7	SW8	SW9	SW11	SW12	SW16	SW17
Total Suspended Solids (mg/L)	25(+)	8	8	<5	<5	<5	<5	<5	6	<5	6
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.02	<0.02	0.03	<0.02	<0.02	0.04	<0.02	<0.02	<0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	0.02	<0.02	0.04	0.02	<0.02	0.02	0.02	0.03	0.02	0.03
Nitrate - NO_3 (mg/L)	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrogen (mg/L)	-	1.3	1.1	1.7	1.4	2.7	1.0	1.0	1.5	1.5	2.0
Phosphorus (mg/L)	-	0.11	<0.1	0.1	<0.1	0.1	<0.1	<0.1	0.1	0.1	0.1
Chloride (mg/L)	-	8.8	5.1	10.0	8.8	8.5	8.2	5.8	7.9	9.3	12.3
BOD	≤ 1.3 to ≤ 1.5(*)	2	<2	2	2	2	<2	2	2	2	2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

*Table 9-13: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)
Ortho-phosphate	High status ≤0.025 (mean)
	Good status ≤0.035 (mean)

* European Communities Environmental Objectives Surface Water Regulations (S.I. 272 of 2009)

Round 1 of Sampling (Windfarm)

Total suspended solids at all sampling locations were generally less than 25mg/l, the threshold value contained within the European Communities (Quality of Salmonid Waters) Regulations (S.I. No. 293 of 1988). 1 no. sample at SW6 exceeded this value at 27 mg/l. This is likely due to the very high rainfall in the days prior to sampling, leading to excess runoff and the associated increase in suspended solids. This high TSS is also likely linked to the low pH value observed at this sampling location, with peaty solids leading to a temporary increase in acidity of the surface waters. Nitrite and nitrate values were below or equal to the laboratory detection limit of 0.05 and 5.0 mg/L respectively.

Ortho-phosphate was below the laboratory detection limit of 0.02mg/L in 5 of 6 locations, with the sample at SW6 returning a value of 0.04mg/l.

In comparison to the European Communities Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), 5 of 6 results for ammonia N were below the "Good Status" threshold, and below the "High Status" threshold. One sample from SW6 exceeded the Good status threshold with a result of 0.05 mg/l.

In relation to ortho-phosphate, again, 5 of 6 were within the "Good Status" and "High status range while SW6 exceeded the "High Status" threshold values.

BOD was below the detection limit of 2 mg/l for 4 of 6 samples, however it exceeded both the "Good status" and "High status" threshold in the remaining two samples.

The results of round 1 sampling are presented in Table 9-10.

Round 2 of Sampling (Windfarm)

Total suspended solids at all sampling locations during round 2 (20/11/2018) were <5mg/L and nitrite and nitrate values were below or equal to the laboratory detection limits.

Ortho-phosphate ranged between <0.03 and 0.04mg/L, while phosphorus was generally below detection limit of 0.1 mg/l, but rose to 0.11 mg/l on two occasions at SW6 and SW12. Ammonia values ranged between <0.02 and 0.08mg/L.

In comparison to the European Communities Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), 5 of 6 sample results for ammonia N were below the "good" and "High Status" threshold while all results 2 of 6 no. samples were below the detection limit for BOD, with the remaining 4 exceeding both the "Good" and "High" status.

The results of round 2 sampling are presented in Table 9-11.

Round 3 of Sampling (Windfarm/ Grid route(s))

Total suspended solids at all sampling locations during round 3 (06/09/2018) ranged from <5mg/L to 6 mg/L. Nitrite and Nitrate values were below or equal to the laboratory detection limits.

Ortho-phosphate ranged between <0.02 and 0.04mg/L, while phosphorus was generally at or below the detection limit of 0.1 mg/. Ammonia values ranged between <0.02 and 0.04mg/L which is within the "High Status threshold" as outlined in Table 9-13.

BOD ranged from <2 to 2 mg/l in all samples.

The results of round 2 sampling are presented in Table 9-12.

Round 1 of Sampling (Grid Connection)

6 no. additional sampling locations were used for the grid connection baseline monitoring. These locations are downstream on the main watercourses intercepted by the proposed route.

Total suspended solids at all sampling locations were generally at or below the limit of detection (5mg/l), considerably below the threshold value of 25 mg/l. SW16 was above the limit of detection at 7 mg/l. Nitrite and nitrate values were below or equal to the laboratory detection limit of 0.05 and 5.0 mg/L respectively within all samples.

Ortho-phosphate was below the laboratory detection limit of 0.02mg/L in all 6 locations.

In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), 5 of 6 results for ammonia N were below the "Good Status" threshold, and below the "High Status" threshold. One sample from SW18 exceeded the Good status threshold with a result of 0.05 mg/l.

In relation to ortho-phosphate, all 6 samples were within the "Good Status" and "High Status" range.

BOD was below the detection limit of 5 mg/l

Table 9-14: Analytical results of Grid route samples (Round 1)

Parameter	EQS	Sample ID					
		SW14	SW15	SW16	SW17	SW18	SW19
Total Suspended Solids (mg/L)	25(+)	<5	<5	9	5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	<0.02	<0.02	0.03	0.02	0.03	0.03
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5.0	<5.0	8	8.8	5.1	<5.0
Nitrogen (mg/L)	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phosphorus (mg/L)	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride (mg/L)	-	13.4	12.9	17.1	17.9	17.5	16.6
BOD	≤ 1.3 to ≤ 1.5(*)	<5	<5	<5	<5	<5	<5

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Table 9-15: Analytical results of Grid route samples (Round 2)

Parameter	EQS	Sample ID					
		SW14	SW15	SW16	SW17	SW18	SW19
Total Suspended Solids (mg/L)	25(+)	<5	<5	7	<5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.02	0.02	0.03	0.02	0.05	0.03
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Nitrogen (mg/L)	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Phosphorus (mg/L)	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chloride (mg/L)	-	13.4	12.7	16.7	18	17.9	16.8
BOD	≤ 1.3 to ≤ 1.5(*)	<5	<5	8	<5	<5	<5

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

Round 2 of Sampling (Grid Connection)

Total suspended solids at all sampling locations were generally at or below the limit of detection (5mg/l), considerably below the threshold value of 25 mg/l. SW16 was above the limit of detection at 7 mg/l. Nitrite and nitrate values were below or equal to the laboratory detection limit of 0.05 and 5.0 mg/L respectively within all samples.

Ortho-phosphate was below the laboratory detection limit of 0.02mg/L in all 6 locations.

In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), 5 of 6 results for ammonia N were below the "Good Status" threshold, and below the "High Status" threshold. One sample from SW18 exceeded the Good status threshold with a result of 0.05 mg/l.

In relation to ortho-phosphate, all 6 samples were within the "Good Status" and "High status range.

BOD was below the detection limit of 5 mg/l for 5 of 6 samples, however it exceeded both the "Good status" and "High status" threshold at SW16.

Construction Access Road

An additional three sampling location were selected downstream of the construction access road and the results for these are discussed below.

Total suspended solids at all sampling locations (taken 19/03/2020) were <5mg/L. Nitrite, nitrate, orthophosphate, nitrogen and phosphorus values were below or equal to the laboratory detection limits.

Ammonia values ranged between <0.02 and 0.02mg/L.

In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), all ammonia and orthophosphate samples were below the "High Status" threshold. BOD was reported at 2mg/L in all samples which exceeds the "Good Status" threshold.

The results of sampling are presented in Table 9-16.

Table 9-16: Analytical results for Access Road (19/03/2020)

Parameter	EQS	Sample ID		
		SW20	SW21	SW22
Total Suspended Solids (mg/L)	25(+)	<5	<5	<5
Ammonia (mg/L)	≤0.065 to ≤ 0.04(*)	0.02	<0.02	<0.02
Nitrite NO_2 (mg/L)	-	<0.05	<0.05	<0.05
Ortho-Phosphate – P (mg/L)	≤ 0.035 to ≤0.025(*)	<0.02	<0.02	<0.02
Nitrate - NO_3 (mg/L)	-	<5	<5	<5
Nitrogen (mg/L)	-	<1	<1	<1
Phosphorus (mg/L)	-	<0.1	<0.1	<0.1
Chloride (mg/L)	-	14.9	13.2	15.4
BOD	≤ 1.3 to ≤ 1.5(*)	2	2	2

(+) S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations
(*) S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy).

9.3.8 Hydrogeology

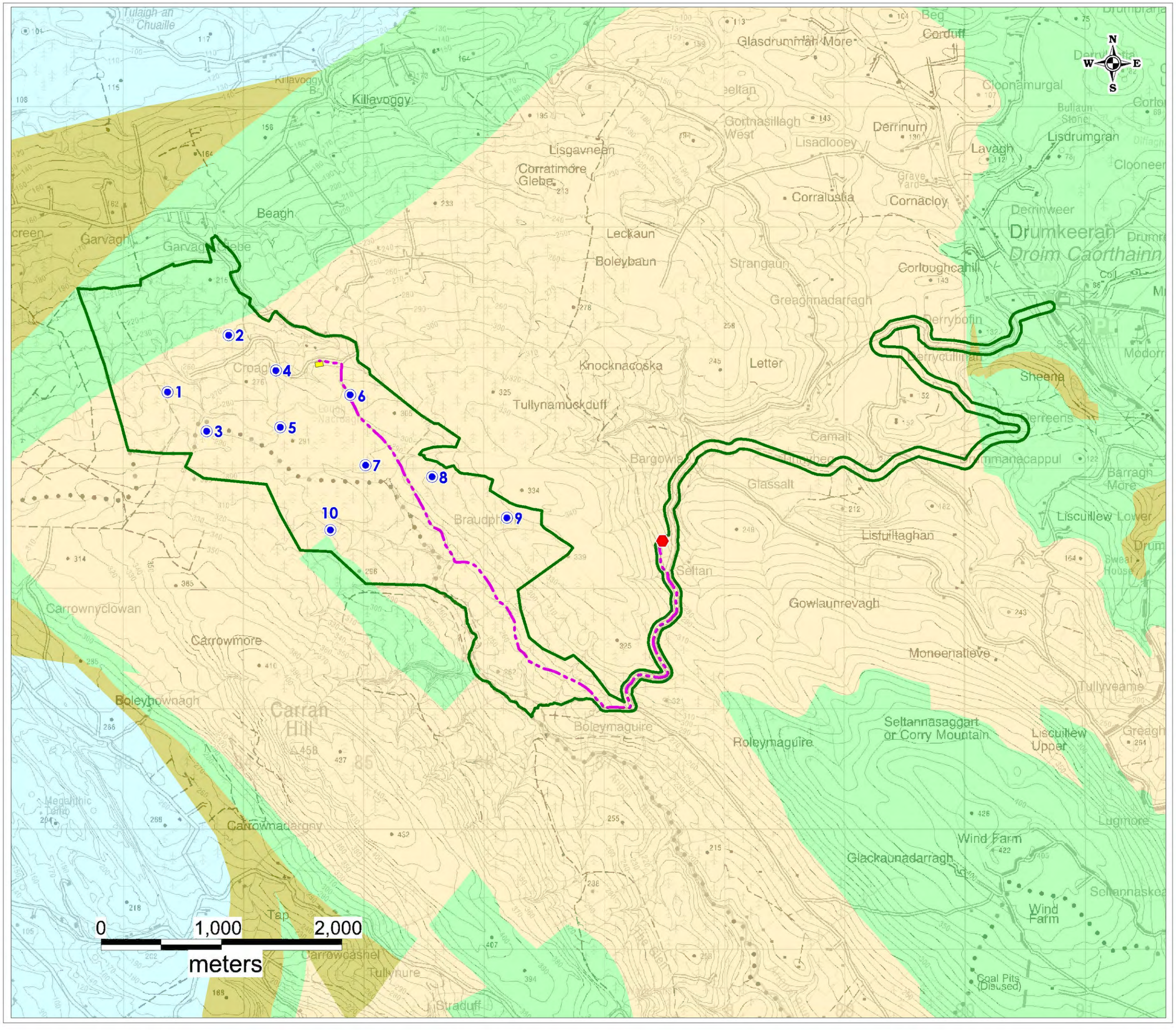
The underlying bedrock within the EIAR site boundary is mapped as being predominantly Namurian Shales, with the north-western tip of the site being mapped as Dinantian Shales and Limestones following a conformable contact (refer to Chapter 8 – Soils & Geology).

The actual bedrock encountered during drilling at the proposed borrow pit locations comprised LIMESTONE (BH1 and BH2) and SILSTONE (BH3 and BH4) which was relatively competent/strong but being locally weak along tight discontinuities. No significant water bearing faults or fractures were encountered. The rueasured bedrock permeability at each of the boreholes (see Table 9.13) are very low which is characteristic of this bedrock aquifer type (refer to Fignre 8.2 and Figure 8.3 of the Land, Soils and Geology Chapter for the borehole locations).

The GSI has classified the Namurian Shales as a Poor Aquifers (Pu -bedrock which is generally unproductive), and the northern Dinantian Shales and Limestones as a Poor Aquifer (Pl–bedrock which is generally unproductive except in local zones). These rocks are described as being devoid of intergranular permeability, with groundwater flow occurring in fault fractures and joints where present. Groundwater paths are suggested to be short, generally 30-300m with groundwater discharging to local streams and to Lough Allen. A bedrock aquifer map is shown as Figure 9-4.

The generally low permeability of these dominantly Naruurian Shales and Dinantian Shales and Limestones will likely act as a barrier to groundwater flow from adjoining karstic groundwater bodies. Typically, groundwater flux is likely to occur in the uppermost part of the aquifer, comprising a broken and weathered zone typically less than 3m thick, a zone of interconnected fissuring 10-15m thick, and a zone of isolated poorly connected fissuring typically less than 150m. (GSI, 2004). However, no significant fault or fissure zones were encountered in any of the boreholes which were drilled to a total depth of approximately 30m.

The GSI have mapped two groundwater bodies within the site, the Lough Allen GWB and the Belhavel Lough GWB. These GWB's are delineated along a similar line to that separating the Arigna and Bonet



Legend

- EIAR Site boundary
- Proposed Turbine
- Proposed Substation
- Proposed Underground Grid Connection Route
- Garvagh Substation
- Locally Important Aquifer - Bedrock which is Moderately Productive only in Local Zones
- Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones
- Poor Aquifer - Bedrock which is Generally Unproductive
- Regionally Important Aquifer - Karstified (conduit)

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Client: MKO	
Job: Croagh WF, Co. Leitrim	
Title: Local Bedrock Aquifer Map	
Figure No: 9.4	
Drawing No: P1459-0-0620-A3-904-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:30,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

river subcatchments described earlier. The Lough Allen GWB encompasses most of the southern half of the proposed development site, while the northern half of the site is within the Belhavel Lough GWB.

Baseflow contribution to streams tends to be low, particularly in summer as the groundwater regime cannot sustain summer base flows due to low storativity within the aquifer. In winter, low permeabilities will lead to a high water table and potential water logging of soils which is consistent with the poorly draining nature of the site. Local groundwater flow directions are assumed to mimic topography whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams, this will typically translate to groundwater flux trending north in the northern section of the Aquifer (Belhavel Lough GWB) and trending south in the southern section (Lough Allen GWB).

Groundwater level data for boreholes are shown Table 9.13 below. The groundwater levels, which were measured in summer, are likely to be higher and closer to ground level during winter. Based on experience from similar aquifer types, a high groundwater table at the topographic setting of the site would suggest low permeability bedrock as demonstrated by the permeability tests .

Table 9-17: Results of Groundwater Level Monitoring and Bedrock Permeability Tests

Water Level	BH1		BH2		BH3		BH4	
	mbgl	mOD	mbgl	mOD	mbgl	mOD	mbgl	mOD
24/06/2019	5.42	291.6	12.65	292	-	-	-	-
25/06/2019	-	-	-	-	9.66	274.6	1.76	277.5
Permeability (m/sec)	2.3×10^{-7}		2.81×10^{-8}		7.3×10^{-7}		5.2×10^{-7}	

9.3.9 Groundwater Vulnerability

The vulnerability rating of the aquifer within the EIAR site ranges between "Low to Moderate vulnerability" to "High to Extreme vulnerability" and this reflects the varying depth of local subsoils and peat (the higher the vulnerability rating is a reflection of how close bedrock is to the ground surface). In areas where subsoil is shallow or absent and where bedrock is outcropping an Extreme vulnerability rating is given. The more elevated areas on the south and southeast of the site are rated "High to Extreme" while the remaining central and northern lower lying section of the site is rated as "Low to Moderate".

However, due to the low permeability nature of the shale bedrock aquifer underlying the site, groundwater flow paths are likely to be short, with recharge emerging close by at seeps and surface streams. This means there is a low potential for groundwater dispersion and movement within the aquifer, making surface water bodies such as drains and streams more vulnerable than groundwater at this site.

9.3.10 Groundwater Hydrochemistry

There is no groundwater quality data for the proposed wind farm site and groundwater sampling would generally not be undertaken for this type of development in terms of EIAR reporting as groundwater quality impacts would not be anticipated.

Based on data from GSI publication Calcareous/Non-calcareous classification of bedrock in the Republic of Ireland (WFD,2004), alkalinity for the Namurian Sedimentary bedrock aquifers generally ranges from 4 – 436 mg/L, with a mean value of 167 mg/l, while electrical conductivity and hardness were reported to have mean values of 418 S/cm and 173 mg/L respectively.

9.3.11 Water Framework Directive Water Body Status & Objectives

The River Basin Management Plan was adopted in 2018 and has amalgamated all previous river basin districts into one national river basin management district. The River Basin Management Plan (2018 - 2021) objectives, which have been integrated into the design of the proposed wind farm development, include the following:

- Ensure full compliance with relevant EU legislation;
- Prevent deterioration and maintain a 'high' status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2021;
- Ensure waters in protected areas meet requirements; and,
- Implement targeted actions and pilot schemes in focused sub-catchments aimed at (1) targeting water bodies close to meeting their objectives and (2) addressing more complex issues that will build knowledge for the third cycle.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status at all.

Strict mitigation measures (refer to Section 9.5.3 and 9.5.4) in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be maintained (see below for WFD water body status and objectives) regardless of their existing status.

9.3.12 Groundwater Body Status

Local Groundwater Body (GWB) status information are available (www.catchments.ie).

The Lough Allen GWB (GWB: IEGBNI_SH_G_002) underlies the south of the site. It is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

The Belhavel Lough GWB (IE_WE_G_0045) underlies much of the southern, and part of the eastern section of the proposed development site. It is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

9.3.13 Surface Water Body Status

Local Surface water Body status and risk result are available from (www.catchments.ie).

The Proposed Development site is located within the Arigna 26A_4 and Bonet 35_6 subcatchments. Each subcatchment and associated watercourse achieved good status under the WFD 2010-2015, with the exception of the Killanummery river which achieved high status.

9.3.14 Designated Sites & Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs) Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The Proposed Development is not located within any designated conservation-site. Designated sites in proximity to the proposed development site are shown in Figure 9-5.

Lough Gill

Lough Gill SAC

Boleybrack Mountain SAC

Owengar Wood

Carrane Hill Bog NHA

Corry Mountain Bog NHA

Corry Mountain Bog NHA

Meharth Lough

Lough Arrow SAC

Lough Arrow

Lough Arrow SPA

Kilronan Mountain Bog NHA

0 2,000 4,000

meters

Legend

- EIAR Site boundary
- Proposed Underground Grid Connection Route
- SPA
- SAC
- pNHA
- NHA

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Client: MKO	
Job: Croagh WF, Leitrim	
Title: Designated Sites Map	
Figure No: 9.5	
Drawing No: P1459-0-0620-A3-905-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:70,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

The south-eastern boundary of the site is bounded by the Corry Mountain Bog NHA. As the NHA is entirely above (in elevation) the proposed development area, no part of the proposed development areas drains towards this designated site. The topographical difference between the site and the NHA is shown graphically in Appendix 9-3 Summary data is presented in Table 9-18.

The natural slope in south-eastern area of the wind farm site is from the NHA area down towards the forestry site and the proposed wind farm site. The natural elevation changes along this boundary are moderate, e.g. between the NHA and proposed T9 location the elevation change is ~10m, i.e. the ground elevation at the turbine location is 10m lower than at the NHA boundary over a separation distance of ~160m.

In addition, there is a firebreak along this boundary between the NHA and the adjoining forested areas. This firebreak is approximately 3-5m wide, and bare peat is exposed within the fire break excavation.

In addition to these prevailing conditions, downhill of the firebreak the forestry site has an altered drainage regime with mound drains installed in the peat that do not extend as far as the NHA. There is also ongoing tree felling and replanting in this area of the forestry plantation.

Based on separation distances, the elevation differences between the NHA boundary and proposed development, the presence of dividing fire break, and the existing altered drainage regime we are satisfied that this physical scientific evidence is more than sufficient to conclude that the potential for alteration of the natural peatland hydrology within the NHA by the proposed wind farm development is negligible.

The proposed grid connection route and construction access road have no potential to impact on this NHA as they use an existing track in the area of the NHA.

Table 9-18: Relative distances and elevation changes to Corry Mountain NHA

Transect ID	Development Element	Horizontal Distance from Infrastructure to NHA (m) (⊥ to contours)	Min. Ground Elevation Difference (m)	Gradient to NHA
X-T8	T8	175	~5	Up-gradient
X-T9	T9	160	~10	Up-gradient
X-BP4	BP4	200	~20	Up-gradient

The closest SAC to the site is Boleybrack Mountain SAC located approximately 5.4 km northeast of the proposed development site. No areas of the site drains in this direction. Similarly, Lough Arrow, a SAC, SPA and NHA is located approximately 9.2km southwest of the site. Again, no areas of the site drain in this direction, therefore there will likely be no impact.

The majority of the northern section of the Proposed Development site ultimately drains into the Bonet River which then flows through the Lough Gill SAC, located approximately 10km north of the site. Lough Gill is a large lake, approximately 8km long and over 20m deep in places. Several species of Lamprey as well as Atlantic Salmon and White Clawed Crayfish are found within the lake. The only priority habitat/species listed is the Orchid-rich Calcareous Grassland.

9.3.15 Within the River Shannon catchment, the closest downstream SAC is Lough Forbes Complex which is located 43.1km (approx. 61km surface water

distance) downstream of the Proposed Development.

Water Resources

There are no mapped public groundwater supplies or group schemes within 6km of the proposed Croagh Wind Farm and 3 km of the associated grid route.

A total of 7 no. groundwater wells, were identified within a 5km radius from the EIAR site boundary in the GSI well database (www.gsi.ie). These wells, as shown on Figure 9-6, are all located south of the proposed site within the Lough Allen GWB and all were described as being domestic wells. Some information on lithology was available from one well in the townland of Tents/Srabra which was described as black shale/limestone. None of these GSI mapped wells are located downgradient of the proposed wind farm development.

GSI mapped wells with accuracy greater than 50m were not assessed due to the poor information/accuracy regarding their location. To overcome the poor accuracy problem of other GSI mapped wells (>50m accuracy) it is conservatively assumed (for the purpose of assessment only) that every private dwelling in the area (shown also on Figure 9-6) has a well supply and this impact assessment approach is described further below. (Please note wells may or may not exist at each property and our discussions with near neighbours together with the presence of a public water supply in the area support this, but our conservative worst case rationale here is that it is better to assume a well may exist at each downgradient property and assess the potential impacts from the proposed development on such assumed wells, rather than make no assessment and find out later that groundwater wells do actually exist).

The private well assessment undertaken below also assumes the groundwater flow direction underlying the site mimics topography, whereby flow paths will be from topographic high points (i.e. top of hill) to lower elevated discharge areas at local streams/rivers.

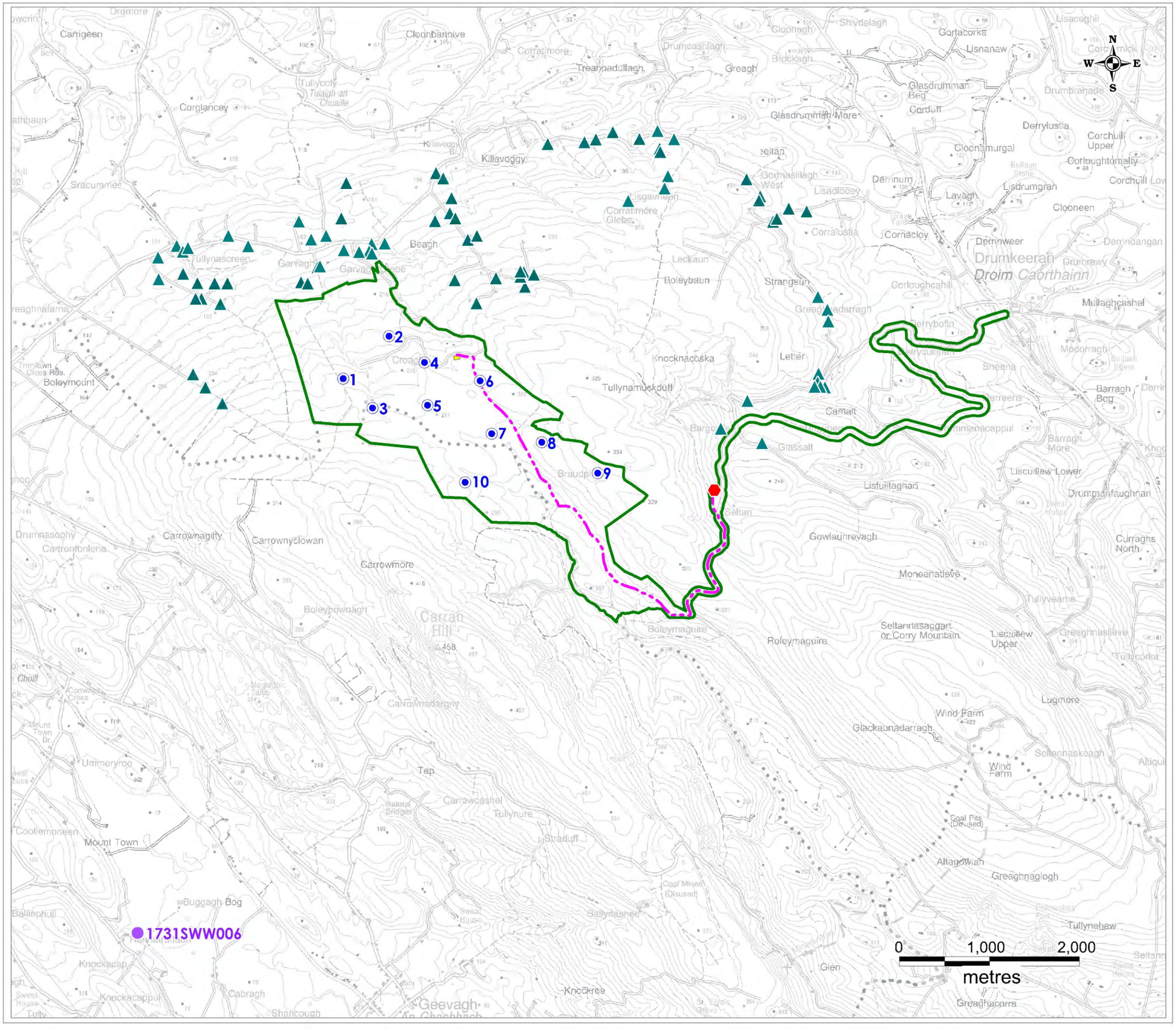
Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the footprint of the proposed development footprint are identified and a worst-case impact assessment for these actual and potential well locations is undertaken.

Based on the above approach no private dwelling houses were identified to be located down-gradient (i.e. downslope) of the proposed wind farm infrastructure development (and in particular turbine and borrow pit locations) and therefore there is no potential to impact on groundwater supplies. This assessment was focused on the turbine locations and borrow pit as this is where the deepest excavations will be required. All excavations required for roads, compounds, met mast, amenity walkways and substations will be relatively shallow and therefore no siguificant potential to impact on groundwater supplies will occur.

According to the EPA Abstraction Register (http://watermaps.wfdireland.ie/HydroTool/Viewer) Lough Nacroagh was utilised as a private drinking water abstraction point (IE_WE_35_188). However, based on discussion with the local residents this source is no longer in use as the premises in question is now connected to the public supply.

9.3.16 Receptor Sensitivity

Due to the nature of wind farm developments, being near surface construction activities, impacts on groundwater are negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages (These are assessed below at Sections 9.5.3.5 and 9.5.3.7). These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources will be carefully managed at the site during the construction and operational phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.



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Client: MKO	
Job: Croagh WF, Leitrim	
Title: Public and Private Water Supply Map	
Figure No: 9.6	
Drawing No: P1459-0-0620-A3-906-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:40,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

Based on criteria set out in Table 9.1, groundwater at the site can be classed as Not Sensitive to pollution because the bedrock is generally relatively impermeable and classified as a poor aquifer. In addition, the majority of the site is covered in blanket peat which acts as a protective cover to the underlying aquifer. Any contaminants which may be accidently released on-site are more likely to travel to nearby streams within surface runoff.

Surface waters such as the Rivers Bonet and Arigna are very sensitive to potential contamination. These rivers and associated lakes are known to be of trout potential and are important locally for fishing (see Biodiversity, Chapter 6).

The designated sites that are hydraulically connected (surface water flow paths only) to the proposed wind farm development site is the Lough Gill SAC. This designated site can be considered very sensitive in terms of potential impacts (see Chapter 6 of the EIAR).

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing hydrological regime thereby avoiding changes to flow volumes leaving the site.

A hydrological constraints map for the site is shown as Figure 9-7. A self-imposed 50m buffer from streams and lakes was applied during the constraints mapping and will be maintained during the construction phase. Apart from the upgrade of existing roads and stream crossings, most of the proposed development areas are generally away from areas on the site that have been determined to be hydrologically sensitive. The large setback distance from sensitive hydrological features means they will not be impacted on by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features within sub-catchments. This will allow attenuation of surface runoff to be more effective.

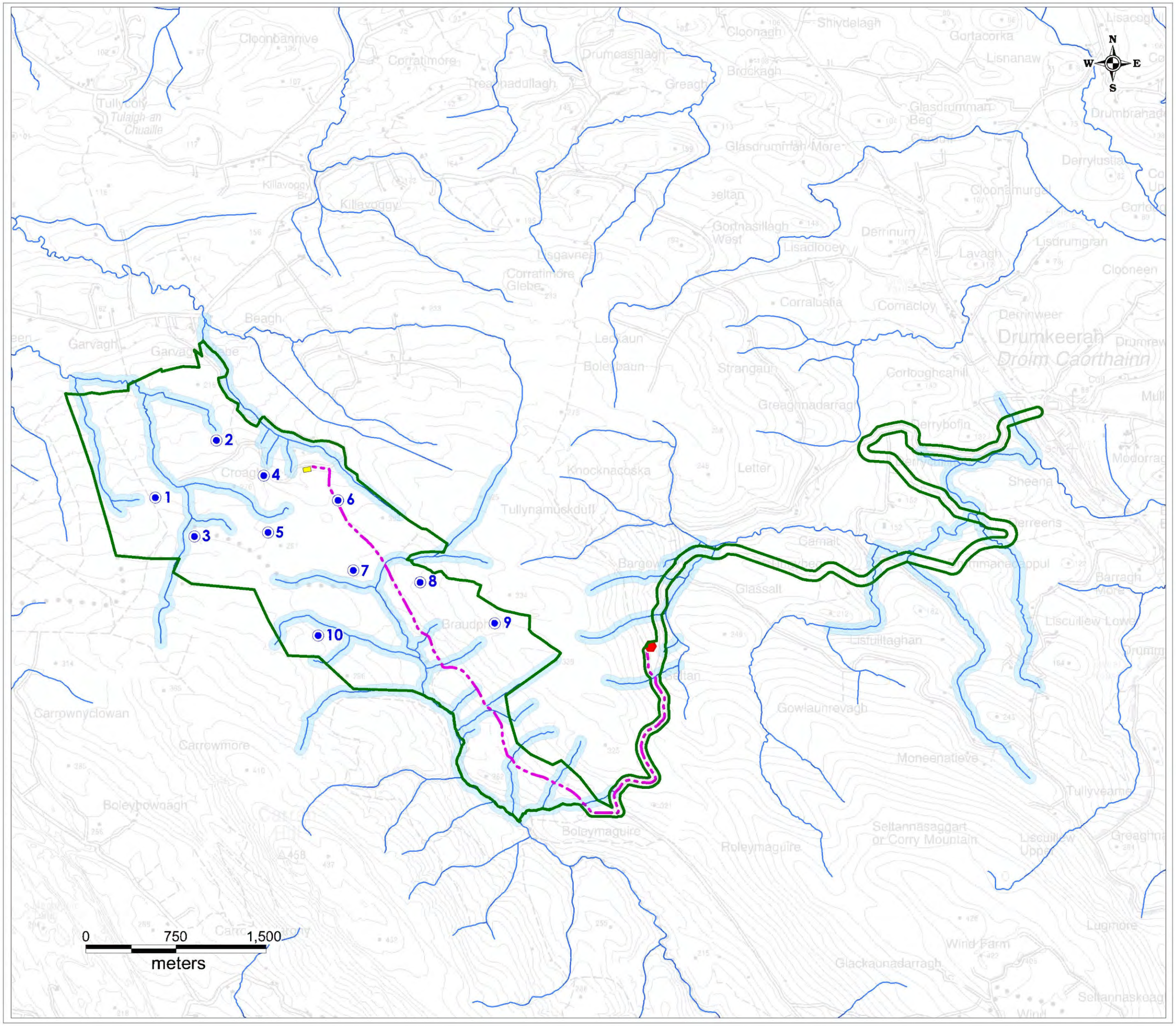
9.4 Characteristics of the Proposed Development

The development comprises of the following:

- 10 no. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas;
- 1 no. permanent meteorological mast up to a height of 100 metres;
- Provision of new site access roads and upgrade of existing roads and associated drainage;
- 1 no. 38 kV electrical substation;
- 2 no. temporary construction compound;
- All associated underground electrical and communications cabling connecting the turbines to the proposed electrical substation;
- 1 no. borrow pit and 2 no. repository areas;
- Forestry felling;
- All works associated with the connection of the proposed wind farm to the national electricity grid at the existing Garvagh Glebe 110kV substation; and,
- All associated site development works.

9.4.1 Development Interaction with the Existing Forestry Drainage Network

In relation to hydrological constraints, a self-imposed buffer zone of 50m has been put in place for on-site streams and lakes. Manmade forestry drains at the site are not considered a hydrological constraint and therefore no buffering of forestry drains has been undertaken.



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Client: MKO	
Job: Croagh WF, Leitrim	
Title: Hydro-Constraints Map	
Figure No: 9.7	
Drawing No: P1459-0-0620-A3-907-0A	
Sheet Size: A3	Project No: P1459-0
Scale: 1:30,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

The general design approach to wind farm layouts in existing forestry is to utilise and integrate with the existing forestry infrastructure where possible whether it be existing access roads or the existing forestry drainage network. Utilising the existing infrastructure means that there will be less of a requirement for new construction/excavations which have the potential to impact on downstream watercourses in terms of suspended solid input in runoff (unless managed appropriately). The existing forestry drains have no major ecological or hydrological value and can be readily integrated into the proposed wind farm drainage scheme using the methods outlined below (Sections 9.3.18 and 9.4.3.2).

9.4.2 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the Proposed Development. The first method involves 'keeping clean water clean' by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards stilling ponds prior to controlled diffuse release over vegetated surfaces. There will be no direct discharges to surface waters. During the construction phase all runoff from works areas (i.e. dirty water) will be attenuated and treated to a high quality prior to being released. A schematic of the proposed site drainage management is shown as Plate 9-2 below. A detailed drainage plan showing the layout of the proposed drainage design elements during construction and operation as shown in Plate 9-2 is shown in Appendix 4-5.

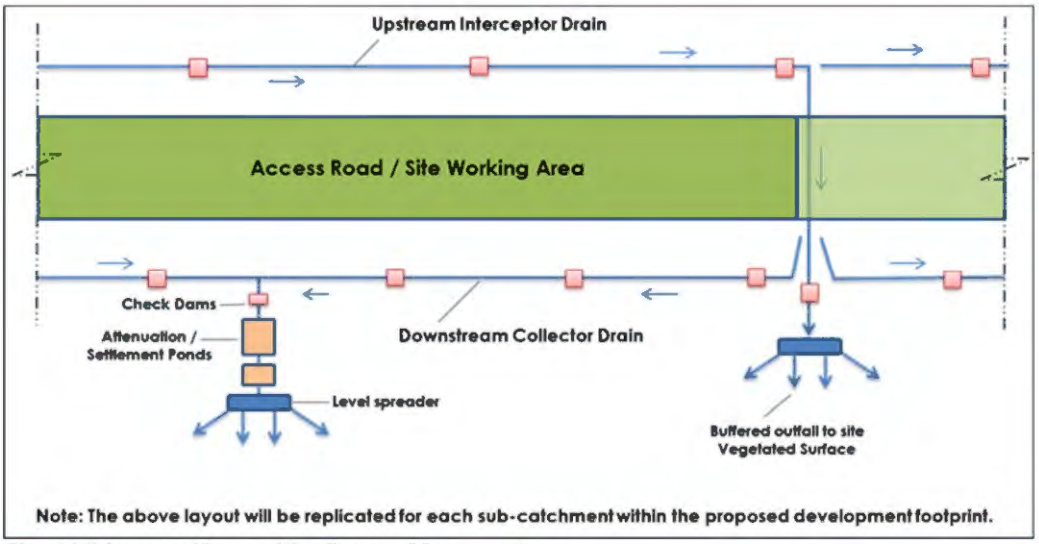


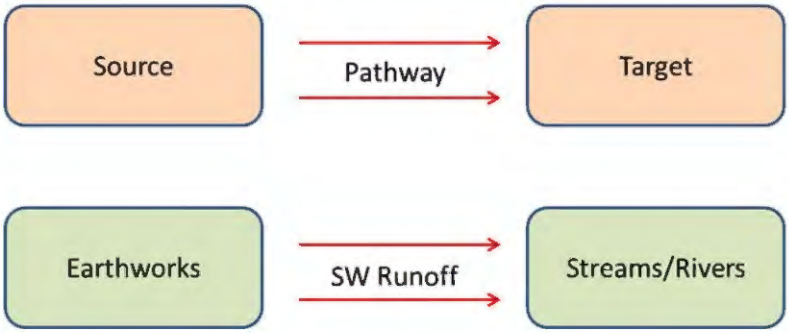
Plate 9-2 Schematic of Proposed Site Drainage Management

9.5 Likely Significant Effects and Associated Mitigation Measures

The potential impacts of the Proposed Development and mitigation measures that will be put in place to eliminate or reduce them are set out below.

9.5.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential impacts on downstream environmental receptors (see below, bottom as an example) as a result of the proposed wind farm development.



As outlined previously, where potential impacts are identified, the classification of impacts in the assessment follows the descriptors set out in the Glossary of effects (EPA, 2017) as outlined in Chapter 1 of this EIAR.

The descriptors used in this environmental impact assessment are those set out in the EPA (2017) Glossary of effects as shown in Chapter 1 of this EIAR.

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 9.5.3 and 9.5.4), we have presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process (

Table 9-19). The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all wind farm construction and operation and decommissioning activities.

Table 9-19: Impact Assessment Process Steps

Step 1	Identification and Description of Potential Impact Source: This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, e.g. human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified siguificant negative impacts. In relation to this type of development, these measures are

Step 1	Identification and Description of Potential Impact Source: This section presents and describes the activity that brings about the potential impact or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of this type of development, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.
		generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post-Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

9.5.2 Do Nothing Scenario

An alternative land-use option to the development of a renewable energy project at the proposed development site would be to leave the site as it is, with no changes made to existing land-use practices. Commercial forestry operations (including the associated drainage measures) would continue at the site.

The existing commercial forestry operations can and will continue in conjunction with this proposed use of the site. Surface water drainage operating in areas of forestry will continue and may be extended in some areas.

9.5.3 Construction Phase - Likely Significant Effects and Mitigation Measures

9.5.3.1 Clear Felling of Coniferous Plantation

It is estimated that 55.1 (hectares) in total of existing plantation forestry will be felled to allow for development of the proposed infrastructure.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses;
- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface watercourses;
- Release of sediment attached to timber in stacking areas; and,
- Nutrient release.

Pathways: Drainage and surface water discharge routes.

Receptors: Surface water quality and associated dependant ecosystems.

Pre-Mitigation Potential Impact: Negative, moderate, indirect, temporary, likely impact on surface water quality and dependant ecosystems.

Proposed Mitigation Measures:

Best practice methods, relating to water protection, incorporated into the forestry management and mitigation measures (listed below) have been derived from:

- Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;
- Coillte (2009): Forest Operations and Water Protection Guidelines;
- Coillte (2009): Methodology for Clear Felling Harvesting Operations;
- Forest Service (Draft): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures; and,
- Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Mitigation by Avoidance:

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document "Forestry and Water Quality Guidelines" are shown in Table 9.17.

Table 9-17 Minimum Buffer Zone Widths (Forest Service, 2000)

Average slope leading to the aquatic zone		Buffer zone width on either side of the aquatic zone	Buffer zone width for highly erodible soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

During the wind turbine construction phase a self-imposed buffer zone of 50 metres will be maintained for all streams These buffer zones are shown on Figure 9-7. With the exception of existing road upgrades and proposed stream crossings all proposed tree felling areas are generally located outside of imposed buffer zones. Additional mitigation (detailed below) will be carried out where tree felling is required inside the buffer zones.

The large distance between most of the proposed felling areas (which are outside the 50m buffer) and sensitive aquatic zones means that potential poor-quality runoff from felling areas will be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes.

The following mitigation measures will be employed during tree felling. Additional measures are indicated for felling inside the 50m buffer zone.

Mitigation by Design:

Mitigation measures which will reduce the risk of entrainment of suspended solids and nutrient release in surface watercourses comprise best practice methods (from the guidance listed above) which are set out as follows:

- Machine combinations (i.e. hand-held or mechanical) will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;
- Trees will be cut manually inside the 50m buffer and using machinery to extract whole trees only;
- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour;
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;
- In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple sediment traps.
- Double silt fencing will also be put down slope of felling areas which are located inside the 50 metre buffer zone;
- All drainage chaunels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone;
- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled;
- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall;
- Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;
- Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;
- Checking and maintenance of roads and culverts will be on-going through the felling operation;
- No crossing of streams by machinery will be permitted and only travel perpendicular to and away from stream will be allowed;
- Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required;
- A permit to refuel system will be adopted at the site; and,
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Silt Traps:

Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.

Drain Inspection and Maintenance:

The following items shall be carried out during pre-felling inspections and after:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines;
- Inspection of all areas reported as having unusual ground conditions;
- Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall;
- Following tree felling all main drains shall be inspected to ensure that they are functioning;
- Extraction tracks nears drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground;
- Culverts on drains exiting the site will be unblocked; and,
- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.

Surface Water Quality Monitoring:

Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling should be conducted within 4 weeks of the felling activity, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown). The felling surface water monitoring data will also be compared with the EIAR baseline water quality sampling data.

Criteria for the selection of water sampling points include the following:

- Avoid man-made ditches and drains, or watercourses that do not have year-round flows, i.e. avoid ephemeral ditches, drains or watercourses;
- Select sampling points upstream and downstream of the forestry activities;
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;
- Where possible, downstream locations should be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and,
- The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed.

Also, daily surface water monitoring forms will be utilised at every works site near watercourses. These will be taken daily and kept on site for record and inspection.

Residual Impact: Negative, slight, indirect, temporary, unlikely impact on surface water quality, and dependant ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

9.5.3.2 Earthworks (Removal of Vegetation Cover, Excavations and Stock Piling) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities that will require earthworks resulting in removal of vegetation cover and excavation of peat and mineral subsoil (where present) are detailed in Chapter 4: Description of the Proposed Development. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from infrastructure excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the grid connection cable trench resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential impacts are significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.

Receptors: Down-gradient rivers and dependant ecosystems.

Pre-Mitigation Potential Impact: Negative, significant, indirect, short term, unlikely impact on down gradient rivers, water quality, and dependant ecosystems.

Mitigation by Avoidance:

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas where possible. From Figure 9-7 it can be seen that all of the key areas of the Proposed Development and the temporary construction access road are actually significantly away from the delineated buffer zones with the exception of existing road upgrades, proposed stream crossings and existing stream crossings requiring upgrading. Additional control measures, which are outlined further on in this section, will be undertaken at these locations.

The large setback distance from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures (discussed below) to be properly installed and operate effectively. The proposed buffer zone will:

- Avoid physical damage to watercourses, and associated release of sediment;
- Avoid excavations within close proximity to surface water courses;
- Avoid the entry of suspended sediment from earthworks into watercourses; and,
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Mitigation by Design:

- Source controls:
  - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other similar/equivalent or appropriate systems.
  - Small working areas, covering stockpiles, weathering off stockpiles andcessation of works.
- In-Line controls:

- Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

- Treatment systems:
  - Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other similar/equivalent or appropriate systems.

It should be noted for this site that an extensive network of forestry and roadside drains already exists, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The integration of the existing forestry drainage network and the proposed wind farm network is relatively simple. The key elements being the upgrading and improvements to water treatment elements, such as in line controls and treatment systems, including silt traps, stilling ponds and buffered outfalls.

The main elements of interaction with existing drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed wind farm drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the construction phase of the wind farm, runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces;
- Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and,
- Drains running parallel to the existing roads that requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.

Water Treatment Train

A final line of defence will be provided by a water treatment train such as a "Siltbuster" if required. If the discharge water from construction areas fails to be of a high quality during the daily inspections then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Silt Fences

Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones.

Silt Bags

Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the development will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:

- General Forecasts: Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works will be suspended if forecasting suggests either of the following is likely to occur:

- >10 mm/hr (i.e. high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures should be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Peat and Subsoil Reinstatement Areas

It is proposed that excavated peat will be used for landscaping throughout the site and any excess peat will be used to reinstate the 1 no. proposed borrow pit and placed within 2 no. possible peat repositories. The proposed borrow pit and peat and spoil repositories arelocated outside the 50m stream and lake buffer zone (refer to Figure 9-7).

During the initial placement of peat and subsoil at repository areas, silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the repository areas. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Drainage from peat reinstatement areas will ultimately be routed to an oversized swale and a number of stilling ponds pond and a 'Siltbuster' with appropriate storage and settlement designed for a 1 in 100 year 6 hour return period before being discharged to the on-site drains.

Peat/subsoil reinstatement areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil reinstatement areas will no longer be a potential source of silt laden runoff

Timing of Site Construction Works

Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling.

Any excess build-up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be inspected daily and removed.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events (as per the CEMP).

Residual Impact: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely impact on down gradient rivers, water quality, and dependant ecosystems.

Significance of Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

9.5.3.3 Potential Impacts on Groundwater Levels and Local Well Supplies During Excavation works & from proposed Borrow Pit

Dewatering of borrow pit (if required) and other deep excavations (i.e. turbine bases) have the potential to impact on local groundwater levels. However, groundwater level impacts will not be significant due the local hydrogeological regime and the proposed borrow pit excavation method as outlined below. No groundwater level impacts will occur from the construction of the grid connection underground cabling trench or any other element of the project (i.e. access roads, substation, carpark, compound, boardwalk, met mast etc) due to the shallow nature of the excavations.

Pathway: Groundwater flowpaths.

Receptor: Groundwater levels.

Pre-Mitigation Potential Impact: Negative, imperceptible, direct, slight, short term, unlikely impact on groundwater levels/flowpaths and groundwater quality.

Impact Assessment

The proposed borrow pit is located in bedrock that has been classified as a Poor bedrock aquifer by the GSI. No groundwater dewatering will be required as rock excavation will progress in a horizontal manner into the side of outcropping bedrock.

The topographical and hydrogeological setting of the proposed borrow pit locations means no significant groundwater dewatering is anticipated to be required during the operation of the borrow pit. Moreover, direct rainfall and surface water runoff will be the main inflows that will require water volume and water quality management. For the avoidance of doubt, we would generally define dewatering as a requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. We consider that this example is very different in scale and operation from the proposed operation of a temporary shallow borrow pit on the side of a hill. In order to explain this thoroughly we will outline our reasoning in a series of bullet points as follows:

- Firstly, the borrow pit areas are located on the side of a local hill where the ground elevations are between 280 and 300m OD;
- These elevations are above the elevations of the local valleys and streams;
- The proposed borrow pit will be between approximately 8 – 10m below ground level which is notable. However, in the context of the topographical/elevated setting of the borrow pit, this depth range is relatively shallow;
- The local bedrock comprises generally siltstone limestone and is known to be generally unproductive. This means that groundwater flows will be relatively minor;
- The investigation drilling encountered competent and relatively unfractured bedrock with tight joint spacing. The measured permeability (refer to Section 9.3.7) at each borehole confirmed the bedrock competency and very low permeability;

- The flow paths (i.e. the distance from the point of recharge to the point of discharge) in this type of geology is short, localised, and will also be relatively shallow;
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations;
- Therefore, shallow groundwater inflows will largely be fed by recent rainfall, and possibly by limited groundwater seepage form localised shallow bedrock;
- The sloping nature of the ground on the hills where the borrow pit is proposed along with the coverage of soil means groundwater recharge is going to be very low;
- As such the shallow groundwater flow system will be small in comparison to the expected surface water flows from the bog surface;
- This means that there will be a preference for high surface water runoff as opposed to groundwater recharge and flow; and,
- Hence, we consider that the management of surface water will form the largest proportion of water to be managed and treated.

In terms of local well supplies, the assessment undertaken in Section 9.3.15 above identified no potential wells within the same sub-catchments as the proposed development. Therefore, there is no well supplies down-gradient of any proposed development area that can be impacted on.

Residual Impact: Due to large separation distances between proposed development works and water wells and local stream and rivers, and the relatively shallow nature of the proposed borrow pit works, and also the prevailing geology of the proposed development site the potential for water level drawdown impacts at receptor locations is considered negligible. The residual effect is considered to be – Negative, imperceptible, direct, short term, unlikely impact on groundwater levels, and Negative, imperceptible, short term, unlikely impact on groundwater quality.

Significance of Effects: For the reasons outlined above, no significant effects on groundwater levels and groundwater quality will occur.

9.5.3.4 Excavation Dewatering and Potential Impacts on Surface Water Quality

Some minor groundwater/surface water seepages will likely occur in turbine base excavations and the borrow pit and this will create additional volumes of water to be treated by the runoff management system. Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are not anticipated.

Pathway: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies.

Pre-Mitigation Potential Impact: Negative, significant, indirect, short term, unlikely impact to surface water quality.

Mitigation by Design:

Management of groundwater seepages and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build up of water in the excavation;
- The interceptor drainage will be discharged to the site constructed drainage system or onto natural vegetated surfaces and not directly to surface waters;

- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit;
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites. They will be used as final line of defence if needed.

Residual Impact: The potential for the release of suspended solids to watercourse receptors is a risk to water quality and the aquatic quality of the receptor. Proven and effective measures to mitigate the risk of releases of sediment have been proposed above and will break the pathway between the potential sources and the receptor. The residual effect is considered to be – Negative, imperceptible, indirect, short term, unlikely impact on local surface water quality.

Significance of the Effects: For the reasons outlined above, no significant effects on the surface water quality will occur.

9.5.3.5 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Groundwater and surface water.

Pre-Mitigation Potential Impact: Negative, slight, indirect, short term, unlikely impact to local groundwater quality. Negative, significant, indirect, short term, unlikely impact to surface water quality.

Proposed Mitigation Measures:

Mitigation measures proposed to avoid release of hydrocarbons at the site are as follows:

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station where possible;
- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- Onsite refuelling will be carried out by trained personnel who will require a permit to refuel

- Fuels stored on site will be minimised. Fuel storage areas if required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within Construction and Environmental Management Plan (Appendix 4.4). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Residual Impact: The potential for the release of hydrocarbons to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of hydrocarbons have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely impact to local groundwater quality. Negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

9.5.3.6 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from domestic wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

Pathway: Groundwater flowpaths and site drainage network.

Receptor: Down-gradient well supplies, groundwater quality and surface water quality.

Pre-Mitigation Potential Impact: Negative, significant, indirect, short term, unlikely impact to surface water quality. Negative, slight, indirect, temporary, unlikely impact to local groundwater.

Proposed Mitigation by Avoidance:

- A self-contained port-a-loo with an integrated waste holding tank will be used at the site compound, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use from the site to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site or discharged to the site.

Residual Impact: No residual impact.

Significance of Effects: For the reasons outlined above, no significant effects on surface water or groundwater quality will occur.

9.5.3.7 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of $\geq 6 \leq 9$ is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment.

Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to introduction of high pH alkaline waters into the system. Batching of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution.

Pathway: Site drainage network.

Receptor: Surface water quality.

Pre-Mitigation Potential Impact: Negative, moderate, indirect, short term, medium probability effect to surface water quality.

Proposed Mitigation by Avoidance:

The following mitigation measures are proposed:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place.
- Where possible pre-cast elements for culverts and concrete works will be used.
- Where concrete is delivered on site, only the chute will be cleaned, using the smallest volume of water practicable. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water will be undertaken at lined cement washout ponds.
- Weather forecasting will be used to plan dry days for pouring concrete.
- The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Impact: The potential for the release of cement-based products or cement truck wash water to groundwater and watercourse receptors is a risk to surface water and groundwater quality, and also the aquatic quality of the surface water receptors. Proven and effective measures to mitigate the risk of releases of cement-based products or cement truck wash water have been proposed above and will break the pathway between the potential source and each receptor. The residual effect is considered to be - Negative, imperceptible, indirect, short term, unlikely impact to surface water quality.

Significance of the Effect: For the reasons outlined above, no significant effects on surface water quality will occur.

9.5.3.8 Morphological Changes to Surface Water Courses & Drainage Patterns

Diversion, culverting and bridge crossing of surface watercourses can result in morphological changes, changes to drainage patterns and alteration of aquatic habitats. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the construction phase.

It is proposed that 9 no. new stream crossings and potentially up to 16 no. existing stream crossing upgrades will be required to facilitate the wind farm development.

Pathway: Site drainage network.

Receptor: Surface water flows, stream morphology and water quality.

Pre-Mitigation Potential Impact: Negative, slight, direct, long term, unlikely impact on stream flows, stream morphology and surface water quality.

Proposed Mitigation by Design:

The following mitigation measures are proposed:

- All proposed new stream crossings will be bottomless culverts or clear span structures and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location;
- Where the proposed underground cabling route follows an existing road or road proposed for upgrade, the cable will pass over or below the culvert within the access road;
- Any guidance / mitigation measures required by the OPW or the Inland Fisheries Ireland during consultation/consenting process (such as Section 50 Applications as defined below) will be incorporated into the design of the proposed crossings;
- As a further precaution, near stream construction work, will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI);
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas; and,
- All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

Residual Impact: With the application of the best practice mitigation outlined above, we consider the residual effect to be - Negative, imperceptible, direct, long term, unlikely impact on stream flows, stream morphology and surface water quality.

Significance of Effects: For the reasons outlined above, no significant effects on stream morphology or stream water quality will occur at crossing locations.

9.5.3.9 Potential Hydrological Impacts on Designated Sites

The northern section of the site drains towards Lough Gill SAC via the River Bonet. The closest section of the Lough Gill SAC is located ~4.7 km north of the site, while the lake itself is situated 10 km north of the site.

There are 6 no. proposed turbines within the Bonet subcatchment which drain towards this SAC.

The Corry Mountain Bog and Carrane Hill Bog NHA are both located nearby within the Arigna sub-catchment.

Pathway: Surface water and groundwater flowpaths.

Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Potential Impact: Indirect, negative, imperceptible, short term, likely impact.

Impact Assessment & Proposed Mitigation Measures:

The north-eastern boundary of the site is bounded by the Corry Mountain Bog NHA. Carrane Hill Bog NHA is located further to the west across the Arigna River valley.

As both NHAs are topographically higher (in elevation) than the proposed development area, there is no groundwater flow or surface water drainage towards these designated sites. Also, Carrane Hill Bog NHA is separated from the proposed development by the upper reaches of the Arigna River which acts as a hydrological boundary between the NHA and the proposed development.

Corry Mountain Bog NHA is located upslope (between 100 – 150m) of proposed turbine locations T8 and T9 and also the proposed borrow pit. However, no groundwater level impacts will occur within Corry Mountain Bog NHA due to proposed excavation works at these locations and this is due to the low permeability of the peat, the SILT/CLAY subsoils and the underlying bedrock (as confirmed by the permeability tests). Any groundwater level impacts will be very localised (10 – 15) to the excavation works.

As a result, there will be no impact on the hydrology of either of the NHAs.

The Proposed Development site ultimately drains into the Killanummery river and Cashel stream, which discharge to the River Bonet. The Bonet river then flows into the Lough Gill SAC (mitigation measures for protection of water quality are reviewed below). Mitigation measures for surface water quality protection are summarised again below:

The proposed mitigation measures which will include buffer zones and drainage control measures (i.e. interceptor drains, swales, stilling ponds) will ensure that the quality of runoff from proposed development areas will be very high. As stated in Impact Section 9.4.1.2 above, there could potentially be an "imperceptible, short term, likely impact" on local streams and rivers but this would be very localised and over a very short time period (i.e. hours). Therefore, significant direct, or indirect impacts on the Lough Gill SAC will not occur.

Due to the large downstream distance to Lough Forbes Complex SAC (approx. 61km surface water distance) and the fact that there are several lakes between the Proposed Development and the SAC (Lough Allen, Lough Corry, Lough Nanoge, Lough Tap, Lough Boderg and Lough Bofin), no effects on Lough Forbes are anticipated (even in the absence of mitigation) due to the large natural attenuation capacity of the watercourses and lakes.

Residual Impact: No significant impacts.

Significance of Effects: For the reasons outlined above, no significant impacts on designated sites will occur.

9.5.3.10 Surface Water Quality Impacts on Lough Nacroagh Water Supply

Lough Nacroagh is currently not used as a private drinking water supply, however an impact assessment is undertaken below in case the source is used as a future supply. (IE_WE_35_188).

Pathway: Site drainage network.

Receptor: Lough Nacroagh WS

Pre-Mitigation potential Impact: Negative, imperceptible, indirect, long term, unlikely impact on Lough Nacroagh WS.

Impact Assessment & Proposed Mitigation Measures:

As stated previously in the chapter, a comprehensive surface water management plan and drainage plan has been prepared for the Proposed Development and this will ensure that surface water runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream rivers and lakes. During the layout process, all surface waters at the site were classified as

very sensitive (the criteria for this are presented in Table 9.1 of the EIAR). Very sensitive surface waters are receptors of high environmental importance such as designated sites (i.e. NHA or SAC) or a public drinking water supply. The surface waters at the proposed development were applied the highest possible sensitivity rating and appropriate mitigation measures which include avoidance and best practice engineering design measures are proposed to avoid significant impacts.

Three turbines, T4, T5 and T6 are situated 250-350m from Lough Nacroagh and are all downstream of the lake and therefore cannot result in impact. The closest turbine to the lake and associated catchment area is T5, which is 200m from the edge of the catchment area. This turbine is still significantly outside the 50m buffer zone and therefore drainage can be adequately managed.

Residual Impact: No impacts on Lough Nacroagh WS will occur.

Significance of Effects: For the reasons outlined above, no significant effects on Lough Nacroagh WS will occur.

9.5.4 Operational Phase - Likely Significant Effects and Mitigation Measures

9.5.4.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the peat or vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. This could potentially increase runoff from the site and increase flood risk downstream of the development. In reality, the access roads will have a higher permeability than the underlying peat. However, it is conservatively assumed in this assessment that the proposed access roads and hardstands are impermeable. The assessed footprint comprises turbine bases and hardstandings, access roads, amenity walkways, site entrances, substation, visitor car park and temporary construction compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The emplacement of the proposed permanent development footprint, as described in Chapter 4 of the EIAR, (assuming emplacement of impermeable materials as a worst-case scenario) could result in an average total site increase in surface water runoff of approximately 2,256 m^3/month (73m^3/day).

Table 9-20). This represents a potential increase of approximately 0.28% in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions (Error! Reference source not found.). This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 35.2 ha, representing 5.4% of the total study area of approximately 670 ha.

Table 9-20: Baseline Site Runoff V Development Runoff

Study Area (ha)	Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 95% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m3)	% Increase from Baseline Conditions (m^3)
670	814,720	26,281	352,450	45,114	42,858	2,256	73	0.28

The additional volume is low due to the fact that the runoff potential from the site is naturally high (95%). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate. The increase in runoff from the proposed development will, therefore, be negligible. This is even before mitigation measures will be put in place.

Pathway: Site drainage network.

Receptor: Surface waters and dependant ecosystems.

Pre-Mitigation Potential Impact: Negative, slight, indirect, permanent, moderate probability effect on all downstream surface water bodies.

Proposed Mitigation by Design:

The operational phase drainage system of the Proposed Development will be installed and constructed in conjunction with the road and hardstanding construction work as described below:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader;
- Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling;
- On steep sections of access road transverse drains ('grips') will be constructed in the surface layer of the road to divert any runoff off the road into swales/road side drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Settlement ponds, emplaced downstream of road swale sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and,
- Settlement ponds will be designed in consideration of the greenfield runoff rate.

Residual Effect: With the implementation of the proposed wind farm drainage measures as outlined above, we consider that residual effect is - Negative, imperceptible, indirect, long-term, moderate probability effect on all downstream surface water bodies.

Significance of Effects: For the reasons outlined above, no significant effects on downstream flood risk will occur.

9.5.5 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

The potential impacts associated with decommissioning of the proposed development will be similar to those associated with construction but of a reduced magnitude, due to the reduced scale of the proposed decommissioning works in comparison to construction phase works.

During decommissioning, it may be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas.

This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage report (SNH) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH gnidance, it is, therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

Some of the impacts will be avoided by leaving elements of the proposed development in place where appropriate. The substation will be retained by EirGrid. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain to facilitate forest management and as amenity pathways. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the hydrological and hydrogeological environment will occur during the decommissioning stage of the proposed development.

9.5.6 Assessment of Cumulative Effects

In terms of cumulative hydrological effects arising from all elements of the Proposed Development and work design, no significant effects are expected and this is largely due to the proposed works being located in 3 no. separate regional surface water catchments.

The wind farm site itself sits inside two separate regional catchments (River Shannon and Garvogne River regional catchments). The grid connection passes through three separate regional surface water catchments (refer to Table 9.5 above) and also due to the fact that the proposed route is along existing roads (with no requirement for in-stream works) no significant cumulative effects with respect to the grid connection and wind farm are expected.

A hydrological cumulative impact assessment was undertaken with regard other wind farm developments within a 20km radius in the River Shannon and Garvogue River regional catchments (there are no other wind farms located within 20km in the Ballysadare River catchment). The wind farm developments assessed are listed in Table 9.14 below and are shown on Figure 9-8.

The total number of turbines that could potentially be operating inside a 20km radius within the River Shannon catchment is 82 (4 no. from the proposed Croagh wind farm and 78 from other wind farms as shown in Table 9.14 below).

Garvogue

Ballysadare

Shannon

0 4 8
kilometres

N
W E
S

Legend

- Site Boundary
- Proposed turbine Layout - Croagh WF
- Proposed Underground Grid Connection Route
- Altagowlan Tubine Locations
- Caranne_Hill Turbine Locations
- Corrie Mountain Turbine Locations
- Carrickheeney Turbine Locations
- Derrysallagh Turbine Locations
- Faughary Turbine Locations
- Geevagh Turbine Locations
- Garvagh Glebe Turbine Locations
- Garvagh Tullyhaw Turbine Locations
- Kilronan Turbine Locations
- Monaneenatieve Turbine Locations
- Spion Kop Turbine Locations
- Tullynamoyle Turbine Locations
- Tullynamoyle Turbine Locations (Extension Proposed)

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Job: Croagh WF, Leitrim

Title: Cumulative Evaluation Impact Map

Figure No: 9.8

Drawing No: P1459-0-0620-A3-908-0A

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Scale: 1:120,000	Drawn By: GD
Date: 25/06/2020	Checked By: MG

In terms of the Garvogue River catchment, the total number of turbines that could potentially be operating inside a 20km radius is 34 (6 no. from the proposed Croagh wind farm and 28 from other wind farms as shown in Table 9.14 below).

The total catchment area of the River Shannon (inside a 20km radius) is ~614km2 and therefore this equates to one turbine for approximately every ~7.5km2 which is considered imperceptible in terms of potential cumulative hydrological impacts. For the Garvogue River catchment within a 20km radius, which has an area of 351km2 inside a 20km radius, this equates to one turbine for approximately every ~10km^2 which is also considered imperceptible.

Also, implementation of the proposed drainage mitigation will ensure there will be no cumulative significant negative impacts on the water environment from the proposed Croagh Windfarm, and other wind farm developments and non-wind farm developments as described in Chapter 2 of the EIAR within a 20km radius in the Shannon River and Garvogue River catchments.

To account for the tree felling required as part of the Proposed Development, 3 no. sites across Co. Cavan, Co. Roscommon and Co. Wicklow are proposed for the replacement of forestry. There is no potential for cumulative effects as the forestry replacement sites are remote from the Proposed Development with no hydrological connection.

With regard non-wind farm related forestry activities and the potential for cumulative impacts, all Coillte scheduled tree felling or replanting will be planned around the Proposed Development construction phase in order to prevent hydrological cumulative impacts. No scheduled tree felling will occur in the same local catchment where wind farm construction is taking place.

Table 9-14 Other Wind Farm Developments Within 20km of the Proposed Development

Regional Catchment	Wind Energy Developments	Total Turbine No.	Turbine No. in Same Catchment as Proposed Development
Garvogue	Carrickheeney WF	4	4
	Faughary WF	3	3
	Tullynamoyle Existing WF	15	15
	Tullynamoyle Ext WF	4	2
	Garvagh Glebe WF	13	4
Garvogue Total			**28**
	Garvagh Glebe WF	13	9
	Corrie Mountain	8	8
	Monaneenatieve WF	5	5
	Spion Kop WF [3]	2	2

[3] *Permission has been granted for the removal of the existing 2 no. turbines and the replacement with 1 no. turbine. The overall cumulative impact with respect other wind farms remains as imperceptible.*

Regional Catchment	Wind Energy Developments	Total Turbine No.	Turbine No. in Same Catchment as Proposed Development
Shannon	Altogowlan WF	9	9
	Garvagh Tullyhaw WF	11	11
	Kilronan WF	10	10
	Derrysallagh WF	12	12
	Carrane Hill WF	4	4
	Tullynamoyle EXT WF	4	2
	Geevagh WF	6	6
Shannon Total			78

9.5.7 Post Consent Monitoring

None required.

10. AIR AND CLIMATE

10.1 Air Quality

10.1.1 Introduction

This chapter identifies, describes and assesses the potential significant direct and indirect effects on air quality and climate arising from the construction, operation and decommissioning of the proposed Croagh Wind Farm.

The site of the Croagh Wind Farm development is located on the boundary of Counties Leitrim and Sligo, approximately 5km west of the village of Drumkeeran and 7km southeast of Dromahair. The townlands within which the proposed development site, ancillary works and grid connection cabling route are located can be found in Chapter 1 Table 1-1 of this EIAR.

The primary land-uses within and in the vicinity of the site comprises commercial forestry. Due to the non-industrial nature of the proposed development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIAR. It is expected that air quality in the existing environment is good, since there are no major sources of air pollution (e.g. heavy industry) in the vicinity of the site.

The production of energy from wind turbines has no direct emissions as is expected from fossil fuel-based power stations. Harnessing more energy by means of renewable sources will reduce dependency on fossil fuels, thereby resulting in a reduction in harmful emissions that can be damaging to human health and the environment. Some minor short term or temporary indirect emissions associated with the construction of the Proposed Development include vehicular and dust emissions.

10.1.1.1 Relevant Guidance

The air quality and climate section of this EIAR is carried out in accordance with the EIA Directive 2011/92/EU as amended by Directive 2014/52/EU and having regard, where relevant, to guidance contained in the Section 1.8.1 of this EIAR.

10.1.1.2 Statement of Authority

This chapter of the EIAR was completed by Eoin McCarthy and Michael Watson. Eoin is a Senior Environmental Scientist with McCarthy O'Sullivan Ltd. with over 8 years of experience in private consultancy. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland. Between them, they have completed Air and Climate EIAR chapters for over twenty wind energy projects.

10.1.2 Air Quality Standards

In 1996, the Air Quality Framework Directive (96/62/EC) was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999. The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC) addresses sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC) addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (SI No. 271 of 2002).
- The third Daughter Directive, Council Directive (2002/3/EC) relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (SI No. 53 of 2004).
- The fourth Daughter Directive, published in 2007, relates to polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air and was transposed into Irish law by the Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2009 (S.I. No. 58 of 2009).

The Air Quality Framework Directive and the first three Daughter Directives have been replaced by the Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality) (as amended by Directive EU 2015/1480) which encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for PM2.5 (fine particles) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.
- The possibility for time extensions of three years (for particulate matter PM10) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 10-1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre ($\mu g/m^3$) and parts per billion (ppb). The notation PM10 is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. PM2.5 represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended by the Air Quality Standards (Amendments) and Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2016 (S.I. 659 2016). These Regulations supersede the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the Ambient Air Quality Assessment and Management Regulations 1999 (S.I. No. 33 of 1999).

Table 10-1 Limit values of Directive 2008/50.EC, 1999/30/EC and 200/69/EC (Source: https://www.epa.ie/air/quality/standards/)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Upper assessment threshold for the protection of Human Health	24 hours	75	28	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Lower assessment threshold for the protection of human health	24 hours	50	19	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010
Nitrogen dioxide (NO_2)	Upper assessment threshold for the protection of human health	1 hour	140	73	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Nitrogen dioxide (NO_2)	Lower assessment threshold for the protection of human health	1 hour	100	52	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen monoxide (NO) and nitrogen dioxide (NO2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM10)	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005
Particulate matter 2.5 (PM2.5)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
Particulate matter 2.5 (PM2.5) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015
Particulate matter 10 (PM_{10})	Upper assessment threshold for the protection of human health	24 hours	30	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
Particulate matter 10 (PM_{10})	Lower assessment threshold for the protection of human health	24 hours	20	-	Not to be exceeded more than 7 times in a calendar year	Based on the indicative limit values for 1 January 2010
Particulate matter 2.5	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020

Pollutant	Limit Value Objective	Averaging Period	Limit Value (ug/m^3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
(PM2.5) Stage 2						

The Ozone Daughter Directive 2002/3/EC is different from the other Daughter Directives in that it sets target values and long-term objectives for ozone rather than limit values. Table 10-2 presents the limit and target values for ozone.

Table 10-2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020
Protection of human health	Maximum daily 8-hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	AOT40* calculated from 1-hour values from May to July	18,000 mg/m^3.h averaged over 5 years	6,000 mg/m^3.h
Information Threshold	1-hour average	180 mg/m^3	-
Alert Threshold	1-hour average	240 mg/m^3	-

*The sum of the differences between hourly ozone concentration and 40 ppb for each hour when the concentration exceeds 40 ppb during a relevant growing season, e.g. for forest and crops.

10.1.2.1 Air Quality and Health

The Environmental Protection Agency (EPA) report '*Air Quality in Ireland 2018*' noted that in Ireland, the premature deaths attributable to poor air quality are estimated at 1,180 people per annum. A more recent European Environmental Agency (EEA) Report, '*Air Quality in Europe – 2019 Report*' highlights the negative effects of air pollution on human health. The report assessed that poor air quality accounted for premature deaths of approximately 412,000 people in Europe in 2016, with regards to deaths relating to $PM_{2.5}$. The estimated impacts on the population in Europe of exposure to NO_2 and O_3 concentrations in 2016 were around 71,000 and 15,100 premature deaths per year, respectively. From this, 1,100 Irish deaths were attributable to fine particulate matter ($PM_{2.5}$), 50 Irish deaths were attributable to nitrogen oxides (NO_2) and 30 Irish deaths were attributable to Ozone (O_3) (Source: *Air Quality in Europe – 2019 Report'*, EEA, 2019. These emissions, along with others including sulphur oxides (SO_x) are produced during fossil fuel-based electricity generation in various amounts, depending on the fuel and technology used.

Whilst there is the potential of such emissions and also dust emissions to be generated from the site operations, a number of mitigation measures will be implemented at this site to reduce the impact from dust and vehicle emissions, which are discussed in Sections 10.2.4 below.

10.1.3 Air Quality Zones

The EPA has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country.

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The site of the Proposed Development lies within Zone D, which represents rural areas located away from large population centres.

10.1.4 Existing Air Quality

The EPA publishes Air Monitoring Station Reports for monitoring locations in all four Air Quality Zones. The ambient air quality monitoring carried out closest to the proposed development site is at Sligo town, Co, Sligo, located approximately 17.8 km northwest of the site of the Proposed Development. EPA air quality data is available for in the report 'Ambient Air Monitoring in Sligo 20th January 2003 – 2nd October 2003', as detailed below in Tables 10-3 to 10-6. This monitoring location lies within Zone C. Lower measurement values for all air quality parameters would be expected for the proposed development site as it lies in a rural location, within Zone D.

Ozone data for 2019 was obtained from the closest active atmospheric monitoring station at Lough Navar, Glenasheevar Road, Co. Fermanagh, located approximately 37.5 km northeast of the site. (https://www.airqualityni.co.uk/site/LN#statistics). This can be found in Table 10-7 below.

10.1.5 Sulphur Dioxide (SO_2)

Sulphur dioxide data for the period January 2003- October 2003 recorded at the Sligo town air monitoring station is presented in Table 10-3. Neither the hourly limit value nor lower assessment threshold set out in the CAFE Directive were exceeded during the monitoring period.

Table 10-3 Sulphur Dioxide Data for Sligo town in 2003.

Parameter	Measurement
No. of hours	6101
No. of measured values	5926
Percentage Coverage	97.1
Maximum hourly value	52.1 ug/m^3
98 percentile for hourly values	38 ug/m^3
Mean hourly value	11 ug/m^3
Maximum 24-hour mean	37.4 ug/m^3
98 percentile for 24-hour mean	28.5 ug/m^3

10.1.5.1 Particulate Matter (PM_{10})

Particulate matter (PM10) data for the 2003 monitoring period in Sligo town is presented in Table 10-4. The 24-hour limit value for the protection of human health (50 µg/m^3) was not exceeded during the measurement period. The upper assessment threshold was exceeded on 26 days and the lower assessment threshold was exceeded on 55 days. The CAFE Directive stipulates that these assessment thresholds should not be exceeded more than 35 times in a calendar year. The mean of the daily values during the measurement period is below the annual limit value for the protection of human health (40 µg/m^3).

Table 10-4 Particulate Matter (PM10) Data Sligo Town January 2003 to October 2003

Parameter	Measurement
No. of days	254
No. of measured values	184
Percentage Coverage	72.4
Maximum daily value	63.2
Mean daily value	17.7

10.1.5.2 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the 2003 monitoring period in Sligo town is presented in Table 10-5. No hourly mean NO_2 value was above the lower assessment threshold. The CAFE Directive stipulates that this threshold should not be exceeded more than 18 times in a calendar year. The mean hourly NO_2 value during the measurement period was below the annual lower assessment threshold for the protection of human health, which is 26 µg/m^3.

Table 10-5 Nitrogen Dioxide and Oxides of Nitrogen Sligo Town January 2003 to October 2003

Parameter	Measurement
No. of hours	6101
No. of measured values	4850
Percentage Coverage	79.5
Maximum hourly value (NO_2)	245 ug/m^3
98 percentile for hourly values (NO_2)	39.5 ug/m^3
Mean hourly value (NO_2)	11.7 ug/m^3
Mean hourly value (NOx)	18.7 ug/m^3

10.1.5.3 Carbon Monoxide (CO)

Carbon monoxide data for the 2003 monitoring period in Sligo town, is presented in Table 10-6. The mean hourly concentration of carbon monoxide recorded was 0.3 mg/m^3. The carbon monoxide limit value for the protection of human health is 10 mg/m^3. On no occasions were values in excess of the 10

mg limit value set out in the CAFE Directive/ Air Quality Standards Regulations 2011 (as amended) recorded.

Table 10-6 Carbon Monoxide Data for 2003 in Sligo Town

Parameter	Measurement
No. of hours	6101
No. of measured values	4784
Percentage Coverage	78.4
Maximum hourly value	7.4 mg/m^3
98 percentile for hourly values	1.0 mg/m^3
Mean hourly value	0.3 mg/m^3
Maximum 8 hour mean	1.6 mg/m^3
98 percentile for 8-hour mean	0.9 mg/m^3

10.1.5.4 Ozone (O_3)

Ozone data for the Lough Navar Atmospheric Monitoring Station, for 2019, is presented in Table 10-7. The mean hourly concentration of ozone recorded was 50 $\mu g/m^3$.There were no exceedances of the daily maximum 8-hour running mean of 120 μgm^3 and no exceedances of the 180 $\mu g/m^3$ information threshold value set for the protection of the general population.

Table 10-7 Summary statistics for O_3 concentrations for year to date 2019: Lough Navar

Parameter	Measurement
Percentage Coverage	98
Annual hourly Mean	50 $\mu g/m^3$
Annual Mean Daily Max 8 Hour	66 $\mu g/m^3$
Max Daily Mean	124 $\mu g/m^3$
Max Hourly Mean	153 $\mu g/m^3$
Max 8-hour running mean > 120$\mu g/m^3$ on more than 25 days	0

10.1.5.5 Dust

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggests that a deposition of 10 mg/m^2/hour can generally be considered as posing a soiling nuisance. This equates to 240 mg/m^2/day. The EPA recommends a maximum daily deposition level of 350 mg/m^2/day when measured according to the TA Luft Standard 2002.

Construction dust has the potential to be generated from on-site activities such as excavation and backfilling. The extent of dust generation at any site depends on the type of activity undertaken, the location, the nature of the dust, i.e. soil, sand, peat, etc., and the weather. In addition, dust dispersion is

influenced by external factors such as wind speed and direction and/or, periods of dry weather. Construction traffic movements also have the potential to generate dust as they travel along the haul route.

The potential dust-related effects on local air quality and the relevant associated mitigation measures are presented in Sections 10.1.6.3 below.

10.1.6 Likely and Significant Impacts and Associated Mitigation Measures

10.1.6.1 'Do-Nothing' Effect

If the Proposed Development were not to proceed, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen (NOx), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil and gas-fired power stations, rather than renewable energy sources such as the proposed renewable energy development. This would result in an indirect negative impact on air quality nationally..

10.1.6.2 Construction Phase

10.1.6.2.1 *Exhaust Emissions*

Turbines and Other Infrastructure

The construction of turbines, the anemometry mast, site roads and other onsite infrastructure will require the operation of construction vehicles and plant on site. Exhaust emissions associated with vehicles and plant will arise as a result of construction activities. This potential effect will not be significant and will be restricted to the duration of the construction phase and localised to works locations. Therefore, this is considered a short-term, slight, negative impact. Mitigation measures to reduce this impact are presented below.

Borrow Pit

The proposed borrow pit will also require the use of construction machinery and plant, thereby giving rise to exhaust emissions. This is also a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

Substation, and Grid Connection Cable

The construction of the proposed substation and the grid connection cabling route to the Garvagh 110kV substation will require the use of construction machinery, thereby giving rise to exhaust emissions. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 14.1 of this EIAR), will also give rise to exhaust emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to exhaust emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- All machinery will be switched off when not in use.
- The majority of aggregate materials for the construction of the proposed development will be obtained from the borrow pit on site. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Impact

Short-term Imperceptible Negative impact.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on air quality due to the construction of the proposed development.

10.1.6.3 Dust Emissions

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, anemometry mast, site roads and other onsite infrastructure (as outlined in Chapter 4 of this EIAR) will give rise to dust emissions during the construction phase. The potential for impacts on off-site receptors is limited due to the isolated nature of the site and the vegetative screening that exists surrounding the site. This potential effect will not be significant and will be restricted to the duration of the construction phase. Therefore, this is a short-term, slight, negative impact. Dust suppression mitigation measures to reduce this impact are presented below.

Borrow Pit

The extraction of material from the borrow pit will give rise to localised dust emissions. This is a short-term, moderate, negative impact. Mitigation measures to reduce this impact are presented below.

Substation and Grid Connection Cable

The construction of the proposed substation, and the excavation of the grid connection cabling route will give rise to localised dust emission during their construction. This is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

Transport to Site

The transport of turbines and construction materials to the wind farm site will give rise to some localised dust emissions during periods of dry weather. This is a short-term slight negative impact. Mitigation measures to reduce the significance of this effect are presented below.

Mitigation

- In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, substation and construction compounds and around the borrow pit area to ensure dust does not cause a nuisance. If necessary, de-silted water will be taken from

stilling ponds in the site's drainage system and will be pumped into a bowser or water spreader to dampen down haul roads, borrow pit and site compounds to prevent the generation of dust where required. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.

- All plant and materials vehicles shall be stored in dedicated areas (on site).
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.
- Turbines and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary.
- The transport of construction materials which may have the potential to generate dust will be undertaken with tarpaulin cover or similar, where necessary.
- The transport of dry excavated material from the on-site borrow pit which may have potential to generate dust will be minimised. If necessary, excavated material will be dampened prior to transport from the borrow pits.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 4-4). The CEMP includes dust suppression measures.

Residual Impact

Short-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no siguificant direct or indirect effects on air quality due to dust emissions during the construction phase of the Proposed Development.

10.1.7 Operational Phase

10.1.7.1.1 *Exhaust Emissions*

Exhaust emissions associated with the operational phase of the Proposed Development will arise from occasional machinery and Light Goods Vehicles (LGV) that are intermittently required onsite for maintenance. This will give rise to a long-term, imperceptible, negative impact.

Mitigation

Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order, thereby minimising any emissions that arise.

Residual Impact

Long-term Imperceptible Negative Impact

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects on air quality from exhaust emissions during the operation of the Proposed Development.

10.1.7.1.2 *Air Quality*

By providing an alternative to electricity derived from coal, oil or gas-fired power stations, the proposed development will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2. The production of renewable energy from the Proposed Development will have a long-term, significant, positive impact on air quality. Further details on the carbon dioxide savings associated with the Proposed Development are presented in Section 10.2.3.

Residual Impact

Long-term Significant Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive effect on air quality due to the operation of the Proposed Development.

10.1.7.1.3 *Human Health*

Exposure to chemicals such as SO_2 and NO_x are known to be harmful to human health. The production of clean renewable energy from the Proposed Development will offset the emission of these harmful chemicals by fossil fuel powered sources of electricity and, therefore, will have a long term slight positive impact on human health. Further information on the impact of the proposed development on Human Health is contained in Chapter 5: Population and Human Health.

Residual Impact

Long-term Slight Positive Impact

Significance of Effects

Based on the assessment above there will be a significant positive effect on human health due to the operation of the Proposed Development.

10.1.7.2 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occurs during the construction phase, albeit of less impact. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.2 Climate

All relevant legislation and policy in relation to climate is outlined in detail in Chapter 2 of this EIAR. A summary of the same is provided in the following sections.

10.2.1 Climate Change and Greenhouse Gases

Although variation in climate is thought to be a natural process, the rate at which the climate is changing has been accelerated rapidly by human activities. Climate change is one of the most challenging global issues facing us today and is primarily the result of increased levels of greenhouse gases in the atmosphere. These greenhouse gases come primarily from the combustion of fossil fuels in

energy use. Changing climate patterns are thought to increase the frequency of extreme weather conditions such as storms, floods and droughts. In addition, warmer weather trends can place pressure on animals and plants that cannot adapt to a rapidly changing environment. Moving away from our reliance on coal, oil and other fossil fuel driven power plants is essential to reduce emissions of greenhouse gases and combat climate change.

10.2.1.1 Greenhouse Gas Emission Targets

Ireland is a Party to the Kyoto Protocol, which is an international agreement that sets limitations and reduction targets for greenhouse gases for developed countries. It is a protocol to the United Nations Framework for the Convention on Climate Change. The Kyoto Protocol came into effect in 2005, as a result of which, emission reduction targets agreed by developed countries, including Ireland, are now binding.

Under the Kyoto Protocol, the EU agreed to achieve a significant reduction in total greenhouse gas emissions in the period 2008 to 2012. These EU emission targets are legally binding on Ireland. Ireland's contribution to the EU commitment for the period 2008-2012 was to limit its greenhouse gas emissions to no more than 13% above 1990 levels.

10.2.1.1.1 *Doha Amendment to the Kyoto Protocol*

In Doha, Qatar, on 8th December 2012, the "Doha Amendment to the Kyoto Protocol" was adopted. The amendment includes:

- New commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020;
- A revised list of greenhouse gases (GHG) to be reported on by Parties in the second commitment period; and
- Amendments to several articles of the Kyoto Protocol which specifically referenced issues pertaining to the first commitment period and which needed to be updated for the second commitment period.

During the first commitment period, 37 industrialised countries and the European Community committed to reduce GHG emissions to an average of 5% below 1990 levels. During the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The composition of Parties in the second commitment period is different from the first; however, Ireland and the EU signed up to both the first and second commitment periods.

Under the protocol, countries must meet their targets primarily through national measures, although market-based mechanisms (such as international emissions trading) can also be utilised.

10.2.1.1.2 *COP21 Paris Agreement*

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C above pre-industrial levels and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each

country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

10.2.1.1.3 COP25 Climate Change Conference

The 25th United Nations Climate Change conference COP25 was held in Madrid and ran from December 2nd to December 13th, 2019. While largely regarded as an unsuccessful conference, the European Union launched its most ambitious plan, 'The European Green New Deal' which aims to lower CO_2 emissions to zero by 2050. The deal includes proposals to reduce emissions from the transport, agriculture and energy sectors and will affect the technology chemicals, textiles, cement and steel industries. Measures such as fines and pay-outs by member states who rely on coal power will be in place to encourage the switch to renewable clean energies such as wind. On the 4th of March 2020, the European Commission put forward the proposal for a European climate law. This aims to establish the framework for achieving EU climate neutrality. It aims to provide a direction by setting a pathway to climate neutrality and to this end, aims to set in legislation the EU's 2050 climate-neutrality objective. If accepted, this climate law will likely be implemented in 2021. Decisions regarding the global carbon market were postponed until the next Climate Conference (COP26) which will be held in Glasgow in November 2020.

10.2.1.1.4 Emissions Projections

Ireland's target is to achieve a 20% reduction of non-Emissions Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the period 2013 – 2020. The Environmental Protection Agency (EPA) publish Ireland's Greenhouse Gas Emission Projection and at the time of writing, the most recent report, 'Ireland's Greenhouse Gas Emissions Projections 2018– 2040 was published in June 2019. The report includes an assessment of Ireland's progress towards achieving its emission reduction targets out to 2020 and 2030 set under the EU Effort Sharing Decision (Decision No 406/2009/EU) and Effort Sharing Regulation (Regulation (EU) 2018/842).

The 2019 emission projections report include the impact of new climate mitigation policies and measures which were outlined in the National Development Plan 2018. These projections see a greater impact from policies and measures and a greater reduction in emissions over the longer term, particularly in the "With Additional Measures" scenario. The 2019 emissions projections do not take into account policies and measures set out in the Climate Action Plan 2019. Such measures will be taken into consideration in an updated future projections report in 2020.

Greenhouse gas emissions are projected to 2040 using two scenarios; 'With Existing Measures' and 'With Additional Measures'. The 'With Existing Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2017 (latest national greenhouse gas emission inventory) are implemented. The 'With Additional Measures' scenario assumes the implementation of the "With Existing Measures" scenario and further implementation of the governments renewable and energy efficiency policies including those set out in the National Renewable Energy Action Plan (NREA), the National Energy Efficiency Action Plan (NEEAP) and the National Development Plan 2018-2027.

The EPA Emission Projections Update notes the following key trends:

- Total emissions are projected to increase from current levels by 1% and 6% by 2020 and 2030, respectively, under the "With Existing Measures" scenario.
- Under the "With Additional Measures" scenario, emissions are estimated to decrease by 0.4% and 10% by 2020 and 2030, respectively.
- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 5% and 6% below 2005 levels in 2020 under the 'With Existing Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction.

- Ireland has exceeded its annual binding limits in 2016 and 2017 under both scenarios, 'With Existing Measures' and 'With Additional Measures'.
- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 10 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Existing Measures' scenario and 9 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The report concludes:

- *"Projections indicate that Ireland will exceed the carbon budget over the period 2021-2030 by 52-67Mt CO_2 equivalent with the gap potentially narrowing to 7-22 Mt CO_2 equivalent if both the ETS and LULUCF flexibilities described in the Regulation are fully utilised."*
- *"To determine compliance under the Effort Sharing Decision, any overachievement of the binding emission limit in a particular year (between 2013 and 2020) can be banked and used towards compliance in a future year. However, even using this mechanism Ireland will still be in non-compliance according to the latest projections."*
- *"A siguificant reduction in emissions over the longer term is projected as a result of the expansion of renewables (e.g. wind), assumed to reach 41-54% by 2030, with a move away from coal and peat... [...] ... However, Ireland still faces significant challenged in meeting EU 2030 targets in the non-ETS sector and national 2050 reduction targets in the electricity generation, built environment and transport sectors. Progress in achieving targets is dependent on the level of implementation of current and future plans."*

10.2.1.1.5 Climate Action Plan

The Climate Action Plan 2019 (CAP) was published on the 1st of August 2019 by the Department of Communications, Climate Action and Environment. The CAP sets out an ambitious course of action over the coming years to address the impacts which climate may have on Ireland's environment, society, economic and natural resources. This Plan clearly recognises that Ireland must significantly step up its commitments to tackle climate disruption.

Chapter 1 of the CAP sets out the nature of the challenge which Ireland faces over the coming years. The CAP notes that the evidence for warming of our climate system is beyond dispute with observations showing that global average temperatures have increased by more than 1°C since pre-industrial times. These changes will cause extensive direct and indirect harm to Ireland and its people, as well as to other countries more exposed and less able than we are to withstand the associated impacts environmental impacts such as extremes in weather, flooding, displacement of population by the creation of climate refugees, poorer water quality and poorer air quality. In order to help reduce CO_2 emissions and reach our 2030 and 2050 emissions targets, CAP has set out a list of renewable energy goals which includes implementing up to 8.2 GW total of increased onshore wind capacity on the island.

The Proposed Development can assist in reaching this target not only by fulfilling the implementation of renewable energy and much needed grid infrastructure, it has the capacity to offset 1,655,640 tonnes of CO_2 thereby reducing the Greenhouse Gas effect and improving air quality as we transition to cleaner energy industries. Please see Section 10.2.3 for details on Carbon offset calculations.

10.2.1.1.6 Progress to Date

The 'Europe 2020 Strategy' is the EU's agenda for growth and jobs for the current decade. The Europe 2020 Strategy targets on climate change and energy include:

- Reducing greenhouse gas (GHG) emissions by at least 20% compared with 1990 levels;
- Increasing the share of renewable energy in final energy consumption to 20%; and
- Moving towards a 20% increase in energy efficiency.

Further details on the Europe 2020 Strategy are included in Chapter 2: Background to the Proposed Development of this EIAR. Regarding progress on targets, the 'Europe 2020 indicators – climate change and energy' report provides a summary of recent statistics on climate change and energy in the EU.

In 2015, EU greenhouse gas emissions, including emissions from international aviation and indirect carbon dioxide (CO2) emissions, were down by 22.1% when compared with 1990 levels. However, regarding the progress of individual Member States, and Ireland in particular, the Europe 2020 indicators include the following statements:

- 24 countries are on track to meet their GHG targets, except Austria, Belgium, Ireland and Luxembourg.
- Luxembourg emitted the most GHG per capita in the EU in 2014 followed by Estonia, Ireland, the Czech Republic and the Netherlands.
- In 2015, Malta was the farthest from reaching their national target, followed by Ireland, Belgium and Luxembourg.

While the EU as a whole is projected to exceed it's 2020 target of reducing GHG emissions by 20%, Ireland is currently one of the countries projected to miss its national targets.

Further details on the Europe 2020 Strategy are included in Section 2.2.3.3 of this EIAR in Chapter 2: Background to the Proposed Development. Regarding progress on targets, the 'Europe 2020 indicators – climate change and energy' report provides a summary of recent statistics on climate change and energy in the EU.

10.2.1.1.7 United Nations Sustainable Development Summit 2015

Transforming our World: the 2030 Agenda for Sustainable Development which includes 17 Sustainable Development Goals (SDGs) and 169 targets was adopted by all UN Member States at a UN summit held in New York in 2015. The Agenda is universally applicable with all countries having a shared responsibility to achieve the goals and targets. Coming into effect on January 1st, 2016, the goals and targets are to be actions over the 15-year period, are integrated and indivisible i.e. all must be implemented together by each Member State.

The Sustainable Development Goals National Implementation Plan 2018-2020 was published by the Department of Communications, Climate Action & Environment in partnerships with OSI, Esri Ireland and the Central Statistics Office. The Plan sets out how Ireland will work to achieve the goals and targets of the Agenda for Sustainable Development both domestically and internationally. Relevant SDGs and how they are implemented into Irish National plans and policies can be found in Table 10-8.

Table 10-8 United Nations Sustainable Development Goals adopted in 2015. https://sustainabledevelopment.un.org/sdgs

SDG	Targets	International Progress to Date (2019)	National Relevant Policy
SDG 7 Affordable and Clean Energy: *Ensure access to affordable, reliable, sustainable and modern energy for all*	› By 2030, ensure universal access to affordable, reliable and modern energy services › By 2030, increase substantially the share of renewable energy in the global energy mix › By 2030, double the global rate of improvement in energy efficiency › By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with	The renewable energy share of total final energy consumption gradually increased from 16.6 per cent in 2010 to 17.5 per cent in 2016, though much faster change is required to meet climate goals. Global primary energy intensity (ratio of energy used per unit of GDP) improved from 5.9 in 2010 to 5.1 in 2016, a rate of improvement of 2.3 per cent, which is still short of the 2.7 per cent annual rate needed to reach target 3 of Sustainable Development Goal 7.	*Ireland's Transition to a Low Carbon Energy Future 2015-2030* *Strategy to Combat Energy Poverty in Ireland* *Ireland's Transition to a Low Carbon Energy Future 2015- 2030* *National Mitigation Plan* *National Energy Efficiency Action Plan for Ireland # 4 2017-2020* *Better Energy Programme* *One World, One Future* *The Global Island*

	their respective programmes of support		
SDG 13 Climate Action: *Take urgent action to combat climate change and its impacts**	Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries Integrate climate change measures into national policies, strategies and planning Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	In 2017, greenhouse gas concentrations reached new highs, with globally averaged mole fractions of CO2 at 405.5 parts per million (ppm), up from 400.1 ppm in 2015, and at 146 per cent of pre-industrial levels. Moving towards 2030 emission objectives compatible with the 2°C and 1.5°C pathways requires a peak to be achieved as soon as possible, followed by rapid reductions. During the period 1998–2017, direct economic losses from disasters were estimated at almost $3 trillion. Climate-related and geophysical disasters claimed an estimated 1.3 million lives. As of April 2019, 185 parties had ratified the Paris Agreement. Parties to the Paris Agreement are expected to prepare, communicate and maintain successive nationally determined contributions, and 183 parties had communicated their first nationally determined contributions to the secretariat of the United Nations Framework Convention on Climate Change, while 1 party had	*National Adaptation Framework* *Building on Recovery: Infrastructure and Capital Investment 2016-2021* *National Mitigation Plan* *National Biodiversity Action Plan 2017-2021* *National Policy Position on Climate Action and Low Carbon Development*
**Acknowledging that the United Nations Framework Convention on Climate Change is the primary international, intergovernmental forum for negotiating the global response to climate change.*			

		communicated its second. Under the Agreement, all parties are required to submit new nationally determined contributions, containing revised and much more ambitious targets, by 2020. Global climate finance flows increased by 17 per cent in the period 2015–2016 compared with the period 2013–2014. As at 20 May 2019, 75 countries are seeking support from the Green Climate Fund for national adaptation plans and other adaptation planning processes, with a combined value of $191 million.	

10.2.1.1.8 *Climate Action Network Europe Off Target Report 2018*

The June 2018 '*Off Target Report*' published by the Climate Action Network (CAN) Europe which ranks EU countries ambition and progress in fighting climate change listed Ireland as the second worst performing EU member state in tackling climate change. It also stated that Ireland is set to miss its 2020 climate (20% reduction in greenhouse gases) and renewable (40% increase in overall energy from renewable electricity sources) energy targets. Additionally, it was noted that Ireland is also off course for its 2030 emissions target.

In March 2019, the Minister for Communications, Climate Action, and the Environment, Richard Bruton, announced a renewable electricity target of 70% by 2030 for Ireland. Furthermore, the release of the Climate Action Plan in June 2019 has noted a 30% reduction in greenhouse gases by 2030. Considering only renewable energy from electricity as part of this plan and to meet the required level of emissions reduction by 2030, Ireland will:

- Reduce CO_2 eq. emissions from the sector by 50–55% relative to 2030 NDP projections.
- Deliver an early and complete phase-out of coal- and peat-fired electricity generation.
- Increase electricity generated from renewable sources to 70%, indicatively comprised of:
  - at least 3.5 GW of offshore renewable energy;
  - up to 1.5 GW of grid-scale solar energy; and
  - up to 8.2 GW total of increased onshore wind capacity.
- Meet 15% of electricity demand by renewable sources contracted under Corporate PPAs.

Achieving 70% renewable electricity by 2030 will involve phasing out coal and peat-fired electricity generation plants, increasing our renewable electricity, reinforcing our grid (including greater interconnection to allow electricity to flow between Ireland and other countries), and putting systems in place to manage intermittent sources of power, especially from wind.

As noted previously, Ireland is not on track for meeting its 2020 renewable energy targets. It is now more critical than ever that we continue to progress renewable energy development in Ireland so as we are successful in meeting our 2030 target.

The Climate Action Plan noted specific sectors which are required to step-up in order to help Ireland achieve its EU targets. The renewable energy sector was cited alongside the country's commitment to increase onshore wind capacity by up to 8.2 GW. The proposed development will help contribute towards this target.

The proposed wind farm development is compatible with the relevant provisions as set out in the Climate Action Plan 2019, relating to the harnessing of renewable energy. In summary, the proposed development will contribute the following:

- Production of 147,168 MWh of electricity which would be sufficient to supply 35,040 Irish households with electricity per year. This calculation is presented in Chapter 4 of this EIAR.
- Helping to meet the target that 70% of our electricity needs will come from renewable sources by 2030.
- Helping to reduce carbon emissions and improving Ireland's security of energy supply.
- Provision of grid connection infrastructure to support the renewable energy output from the proposed development.

Further detail on the EU 2030 targets are noted in Chapter 2, Section 2.3 of this EIAR.

10.2.1.1.9 Climate Change Performance Index

Established in 2005, the Climate Change Performance Index (CCPI) is an independent monitoring tool which tracks countries climate protection performance. It assesses individual countries based on climate policies, energy usage per capita, renewable energy implementation and Greenhouse Gas Emissions (GHG) and ranks their performance in each category and overall. The 2020 CCPI was published in December 2019 and presented at the COP25. While the CCPI 2020 indicated signs of potential reductions in global emissions, no country achieved its Paris Climate targets and therefore the first three places of the ranking system remain unoccupied.

Ireland, ranked the worst EU performer in the CCPI 2019, climbed 7 places from 48th out of 60 globally ranked countries to 41st place and has moved from a "very low" to "low" in international performance. However, it remains at "very low" at a national performance level. The CCPI report states that while some improvements have been made, GHG per capita emissions are at a high level and "significant challenges lie ahead in closing Ireland's emission gap, meeting the current (2030) target and aligning Ireland's emission trajectory with a net zero goal for 2050. Therefore, the country still ranks among the bottom ten performers in this indicator." Recognising Ireland's Climate Action Plan 2019, the CCPI states:

"*the government must go much further in implementing policies across all sectors that drive sustained emissions reductions over the next decade. Near-term ambition needs to be ratcheted up quickly by specifying deep cuts in fossil fuel and reactive nitrogen usage to put Ireland on a net zero emissions pathway aligned with the Paris temperature goals*".

10.2.2 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The nearest meteorological monitoring station, with data over a 30-year period (1971-2000), is the Claremorris monitoring station which is located 69km southwest of the development site. Meteorological data for this period at this location can be found in Table 10-9. The wettest months are October and December, and April is usually the driest. July is the warmest month with an average temperature of 18.9° Celsius. The mean annual temperature recorded at Claremorris was 12.9° Celsius.

Table 10-9 Data from Met Eireann Weather Station at Claremorris 1979-2000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
mean daily max	7.5	8.1	9.8	12.1	14.9	17.0	18.9	18.7	16.4	13.1	9.9	8.1	12.9
mean daily min	1.7	1.8	2.9	3.9	6.1	8.8	11.0	10.6	8.6	6.4	3.5	2.5	5.7
mean temperature	4.6	4.9	6.3	8.0	10.5	12.9	15.0	14.7	12.5	9.8	6.7	5.3	9.3
absolute max.	13.3	13.6	16.2	22.3	25.4	29.8	30.5	28.0	25.1	19.9	15.9	14.3	30.5
min. maximum	-2.9	0.1	0.0	5.0	6.1	11.2	11.7	12.2	10.5	6.8	1.3	-1.5	-2.9
max. minimum	11.3	10.9	10.4	11.3	14.2	15.3	17.0	16.7	16.7	15.6	12.5	12.1	17.0
absolute min.	-11.7	-9.1	-8.0	-5.5	-3.1	0.7	0.6	2.6	-1.2	-4.3	-5.3	-12.9	-12.9
mean num. of days with air frost	8.7	7.3	5.2	3.3	0.8	0.0	0.0	0.0	0.1	1.2	5.3	7.6	39.5
mean num. of days with ground frost	15	14	12	10	5	0	0	0	2	5	12	14	89
mean 5cm soil	3.2	3.1	4.5	7.3	10.9	14.1	15.5	14.6	12.0	8.9	5.3	4.2	8.6
mean 10cm soil	3.5	3.4	4.7	7.0	10.3	13.5	15.0	14.3	12.0	9.3	5.8	4.5	8.6
mean 20cm soil	4.2	4.2	5.5	7.7	10.7	13.8	15.3	15.0	13.0	10.3	6.9	5.3	9.3
RELATIVE HUMIDITY (%)													
mean at 0900UTC	90.7	90.3	88.7	82.5	79.3	80.4	83.6	86.2	88.1	91.6	91.2	91.0	87.0

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean at 1500UTC	85.6	79.8	75.7	67.9	68.0	71.1	73.2	73.4	74.7	80.2	84.4	88.1	76.8
SUNSHINE (hours)													
mean daily duration	1.3	1.9	2.6	4.3	5.0	4.4	3.7	3.8	3.2	2.4	1.7	0.9	2.9
greatest daily duration	7.9	9.3	10.8	13.4	15.1	15.8	14.8	13.7	11.4	9.3	8.6	6.7	15.8
mean num. of days with no sun	9.5	7.3	5.7	2.8	2.0	2.2	2.2	2.1	3.4	5.0	8.1	10.8	61.1
RAINFALL (mm)													
mean monthly total	127.9	102.1	101.6	63.7	68.1	64.5	70.1	95.7	94.3	128.2	127.7	129.6	1173.6
greatest daily total	31.5	107.0	26.8	34.0	51.3	38.0	42.2	49.7	41.0	46.7	54.9	41.2	107.0
mean num. of days with >= 0.2mm	21	18	21	16	16	15	17	18	18	21	21	22	224
mean num. of days with >= 1.0mm	18	15	17	12	12	11	12	13	14	17	18	17	176
mean num. of days with >= 5.0mm	9	7	7	4	4	4	4	6	5	8	8	9	75
WIND (knots)													
mean monthly speed	10.2	10.3	10.2	8.7	8.1	7.7	7.2	6.8	7.7	8.7	8.9	9.7	8.7
max. gust	96	85	74	74	62	51	66	78	58	70	67	81	96
max. mean 10-minute speed	59	48	45	41	41	34	39	32	37	46	40	52	59

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
mean num. of days with gales	1.4	0.9	0.7	0.1	0.1	0.0	0.0	0.0	0.1	0.3	0.4	0.8	4.8
WEATHER (mean no. of days with..)													
snow or sleet	5.7	4.4	3.8	1.6	0.2	0.0	0.0	0.0	0.0	0.1	1.2	3.1	20.0
snow lying at 0900UTC	2.3	0.7	0.7	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7	4.6
Hail	4.4	3.2	5.4	3.2	1.6	0.4	0.1	0.0	0.7	0.8	2.6	2.7	25.2
Thunder	0.3	0.1	0.2	0.2	0.4	0.7	0.7	0.2	0.2	0.2	0.3	0.5	4.0
Fog	3.4	2.3	1.6	1.8	1.2	1.4	2.0	3.2	3.3	3.2	2.6	3.4	29.5

10.2.3 Calculating Carbon Losses and Savings from the Proposed Development

10.2.3.1 Background

In addition to the combustion of fossil fuels, greenhouse gases are also released through natural processes such as the decomposition of organic material (which is composed of carbon). Bogs and peatlands are known to store large amounts of carbon. Due to the waterlogged nature of these habitats, stored carbon is not broken down and released into the atmosphere. The construction of wind farms on bog and peat habitats may affect the natural hydrological regime, thus exposing and drying out the peat and allowing the decomposition of carbon. It is necessary therefore to demonstrate that any wind farm constructed on such sites saves more carbon than is released. The site of the proposed development is partially situated on peat habitats. For this reason, the carbon balance between the use of renewable energy and the loss of carbon stored in the peat is assessed in this section of the EIAR.

CO_2 emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is alive and converts it to organic carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully and the organic carbon is retained in the ground.

The carbon balance of proposed wind farm developments in peatland habitats has attracted significant attention in recent years. When development such as wind farms are proposed for peatland areas, there will be direct impacts and loss of peat in the area of the development footprint. There may also be indirect impacts where it is necessary to install drainage in certain areas to facilitate construction. The works can either directly or indirectly allow the peat to dry out, locally, which permits the full decomposition of the stored organic material with the associated release of the stored carbon as CO_2. It is essential therefore that any wind farm development in a peatland area saves more CO_2 than is released.

10.2.3.2 Methodology for Calculating Losses

A methodology was published in June 2008 by scientists at the University of Aberdeen and the Macauley Institute with support from the Rural and Environment Research and Analysis Directorate of the Scottish Government, Science Policy and Co-ordination Division. The document, '*Calculating Carbon Savings from Wind Farms on Scottish Peat Lands*', was developed to calculate the impact of wind farm developments on the soil carbon stocks held in peat. This methodology was refined and updated in 2011 based on feedback from users of the initial methodology and further research in the area. The web-based version of the carbon calculator, which supersedes the excel based versions of the tool, was released in 2016. The tool provides a transparent and easy to follow method for estimating the impacts of wind farms on the carbon dynamics of peatlands. Previously guidance produced by Scottish Natural Heritage in 2003 had been widely employed to determine carbon payback in the absence of any more detailed methods.

Although the loss of carbon fixing potential from plants on peat land is not substantial, it is nonetheless calculated for areas from which peat is removed and the areas affected by drainage. This calculation can take account of the annual gains due to the carbon fixing potential of the peat land and the time required for any habitat restoration. The carbon sequestered in the peat itself represents a much more substantial potential source of carbon loss. During wind farm construction, carbon is lost as a result of peat excavation and peat drainage. The amount of carbon lost is estimated using default values from the Intergovernmental Panel on Climate Change (IPCC, 1997) as well as by more site-specific equations

derived from the scientific literature. Carbon gains due to habitat improvement and site restoration are calculated in a similar fashion.

Peatlands are essentially unbalanced systems. When flooded, peat soils emit less carbon dioxide but more methane than when drained. In waterlogged soils, carbon dioxide emissions are usually exceeded by plant fixation, so the net exchange of carbon with the atmosphere is negative and soil carbon stocks increase. When soils are aerated, carbon emissions usually exceed plant fixation, so the net exchange of carbon with the atmosphere is positive. In order to calculate the carbon emissions resulting from the removal or drainage of the peat, the Macauley Institute method accounts for emissions occurring if the peat had been left in-situ and subtracts these from the emissions occurring after removal and drainage.

The Macauley Institute methodology states that the total volume of peat impacted by the construction of the wind farm is strongly correlated to the extent of the peatland affected by drainage at the site.

The drainage of peat soils leads to continual loss of soil carbon until a new steady state is reached, when inputs are approximately equal to losses. For peats, this steady state approximates 0% carbon, so 100% carbon loss from drained peats is assumed if the site is not restored after decommissioning of the wind farm. The amount of carbon lost is calculated on the basis of the annual emissions of methane and carbon dioxide, the area of drained peat, and the time until the site is restored. In the case of the proposed wind farm site, the model has been prepared on the basis of two scenarios, one where restoration of the wind farm areas will occur on decommissioning, and another where restoration will not occur.

The effects of drainage may also reduce dissolved and particulate organic carbon retention within the peat. Losses of carbon dioxide due to leaching of dissolved and particulate organic carbon are calculated as a proportion of the gaseous losses of carbon from the peat. The Macauley Institute method assumes that published good practice is employed in relation to avoiding the risk of peat landslides. This is certainly the case in respect of the proposed development, which has been the subject of a peat stability risk assessment, as described in the *Geotechnical Peat Stability Assessment Report* in Appendix 8-1 of this EIAR. Therefore, this potentially large carbon loss pathway is omitted from the calculations.

Clearfelling of existing forestry surrounding turbine locations may often be necessary to allow for the construction of the proposed development footprint and the erection of the wind turbines, to avoid reductions in the wind energy yield of the wind farm proposal and to protect local bat populations. Forestry may be felled earlier than originally planned due to the wind farm development, so limiting the nature and longevity of the resulting timber produced. If a forestry plantation was due to be felled with no plan to replant, the effect of the land use change is not attributable to the wind farm development and is omitted from the calculation. If, however, the forestry is felled for the development, the effects are judged to be attributable to the wind farm development. Carbon losses as a result of felling are calculated from the area to be felled, the average carbon sequestered annually, and the lifetime of the wind farm. Alterations in soil carbon levels following felling are calculated using the equations for drainage and site restoration already described.

10.2.3.3 Calculating Carbon Losses and Savings

10.2.3.3.1 *Carbon Losses*

The Scottish Government on-line carbon calculator as outlined in the sections above, was used to assess the impacts of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage, habitat improvement, forestry felling and site restoration.

A copy of the outputs is provided as Appendix 10-1 of this EIAR. Where available and relevant, site-specific information was inserted into the worksheet. Otherwise, default values were used.

The worksheet was pre-loaded with information specific to the CO_2 emissions from the United Kingdom's electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK. Similar data to that used in the worksheet to calculate the CO_2 emissions from the UK electricity generation plant, was not available for the Irish electricity generation plant, and so the CO_2 emissions savings from the proposed wind farm development were calculated separately from the worksheet.

The main CO_2 losses due to the proposed wind farm development are summarised in Table 10-10.

Table 10-10 CO_2 losses from the Proposed Development

Origin of Losses	CO_2 Losses (tonnes CO_2 equivalent)	
	Expected	Maximum
Losses due to turbine life (e.g. due to production, transportation, erection, operation and dismantling of the wind farm)	41,945	41,945
Losses due to backup (i.e. electricity obtained from fossil fuel source to stabilise electricity supply to the national grid)	28,382	28,382
Losses due to reduced carbon fixing potential	1,401	2,624
Losses due to leaching of dissolved and particulate organic carbon	0	0
Losses from soil organic matter (CO2 loss from removed and drained peat)	29,232	74,910
Losses due to felling forestry	21,463	24,095
Total	122,074	171,606

The worksheet model calculates that the proposed development is expected to give rise to 122,074 tonnes of CO_2 equivalent losses over its 30-year life. Of this total figure, the proposed wind turbines directly account for 41,495 tonnes, or 34%. Losses due to backup account for 28,382 tonnes, or 23%. Losses from soil organic matter, reduced carbon fixing potential and the felling of forestry accounting for the remaining 43% or 52,096 tonnes. The figure of 29,232 tonnes of CO_2 arising from ground activities associated with the proposed development is calculated based on the entire development footprint being "Acid Bog", as this is one of only two choices the model allows (the other being Fen). The habitat that will be impacted by the development footprint comprises predominantly commercial forestry rather than the acid bog assumed by the model that gives rise to the 21,463 tonnes and therefore the actual CO_2 losses are expected to be lower than this value.

The figures discussed above are based on the assumption that the hydrology of the site and habitats within the site are restored on decommissioning of the proposed wind farm after its expected 30-year useful life. As a worst-case scenario, the model was also used to calculate the CO_2 losses from the wind

farm if the hydrology and habitats of the site were not to be restored, as may be the case if the turbines were replaced with newer models, rather than decommissioned entirely and taking account of the future peat extraction activities. This worst-case scenario would increase the expected carbon losses by an additional 49,535 tonnes, or by 41% to 171,606 tonnes. Any failure to restore the site habitats or hydrology for the reasons outlined above would be further offset by the carbon-neutral renewable energy that the new turbines would generate.

10.2.3.3.2 Carbon Savings

According to the model described above, the proposed wind farm development will give rise to total losses of 122,074tonnes of carbon dioxide.

A simple formula can be used to calculate carbon dioxide emissions reductions resulting from the generation of electricity from wind power rather than from carbon-based fuels such as peat, coal, gas and oil. The formula is:

$$CO_2 \text{ (in tonnes)} = \frac{(A \times B \times C \times D)}{1000}$$

where: A = ... The rated capacity of the wind energy development in MW

B = ... The capacity or load factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc.

C = ... The number of hours in a year

D = ... Carbon load in grams per kWh (kilowatt hour) of electricity generated and distributed via the national grid.

For the purposes of this calculation, the rated capacity of the proposed wind farm is assumed to be approximately 48 MW.

A load factor of 0.35 (or 35%) has been used for the proposed development.

The number of hours in a year is 8,760.

The most recent data for the carbon load of electricity generated in Ireland is for 2018 and was published in Sustainable Energy Authority Ireland's (SEAI) December 2019 report, '*Energy in Ireland, 2019 Report.*' The emission factor for electricity in Ireland in 2018 was 375 g CO_2/kWh.

The calculation for carbon savings is therefore as follows:

$$CO2 \text{ (in tonnes)} = \frac{(48 \times 0.35 \times 8{,}760 \times 375)}{1000}$$

$$= \mathbf{55{,}188} \text{ tonnes per annum}$$

Based on this calculation, approximately 55,188 tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the proposed wind farm. Over the proposed thirty-year lifetime of the wind farm, therefore, 1,655,640 tonnes of carbon dioxide will be displaced from traditional carbon-based electricity generation.

As noted previously areas cleared of forestry for the proposed development at Croagh will be replaced by replanting at alternatives sites. A total of 54.2 hectares of new forestry will be replanted at alternative sites to compensate the loss of forestry at the development site. Given that losses due to felling forestry

account for 21,463 tonnes of CO_2, it has been assumed for the purposes of this calculation that the same quantity of CO_2 can be saved by replanting forestry at alternative sites.

In total, it is estimated that **1,655,640** tonnes of carbon dioxide will be displaced over the proposed thirty-year lifetime of the wind farm.

Based on the Scottish Government carbon calculator as presented above 122,074 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development. This represents 7.4% of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project. The 122,074 tonnes of CO_2 that will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the proposed development will be offset by the proposed development in approximately **26.5 months** of operation.

10.2.4 Likely Significant Effects and Associated Mitigation Measures

10.2.4.1 'Do-Nothing' Effect

If the proposed development were not to proceed, greenhouse gas emissions, e.g. carbon dioxide (CO2), carbon monoxide and nitrogen oxides associated with construction vehicles and plant would not arise. However, the opportunity to further significantly reduce emissions of greenhouse gas emissions, including carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2), to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol and EU law would also be lost. This would be a long-term, moderate, negative impact.

10.2.4.2 Construction Phase

10.2.4.2.1 *Greenhouse Gas Emissions*

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, site roads, site entrances, anemometry mast bases and all associated infrastructure will require the operation of construction vehicles and plant on site. Greenhouse gas emissions, e.g. carbon dioxide (CO_2), carbon monoxide and nitrogen oxides associated with vehicles and plant will arise as a result of the construction and demolition activities. This potential impact will be slight, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative impact. Mitigation measures to reduce this impact are presented below.

Grid Connection

The construction of 1 No. 38 kV substation and excavation of associated cable trenches will require the use of construction machinery giving rise to greenhouse emissions. This is a short-term slight negative impact, which will be reduced through use of the best practice mitigation measures as presented below.

Transport to Site

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 14.1 of this EIAR), will give rise to greenhouse gas emissions associated with the transport vehicles. This constitutes a slight negative impact in terms of air quality. Mitigation measures in relation to greenhouse gas emissions are presented below.

Mitigation

- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Turbine components and construction materials will be transported to the site on specified routes, assessed in Section 14.1 of this EIAR and agreed with the Planning Authority prior to the construction phase.
- The majority of aggregate materials for the construction of site access tracks and all associated infrastructure will be won from the borrow pit onsite, which will further reduce potential emissions.

Residual Impact

Short-term Imperceptible Negative Impact on Climate as a result of greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will be no significant direct or indirect effects.

10.2.4.3 Operational Phase

10.2.4.3.1 *Greenhouse Gas Emissions*

The proposed development will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. The proposed development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 30-year lifespan of the proposed wind farm. The proposed project will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the proposed wind farm will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect.

Residual Impact

Long-term Moderate Positive Impact on Climate as a result of reduced greenhouse gas emissions.

Significance of Effects

Based on the assessment above there will long-term positive effects.

10.2.4.4 Decommissioning Phase

Any impact and consequential effect that occurs during the decommissioning phase are similar to that which occur during the construction phase, be it of less impact. The mitigation measures prescribed for the construction phase of the proposed development will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.3 Cumulative Assessment

Potential cumulative effects on air quality and climate between the Proposed Development and other developments in the vicinity were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment are described in Section 2.5 of this EIAR.

The nature of the proposed development is such that, once operational, it will have a long-term, moderate, positive impact on the air quality and climate.

During the construction phase of the Proposed Development and other developments within 20 kilometres of the wind farm site that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Section 10.2.4.2 and Section 10.3.4.2 are implemented during the construction phase of the Proposed Development, there will be no cumulative negative effect on air and climate.

There will be no net carbon dioxide (CO_2) emissions from operation of the proposed wind farm. Emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) or dust emissions during the operational phase of the Proposed Development will be minimal, relating to the use of operation and maintenance vehicles onsite, and therefore there will be no measurable negative cumulative effect with other developments on air quality and climate.

The nature of the Proposed Development and other wind energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality and climate.

11. NOISE & VIBRATION

11.1 Introduction

11.1.1 Background & Objectives

This chapter of the EIAR describes the assessment undertaken of the potential noise and vibration impact from the proposed Croagh Wind Farm Development (the 'Proposed Development') on local residential amenity. The Proposed Development comprises up to 10 no. wind turbines with a maximum overall ground level to blade tip height of up to 170 metres, an electricity substation, construction compound and all ancillary infrastructure. A full description of the proposed development is provided in Chapter 4 of this EIAR. There are 78 no. noise sensitive locations within 2.2 km of the proposed turbine locations. The nearest noise sensitive location (NSL) is located approximately 850m to the nearest proposed turbine location (i.e. Location H037 from proposed turbine T6).

Noise impact assessments have been prepared for the operational phase and the construction phase of the Proposed Development to the nearest noise sensitive locations (NSLs). To inform this assessment background noise levels have been measured at locations representative of the nearest NSLs to assess the potential impacts associated with the operation of the Proposed Development. The current *Wind Energy Development Guidelines for Planning Authorities,* published by the Department of the Environment, Heritage and Local Government in 2006, defines a noise sensitive location as any occupied dwelling house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational amenity importance. In this instance all of the NSLs are dwellings.

Existing, under construction, permitted and proposed wind farm developments have been identified in the wider study area and the cumulative impact of these developments has been considered in this assessment. Further details on each of these developments is provided in Chapter 2 of this EIAR.

11.1.2 Statement of Authority

This chapter of the EIAR has been prepared by the following staff of AWN Consulting Ltd:

Dermot Blunnie

Dermot Blunnie (Senior Acoustic Consultant) holds a BEng. from the University of South Wales, a M.Sc. from the University of Derby and IOA Diploma in Acoustics and Noise Control from the Institute of Acoustics. He has over 10 years' experience as an acoustic consultant and is a member of the Institute of Acoustics. He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

Leo Williams

Leo Williams holds a BA, BAI (Mechanical and Manufacturing Engineering) and a MAI (Mechanical and Manufacturing Engineering). He is an Associate Member of the Institute of Acoustics (IOA) and has completed the IOA Diploma in Acoustics and Noise Control. He has over five years' experience working in the field of acoustics and has prepared numerous environmental impact assessment chapters for various developments such as infrastructural developments, mixed use developments and specialises in wind energy development projects.

Mike Simms

Mike Simms BE MEngSc MIOA MIET, Senior Acoustic Consultant at AWN, who has worked in the field of acoustics for over 19 years and has been a consultant since 1998. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, energy, industrial, commercial and residential.

11.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. To take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3 dB.

The frequency of sound, the rate at which a sound wave oscillates, is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. The 'A-weighting' system defined in the international standard, BS ISO 226:2003 Acoustics Normal Equal-loudness Level Contours has been found to provide the best correlations with human response to perceived loudness. SPL's measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 11-1.

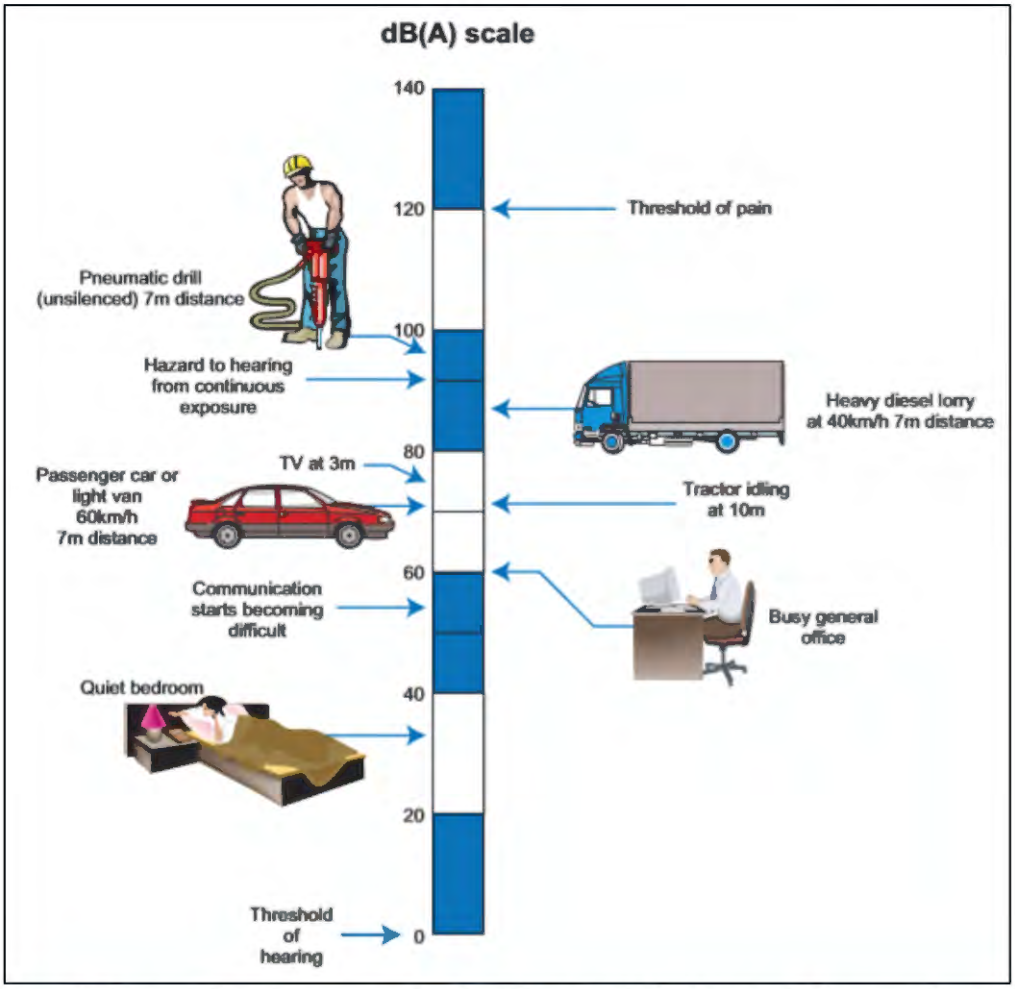

Figure 11-1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

For a glossary of terms used in this chapter please refer to Appendix 11-1.

11.3 Assessment Methodology

The assessment of impacts for the Proposed Development have been undertaken with reference to the most appropriate guidance documents relating to environmental noise and vibration which are set out in Section 11.3.2.

In addition to the specific guidance documents outlined in this chapter, the Environmental Impact Assessment (EIA) guidelines listed in Chapter 1 were considered and consulted for the purposes of preparing this EIAR chapter.

The methodology adopted for this noise impact assessment is summarised as follows:

- Review of appropriate guidance to identify appropriate noise and vibration criteria for both the construction and operational phases;
- Characterise the receiving environment through baseline noise surveys at various NSLs surrounding the proposed development;
- Undertake predictive calculations to assess the potential impacts associated with the construction phase of the proposed development at NSLs;

- Undertake predictive calculations to assess the potential impacts associated with the operational of the proposed development at NSLs; evaluate the potential noise and vibration impacts and effects;
- Specify mitigation measures to reduce, where necessary, the identified potential outward impacts relating to noise and vibration from the proposed development; and
- Describe the significance of the residual noise and vibration effects associated with the proposed development.

11.3.1 EPA Description of Effects

The significance of effects of the proposed development shall be described in accordance with the EPA guidance document Draft *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR), (EPA, 2017).*

The effects associated with the proposed development are described with respect to the EPA gnidance in the relevant sections of this chapter.

11.3.2 Guidance Documents and Assessment Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

11.3.2.1 Construction Phase

11.3.2.1.1 *Construction Noise*

There is no published statutory Irish gnidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise.*

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at the façade of residential noise sensitive receivers, (construction noise only), indicates a potential significant noise impact is associated with the construction activities.

Table 11-1 sets out the values which, if exceeded, potentially signify a significant effect as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 11-1 Example Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period (T)	Threshold values, $L_{Aeq,T}$ dB		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

This assessment method is only valid for residential properties. For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5 dB. In this instance, with the rural nature of the site, properties near the development have daytime ambient noise levels that typically range from 40 to 50 dB $L_{Aeq,1hr}$. Therefore, all properties will be afforded a Category A designation.

See Section 11.5.2 for the detailed assessment in relation to the proposed development. If the specific construction noise level exceeds the appropriate category value (e.g. 65 dB $L_{Aeq,T}$ during daytime periods) then a significant effect is deemed to have occurred.

11.3.2.1.2 *Additional Vehicular Activity*

For the assessment of potential noise impacts from construction related traffic along public roads and haul routes it is proposed to adopt guidance from Design Manual for Roads and Bridges (DMRB), Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure 2019.

Table 11-2, taken from Section 13.7 of DMRB presents gnidance as to the likely impact associated with any change in the background noise level ($L_{Aeq,T}$) at a noise sensitive receiver as a result of construction traffic.

Section 3.19 of DMRB states that construction noise and construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights;
- A total number of days exceeding 40 in any 6 consecutive months.

Table 11-2 Likely Impacts Associated with Change in Traffic Noise Level (Source DMRB, 2019)

Change in Sound Level	Magnitude of Impact
0	No Change
0.1 – 0.9	Negligible
1.0 – 2.9	Minor
3.0 – 4.9	Moderate
>5	Major

The DMRB gnidance outlined will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely impacts during the construction phase.

11.3.2.1.3 Construction Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. With respect to this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – *Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration* (BSI, 1993); and
- BS 5228 – *Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration* (BSI, 2009+A1:2014).

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is generated the limits discussed above may need to be reduced by 50%.

The Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* (NRA, 2004) also contains information on the permissible construction vibration levels during the construction phase as shown in Table 11-3.

Table 11-3 Allowable Transient Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

11.3.2.2 Operational Phase

11.3.2.2.1 Noise

The noise assessment in this chapter has been based on gnidance in relation to acceptable levels of noise from wind farms as contained in the document *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government in 2006. These gnidelines are in turn based on detailed recommendations set out in the Department of Trade and Industry (UK) Energy Technology Support Unit (ETSU) publication *The Assessment and Rating of Noise from Wind Farms* (1996). The ETSU document has been used to supplement the guidance contained within the *Wind Energy Development Guidelines* publication where necessary.

11.3.2.2.2 Wind Energy Development Guidelines

Section 5.6 of the Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (2006) addresses noise and outlines the appropriate noise criteria in relation to wind farm developments.

The following extracts from this document should be considered:

> "*An appropriate balance must be achieved between power generation and noise impact.*"

While this comment is noted it should be stated that the Guidelines give no specific advice in relation to what constitutes an 'appropriate balance'. In the absence of this, guidance will be taken from alternative and appropriate publications.

> "*In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed.*"

As will be seen from the calculations presented later in this chapter, the various issues identified in this extract have been incorporated into our assessment.

"In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours."

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

"However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recoguised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the $L_{A90,\ 10min}$ of the wind energy development be limited to an absolute level within the range of 35 – 40dB(A)."

In relation to night time periods the following guidance is given:

"A fixed limit of 43dB(A) will protect sleep inside properties during the night."

This limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night time lower limit noise criterion curve in relation to wind farm developments.

In summary, the Wind Energy Development Guidelines outlines the following guidance to identify appropriate wind turbine noise criteria curves at noise sensitive locations:

- an appropriate absolute limit level for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night time periods.

While the caveat of an increase of 5dB(A) above background for night-time operation is not explicit within the current guidance it is commonly applied in noise assessments prepared and is detailed in numerous examples of planning conditions issued by local authorities and An Bord Pleanála. Therefore, a night time 5dB(A) above background allowance has also been adopted in the criteria for this assessment.

This set of criteria has been chosen as it is in line with the relevant Irish guidance. The proposed operational noise criteria curves for wind turbine noise at various noise sensitive locations are presented in Section 11.4.1.

11.3.2.2.3 The Assessment and Rating of Noise from Wind Farms – ETSU-R-97

As stated previously the core of the noise guidance contained within the *Wind Energy Development Guidelines* is based on the 1996 ETSU publication *The Assessment and Rating of Noise from Wind Farms* (ETSU-R-97).

ETSU-R-97 calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive locations. ETSU-R-97 considers that absolute noise limits applied at all wind speeds are not suited to wind turbine developments and recommends that noise limits should be set relative to the existing background noise levels at noise sensitive locations. A critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on-site noise surveys.

ETSU-R-97 states on page 58, "*...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question...*". Therefore, the noise contribution from all wind turbine development in the area should be included in the assessment.

11.3.2.2.4 Institute of Acoustics Good Practice Guide

The guidance contained within the institute of Acoustics (IoA) document A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (2013) (IOA GPG) and Supplementary Guidance Notes are considered to represent best practice and have been adopted for this assessment. The IOA GPG states, that at a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine). Background noise measurements (i.e. $L_{A90,10min}$) should be related to wind speed measurements that are collated at the site of the wind turbine development. Regression analysis is then conducted on the data sets to derive background noise levels at various wind speeds to establish the appropriate day and night time noise criterion curves.

Noise emissions associated with the wind turbine can be predicted in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation (1996). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the appropriate noise criteria.

Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria, consideration can be given to detailed downwind analysis and operating turbines in low noise mode, which is typically offered by modern wind turbine units.

For guidance on the methodology for the background noise survey and operation impact assessment for wind turbine noise the IoA GPG has been taken into account.

Assessment of Cumulative Turbine Noise Impacts

The IOA GPG states that cumulative noise exceedances should be avoided and where existing or permitted development is at the noise limit any new turbine noise sources should be designed to be 10 dB below the limit value.

Section 5.1 of the relevant IoA GPG states the following:

> *"5.1.1 ETSU-R-97 states at page 58, "...absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question..."*
>
> *5.1.2 The HMP[1] Report states that "If an existing wind farm has permission to generate noise levels up to ETSU-R-97 limits, planning permission noise limits set at any future neighbouring wind farm would have to be at least 10 dB lower than the limits set for the existing wind farm to ensure there is no potential for cumulative noise impacts to breach ETSU-R-97 limits (except in such cases where a higher fixed limit could be justified)". Such an approach could prevent any further wind farm development in the locality, and a more detailed analysis can be undertaken on a case by case basis.*
>
> *5.1.3 As with the assessment of noise for all wind farm developments, sequential steps need to be taken, but such steps require more detailed attention due to the added complexity of cumulative noise impacts. The advice of the EHO[2] could be invaluable to this part of the assessment."*
>
> *Cumulative impact assessment necessary*
>
> *5.1.4 During scoping of a new wind farm development consideration should be given to cumulative noise impacts from any other wind farms in the locality. If the proposed wind farm produces noise levels within 10 dB of any existing wind farm/s at the same receptor location, then a cumulative noise impact assessment is necessary.*
>
> *5.1.5 Equally, in such cases where noise from the proposed wind farm is predicted to be 10 dB greater than that from the existing wind farm (but compliant with ETSU-R-97 in its own right), then a cumulative noise impact assessment would not be necessary."*

11.3.2.2.5 Future Potential Guidance Change

Proposed changes to the assessment of noise impacts associated with on-shore wind energy developments are outlined in the *Draft Revised Wind Energy Development Guidelines* December 2019 prepared by the Department of Housing, Planning and Local Government. These Guidelines are currently in draft format and subject to public and stakeholder consultation. In line with best practice, the assessment presented in the EIAR is based on the current guidance outlined in Section 5.6 of the Wind Energy Development Guidelines for Planning Authorities, 2006.

11.3.2.2.6 World Health Organisation (WHO) Noise Guidelines for the European Region

The World Health Organisation (WHO) *Environmental Noise Guidelines for the European Region* (2018) provide guidance on protecting human health from exposure to environmental noise. They set

1 HMP: Hayes McKenzie Partnership Ltd. Report on "Analysis of How Noise Impacts are considered in the Determination of Wind Farm Planning Applications" Ref HM: 2293/R1 dated 6th April 2011.
2 Environmental Health Officer

health-based recommendations based on average environmental noise exposure of several sources of environmental noise, including wind turbine noise.

Recommendations are rated as either 'strong' or 'conditional'. A strong recommendation, *"can be adopted as policy in most situations"* whereas a conditional recommendation, *"requires a policy-making process with substantial debate and involvement of various stakeholders. There is less certainty of its efficacy owing to lower quality of evidence of a net benefit, opposing values and preferences of individuals and populations affected or the high resource implications of the recommendation, meaning there may be circumstances or settings in which it will not apply".*

The objective of the WHO *Environmental Noise Guidelines for the European Region* is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise. The guidelines present recommendations for

each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

In relation to wind turbine noise, the WHO Guideline Development Group (GDG) state the following:

> *"For average noise exposure, the GDG conditionally recommends reducing noise levels produced by wind turbines below 45 dB L_{den}, as wind turbine noise above this level is associated with adverse health effects.*
>
> *No recommendation is made for average night noise exposure L_{night} of wind turbines. The quality of evidence of night-time exposure to wind turbine noise is too low to allow a recommendation.*
>
> *To reduce health effects, the GDG conditionally recommends that policymakers implement suitable measures to reduce noise exposure from wind turbines in the population exposed to levels above the guideline values for average noise exposure. No evidence is available, however, to facilitate the recommendation of one particular type of intervention over another."*

The quality of evidence used for the WHO research is stated as being 'Low', the recommendations are therefore conditional.

The WHO Environmental Noise Guidelines aim to support the legislation and policy-making process on local, national and international level, thus shall be considered by Irish policy makers for any future revisions of Irish National Guidelines.

There is potential increased uncertainty due to the parameter used by the WHO for assessment of exposure (i.e. L_{den}), which it is acknowledged may be a poor characterisation of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes, as stated below.

> *"Even though correlations between noise indicators tend to be high (especially between L_{Aeq}-like indicators) and conversions between indicators do not normally influence the correlations between the noise indicator and a particular health effect, important assumptions remain when exposure to wind turbine noise in L_{den} is converted from original sound pressure level values. The conversion requires, as variable, the statistical distribution of annual wind speed at a particular height, which depends on the type of wind turbine and meteorological conditions at a particular geographical location. Such input variables may not be directly applicable for use in other sites. They are sometimes used without specific validation for a particular area, however, because of practical limitations or lack of data and resources. This can lead to increased uncertainty in the assessment of the relationship between wind turbine noise exposure and health outcomes. Based on all these factors, it may be concluded that the acoustical description of wind turbine noise by means of L_{den} or L_{night} may be a poor*

characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes...

...Further work is required to assess fully the benefits and harms of exposure to environmental noise from wind turbines and to clarify whether the potential benefits associated with reducing exposure to environmental noise for individuals living in the vicinity of wind turbines outweigh the impact on the development of renewable energy policies in the WHO European Region."

It is therefore considered that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) if applied, as target noise criteria for an existing or proposed wind turbine development in Ireland, should be done with caution. The L_{den} criteria has been not adopted as part of this assessment; this is based upon the review set out above and the conclusion that the conditional WHO recommended average noise exposure level (i.e. 45dB L_{den}) may be a poor characterization of wind turbine noise and may limit the ability to observe associations between wind turbine noise and health outcomes.

Based upon the review set out above, it is concluded that the conditional WHO recommended average noise exposure level (i.e. 45dB Lden) should not currently be applied as target noise criteria for an existing or proposed wind turbine development in Ireland.

11.3.3 Special Characteristics of Turbine Noise

11.3.3.1 Infrasound/Low Frequency Noise

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document *Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3)* (EPA, 2011) is noted here:

"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."

With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document *Community Noise* (WHO, 1995) has stated that:

"There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects."

In 2010, the UK Health Protection Agency published a report entitled Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

"Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.

For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. In relation to the issne of infrasound, the article states the following:

"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.

Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."

The article concludes that:

"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is no robust evidence that low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, generally has adverse effects on wind farm neighbours".

A report released in January 2013 by the South Australian Environment Protection Authority namely, Infrasound levels near windfarms and in other environments (EPA and Resonate Acoustics, 2013)[3] fomd that the level of infrasound from wind turbines is insignificant and no different to any other source of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people.

The study included several houses in rnral and urban areas, both adjacent to and away from a wind farm, and measured the levels of infrasound with the wind farms operating and switched off.

There were no noticeable differences in the levels of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building.

The EPA's study concluded that the level of infrasound at houses near wind turbines was no greater than in other urban and rnral environments, and stated that:

"The contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment."

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3 *EPA South Australia, 2013, Wind farms https://www.epa.sa.gov.au/files/477912_infrasound.pdf*

A German report[4], titled "Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources" presents the details of a measurement project which ran from 2013. The report was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016 and concluded the following in relation to infrasound from wind turbines:

> *"The measured infrasound levels (G levels) at a distance of approx. 150 m from the turbine were between 55 and 80 dB(G) with the turbine running. With the turbine switched off, they were between 50 and 75 dB(G). At distances of 650 to 700 m, the G levels were between 55 and 75 dB(G) with the turbine switched on as well as off."*
>
> *"For the measurements carried out even at close range, the infrasound levels in the vicinity of wind turbines – at distances between 150 and 300 m – were well below the threshold of what humans can perceive in accordance with DIN 45680 (2013 Draft)[5]"*
>
> *"The results of this measurement project comply with the results of similar investigations on a national and international level."*

In snmmary, considering the modernisation of wind turbines and the conclusions of the studies quoted above, infrasound associated with wind turbines is insignificant in comparison to typical prevailing levels of infrasound and is below the threshold of hearing for hnmans even in proximity to turbines before set back distances of hundreds of meters are taken into account.

11.3.3.2 Amplitude Modulation

In the context of this assessment, amplitude modulation (AM) is defined in the IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise (IOA, 2016) as:

> *"Periodic fluctuations in the level of audible noise from a wind turbine (or wind turbines), the frequency of the fluctuations being related to the blade passing frequency (BPF) of the turbine rotor(s)."*

It is now generally accepted that there are two mechanisms which can cause amplitude modulation:

- 'Normal' AM, and;
- 'Other' AM (sometimes referred to 'Excessive' AM).

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

'Normal' AM

An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

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4 *Report available at https://www4.lubw.baden-wuerttemberg.de/servlet/is/262445/low-frequency_noise_incl_infrasound.pdf?command=downloadContent&filename=low-frequency_noise_incl_infrasound.pdf*

5 *DIN 45680:2013-09 – Draft "Measurement and Assessment of Low-frequency Noise Immissions" November 2013*

The RenewableUK AM project (RenewableUK, 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognised and was discussed in ETSU-R-97 in 1996.

'Other' AM

In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM project report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of AM, presumably relating back to blade swish as described in ETSU-R-97.

11.3.3.2.1 Frequency of Occurrence of AM

Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report *Research into Aerodynamic Modulation of Wind Turbine Noise* (2007). The broad conclusions of this report were that aerodynamic modnlation was only considered to be an issue at 4, and a possible issue at a further 8, of 133 sites in the UK that were operational at the time of the study and cousidered within the review. At the 4 sites where AM was confirmed as an issue, it was considered that conditions associated with AM uright occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine control system. The research has shown that AM is a rare and unlikely occurrence at operational wind farms.

It shonld be noted that AM is associated with wind turbine operation and it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule.

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F — "*even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent.*"

Page 6 Modnle F — "*It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months.*"

Page 61 Module F — "*There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site,*

based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."

11.3.3.2.2 Assessment of AM

Research and Guidance in the area is ongoing with recent publications being issued by the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) (The Reference Method). The document proposes an objective method for measuring and rating AM. The AMWG does not propose what level of AM is likely to result in adverse community response or propose any limits for AM. The purpose of the group is simply to use existing research to develop a Reference Methodology for the measurement and rating of amplitude modulation.

The definition of any limits of acceptability for AM, or consideration of how such limits might be incorporated into a wind farm planning condition, is outside the scope of the AMWG's work and is currently the subject of a separate UK Government funded study. In the absence of published guidance to date, it is considered best practice to adopt the penalty rating and assessment scheme contained in an article published in the Institute of Acoustics publication *Acoustics Bulletin* (Vol. 42 No. 2 March/April 2017) titled, *Perception and Control of Amplitude Modulation in Wind Turbines Noise.*

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve long-term, post-commissioning measurements. The 'Reference Method' for measuring AM outlined in the IoA AMWG document will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

11.3.4 Comments on Human Health Impacts

11.3.4.1 The National Health and Medical Research Council

The relevant Australian authority on health issues, the National Health and Medical Research Council (NHMRC), conducted a comprehensive independent assessment of the scientific evidence on wind farms and human health, the findings are contained in the NHMRC Information Paper: *Evidence on Wind Farms and Human Health* 2015, this report concluded:

> *"After careful consideration and deliberation, NHMRC concluded that there is no consistent evidence that wind farms cause adverse health effects in humans. This finding reflects the results and limitations of the direct evidence and also takes into account the relevant available parallel evidence on whether or not similar noise exposure from sources other than wind farms causes health effects".*

11.3.4.2 Health Canada

Health Canada, Canada's national health organisation, released preliminary results of a study into the effect of wind farms on human health in 2014[6]. The study was initiated in 2012 specifically to gather new data on wind farms and health. The study considered physical health measures that assessed stress levels using hair cortisol, blood pressure and resting heart rate, as well as measures of sleep quality. More than 4,000 hours of wind turbine noise measurements were collected and a total of 1,238 households participated.

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6 *Health Canada 2014, Wind Turbine Noise and Health Study: Summary of Results. Available at https://www.canada.ca/en/health-canada/services/environmental-workplace-health/noise/wind-turbine-noise/wind-turbine-noise-health-study-summary-results.html*

No evidence was found to support a link between exposure to wind turbine noise and any of the self-reported illnesses. Additionally, the study's results did not support a link between wind turbine noise and stress, or sleep quality (self-reported or measured). However, an association was found between increased levels of wind turbine noise and individuals reporting of being annoyed.

11.3.4.3 New South Wales Health Department

In 2012, the New South Wales (NSW) Health Department provided written advice to the NSW Government that stated existing studies on wind farms and health issues had been examined and no known causal link could be established.

NSW Health officials stated that fears that wind turbines make people sick are 'not scientifically valid'. The officials wrote that there was no evidence for 'wind turbine syndrome', a collection of ailments including sleeplessness, headaches and high blood pressure that some people believe are caused by the noise of spinning blades.

11.3.4.4 The Australian Medical Association

The Australian Medical Association put out a position statement, *Wind Farms and Health* 2014[7]. The statement said:

> *"The available Australian and international evidence does not support the view that the infrasound or low frequency sound generated by wind farms, as they are currently regulated in Australia, causes adverse health effects on populations residing in their vicinity. The infrasound and low frequency sound generated by modern wind farms in Australia is well below the level where known health effects occur, and there is no accepted physiological mechanism where sub-audible infrasound could cause health effects."*

11.3.4.5 Journal of Occupational and Environmental Medicine

The review titled, *Wind Turbines and Health: A Critical Review of the Scientific Literature* was published in the Journal of Occupational and Environmental Medicine, 2014. An independent review of the literature was undertaken by the he Department of Biological Engineering of the Massachusetts Institute of Technology (MIT). The review took into consideration health effects such as stress, annoyance and sleep disturbance, as well as other effects that have been raised in association with living close to wind turbines. The study found that:

> *"No clear or consistent association is seen between noise from wind turbines and any reported disease or other indicator of harm to human health."*

The report concluded that living near wind farms does not result in the worsening of the quality of life in that region.

11.3.4.6 Summary

The peer reviewed research outlined in the preceding sections supports that there are no negative health effects on people with long term exposure to wind turbine noise. Please refer to Chapter 5 of the EIAR for further details of potential health impacts associated with the proposed development.

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7 *Australian Medical Association, 2014, Wind farms and health. Available at https://ama.com.au/position-statement/wind-farms-and-health-2014*

11.3.5 Vibration

A recent report published in Germany by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg in 2016, "*Low Frequency Noise incl. Infrasound from Wind Turbines and Other Sources*", Conducted vibration measurements study for an operational Nordex N117 – 2.4 MW wind turbine. The report concluded that at distances of less than 300m from the turbine vibration levels had dropped so far that they could no longer be differentiated from the background vibration levels.

Considering the distances from nearest NSL's to any of the proposed turbines (>750m), levels of vibration will be significantly below any thresholds for perceptibility. Therefore, vibration criteria have not been specified for the operational phase of the proposed development.

11.3.6 Noise Conditions for Other Wind Farm Developments

The Planning Permissions relating to the other wind farm developments are discnssed in the following sections. As previously stated, it is a requirement that turbine noise emissions from all existing, permitted and proposed wind energy developments are included in the noise impacts assessment.

11.3.6.1 Garvagh Glebe Wind Farm

The permissible noise limits for the Garvagh Glebe development are contained in Condition No. 3 of planning permission granted by Leitrim County Comcil, Reference 03/257.

The permitted development provides, by way of condition of consent, that noise levels at all dwellings shall not exceed 45dB $L_{eq,5min}$.

For the assessment presented in this report we have assumed that the absolute noise limit of 43dB $L_{A90\ 10min}$ on turbine noise from the Garvagh Glebe wind farm will apply to all NSLs.

11.3.7 Background Noise Assessment

An environmental noise survey was undertaken to determine typical backgromd noise levels at representative NSLs surromding the development site. The background noise survey was conducted through installing unattended somd level meters at 10 no. representative locations in the surromding area.

All measurement data collected during the background noise surveys has been carried out in accordance with the Institute to Acoustic's Good Practice Gnide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (IoA GPG, 2013) and accompanying, Supplementary Guidance Note 1: Data Collection (2014) discussed in the following Section.

The NSLs are spread over a large area and the noise monitoring locations were selected to obtain backgromd noise levels representative of the noise environments at noise sensitive locations surrounding the site. Consideration was also given to the potential for noise from existing turbines effecting the survey when selecting the locations.

As set out in the IOA GPG:

> *"Where a new wind farm is proposed and a receptor is also within the area acoustically affected by an already operational wind farm, then noise from the existing wind farm must not be allowed to influence the background noise measurements for the proposed development."*

In addition to data filtering, which is discussed in later sections, the noise monitoring campaign was expanded so as to capture data at locations further from the acoustic influence of existing turbines. Examples of this "doubling up" on locations in different sectors surrounding the site is the Location D and Location B pairing and also Location E and Location J. The monitoring locations are representative of houses within a given "cluster" of properties in the localised area.

11.3.7.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary noise model contour at an early stage of the assessment. Any locations that fell inside the predicted 35 dB LA90 noise contour were considered for noise monitoring in line with current best practice guidance outlined in the IoA GPG. The selection of the noise monitoring locations was informed by site visits and supplemented by reviewing of aerial images of the study area and other online sources of information (e.g. Google Earth).

The selected locations for the noise monitoring are outlined in the following sections. Coordinates for the noise monitoring locations are detailed in Table 11-4 and illustrated in Figure 11-2.

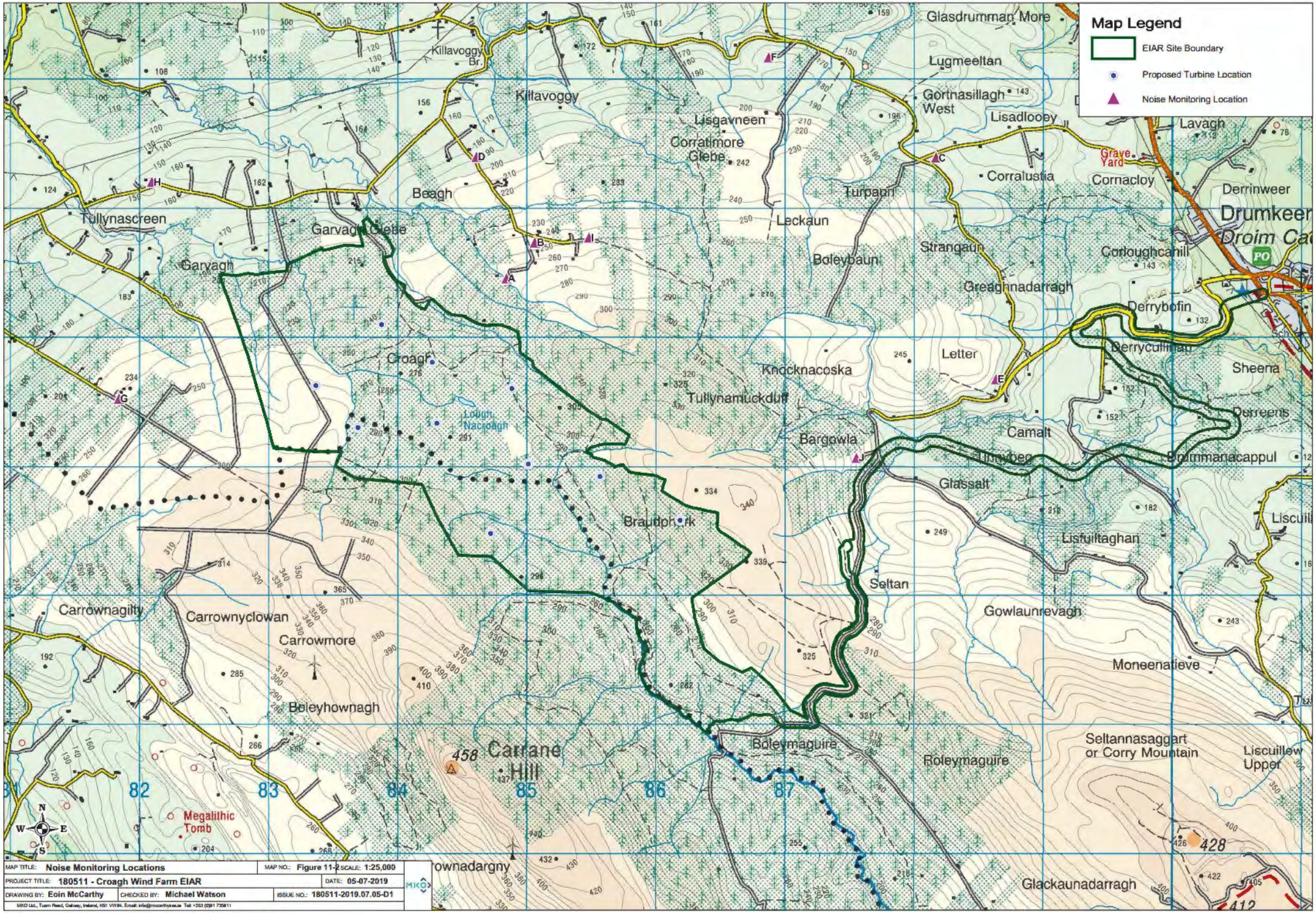
Table 11-4 Measurement Location Coordinates

Location	Coordinates – Irish Grid (ITM)	
	Easting	Northing
A (H37)	584799	824463
B (H32)	585018	824742
C (H52)	588128	825402
D (H30)	584566	825405
E (H58)	588593	823683
F (H45)	586831	826176
G (H1)	581795	823532
H (H12)	582051	825211
I (H35)	585438	824780
J (H65)	587511	823073

The background noise away from any significant sources were typically noted to be distant traffic movements, activity in and around the residences and wind generated noise from nearby foliage and other typical anthropogenic sources typically found in such rural settings.

Site visits were carried out during the morning and afternoon time; therefore, no observations were made during night-time periods. There was no perceptible source of vibration noted at any of the survey locations.

Plate 11-1to 11-10 illustrate the installed noise monitoring kits.



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11.3.7.1.1 Location A



Plate 11-1 Location A (H37)

11.3.7.1.2 Location B



Plate 11-2 Location B (H32)

11.3.7.1.3 Location C



Plate 11-3 Location C (H52)

11.3.7.1.4 Location D



Plate 11-4 Location D (H30)

11.3.7.1.5 Location E



Plate 11-5 Location E (H58)

11.3.7.1.6 Location F



Plate 11-6 Location F (H45)

11.3.7.1.7 Location G



Plate 11-7 Location G (H1)

11.3.7.1.8 Location H



Plate 11-8 Location H (H12)

11.3.7.1.9 Location I



Plate 11-9 Location I (H35)

11.3.7.1.10 Location J



Plate 11-10 Location J (H65)

11.3.7.2 Measurement Periods

Noise measurements were conducted at each of the monitoring locations over the periods outlined in Table 11-5.

Table 11-5 Measurement Periods

Location	Start Date	End Date
A (H37)	24 January 2019	8 March 2019
B (H32)	24 January 2019	8 March 2019
C (H52)	24 January 2019	8 March 2019
D (H30)	24 January 2019	8 March 2019
E (H58)	24 January 2019	8 March 2019

Location	Start Date	End Date
F (H45)	24 January 2019	8 March 2019
G (H1)	24 January 2019	8 March 2019
H (H12)	24 January 2019	8 March 2019
I (H35)	14 February 2019	27 March 2019
J (H65)	8 March 2019	27 March 2019

The survey was completed when an adequate number of datasets had been measured as recommended in the IOA GPG to determine a suitable representation of the typical background noise.

11.3.7.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. Battery checks and meter calibrations were carried out half way through the survey periods. The following instrumentation was used at the various locations:

Table 11-6 Instrumentation Details

Location	Equipment	Serial Number
A (H37)	RION – NL-52	620878
B (H32)	RION – NL-52	732145
C (H52)	RION – NL-52	732075
D (H30)	RION – NL-52	1021277
E (H58)	RION – NL-52	710288
F (H45)	RION – NL-52	620867
G (H1)	RION – NL-52	976222
H (H12)	RION – NL-52	186671
I (H35)	RION – NL-52	186667
J (H65)	RION – NL-52	186671

Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator where appropriate. Instruments were calibrated on each interim visit and any drift noted. Relevant calibration certificates are presented in Appendix 11-2.

Rain fall was monitored and logged using a Texas Instruments TR-525 console and a data logger that was installed on-site for the duration of the surveys. This allows for the identification of periods of rain fall to allow for the removal of sample periods affected by rainfall from the noise monitoring data sets in line with best practice when calculating the prevailing background noise levels.

Wind data was measured at an anemometer located within the site of the proposed development and was supplied to AWN for data analysis.

Table 11-7 Met Mast Details

Description	Coordinates (ITM)	
	Easting	Northing
MET MAST	584,274	823,568

11.3.7.4 Procedure

Measurements were conducted at ten locations over the survey periods outlined in Table 11-5. Data samples for all measurements (noise, rainfall and wind) were logged continuously at 10-minute interval periods for the duration of the survey.

Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site. $L_{Aeq,10min}$ and $L_{A90,10min}$ parameters were measured in this instance.

11.3.7.5 Analysis of Background Noise Data

The data sets have been filtered to remove issues such as the dawn chorus and the influence of other atypical noise sources. An example of atypical sources would be short isolated periods of raised noise levels attributable to local sources, agricultural activity, boiler flues, operation of gardening equipment etc. In addition, sample periods affected by rainfall or when rainfall resulted in prolonged periods of atypical noise levels have also been screened form the data sets. The assessment methods outlined above are in line with the guidance contained in the IoA *GPG*.

Consideration has been given to removing contributing noise from the existing Garvagh Glebe turbines for the measured noise data. For guidance, reference has been made to Section 5.2.3 of the IOA GPG which states:

> *"5.2.3 In the presence of an existing wind farm, suitable background noise levels can be derived by one of the following methods:*
>
> - *switching off the existing wind farm during the background noise level survey (with associated cost implications);*
> - *accounting for the contribution of the existing wind farm in the measurement data e.g. directional filtering (only including background data when it is not influenced by the existing turbines e.g. upwind of the receptor, but mindful of other extraneous noise sources e.g. motorways) or subtracting a prediction of noise from the existing wind farm from the measured noise levels;*
> - *utilising an agreed proxy location removed from the area acoustically affected by the existing wind farm/s; or utilising background noise level data as presented within the Environmental Statement/s for the original wind farm/s (the suitability of the background noise level data should be established)."*

The approach adopted here is to apply wind directional filtering to the measured data in order to assess background noise data when it was not influenced by the existing turbines e.g. upwind of the NSL.

Additional filtering has been applied due to the contribution of existing wind farms in the area. In order to capture baseline noise levels unaffected by existing wind farms, wind direction filtering has

been applied. Measurement locations where this approach has been applied include locations A, B, I and J. The filtering involved identifying the downwind direction sector for each of these locations, i.e. the wind directions where the wind was blowing from existing wind farms to a given noise sensitive receiver or dwelling and therefore having the potential for the highest noise contribution at these locations. Downwind periods were therefore excluded and upwind periods only were used to derive the background noise levels at these four locations. This approach is outlined in Section 5.2.3 of the IOA GPG.

The results presented in the following sections refer to the noise data collated during 'quiet periods' of the day and night as defined in the IoA *GPG*. These periods are defined as follows:

- Daytime Amenity hours are:
  - all evenings from 18:00 to 23:00hrs;
  - Saturday afternoons from 13:00 to 18:00hrs, and;
  - all day Sunday from 07:00 to 18:00hrs.
- Night-time hours are 23:00 to 07:00hrs.

The background noise levels are derived for each location with reference to the standardised 10m height wind speed relative to the assessment hub height of 103.5m.

11.3.7.5.1 Consideration of Wind Shear

Wind shear is defined as the increase of wind speed with height above ground. As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. The issue of wind shear has been considered in this assessment and followed relevant guidance as outlined in the IoA GPG. It is standard procedure to reference noise data to standardised 10 metre height wind speed.

Wind speed measurements at 65m and 85m heights have been corrected to a height of 103.5m (the hub height adopted for the noise assessment) in accordance with Method B of Section 2.6 of the IOA GPG. The calculated hub height wind speeds were then corrected to standardised 10 metre height wind speed.

The IoA GPG presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Shear Exponent Profile: $U = U_{ref} \times [(H \div H_{ref})]^{m}$

Where:

U	Calculated wind speed
U_{ref}	Measured HH wind speed.
H	Height at which the wind speed will be calculated.
H_{ref}	Height at which the wind speed was measured.
m	shear exponent = $\log(U/U_{ref})/\log(H/H_{ref})$

The Calculated hub height wind speeds have been standardised to 10 m height using the following equation:

Roughness Length Shear Profile:

$$U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured or calculated HH wind speed.
U_1	The wind speed to be calculated.
U_2	The measured or calculated HH wind speed.
z	The roughness length.

Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This 'normalisation' procedure was adopted for comparability between test results for different turbines.

Any reference to wind speed in this chapter should be understood to be the standardised 10m height wind speed reference unless otherwise stated.

11.3.8 Turbine Noise Calculations

A series of computer-based prediction models have been prepared to quantify the cumulative noise level associated with the operation of the permitted and proposed developments. This section discusses the methodology for the noise modelling process.

11.3.8.1 Noise Modelling Software

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, DGMR iNoise Enterprise, calculates noise levels in accordance with ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, (ISO, 1996).

iNoise is a proprietary noise calculation package for computing noise levels and propagation of noise sources. iNoise calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated considering a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (LWA);
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- attenuation due to atmospheric absorption; and
- meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

11.3.8.2 Input Data and Assumptions

The calculation settings, input data and any assumptions made in the assessment are described in the following sections. Additional information relating to the noise model inputs and calculation settings is provided in Appendix 11-3.

11.3.8.2.1 *Turbine Details*

Table 11-8 details the co-ordinates of the 10 no. proposed turbines that are being considered in this assessment.

Table 11-8 Proposed Croagh Turbine Co-ordinates

Turbine Ref.	Co-ordinates (ITM)	
	Easting	Northing
T01	583,322	823,639
T02	583,831	824,112
T03	583,648	823,314
T04	584,223	823,820
T05	584,259	823,347
T06	584,841	823,616
T07	584,968	823,032
T08	585,523	822,935
T09	586,144	822,595
T010	584,676	822,493

For the purposes of this assessment, consideration has been given to several potential turbine technologies that have been identified as being suitable for the Proposed Development. The actual turbine to be installed on the site will be the subject of a competitive tender process and could include other turbines models not currently available. Regardless of the make or model of the turbine eventually selected for installation on site, the noise emission of the turbine shall be of no greater significance than that used for the purposes of this assessment, and will ensure the required noise limits are achieved at all noise sensitive locations.

Sound power levels (L_{WA}) have been supplied for the various turbines under consideration. These levels have been reviewed and an envelope method used whereby the worst case, i.e. highest noise levels, for the proposed turbine models have been selected and input into the noise model. For the purposes of this assessment, calculations are based on a turbine HH of 103.5m above ground.

Table 11-2 details the noise spectra used for noise modelling purposes for the proposed Croagh Wind Farm development. As discussed in previous sections, appropriate guidance is couched in terms of a L_{A90} criterion. The provided turbine noise is referenced in terms of the L_{Aeq} parameter, best practice guidance contained within the *Institute of Acoustics Good Practice Guide* (IoA GPG) states that "L_{A90} levels should be determined from calculated L_{Aeq} levels by subtraction of 2 dB". Therefore, in

accordance with best practice guidance, a 2dB reduction has been applied to the predicted results in this assessment.

For the purposes of all predictions presented in this report to account for various uncertainties in the measurement of turbine source levels, a +2dB uncertainty factor has been added to all noise emission values in line with guidance for wind turbine noise assessment contained in the IOA GPG.

Table 11-9 Lwa Spectra Used for Prediction Model – Croagh Wind Farm

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
4	84.3	89.7	92.6	94.3	94.1	92.4	85.2	69.8	100.2
5	88	93.4	96.3	98	97.8	96.1	88.9	73.1	103.9
6	88.6	94.3	97.7	99.6	99.6	97.4	90.2	77.3	105.3
7	89.3	95	98.6	100.4	100.1	98.1	90.9	72.9	106
≥8	89.5	95.1	98.4	100	100.1	98.4	91.3	73.2	106

Best practice specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility. On review of derived noise emission levels, a tonal penalty has not been included within the predicted noise levels. A warranty will be provided by the manufacturers of the selected turbine to ensure that the noise output will not require a tonal noise correction under best practice guidance.

A list of existing, permitted and proposed windfarm developments in proximity to the subject site was provided at the early stages of the assessment process. A noise modelling exercise was carried out to address the potential for cumulative impacts associated with other windfarms in conjunction with the Croagh development. Other developments that did not significantly contribute to cumulative noise levels surrounding the site were excluded from the assessment in line with guidance set out in the IOA Good Practice Guide. Other developments that were predicted to contribute to cumulative impacts included:

- Garvagh Glebe – Operational development of 10 no. turbines with an associated HH of 70m.
- Black Banks 1 – Operational development of 4 no. turbines with an associated HH of 49m.
- Black Banks 2 – Operational development of 8 no. turbines with an associated HH of 49m.

The following noise data presented in Table 11-10 and Table 11-11 was used as inputs for the other developments identified within the study area, as identified above, see Chapter 2 of this EIAR for further details.

Table 11-10 L_{wa} Spectra Used for Prediction Model – Garvagh Glebe Wind Farm

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
5	82.5	89.2	93.4	92.3	90.4	89.8	84.5	71.9	98.6

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
6	84.5	91.9	96.6	97.0	95.7	94.0	89.9	79.0	102.7
7	86.1	93.9	98.1	97.9	97.0	96.5	92.5	80.2	104.3
≥8	91.8	98.3	100.9	98.6	96.0	90.7	76.9	61.1	105.2

Table 11-10 details the noise emission values used for noise modelling of the Garvagh Glebe turbines. The relevant noise emission data in AWN's database has been utilised following the identification of the turbine model installed at the Garvagh Glebe development.

Table 11-11 L_{wa} Spectra Used for Prediction Model – Black Banks 1 and 2 Wind Farms

Wind Speed (m/s)	Octave Bank Centre Frequency (Hz)								dB L_{WA}
	63	125	250	500	1000	2000	4000	8000	
5	72.2	80.1	85.9	91.5	91.2	87.3	80.9	70.7	95.9
6	76.6	84.5	90.3	95.9	95.6	91.7	85.3	75.1	100.3
7	79.9	87.8	93.6	99.2	98.9	95.0	88.6	78.4	103.6
≥8	80.5	88.4	94.2	99.8	99.5	95.6	89.2	79.0	104.2

The above noise emission levels have been used for Black Banks 1 and 2 wind farms.

Table 11-11 details the noise emission values used for noise modelling of the Black Banks turbines which data has been taken from manufacturer's data.

Appendix 11-4 presents additional details relation to the turbine noise model inputs and the turbine location coordinates for other turbines.

11.3.8.3 Consideration of Wind Direction and Noise Propagation

When considering noise impacts of wind turbines, the effects of propagation in different wind directions should be considered. The day to day operations of the optimised development will not result in a worst-case condition of all noise locations being downwind of all turbines at the same time i.e. omni-directional predictions. Therefore, to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions in accordance with the IoA GPG Guidance.

For any given wind direction, a property can be assigned one of the following classifications in relation to turbine noise propagation:

- Downwind (i.e. 0° ±80°);
- Crosswind (i.e. 90° ±10° and 270° ±10°);
- Upwind (i.e. 180° ±70°).

Figure 11-3 illustrates the directivity attenuation factor that has been applied to turbines when considering noise propagation in downwind conditions (downwind is represented by 0° with upwind being 180°).

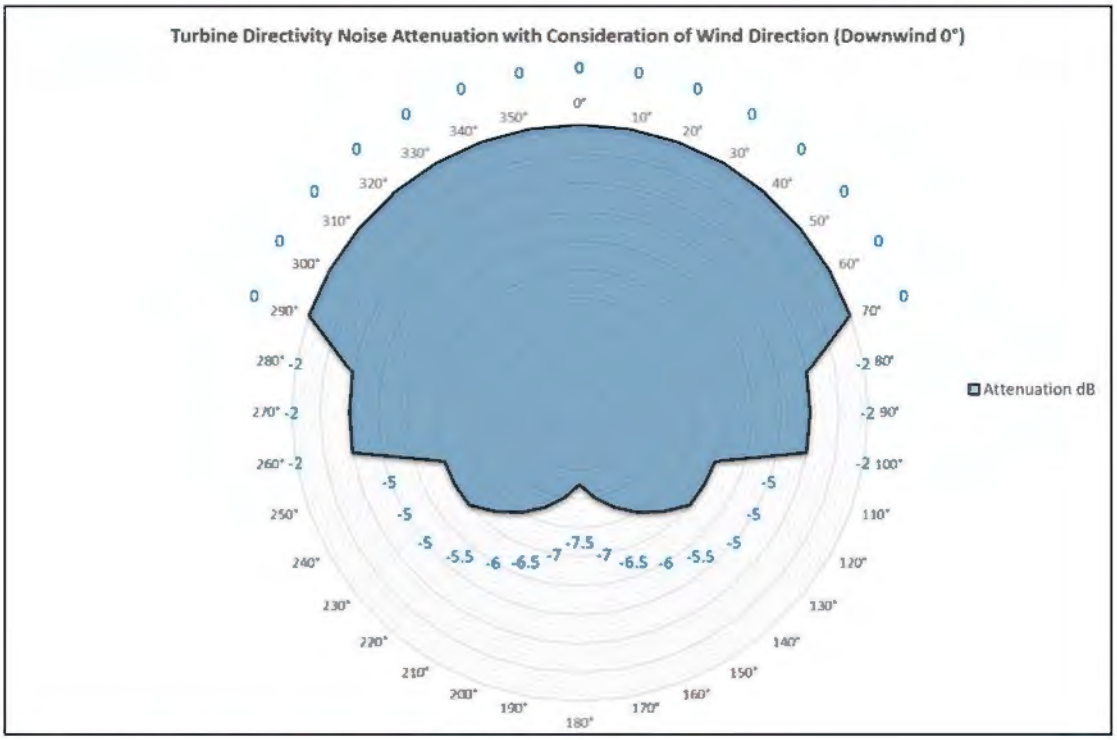


Figure 11-2 Turbine Directivity Attenuation with Consideration of Wind Direction

11.3.8.4 Assessment of Turbine Noise Levels

The predicted cumulative turbine noise level from the proposed development, and contributing permitted and proposed developments in the area will be compared against the derived turbine noise limits and any exceedances of the limits will be identified and assessed. Where necessary, appropriate mitigation measures will be outlined.

The following presents a breakdown of the various steps involved in the assessment of operational turbine noise level:

- Screen the cumulative turbine noise predictions against the lowest potential (worst-case) criteria outlined in Table 11-9 to identify any locations with a potential exceedance.
- Undertake directional noise prediction calculations to refine the noise prediction results as described in Section 11.3.8.3.
- Identify any locations with potential cumulative exceedances that occur as result of the proposed development only (i.e. Croagh turbines).
- Calculate the level of attenuation required from the Croagh turbines to achieve the adopted turbine noise criteria or the attenuation required to Croagh such that the predicted contribution of the Croagh turbines is 10 dB below the cumulative turbine limit value in accordance with best practice guidance.

11.3.9 Assessments of Construction Impacts

The potential impacts of the construction phase noise and vibration in addition to the potential impacts from additional vehicular activity on public roads will be assessed in accordance with best practice guidance as outlined in Section 11.3.2.1.

11.4 Receiving Environment

This stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive locations (NSLs) in proximity to the proposed development. The methodology for the assessment is outlined in Section 11.3.7 and the results of the assessment are outlined in the following sections.

A variety of wind speed and weather conditions were encountered over the survey period outlined in Section11.3.7.2. Figure 11-4 illustrates the distributions of wind speed and wind direction standardised to 10 metre height over the baseline noise survey period detailed in Table 11-5.

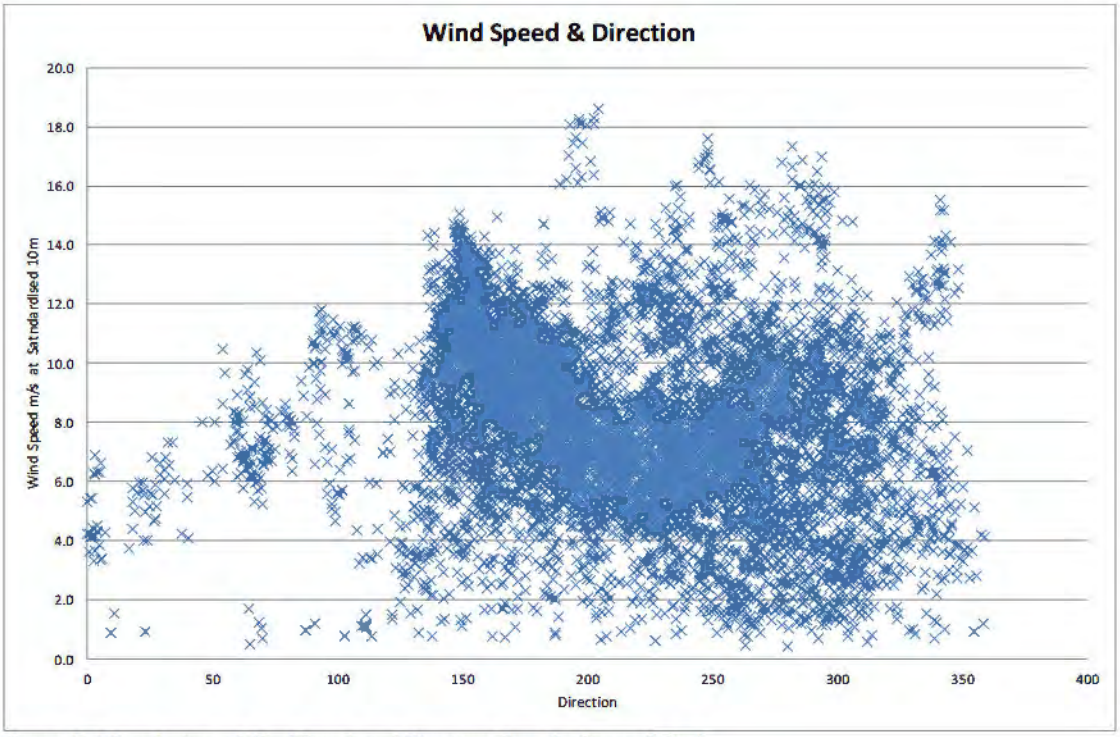


Figure 11-4 Distributions of Wind Speeds and Directions Over the Survey Period

11.4.1 Background Noise Levels

The following sections present an overview and results of the noise monitoring data obtained from the background noise survey in accordance with the methodology set out above. For each location two graphs are presented one shows the screened noise datasets used to derive the daytime background noise levels and the other shows the night time datasets.

11.4.1.1 Location A (H37)

11.4.1.1.1 Daytime Quiet Periods

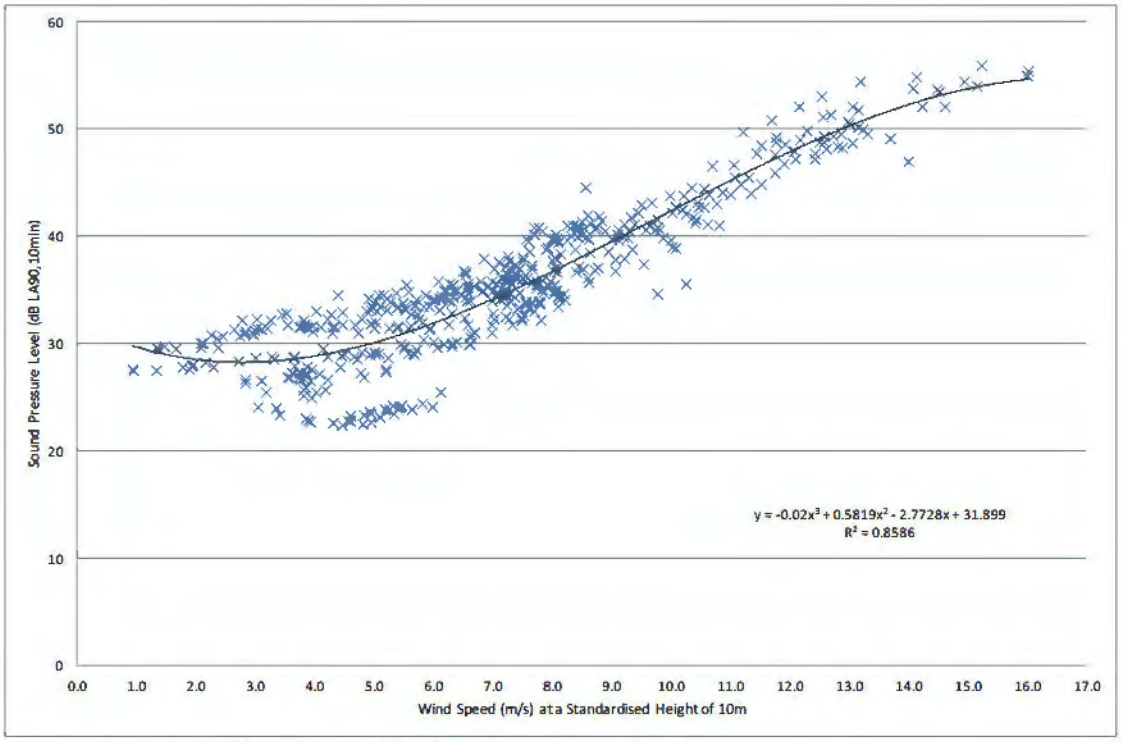


Figure 11-3 Location A (H37) Background Noise Levels $L_{A90,10\,min}$ dB – Daytime

11.4.1.1.2 Night-time Quiet Periods

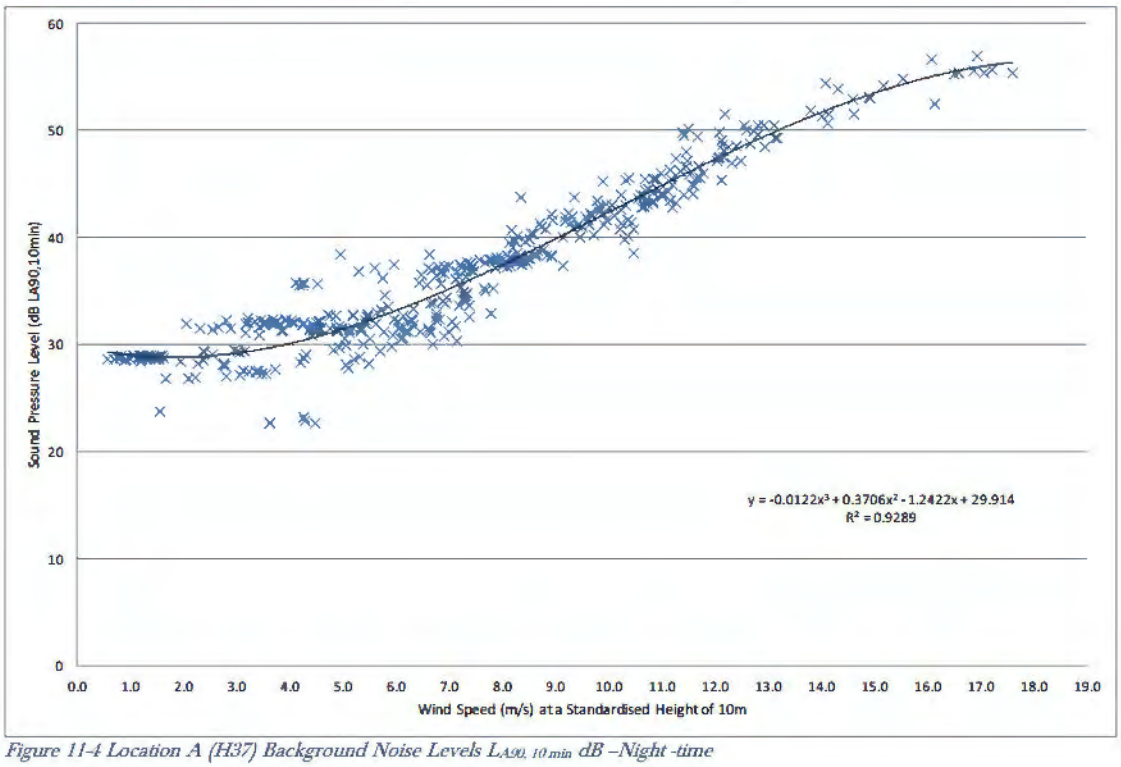


Figure 11-4 Location A (H37) Background Noise Levels $L_{A90,10\,min}$ dB –Night -time

11.4.1.2 Location B (H32)

11.4.1.2.1 Daytime Quiet Periods

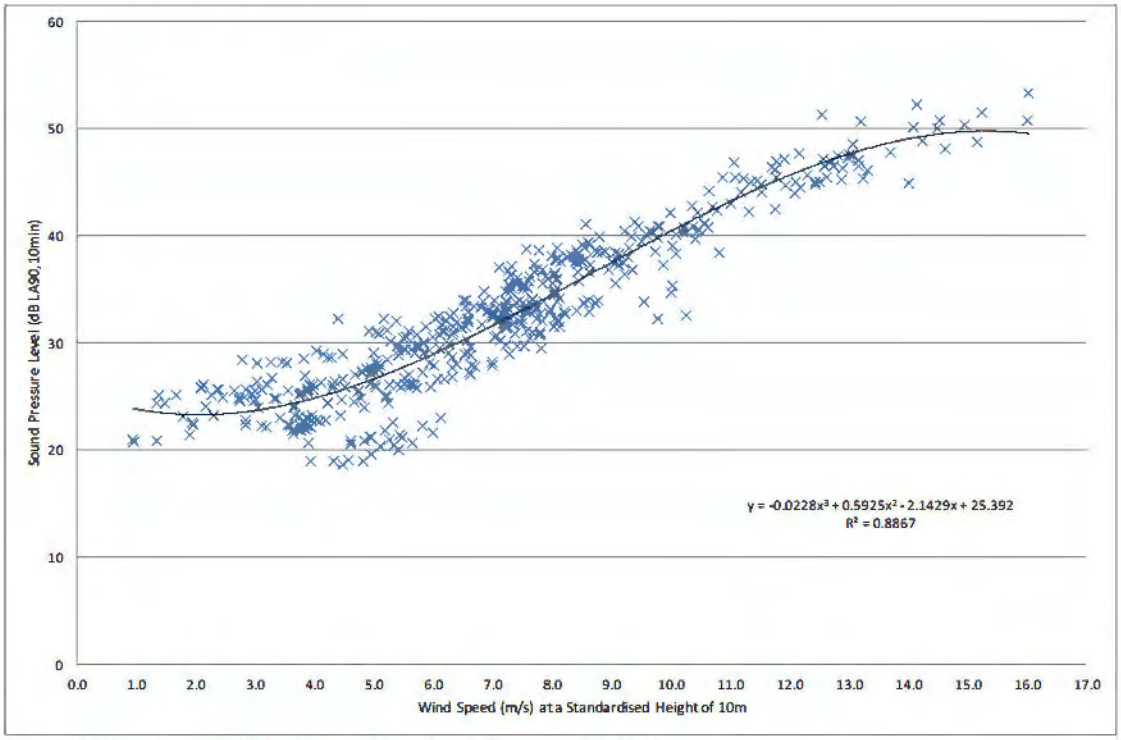


Figure 11-5 Location B (H32) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Daytime

11.4.1.2.2 Night-time Quiet Periods

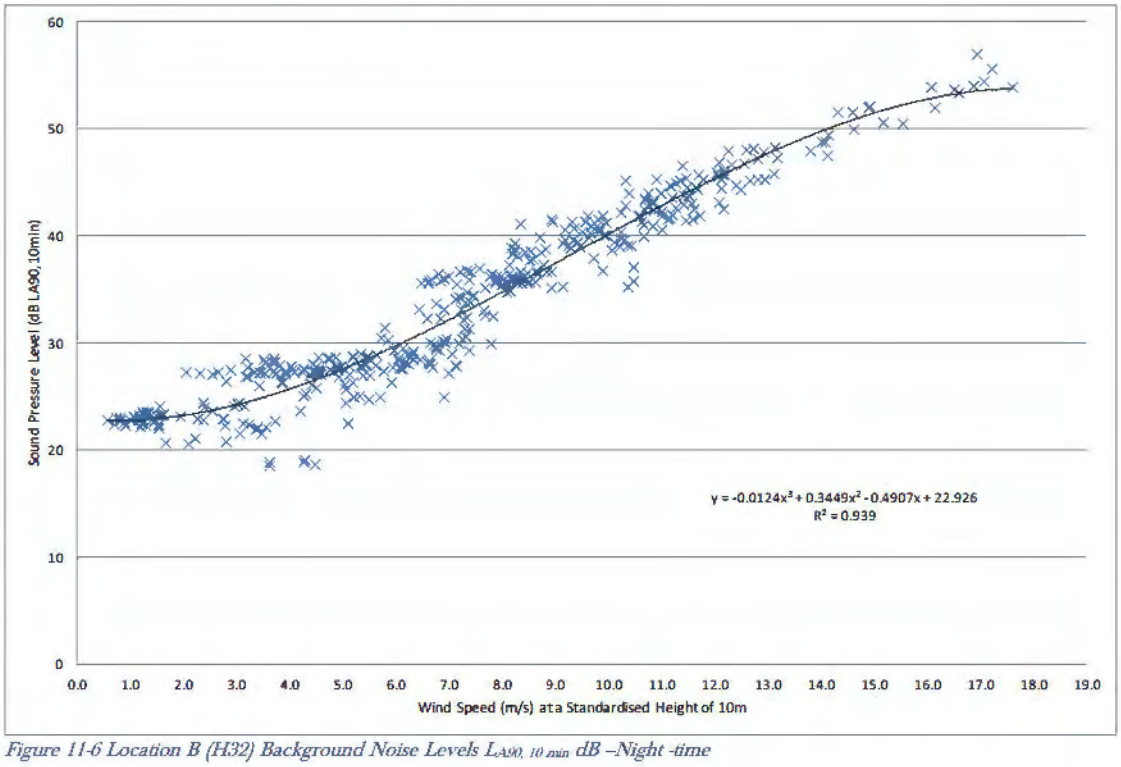


Figure 11-6 Location B (H32) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Night -time

11.4.1.3 Location C (H52)

11.4.1.3.1 Daytime Quiet Periods

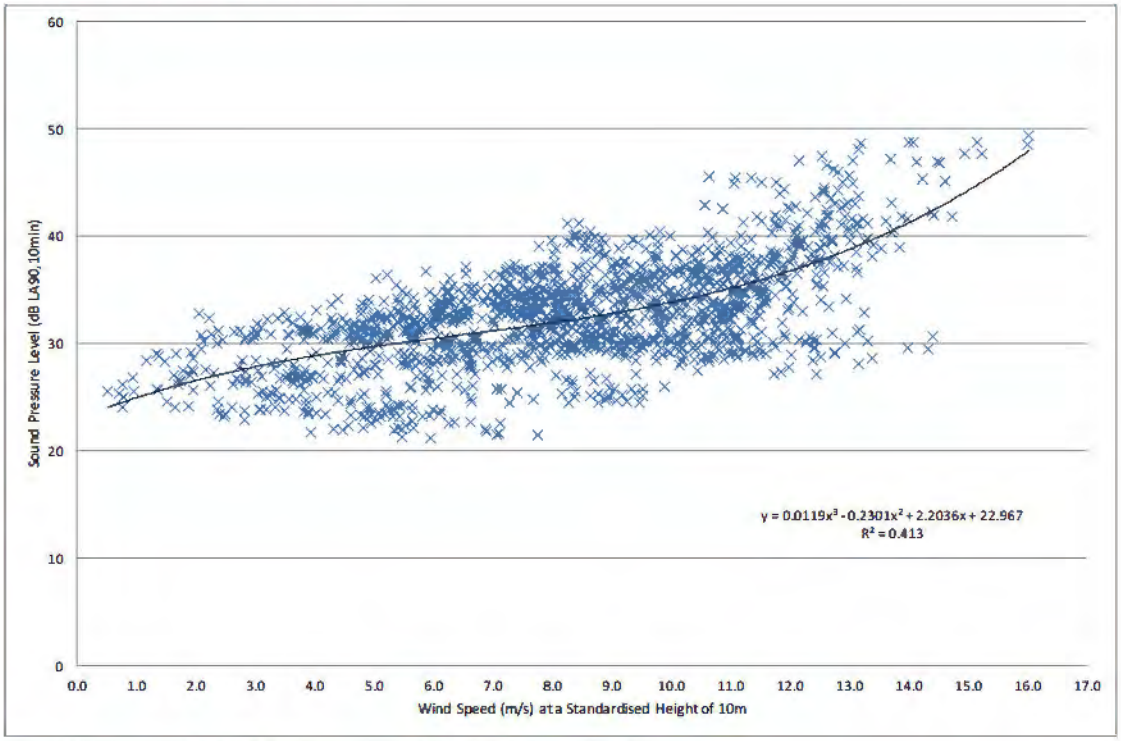


Figure 11-7 Location C (H52) Background Noise Levels $L_{A90,\ 10\,min}$ dB – Daytime

11.4.1.3.2 Night-time Quiet Periods

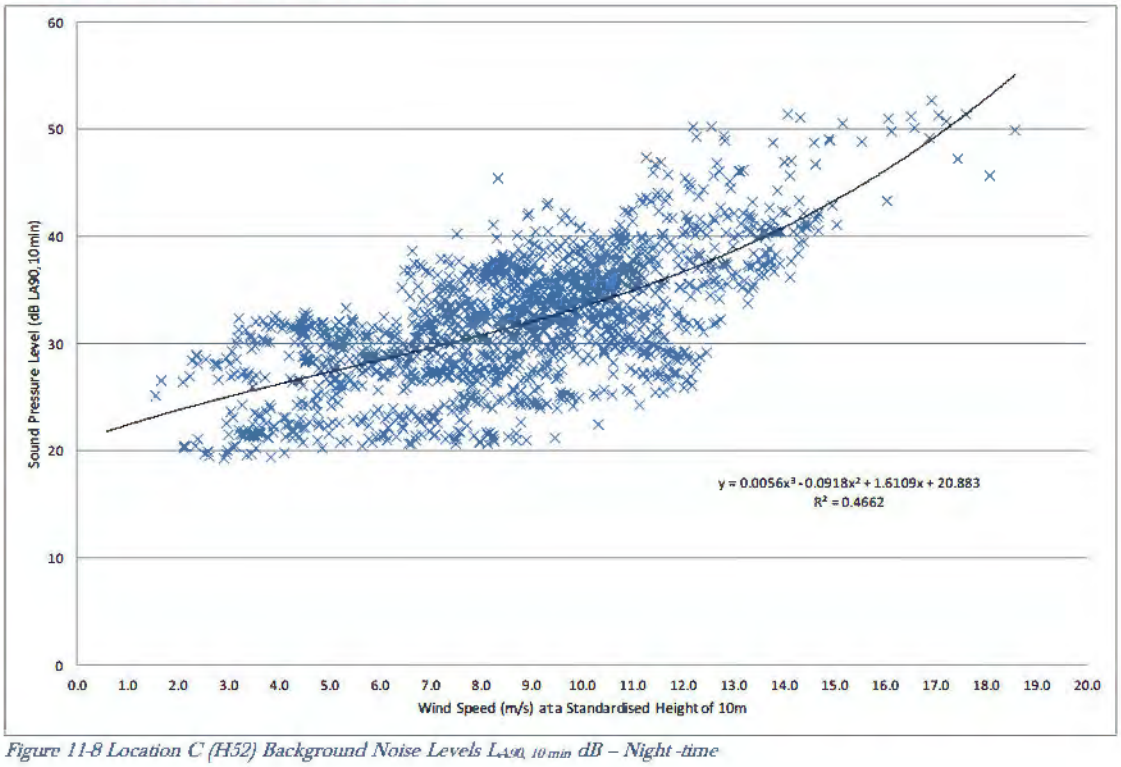


Figure 11-8 Location C (H52) Background Noise Levels $L_{A90,\ 10\,min}$ dB – Night -time

11.4.1.4 Location D (H30)

11.4.1.4.1 Daytime Quiet Periods

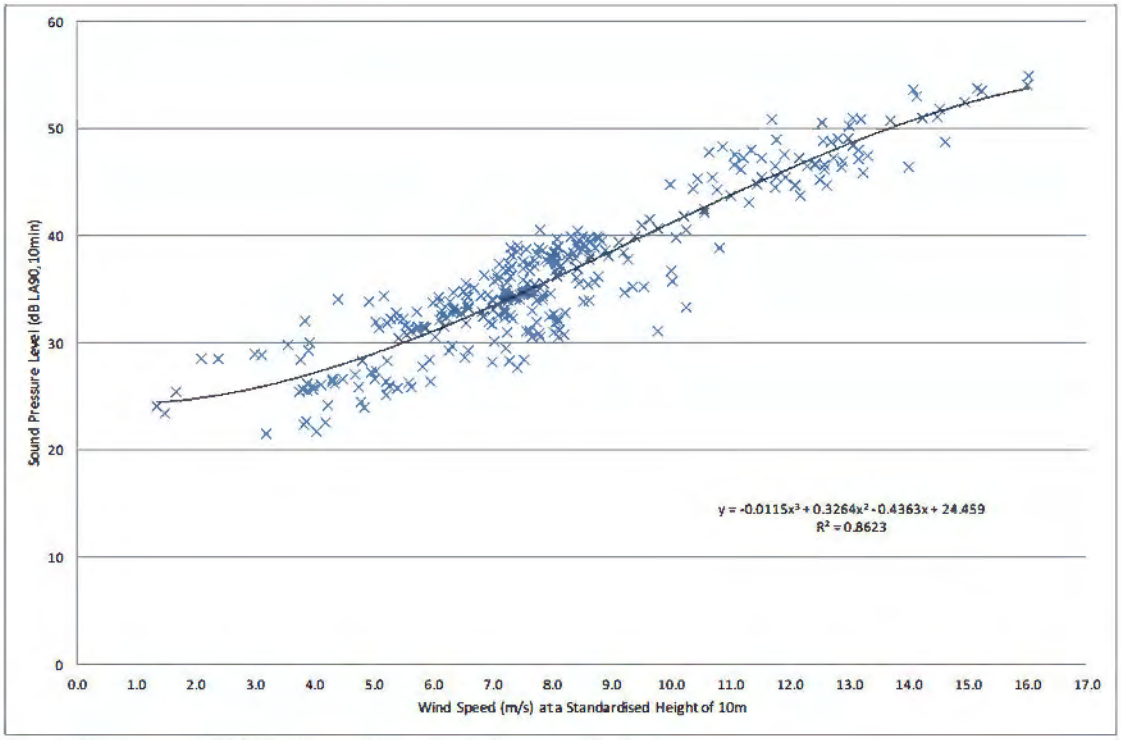


Figure 11-9 Location D (H30) Background Noise Levels $L_{A90,\ 10\ min}$ dB –Daytime

11.4.1.4.2 Night-time Quiet Periods

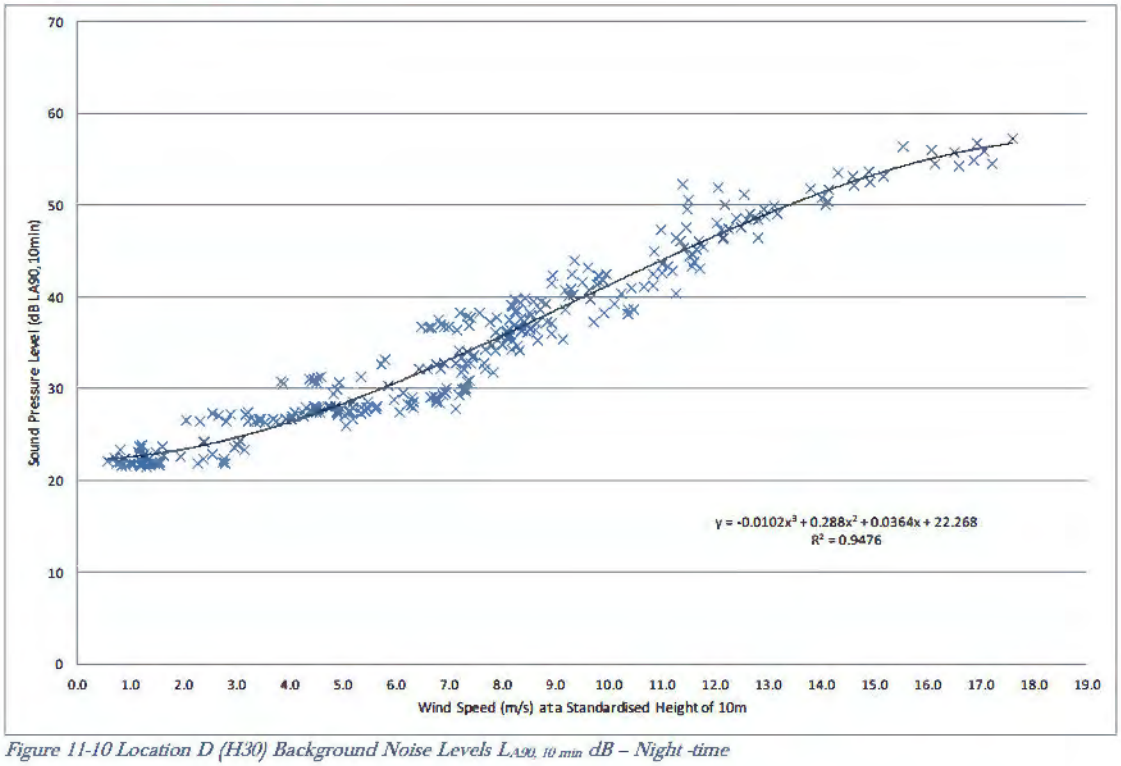


Figure 11-10 Location D (H30) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night -time

11.4.1.5 Location E (H58)

11.4.1.5.1 Daytime Quiet Periods

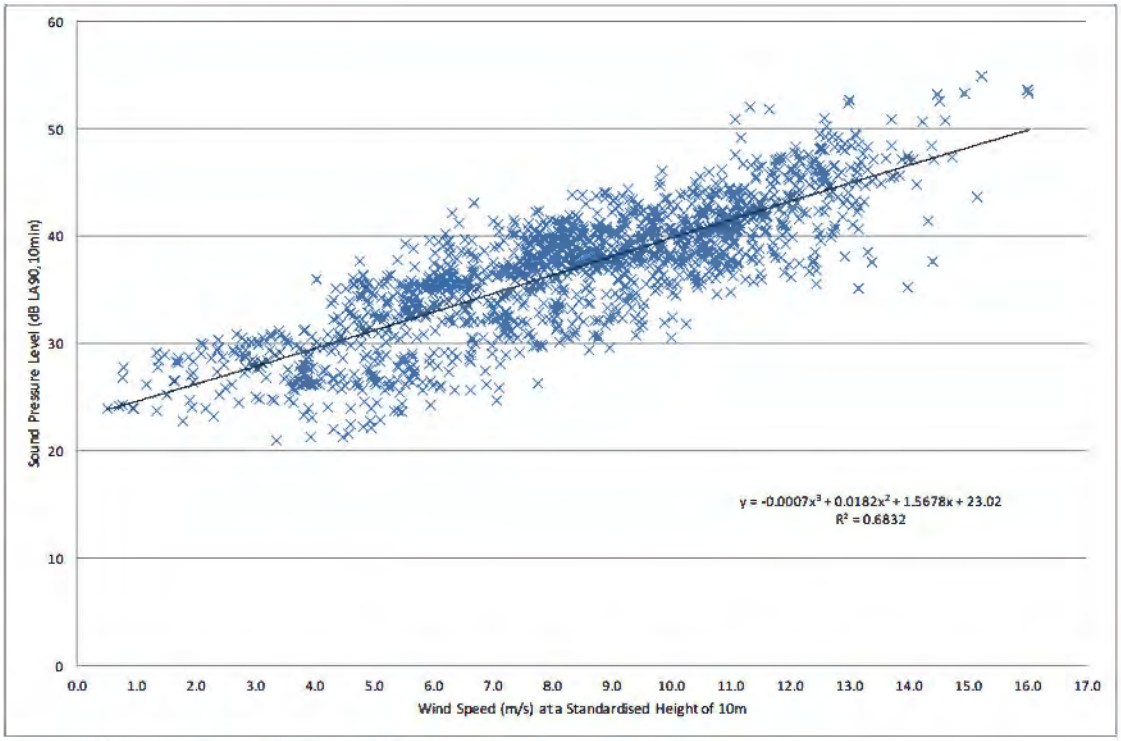


Figure 11-11 Location E (H58) Background Noise Levels $L_{A90,\ 10\,min}$ dB – Daytime

11.4.1.5.2 Night-time Quiet Periods

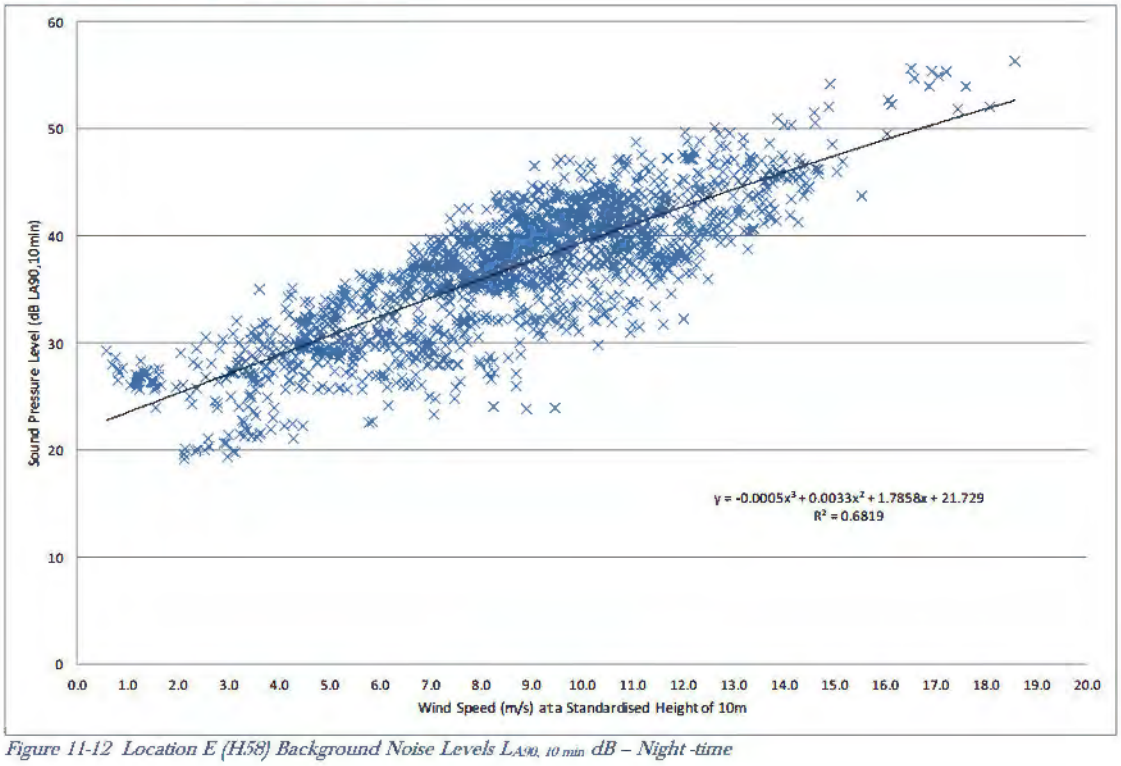


Figure 11-12 Location E (H58) Background Noise Levels $L_{A90,\ 10\,min}$ dB – Night -time

11.4.1.6 Location F (H45)

11.4.1.6.1 Daytime Quiet Periods

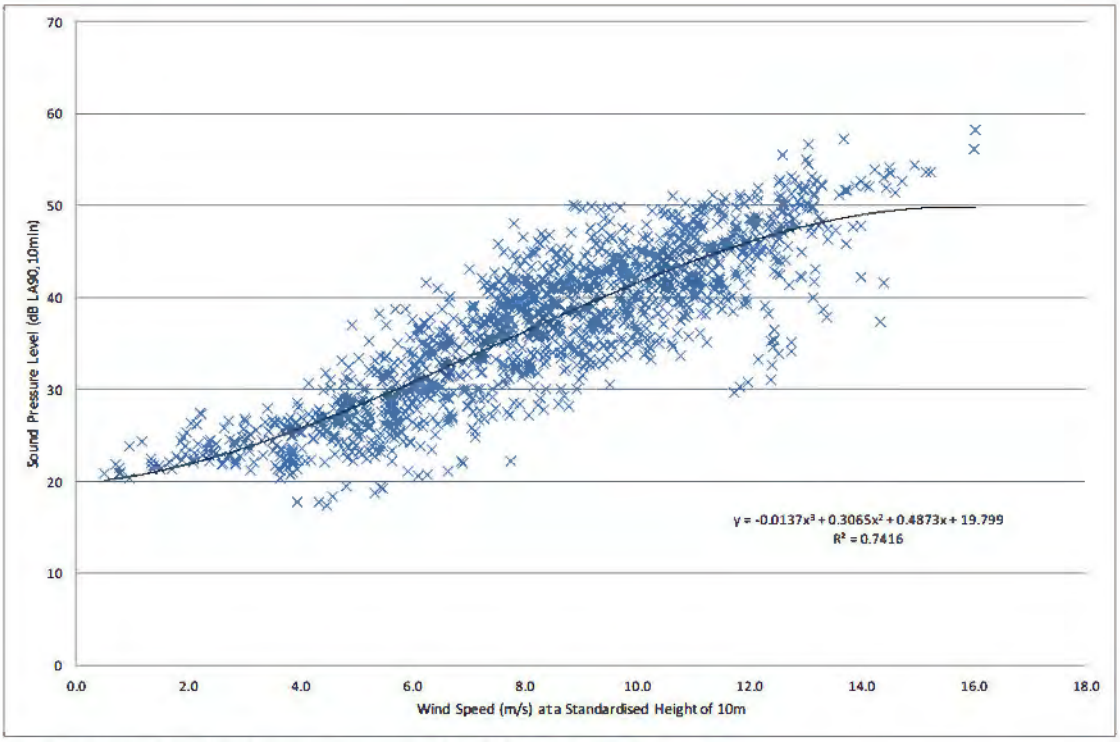


Figure 11-13 Location F (H45) Background Noise Levels $L_{A90,\,10\,min}$ dB – Daytime

11.4.1.6.2 Night-time Quiet Periods

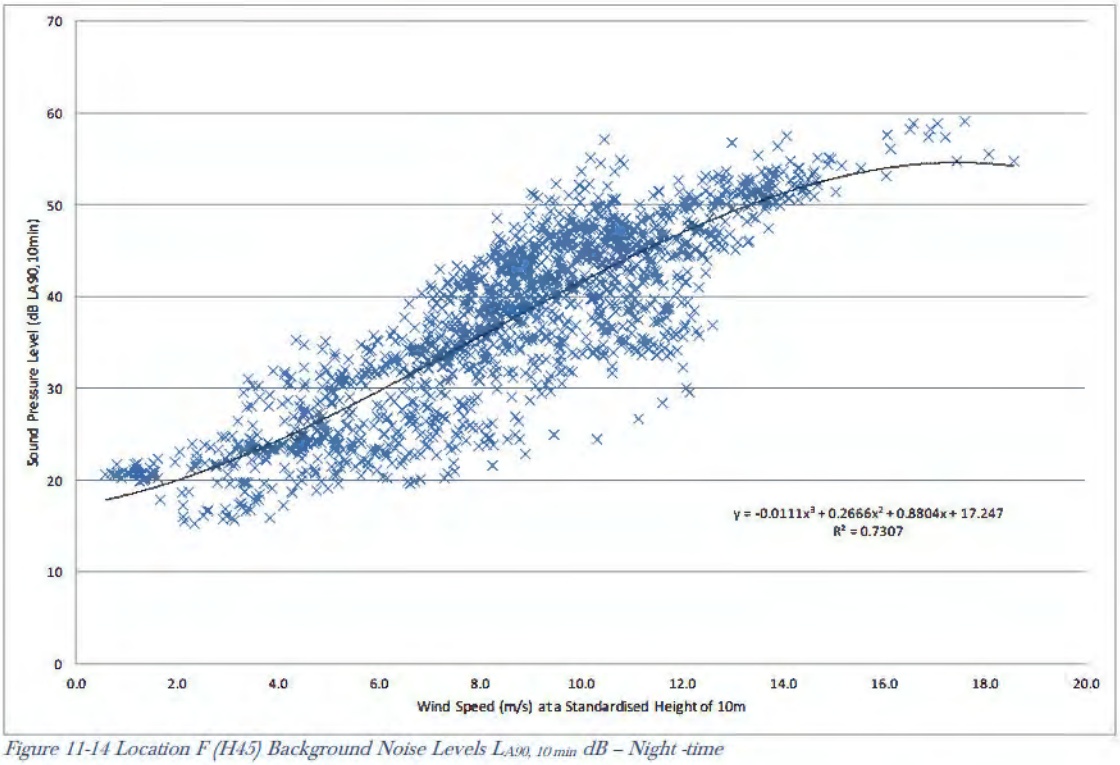


Figure 11-14 Location F (H45) Background Noise Levels $L_{A90,\,10\,min}$ dB – Night -time

11.4.1.7 Location G (H1)

11.4.1.7.1 Daytime Quiet Periods

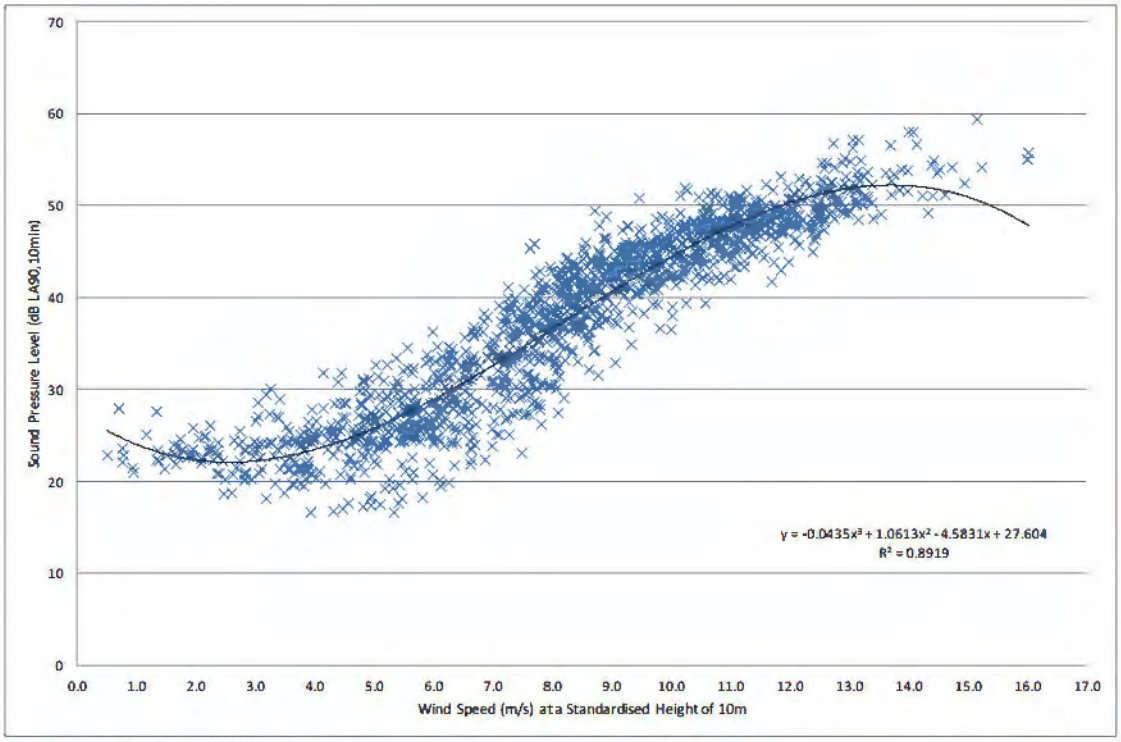


Figure 11-15 Location G (H1) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Daytime

11.4.1.7.2 Night-time Quiet Periods

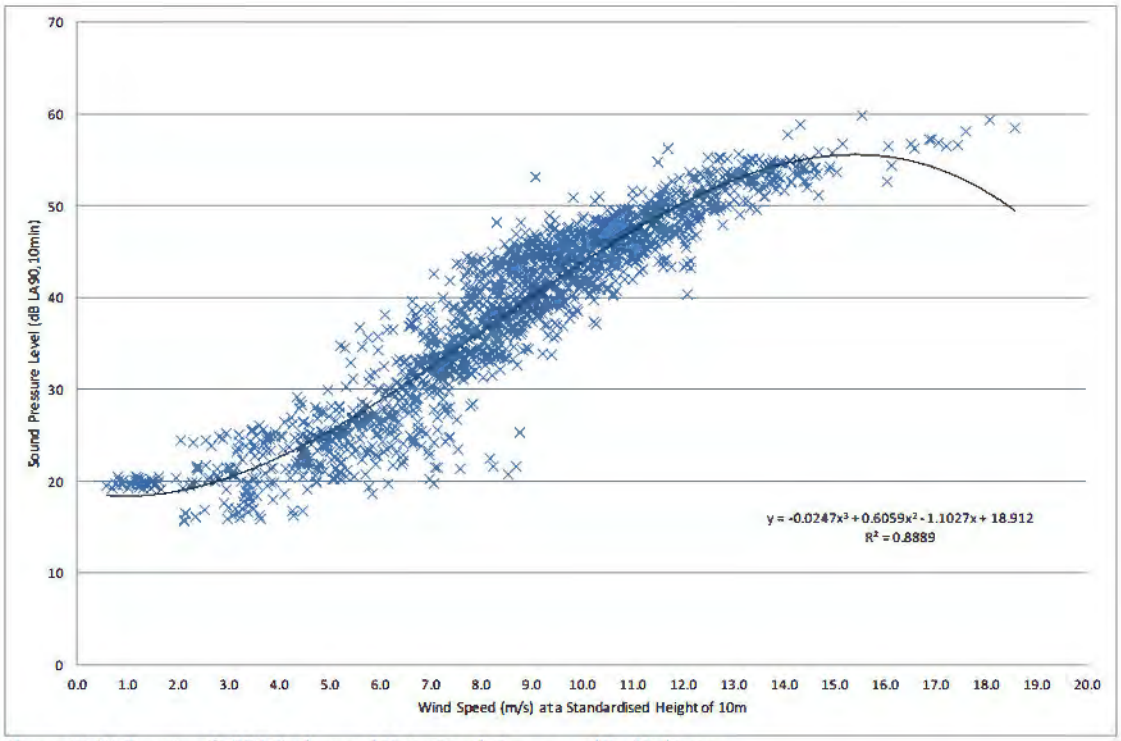


Figure 11-16 Location G (H1) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night-time

11.4.1.8 Location H (H12)

11.4.1.8.1 Daytime Quiet Periods

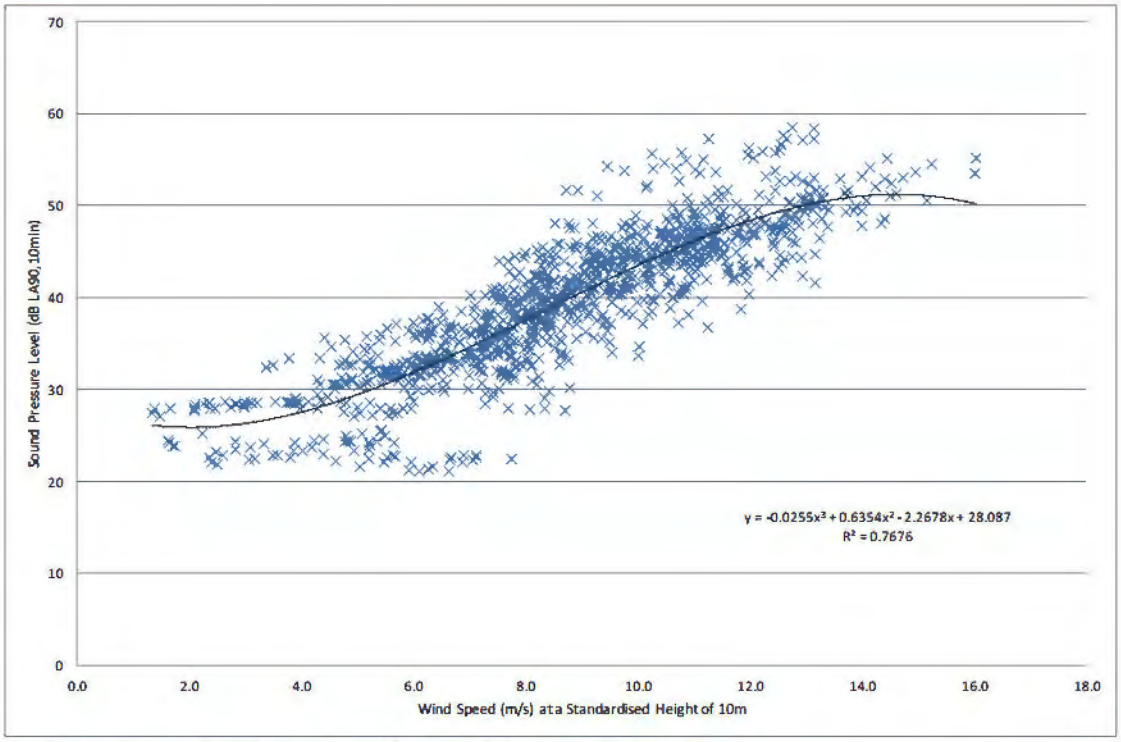


Figure 11-17 Location H (H12) Background Noise Levels $L_{A90,\,10\,min}$ dB – Daytime

11.4.1.8.2 Night-time Quiet Periods

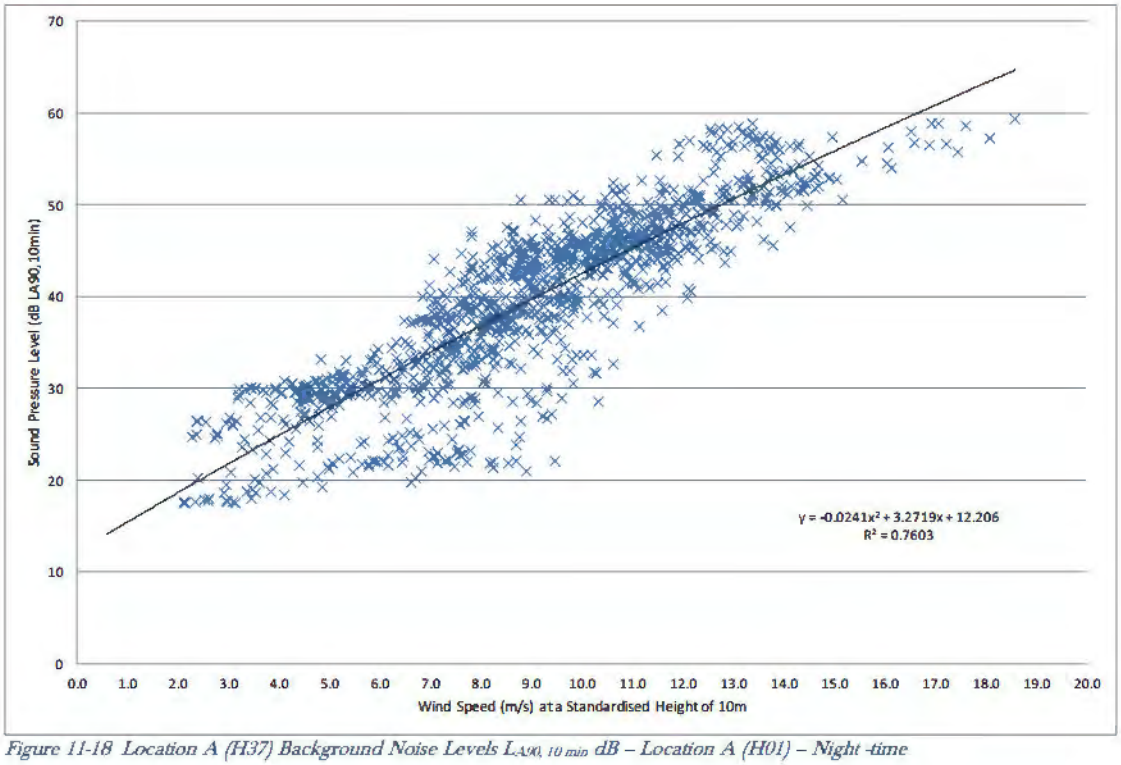


Figure 11-18 Location A (H37) Background Noise Levels $L_{A90,\,10\,min}$ dB – Location A (H01) – Night-time

11.4.1.9 Location I (H35)

11.4.1.9.1 Daytime Quiet Periods

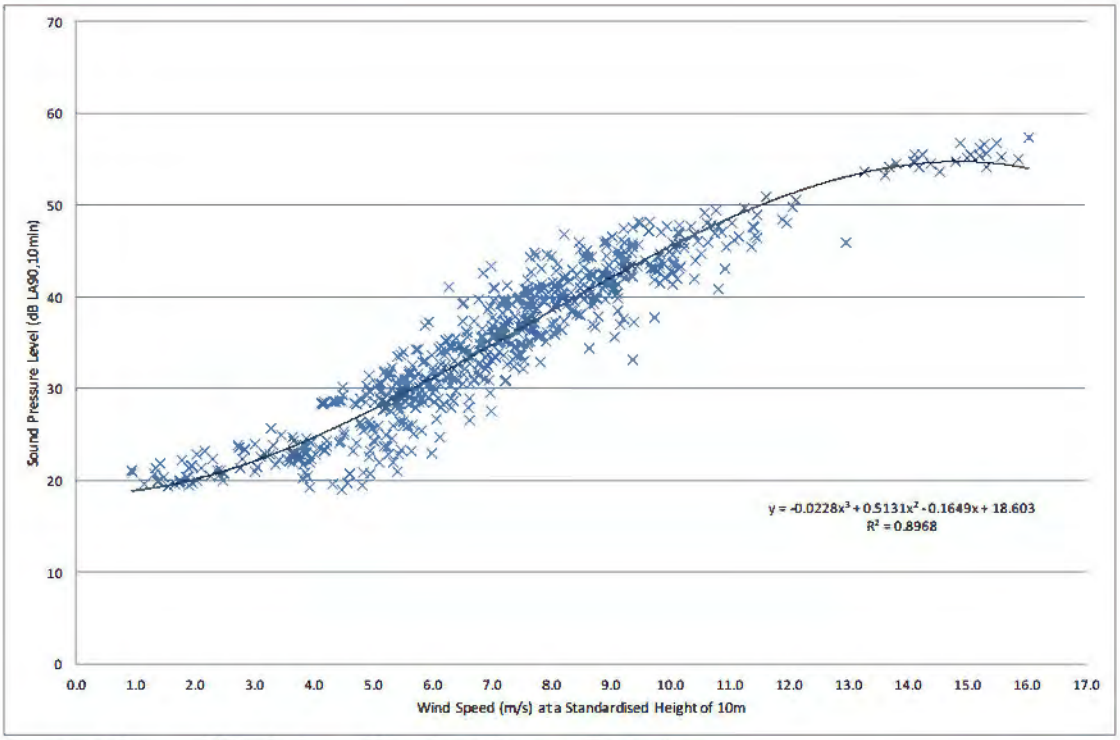


Figure 11-19 Location I (H35) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Daytime

11.4.1.9.2 Night-time Quiet Periods

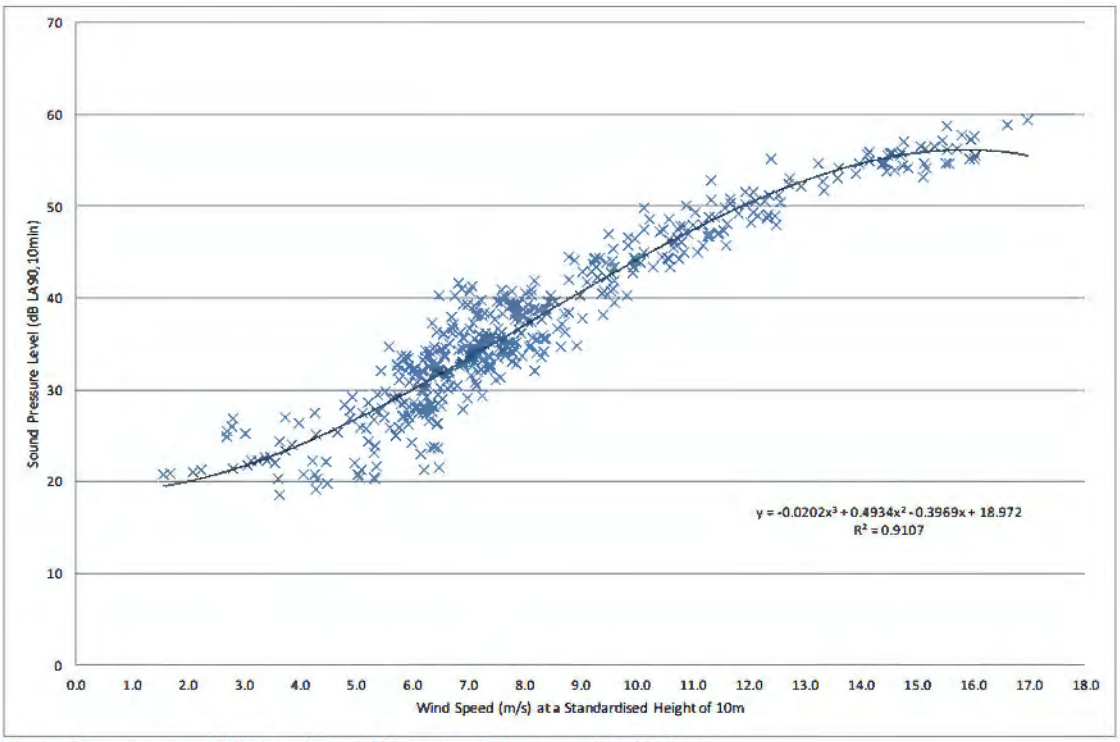


Figure 11-20 Location I (H35) Background Noise Levels $L_{A90,\ 10\ min}$ dB – Night -time

11.4.1.10 Location J (H65)

As described in Section 11.5.6 above, directional filtering was applied to the measured noise data in order to capture prevailing background noise levels without the contribution of existing windfarms. Over the two-week survey period at this location the prevailing wind conditions were from the south west and west and therefore a very low number of data points were captured in upwind conditions, therefore it was not possible to derive background noise levels.

11.4.1.11 Summary of Background Noise Levels

Table 11-12 presents the various derived $L_{A90,10min}$ noise levels for each of the monitoring locations for daytime qniet periods and night time periods. These levels have been derived using regression analysis carried out on the data sets in line with guidance contained the IoA GPG and its SGN No. 2 Data Collection.

The background noise data shall be used to derive appropriate noise limits for each of the noise sensitive locations. In a situation where measurements have been conducted near another receiver, the backgromid noise levels measured nearby have been deemed representative for establishing appropriate noise limits.

Table 11-12 Derived Noise Levels of $L_{A90,10min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A (H37)	Day	28.3	28.8	30.1	31.9	34.1	36.7	39.5	42.4
	Night	29.0	29.8	31.2	32.9	35.0	37.3	39.8	42.4
B (H32)	Day	23.7	24.8	26.6	28.9	31.6	34.5	37.5	40.4
	Night	24.2	25.7	27.5	29.7	32.1	34.7	37.4	40.1
C (H52)	Day	27.8	28.9	29.7	30.5	31.2	32.0	32.8	33.9
	Night	25.0	26.2	27.3	28.5	29.6	30.8	32.0	33.4
D (H30)	Day	25.8	27.2	29.0	31.1	33.5	36.0	38.6	41.2
	Night	24.6	26.2	28.1	30.4	32.8	35.4	38.1	40.8
E (H58)	Day	27.9	29.5	31.2	32.9	34.6	36.4	38.1	39.8
	Night	27.1	28.9	30.7	32.5	34.2	36.0	37.7	39.4
F (H45)	Day	23.6	25.8	28.2	30.8	33.5	36.3	39.0	41.6
	Night	22.0	24.3	26.9	29.7	32.7	35.7	38.7	41.6
G (H1)	Day	22.2	23.5	25.8	28.9	32.6	36.6	40.6	44.4
	Night	20.4	22.6	25.5	28.8	32.4	36.2	40.1	43.8
H (H12)	Day	26.3	27.6	29.4	31.8	34.6	37.6	40.6	43.4
	Night	21.8	24.9	28.0	31.0	33.9	36.8	39.7	42.5
I (H35)	Day	22.1	24.7	27.7	31.1	34.8	38.5	42.1	45.5
	Night	21.7	23.9	26.7	29.9	33.3	36.9	40.5	44.1
Envelope	Day	22.1	23.5	25.8	28.9	31.2	32.0	32.8	33.9
	Night	20.4	22.6	25.5	28.5	29.6	30.8	32.0	33.4

A worst-case envelope based on the lowest average levels at the various wind speeds for both day and night time is also presented in Table 11-12. The derived background noise curves for this assessment are set out in the table below.

Table 11-13 Assignment of background noise levels to noise-sensitive locations

Representative Background Noise Levels	Noise Sensitive Location (NSL)
A	H037
B	H032
C	H052
D	H030
E	H058
F	H045
G	H001
H	H012
I	H035
Envelope	All other locations

11.4.2 Wind Turbine Noise Criteria

A lower daytime threshold of 40 dB $L_{A90,10\text{-}min}$ has been adopted for low noise environments where the background noise is less than 30 dB(A). This follows a review of the prevailing background noise levels and is deemed appropriate considering of the following:

- The EPA document 'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)' (EPA, 2016) proposes a daytime noise criterion of 45 dB(A) in 'areas of low background noise'. The proposed lower threshold here is 5 dB more stringent than this level.
- The nearby Garvagh Glebe wind farm has permitted noise limits are as per Condition by Leitrim County Council, Reference 03/257 with a lower threshold for turbine noise of 45 dB $L_{Aeq,5min}$.
- It is reiterated that the 2006 Wind Energy Development Guidelines states that "An appropriate balance must be achieved between power generation and noise unpact."

Based on other national guidance (EPA, 2016) in relation to acceptable noise levels in areas of low background noise and grant of planning conditions for other permitted wind turbine development in the area it is considered that the criteria adopted as part of this assessment are robust.

Following comparison of the previously presented guidance the proposed operational limits in $L_{A90,10min}$ for the proposed development are:

- 40 dB $L_{A90,10min}$ for quiet daytime environments of less than 30 dB $L_{A90,10min}$;
- 45 dB $L_{A90,10min}$ for daytime environments greater than 30 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher), and;
- 43 dB $L_{A90,10min}$ or a maximum increase of 5 dB above background noise (whichever is higher) for night time periods.

With respect to the methodology in relevant guidance documents outlined in Section 11.3.2.2 the noise criteria curves in Table 11-14 have been derived for the NSLs surrounding the proposed development. These limit values are determined through applying the criteria to the derived background noise levels.

Table 11-14 Noise Criteria Curves

Location	Period	Derived LA90, 10 min Levels (dB) at various Standaridsed10m Height Wind Speed (m/s)							
		3	4	5	6	7	8	9	10
A (H37)	Day	40.0	40.0	45.0	45.0	45.0	45.0	45.0	47.4
	Night	43.0	43.0	43.0	43.0	43.0	43.0	44.8	47.4
B (H32)	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.0	45.4
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	45.1
C (H52)	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
D (H30)	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0	46.2
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.1	45.8
E (H58)	Day	40.0	40.0	45.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.4
F (H45)	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0	46.6
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.7	46.6
G (H1)	Day	40.0	40.0	40.0	40.0	45.0	45.0	45.6	49.4
	Night	43.0	43.0	43.0	43.0	43.0	43.0	45.1	48.8
H (H12)	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.6	48.4
	Night	43.0	43.0	43.0	43.0	43.0	43.0	44.7	47.5
I (H35)	Day	40.0	40.0	40.0	45.0	45.0	45.0	47.1	50.5
	Night	43.0	43.0	43.0	43.0	43.0	43.0	45.5	49.1
Envelope	Day	40.0	40.0	40.0	45.0	45.0	45.0	45.0	45.0
	Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

11.5 Likely Significant Effects and Associated Mitigation Measures

11.5.1 Do-Nothing Scenario

If the development is not progressed the existing noise environment in the vicinity of the site and noise sensitive receivers will remain largely unchanged as commercial forestry operations would continue and no other significant wind energy projects are currently permitted or proposed within 5km of the site of the proposed development.

11.5.2 Construction Phase Potential Impacts

A variety of items of plant will be in use for the purposes of site preparation, construction of turbines, roads, substation and other site works. There will be vehicular movements to and from the site that will make nse of existing roads. Due to the nature of these activities, there is potential for generation of significant levels of noise. These are discussed in the following Sections.

Due to the nature of the construction activities it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels at the nearest sensitive receptor using guidance set out in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

The predicted noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to comply with current best practice guidance. It should also be noted that the predicted "worst case" levels are expected to occur for ouly short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for most of the time at most properties in the vicinity of the proposed development.

There are several stages and elements associated with the construction phase of the proposed development which will include the following:

- Turbines and Hardstands;
- Substation and Grid connection;
- Site entrances;
- Internal roads;
- a Meteorological Mast;
- Internal amenity pathways;
- Additional amenity links; and
- Amenity Carpark.

Detailed information is included in Chapter 4: Description of the Proposed Development.

In general, the distances between the construction activities associated with the Proposed Development and the nearest NSLs are such that there will be no significant noise and vibration impacts at NSLs. The following sections present an assessment of the main stages of the construction phase that have the potential for associated noise and vibration impacts, all other stages and element are considered not to have significant noise and vibration impacts at NSLs.

11.5.2.1 Turbines, Hardstands, Substation, Grid Connection, Met Mast, Amenity Walkways including car park and Internal Roads

As the constrnction programme has been established in outline form only, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical

noise levels using guidance set out in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. In this instance, the noise sensitive locations surround the site at distances varying with the nearest property to any proposed work area being the order of 590m (i.e. approximate distance between H037 and the nearest section of existing track to be upgraded). Turbine foundation works are anticipated at a distance of some 850m from the nearest NSL (H037). Several indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential impacts prepared to nearby houses. The assessment is representative of a worst-case with respect to equipment on-times and number of plant items operating simultaneously, construction noise levels will be lower at properties located further from the works.

11.5.2.1.1 Noise

Turbines and Hardstanding

Several indicative sources that would be expected on a site of this nature have been identified and predictions of the potential noise emissions calculated at the nearest noise sensitive receiver. The assessment is considered to be a worst-case, construction noise levels will be lower at properties located further from the works. The nearest sensitive location (R037) is situated approximately 850m from proposed Turbine 6.

Table 11-15 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009. Calculations have assumed an on-time of 66% for each item of plant i.e. 8-hours over a 12 hours assessment period.

Table 11-15 Typical Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$)	Predicted Noise Level at 850m (dB $L_{Aeq,T}$) Turbine Construction
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	40
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	38
Piling Operations (C.12.14)	Standard pile driving.	88	49
General Construction (Various)	All general activities plus deliveries of materials and plant.	82	45
Dewatering Pumps (D.7.70)	If required.	80	41
JCB (D.8.13)	For services, drainage and landscaping.	82	43
Vibrating Rollers (D.8.29)	Road surfacing.	77	38

Item (BS 5228 Ref.)	Activity/ Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$)	Predicted Noise Level at 850m (dB $L_{Aeq,T}$) Turbine Construction
Rock Crusher (C.1.14)	Associated with blasting for turbine foundations (If required)	82	43
Rock Breaking (C.9.11)	Rock Breaking for turbine foundations (If required)	93	54
Grid Connection Works	Breaking, excavation, loaders and road roller	82	42
Total Construction Noise (cumulative for all activities)			57

The predicted noise levels from turbine construction activities at the closest dwellings are in the range of 38 to 57 dB $L_{Aeq,T}$.

In all instances the total construction noise levels are predicted to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,T}$), as outlined in Section 11.4.1 above, and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations in terms of construction noise.

There are no items of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Table 11-1.

Substation and Grid Connection Works

The proposed substation is located in northern sector of the site close to proposed Turbine 7. The noise impact at the nearest NSL has been assessed to identify the potential greatest impact associated with the construction of the Substation.

The nearest NSL to the substation site is R037 at approximately 620m away with grid connection works expected to take place at a closer distance of 580m to the same NSL at the closest point of the works. Based on the same construction activities as outlined in Table 11-15 it is predicted that the likely worst-case potential noise level due to construction activities associated with the substation will be in the order of 54dB $L_{Aeq,T}$ at the nearest NSL which is well below the significance threshold of 65dB $L_{Aeq,1hr.}$ outlined in Section 11.4.1.1.

It is concluded that there will be no significant noise impacts associated with the construction of the substation and grid connection and therefore no specific mitigation measures will be required.

Internal Roads

It is proposed to construct new internal roads and upgrade existing internal roads to access the proposed turbines and associated infrastructure, such as site access roads, as part of the proposed development. Review of the internal road layout has identified that the nearest NSL is H065 which is located 135m from the proposed works. All other locations are at greater distances with the majority at significantly greater distances. The full description of the proposed internal roads is outlined in Chapter 4 of the EIAR.

The predicted noise level associated with construction of internal roads is 53 dB $L_{Aeq,T}$ at the nearest NSL. At NSLs at greater distances the predicted noise level is lower again.

Therefore, it is concluded that there will be no significant noise impacts associated with the construction of internal roads and therefore no specific mitigation measures will be required.

11.5.2.1.2 Vibration

As would be expected, vibration associated with construction activities is typically greater in magnitude in close proximity to the plant or equipment generating the vibration. AWN previously has measured vibration generated by breaking activities on an unrelated site. At distances of 50-60m measured vibration levels were in the range 0.13 – 0.25 $mm.s^{-1}$ Peak Particle Velocity.

With reference to the vibration criteria presented in Table 11-2, these levels are an order of magnitude lower than the lowest recommended vibration level. Therefore, when considering the Proposed Development, the distance between areas of works and the nearest NSL is hundreds of meters. Cousidering the low levels of vibration close to construction sources and the dissipation of vibration over distance, there will be no vibration impact on sensitive receivers in the area surrounding the development.

11.5.2.1.3 Description of Effects

With respect to the EPA criteria for description of effects, the potential worst-case associated effects at the nearest noise sensitive locations associated with the construction of Turbines, Hardstands, Substation, Grid Connection and Internal Roads of the proposed development are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

It is not expected that there will be any significant cumulative impacts at NSLs should the various elements of the coustruction phase be undertaken simultaneously.

11.5.2.2 Construction Traffic

This section has been prepared in order to review potential noise impacts associated with construction traffic on the local road network. The information presented in Chapter 14 has been used to inform the assessment here. The following situations are commented upon here:

- Stage 1a – Site Preparation – Concrete Pouring
- Stage 1b – Site Preparation & Ground Works
- Stage 2a – Extended Artic Deliveries
- Stage 2b – Conventional Deliveries

Table 11-16 Assumptions for Construction Traffic Noise Assessment: Northern Delive

Route	Stage	Traffic Units	%HGV
L-4232	Existing	217	44%
	1a	697	65%
	1b	345	42%
	2a – Large Deliveries	357	55%
	2b – Conventional deliveries	272	41%
R280 North	Existing	2,074	11%
	1a	2,514	24%
	1b	2,202	13%
	2a – Large Deliveies	2,214	15%
	2b – Conventional deliveries	2,129	12%
R280 South	Existing	2,074	11%
	1a	2,514	24%
	1b	2,202	13%
	2a – Large Deliveies	2,214	15%
	2b – Conventional deliveries	2,129	12%
N4 east of Carrick-on-Shannon	Existing	8,458	14%
	1a	8,898	17%
	1b	8,586	14%
	2a – Large Deliveies	8,598	15%
	2b – Conventional deliveries	8,513	14%
N16 west of Belcoo	Existing	3,097	13%
	1a	3,537	21%
	1b	3,225	14%
	2a – Large Deliveies	3,237	15%
	2b – Conventional deliveries	3,152	13%

Based on the assumptions presented above changes in noise level based on the existing flows have been estimated and is presented in Table 11-17.

Table 11-17 Estimated Changes in Traffic Noise Levels

Route	Stage	Change in Traffic Noise Level dB(A)	Estimated Number of Days
L-4232	1a	5.1	10
	1b	2.0	245
	2a	2.2	10
	2b	1.0	18
R280 North	1a	0.8	10
	1b	0.3	245
	2a	0.3	10
	2b	0.1	18
R280 South	1a	0.8	10
	1b	0.3	245
	2a	0.3	10
	2b	0.1	18
N4 east of Carrick-on-Shannon	1a	0.2	10
	1b	0.1	245
	2a	0.1	10
	2b	0.0	18
N16 west of Belcoo	1a	0.6	10
	1b	0.2	245
	2a	0.2	10
	2b	0.1	18

In the majority of routes and construction phases, the predicted increases in traffic noise levels during each of the construction stages of the proposed development are less than 3 dB. With reference to the criteria set out in Section 11.3.2.1.2 the potential impacts are minor are worst case and no additional mitigation measures are proposed.

Along the L4232 during Stage 1a, the noise level increase is 5dB. However, the predicted noise level due to construction traffic along this road results in a noise level of 63dB $L_{Aeq,1hr}$ which is within the criteria for construction noise presented in Table 11-1.

It is concluded that there will be no significant noise impacts associated with the additional traffic generated during the construction phase of the proposed development and therefore no specific mitigation measures will be required.

11.5.2.2.1 Description of Effects

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest noise sensitive associated with the additional traffic generated during the construction phase of the proposed development are described below.

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

11.5.2.3 Borrow Pits

To inform this aspect of the proposal a comparative noise assessment has been prepared and is outlined in the following paragraphs. Two situations have been considered as follows:

- Scenario A Blasting operation[8]
- Scenario B Rock breaking operation
- In terms of these activities please note the following:
- A mobile crusher will operate on site for both options.
- In Scenario B that two rock breakers will be in use on site during daytime periods for an estimated three-month period.
- For the purposes of this assessment we have assumed the plant is working in the vicinity of the potential borrow pit location indicated in Table 11-18.
- Table 11-19 outlines the assumed noise levels for the plant items as extracted from BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- If the blasting option is undertaken it is estimated that some 8 to 12 blasts will be required over a 4-week period. It is expected that no more than 1 blast would occur in a single working day.

Table 11-18 Proposed Borrow Pit Locations

Borrow Pit ID	Co-ordinates	
	Easting	Northing
BOR 1	585,735	822,430

8 *Note that blasting may be required at some turbine base locations. If this is the case the mitigation measures detailed in the relevant section of this chapter will be applicable to these activities. The assessment presented here for borrow pit activities will be comparable to those expected in relation to works associated with turbine foundations and ancillary constructions, where relevant.*

Table 11-19 Typical Plant Noise Levels

Item	BS 5228 Ref:	dB L_w Levels per Octave Band (Hz)								dB(A)
		63	125	250	500	1k	2k	4k	8k	
Crusher	Table C1.14	121	114	107	109	103	99	94	87	110
Rock Breaker	Table C9.11	119	117	113	117	115	115	112	108	121

A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works for the two scenarios outlined above A percentage on-time of 66% has been assumed for the noise calculations. The predicted levels are detailed in Table 11-20 at the 10 no. closest NSLs.

Table 11-20 Typical Plant Noise Levels

Borrow Pit			
Loc.	Predicted Construction Noise Level $L_{Aeq,1hr}$ Scenario		Diff. dB(A)
	A	B	
R065	28	39	-11
R037	26	36	-10
R034	26	36	-10
R069	26	36	-11
R035	25	35	-10
R038	25	35	-10
R032	25	35	-10
R064	25	35	-10
R036	24	34	-10
R031	23	32	-10

Review of the data contained in Table 11-19 confirms the following:

- Predicted construction noise levels for both Scenario A and B at the borrow pit are well within the relevant construction noise criteria (65dB $L_{Aeq,T}$). It is assumed that construction works at the borrow pit will only occur during daytime periods only (07:00 to 19:00hrs).
- The blasting proposal results in lower levels of construction noise as the rock breaking plant is not required in this scenario. Predicted noise levels are lower at all assessed locations for Scenario A. Predicted levels of 10 to 11dB(A) lower at the various locations assessed.

- It is accepted that the individual blast events will be audible at certain locations. Blast events will be designed and controlled such that the best practice limits values outlined in the mitigation section of this chapter are not exceeded.

11.5.3 Operational Phase Potential Impacts

11.5.3.1 Turbine Noise Assessment

The cumulative noise levels for the proposed, existing and permitted sites in the study area have been calculated for all noise sensitive receivers identified within 5 km of the proposed turbines.

A worst-case assessment has been completed assuming all noise locations are downwind of all turbines at the same time. The predicted levels have been compared against the adopted noise criteria curves as detailed in Table 11-14. Table 11-21 presents the details of the exercise at all 78 no. noise sensitive locations considered as part of this assessment.

Table 11-21 Review of Cumulative Predicted Turbine Noise Levels against Relevant Criteria

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
R001	Dwelling	28.1	31.5	33	33.9	34.3
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R002	Dwelling	27.3	30.7	32.2	33.1	33.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R003	Dwelling	25.8	29	30.5	31.4	32.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R004	Dwelling	26.6	29.9	31.4	32.3	32.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R005	Dwelling	27.2	30.5	32	32.9	33.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R006	Dwelling	26.8	30	31.6	32.5	33.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R007	Dwelling	27.4	30.7	32.2	33.1	33.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R008	Dwelling	28.2	31.6	33.1	34	34.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R009	Dwelling	23.8	27.2	28.7	29.5	29.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R010	Dwelling	23.9	27.3	28.7	29.6	30.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R011	Dwelling	24.5	28	29.4	30.3	30.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R012	Dwelling	26.7	29.9	31.4	32.3	33.0
	Daytime Criterion	40.0	40.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R013	Dwelling	27.8	31.1	32.6	33.5	34.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R014	Dwelling	31.9	35.4	36.9	37.8	38.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
R015	Dwelling	32.4	35.8	37.4	38.3	38.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R016	Dwelling	28.7	31.9	33.5	34.4	34.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R017	Dwelling	30	33.3	34.9	35.8	36.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R018	Dwelling	31.4	34.9	36.4	37.3	37.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R019	Dwelling	30.2	33.5	35.1	36	36.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R020	Dwelling	31.6	35	36.5	37.5	37.8
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R021	Dwelling	32	35.4	37	37.9	38.3
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R022	Dwelling	32.2	35.5	37.1	38.1	38.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R023	Dwelling	32.5	35.9	37.5	38.4	38.8
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R024	Dwelling	31.5	35	36.5	37.4	37.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R025	Dwelling	28.4	31.2	33	34	34.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R026	Dwelling	28.5	31.2	33.1	34.1	35.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R027	Dwelling	29.4	32.1	34	35	35.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R028	Dwelling	30	33.3	34.9	35.8	36.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R029	Dwelling	29.8	32.9	34.6	35.6	36.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R030	Dwelling	30.5	33.3	35.2	36.2	37.1
	Daytime Criterion	40.0	40.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R031	Dwelling	32.3	35.1	37	38	38.8
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Night time Excess	–	–	–	–	–
R032	Dwelling	34.5	36.9	39.1	40.2	41.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R033	Derelict	33.8	35.8	38.2	39.3	40.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R034	Dwelling	35	36.9	39.5	40.6	41.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R035	Dwelling	33.5	35.4	37.9	39	40.3
	Daytime Criterion	40.0	40.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R036	Dwelling	35.1	38.2	39.9	40.9	41.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R037	Dwelling	36.9	39.7	41.7	42.7	43.3
	Daytime Criterion	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	0.3
R038	Dwelling	34.2	36.2	38.7	39.8	41.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R039	Dwelling	26	28.6	30.5	31.5	32.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R040	Dwelling	25.4	27.8	29.8	31	32.3

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R041	Dwelling	25.6	27.9	30	31.1	32.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R042	Dwelling	24.6	26.2	28.7	30	32.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R043	Dwelling	24.3	26.1	28.5	29.8	31.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R044	Dwelling	24.3	26	28.5	29.8	31.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R045	Dwelling	25.6	27.3	29.7	31	32.9
	Daytime Criterion	40.0	40.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R046	Derelict	25.8	27.4	29.9	31.1	33.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R047	Dwelling	25.8	27.4	30	31.3	33.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R048	Derelict	26.3	27.9	30.5	31.9	33.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R049	Dwelling	24.6	25.7	28.6	30.1	32.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R050	Dwelling	24.9	26.3	29	30.5	32.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R051	Derelict	25.1	26.5	29.2	30.8	32.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R052	Dwelling	24.9	26.3	29	30.6	32.5
	Daytime Criterion	40.0	40.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R053	Dwelling	24.2	25.6	28.4	29.9	32.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R054	Dwelling	23.9	25.3	28.1	29.6	31.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R055	Dwelling	25.7	26.9	29.9	31.6	33.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R056	Derelict	25.7	26.8	29.9	31.6	33.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
R057	Dwelling	26	27	30.2	31.8	34.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R058	Dwelling	28.9	29.6	33.1	35.1	36.8
	Daytime Criterion	40.0	45.0	45.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R059	Dwelling	29.6	30.4	33.8	35.7	37.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R060	Derelict	29.3	30.1	33.5	35.5	37.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R061	Dwelling	29.5	30.3	33.7	35.7	37.4
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R062	Derelict	29.8	30.5	34	35.9	37.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R063	Derelict	33.7	34.1	37.8	39.7	41.3
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R064	Dwelling	33.8	35.8	38.3	39.4	40.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R065	Dwelling	37.2	37.4	41.3	43.2	44.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Daytime Excess	–	–	1.3	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	0.2	1.6
R066	Dwelling	24.5	27.7	29.2	30.2	30.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R067	Dwelling	24.9	28.1	29.7	30.6	31.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R068	Derelict	27.4	30.8	32.3	33.2	33.6
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R069	Dwelling	34.1	34.7	38.4	40.4	41.9
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R070	Dwelling	28.6	30.3	32.8	34	35.7
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R071	Derelict	24.5	26	28.6	30.1	32.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R072	Dwelling	24.8	26.7	29	30.3	32.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R073	Dwelling	29.7	32.9	34.5	35.5	36.0
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0

House ID	Description	dB $L_{A90,10min}$ at Various Standarised Wind Speeds (m/s)				
		4	5	6	7	≥8
	Night time Excess	–	–	–	–	–
R074	Dwelling	28	31.3	32.9	33.7	34.2
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R075	Dwelling	32.2	35.6	37.2	38.1	38.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R076	Dwelling	32.9	36.2	37.8	38.7	39.1
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R077	Derelict	32	34.7	36.6	37.6	38.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–
R078	Derelict	29.3	32.7	34.2	35.1	35.5
	Daytime Criterion	40.0	40.0	40.0	45.0	45.0
	Daytime Excess	–	–	–	–	–
	Night time Criterion	43.0	43.0	43.0	43.0	43.0
	Night time Excess	–	–	–	–	–

A noise contour for the omni-directional rated power wind speed (i.e. highest noise emission) for the cumulative scenario and the proposed development in isolation is presented in Appendix 11-5.

The cumulative predicted noise levels at various wind speeds have been compared against the noise criteria curves. The predicted noise levels for the various wind speeds are within the noise criteria curves at all but two no. NSLs. The only two NSLs where there is a predicted potential exceedance of the cumulative noise criteria are at R037 and R065.

At NSL R037, there is a marginal exceedance of magnitude 0.2dB during the night time at 8m/s. Further discussion is provided in Section 11.5.3.1.1.

At R065, there is a potential exceedance of 1dB during the daytime at 6m/s and a potential exceedance of 0.8dB at ≥8m/s during the night time. As referenced above, the potential exceedance is relative to the cumulative noise criteria and the predicted noise level at H065 contains noise contributions from the proposed Croagh wind farm and the existing Garvagh Glebe and Black Banks wind farms to different degrees.

A review of the relative contributions of the various windfarms confirms that the Croagh Wind Farm is significantly lower than the relative contribution of the existing wind farms which are closer in proximity to R065. The specific exceedances are examined as follows:

- At 6 m/s, a potential exceedance of 1.3dB over the daytime criterion is predicted. The relative contribution of the Croagh wind farm at 6m/s is 27.2dB while the relevant noise limit at this wind speed is 40 dB. As such, the predicted contribution of the Croagh turbines is 12.8dB below the noise criteria.
- At 7m/s, a potential exceedance of 0.2dB over the night-time criterion is predicted. As above, the contribution of the Croagh turbines is 28dB which is 15dB below the night-time noise criterion of 43dB.
- At 8 m/s, a potential exceedance of 1.6dB over the night-time criterion is predicted. Likewise, the relative contribution of the Croagh wind farm is 28dB which is 15.1dB below the night-time noise criterion of 43dB.

On this basis, it is demonstrated that the predicted contribution of the Croagh turbines is more than 10dB below the contribution of the existing developments at R065[9]. As a result, the predicted noise levels generated by the proposed Croagh development does not result in an increase in the noise levels experienced at dwelling R065 and therefore is not causing an exceedance of the cumulative noise criteria.

11.5.3.1.1 Consideration of Wind Direction

The preceding section considered omni-directional cumulative noise i.e. assuming all noise locations being downwind of all turbines at the same time. The next step in the assessment is to consider wind directionality and turbine noise propagation in the noise prediction model using the methods outlined in Section 11.3 8 3.

A full suite of directional noise prediction results for all NSLs is presented in Appendix 11-6.

On review of the results of the noise model for dwelling R065, it could be seen that the Croagh turbines were not a significant contributor to the operational noise levels, i.e. the predicted contribution from the Croagh site was 10dB less than other turbines, therefore in line with best practice guidance the Croagh turbines are not predicted to increase the noise level at this location. At dwelling H037, the contribution from turbines on the Croagh site was closer in magnitude to other turbines and therefore has been assessed in more detail below.

Directional noise prediction models have been developed to identify the number and magnitude of potential exceedances to the noise criteria at dwelling R037 with the proposed Croagh turbines operating in standard mode.

The only wind direction where any potential exceedance of the criteria has been found is the southerly wind direction (180°). The predicted potential exceedances are presented in the table below. An exceedance of 0.3 dB has been found at R037, which lies to the north of the proposed turbine T6. This represents the only wind direction where a potential exceedance is predicted.

[9] A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, Institute of Acoustics (2013).

Table 11-22 Summary of Predicted Exceedances – R037

Dwelling R037		Excesses of Criterion dB LA90,10min at Various Standarised Wind Speeds (m/s)				
Wind Direction	**Period**	**4**	**5**	**6**	**7**	**8**
South	Daytime	–	–	–	–	–
	Night time	–	–	–	–	0.3

This assessment has used a worst-case sound emission envelope of three candidate turbine technologies operating in standard mode. Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve noise criteria during certain periods (i.e. day or night) and in specific wind conditions (i.e. wind speed and direction). The turbine technology that will be chosen will offer various low noise modes of operation which typically will have an associated energy output reduction.

It proposed that turbine operation be modified during the wind speed conditions and periods of day or night identified above in order to remove the predicted potential exceedance at dwelling R037.

In summary, since the cumulative predicted noise levels associated with the combined operation of the Croagh Wind Farm and existing developments, will be within best practice noise criteria curves recommended in Irish guidance 'Wind Energy Development Guidelines there will be no significant effect associated with the development.

While noise levels at low wind speeds will increase due to the development, the predicted levels will remain low, albeit a new source of noise will be introduced into the soundscape. The predicted operational noise effects are summarised as below at the closest noise sensitive locations to the site:

Quality	*Significance*	*Duration*
Negative	Moderate	Long term

For the majority of locations, further from the Croagh development and in instances where turbine noise from existing wind farms are audible, the effect of the operational turbines can be considered to be as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Long term

11.5.3.2 Internal Site Roads

Considering that there is no significant traffic expected on site roads during the operational phase and the significant distances from any site road to the nearest NSL; there are no noise and vibration impacts anticipated from site roads during the operational phase.

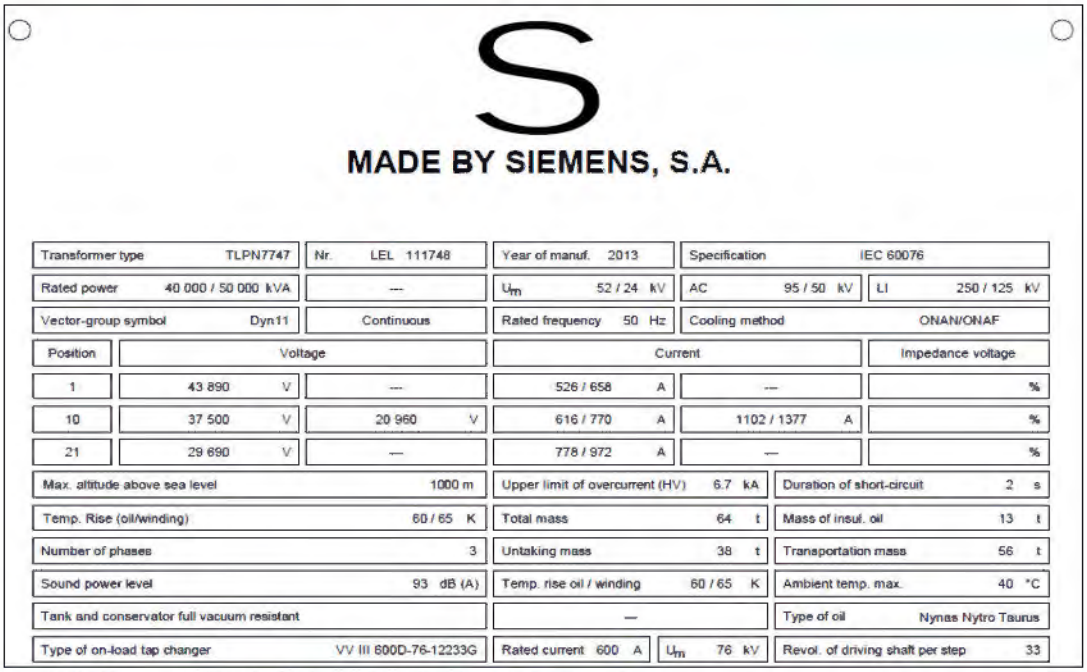
11.5.3.2.1 *Description of Effects*

With respect to the EPA criteria for description of effects, the potential worst-case effects at the nearest noise sensitive location associated with the operation of internal roads are described over.

Quality	Significance	Duration
Negative	Imperceptible	Long-term

11.5.3.3 Substation

As part of the development the substation will be operational continuously. The noise emission level associated with a typical substation that would support a development of this nature is 93 dB L_{wA}.



S

MADE BY SIEMENS, S.A.

Transformer type	TLPN7747	Nr.	LEL 111748	Year of manuf.	2013	Specification	IEC 60076	
Rated power	40 000 / 50 000 kVA		---	U_m	52 / 24 kV	AC	95 / 50 kV	LI 250 / 125 kV
Vector-group symbol	Dyn11		Continuous	Rated frequency	50 Hz	Cooling method	ONAN/ONAF	
Position	Voltage			Current			Impedance voltage	
1	43 890 V		---	526 / 658 A		---		%
10	37 500 V		20 960 V	616 / 770 A		1102 / 1377 A		%
21	29 690 V		---	778 / 972 A		---		%
Max. altitude above sea level	1000 m			Upper limit of overcurrent (HV)	6.7 kA	Duration of short-circuit	2 s	
Temp. Rise (oil/winding)	60 / 65 K			Total mass	64 t	Mass of insul. oil	13 t	
Number of phases	3			Untaking mass	38 t	Transportation mass	56 t	
Sound power level	93 dB (A)			Temp. rise oil / winding	60 / 65 K	Ambient temp. max.	40 °C	
Tank and conservator full vacuum resistant				---		Type of oil	Nynas Nytro Taurus	
Type of on-load tap changer	VV III 600D-76-12233G			Rated current 600 A	U_m 76 kV	Revol. of driving shaft per step	33	

Figure 11-21 Statement of Lw for Typical Sub Station Used for Assessment

An iteration of the noise model has been developed to consider the expected noise level from the plant at the nearest noise sensitive locations to the proposed substation. The predicted noise levels at the closest 10 no. receivers are presented in Table 11-23.

Table 11-23 Predicted Substation Noise Levels

House ID	Height (m)	Predicted $L_{Aeq,T}$ dB
R037	4	27
R036	4	25
R032	4	21
R031	4	20
R034	4	20
R038	4	20
R064	4	19
R035	4	19

House ID	Height (m)	Predicted $L_{Aeq,T}$ dB
R076	4	19
R022	4	17

The worst case predicted level is expected to be the order of 25 - 27dB(A) at R36 and R037. These noise levels will be in line with or less than prevailing background noise levels. At other locations the predicted level is 21dB or less.

11.5.3.3.1 Description of Effects

The description of the predicted impact is as follows:

Quality	*Significance*	*Duration*
Negative	Imperceptible	Long term

11.5.3.4 Grid Connection

There are no noise and vibration impacts anticipated from the operation of the grid connection.

11.5.4 Construction Phase Mitigation

The assessment of potential impacts has demonstrated that the proposed development is predicted to comply with the identified criteria for the construction phase. While no specific mitigation measures are required to achieve construction noise criteria, a schedule of best practice mitigation measures has been developed and is set out in the following sections.

Regarding construction activities, BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise* and BS 5228-2:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Vibration* have been taken into account.

11.5.4.1 Construction Phase – Noise

The following best practice measures will be implemented by the contractor for the construction phase:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;
- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- keeping site access roads even to mitigate the potential for vibration from lorries.

Furthermore, a variety of practicable noise control measures will be employed. These include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and;
- regular maintenance and servicing of plant items.

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. The following list of measures will be implemented on site, to ensure compliance with the relevant construction noise criteria:

- No plant nsed on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surroumded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Section 11.3.2.1.1 . using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.
- The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it will be necessary on occasion to work outside of these hours.

11.5.4.2 Construction Phase – Vibration

It is recommended that vibration from construction activities be limited to the values set out in Table 11-2. It should be noted that these limits are not absolute but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with cantion.

Considering the large distances between locations where piling may take place and the nearest noise sensitive locations, no significant impact will be experienced. Therefore, no mitigation measures are proposed for piling operations.

- Specific to blasting the following mitigation measures will be employed to control the vibration impact during blasts:Trial blasts may be undertaken to obtain scaled distance analysis;
- Ensuring appropriate bnrden to avoid over or under confinement of the charge;
- Accurate setting out and drilling;
- Appropriate charging;
- Appropriate stemming with appropriate material such as sized gravel or stone chipping;
- Delay detonation to ensure small maximum instantaneous charges;
- Decked charges and in-hole delays;
- Blast monitoring to enable adjustment of subsequent charges;
- Good blast design to maximise efficiency and reduce vibration;
- Avoid using exposed detonating cord on the surface.

11.5.5 Operational Phase Mitigation

An assessment of the operation noise levels has been undertaken in accordance with best practice guidelines and procedures as outlined in Section 11.3.2. The findings of the assessment confirmed that the predicted operational noise levels will be within the relevant best practice noise criteria curves for wind farms at all but one noise sensitive location. Therefore, on a very limited basis, curtailment of turbine operation in certain wind speeds and directions will be required to achieve the noise criteria in line with the WEDGs 2006. This will depend on the turbine technology selected for the Croagh Wind Farm site and the associated noise emissions at the various wind speeds, however the methodology used in this assessment represents a worst case with respect to turbine noise emissions . In the final design, a detailed curtailment strategy matrix will be developed at the detailed design stage in order to achieve the relevant noise criteria at all NSLs

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with them will comply with the noise criteria curves as per best practice guidance outlined in Section 11.4.2.1.1 and/or the relevant operational criteria associated with the grant of planning for the proposed development. If necessary suitable curtailment strategies will be designed and implemented for alternative technologies to ensure compliance with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

An assessment of the operational noise levels has also been undertaken in relation to the predicted operational noise levels from the internal site roads, amenity facilities and substation will be within the relevant best practice noise criteria. Therefore, no mitigation measures are required for these elements.

Mitigation measures for the management of turbine related noise are outlined in the following section.

11.5.5.1 Low Frequency Noise

In the unlikely event that an issue with low frequency noise is associated with the proposed development once operational, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011.

11.5.5.2 Amplitude Modulation

In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, the operator shall employ an independent acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, *A Method for Rating Amplitude Modulation in Wind Turbine Noise* (August 2016) or subsequent revisions (August 2016).

The measurement method outlined in the IoA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

11.5.5.3 Monitoring

Construction Phase

Noise and vibration monitoring should be considered in accordance with the guidance contained in British Standard BS5528 during the construction phase.

Operational Phase

Post commissioning operational noise monitoring will be undertaken to ensure compliance with the relevant planning noise criteria. In relation to assessment of operational wind turbine noise, the guidance outlined in the IoA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) will be followed. Should the assessment identify any exceedances of the appropriate criteria, relevant corrective actions will be taken.

11.5.6 Decommissioning Phase

In relation to the decommissioning phase, lower overall noise levels compared to those calculated for the construction phase would be expected, as roads, hardstands and turbine foundations would be left in situ and no rock breaking or blasting would occur.

The total predicted decommissioning noise levels are predicted to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,1hr}$) and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations in terms of construction and decommissioning noise.

11.5.6.1 Decommissioning Phase Mitigation

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those best practice measures proposed for the construction phase of the development, i.e. as per Section 11.5.4.

11.6 Description of Residual Effects

11.6.1 Construction and Decommissioning Phase

During the construction phase of the project there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other activities. However, given that the construction phase of the development is temporary in nature and the distances between the main construction works and nearby noise sensitive properties, the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation with exceptional allowances, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration effect is kept to a minimum.

With respect to the EPA's criteria for description of effects, in terms of these construction activities, the potential worst-case associated residual effects at the nearest noise sensitive locations associated with the various elements of the construction and decommissioning phases are described below.

11.6.1.1 General Construction – Turbines and Hardstands, Substation and Grid Connection

11.6.1.1.1 *Turbines and Hardstands*

The predicted residual noise and vibration effect associated with this element of the construction phase is described follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

11.6.1.1.2 *Substation and Grid Connection*

The predicted residual noise and vibration effect associated with this element of the construction phase is described follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers the locations of the greatest potential impact.

11.6.1.1.3 *Internal Road Construction*

The predicted residual noise and vibration effect associated with the proposed internal road construction operations at NSLs is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Short-term

The above effects should be considered in terms that the effect is variable, and that this assessment considers one location with the greatest potential impact.

11.6.1.2 Borrow Pit Activity

The predicted worst-case noise and vibration effects associated with proposed borrow pit operations at NSLs are summarised as follows:

Quality	*Significance*	*Duration*
Negative	Slight	Temporary

11.6.1.3 Construction Traffic

The effects associated with the overall noise levels from construction traffic is outlined along and has been broken down into the various Stages and are described below.

Quality	*Significance*	*Duration*
Negative	Not Significant	Short-terun

11.6.2 Operational Phase

11.6.2.1 Noise

11.6.2.1.1 *Wind Turbine Noise*

At location H037, the predicted turbine noise levels with the operation of the proposed Croagh development are marginally above the relevant criteria. As discussed above, once mitigation is applied in the downwind direction this potential exceedance will be removed. Therefore, the associated effects at H037 are as follows:

Quality	*Significance*	*Duration*
Negative	Not significant	Long-term

At location H065, the predicted increases in turbine noise levels with the operation of the proposed Croagh development will be an order of magnitude that is inaudible to the human ear. Predicted noise levels at this dwelling are dominated by existing wind turbines. Therefore, any changes to the noise environment will be inaudible and the associated effects at H065 are as follows:

Quality	*Significance*	*Duration*
Neutral	Imperceptible	Long-term

At all other noise sensitive locations, the predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance 'Planning Guidelines for Wind Farm Development 2006' it is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the development the predicted levels will remain low and is not expected to cause any significant changes to the environment.

The predicted operational noise effects can be described as follows:

Quality	*Significance*	*Duration*
Negative	Not significant	Long-term

The above effect should be considered in terms that the effect is variable and that this assessment considers periods of the greatest potential effect.

11.6.2.1.2 Substation Noise

The associated effect from the day to day operation of the substation is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Not significant	Long-term

11.6.2.2 Vibration

There are no expected sources of vibration associated with the operational phase of the proposed development. In relation to of vibration the associated effect is summarised as follows:

Quality	*Significance*	*Duration*
Negative	Imperceptible	Long-term

11.6.3 Cumulative Effects

Cumulative assessment has been considered in this chapter with due consideration of the proposed development in combination with any existing, approved and permitted wind turbine developments in the wider study area as noted in Section 11.3.6. The effects have been confirmed in Section 11.5.3. The description of effects presented for the operational phase of the proposed development includes cumulative effects.

12. LANDSCAPE AND VISUAL

12.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) addresses the potential landscape and visual impacts of the Croagh Wind Farm. The emphasis in this chapter is on the likely significant effects of the proposed development. It covers the assessment methodology, a description of the proposed development and the existing landscape based on relevant guidance. It includes a description of the landscape policy of Counties Leitrim and Sligo with specific reference to wind energy and the study area in which the proposed development site is located.

The landscape of the area is described in terms of its existing character, which includes a description of landscape values and the landscape's sensitivity to change. The landscape and visual impact assessment of the proposed wind farm uses visibility mapping, representative viewpoints and photomontages as tools to inform the assessment which includes an assessment of landscape value and sensitivity. The potential impacts in both landscape and visual terms are then assessed, including cumulative impacts.

A full description of the proposed development and project is provided in Chapter 4 of this EIAR.

12.2 Statement of Authority

This chapter was prepared by Joanna Mole, a Landscape and Visual Impact Assessment Specialist and Chartered Landscape Architect with McCarthy Keville O'Sullivan Ltd. with over 15 years of experience in both private practice and local authorities. Joanna holds a BSc (Hons) in Landscape Design & Plant Science from Sheffield University, a Postgraduate Diploma in Landscape Architecture from Leeds Beckett University, a MSc in Renewable Energy Systems Technology from Loughborough University. Joanna is a Chartered Landscape Architect with specialist knowledge in Landscape and Visual Impact assessments for projects ranging from individual houses to large windfarms, solar farms, cycle route design and landscape contract management. Joanna holds chartered membership of the British Landscape Institute since 1998 and has been an examiner for British Landscape Institute professional practice exam.

12.2.1 Proposed Development Description

Coillte intends to apply for planning permission to construct a wind farm at Croagh, located on the boundary of Co. Leitrim and Co. Sligo. The proposed wind farm will comprise up to 10 No. turbines with a tip height of up to 170 metres and all associated foundations and hardstanding areas, access roads including upgrade of existing site roads and provision of new roads, 1 no. onsite electrical substation, excavation of 1 No. borrow pit, 2 no. peat repositories, underground electrical and communications cabling connecting the turbines to the proposed onsite substation, underground cabling connecting the onsite substation to the existing Garvagh substation, 2 no. temporary construction compounds, 1 No. permanent met mast, car park, amenity walkways and boardwalk and signage site drainage and all associated works.

Of the proposed turbines, 8 No. turbines and associated infrastructure are located within the functional area of Leitrim County Council and 2 No. turbines and associated infrastructure are located in the functional area of Sligo County Comcil. A detailed description of the proposed development is included in Chapter 4 of this EIAR.

12.2.1.1 Mitigation by Good Design

Through the iterative project site selection and design process, informed by early-stage impact assessment work, landscape modelling, ZTV mapping and photomontage preparation, every effort has been made to bring forward the optimum site selection and design for the project now proposed with respect to landscape and visual factors. The final project layout that is the subject of this LVIA, already incorporates the following landscape and visual design considerations for good wind farm design:

- The turbines have been located within an area surrounded by lands of high elevations which limits open views of the project, particularly from potentially sensitive receptors such as settlements (Note the ZTV outputs).
- The turbine layout has been designed to create a coherent cluster, contignous and connected to each other visually and with consistent spacing.
- The turbine layout and scale has been designed to fit with the existing turbines located in the vicinity of the development which are at a higher elevation to the proposed development.
- All turbines have been located greater than 4x tip height from the nearest point of the curtilage of any residential property in order to protect residential visual amenity.
- The internal site road layout makes use of the existing tracks wherever possible (to be upgraded for the delivery of wind turbine components), to minimise the requirement for new tracks within the site; and
- Felling of existing coniferous plantation is predominantly limited to keyhole felling in localised parts of the site, in keeping with existing practices in the commercial forestry plantation on-site.

During the initial site selection process, landscape sensitivity was identified as a key constraint and so landscapes considered to be less sensitive are preferred over sites with more sensitivity to change. During site design process, the potential visibility of the project was reduced by removing two turbines located to the north west of the site which would have extended the spatial extent of the project and the number of visual receptors. The site location and current layout minimises the theoretical potential for visibility and the site visits and assessment tools show that the actual visibility is far less than the theory. Where visibility does occur, the design is in accordance with best practice and a coherent project, sympathetic to its neighbouring wind turbines, is evident.

12.2.2 Scoping Replies/Pre-Planning Meetings

A scoping and consultation exercise has been carried out by MKO., as detailed in Section 2.5 of Chapter 2 of this EIAR. Pre-planning meetings were held with Leitrim County Council on 10th June 2019 and Sligo County Council on 21st June 2019 details of which are outlined in Section 2.6 of Chapter 2 of this EIAR. The issues raised relevant to the LVIA Chapter are set out below.

12.2.2.1 County Leitrim

The following locations were requested to be cousidered for viewpoint selection:

a) *Corry Strand on north shore of Lough Allen (amenity point)*
b) *Parkes Castle on north shore of Lough Gill.*
c) *Manorhamilton Town*
d) *Dromahair Village*
e) *Creevelea Abbey outside Dromahair*

12.2.2.2 County Sligo

The following points were raised with regards to the LVIA Chapter:

a) *ZTV and visibility from scenic roads and the shore of Lough Gill*
b) *Important for the LVIA to distinguish between the different landscapes on either side of the hill (the Leitrim side and the Sligo side), and that they will be particularly focusing on cumulative effects and potential perceived differences in scale of the existing and proposed turbines.*
c) *Size/scale of proposed turbines*

12.3 Brief Methodology and Assessment Criteria

This section broadly outlines the methodology used to undertake the landscape and visual impact assessment of the proposed development, a more detailed description of the methodology is outlined in detail in Appendix 12.1, and the guidance used in the preparation of each section. There are four main sections to this assessment:

- Landscape Baseline
- Visual Baseline
- Cumulative Baseline
- Likely and Significant Effects – outlining the assessment of landscape, visual and cumulative effects

12.3.1 Scope and Definition of Landscape and Visual Impact (LVIA) Study Area

For the purposes of this EIAR, where the 'proposed development site' or 'the site' is referred to, this relates to the EIAR site boundary, as delineated in Figure 1.1 of this EIAR. This total area measures approximately 670 hectares. The proposed development site is discussed in some detail in terms of its landscape character.

However, the landscape and visual baseline mapping and viewpoint selection are based on wider study areas. The general study area has been chosen as 20 kilometres for visual and landscape effects. However, for the effects on landscape character 15 kilometres from the proposed wind turbine locations is an appropriate distance. These are the study areas for which the baseline maps and viewpoint locations are produced and are referred to as the 'study area'. Furthermore, on the basis of desk studies and survey work undertaken, the professional judgement of the assessment team, experience from other relevant projects and policy guidance or standards, the following topic areas have been scoped out of the assessment:

- Effects on landscape and visual receptors that have minimal or no theoretical visibility (as predicted by the ZTV) and/or very distant visibility, and are therefore unlikely to be subject to significant effects;
- Effects on designated landscapes beyond a 20km radius from the proposed development, from where it is judged that potential significant effects on key characteristics and/or special qualities, or views are judged unlikely to occur;
- Effects on landscape character beyond a 15km radius from the proposed development, where it is judged that potential significant effects on landscape character are unlikely to occur;
- Effects on visual receptors beyond a 20km radius from the proposed development, where it is judged that potential significant effects are unlikely to occur;
- Cumulative effects in relation to single turbines (except where otherwise stated);

- Cumulative landscape effects beyond a 15km radius and cumulative visual effects beyond a 20km radius from the proposed development, where it is judged that potential significant effects on landscape character are unlikely to occur;
- Areas in County Cavan due to distance from the proposed development and the lack of significant visual or landscape receptors within the small area of the county falling within the study area

12.3.2 Guidelines

Ireland signed and ratified the European Landscape Convention (ELC) in 2002, which introduces a pan-European concept which centres on the quality of landscape protection, management and planning. The Department of Arts, Heritage and the Gaeltacht has published a National Landscape Strategy for Ireland in 2015. The Strategy aims to ensure compliance with the ELC and contains six main objectives, which include developing a national Landscape Character Assessment and Developing Landscape Policies.

In 2000, the Department of the Environment and Local Government published 'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities', which recommended that all Local Authorities adopt a standardised approach to landscape assessment for incorporation into Development Plans and consideration as part of the planning process. However, this DoEHLG 2000 guidance remains in draft form.

This landscape and visual impact assessment was primarily based on the *Guidelines for Landscape and Visual Impact Assessment* or GLVIA (The Landscape Institute/Institute of Environmental Management and Assessment, UK, 2013). A range of other guidelines also inform the preparation of this landscape and visual impact assessment, which include:

- Wind Energy Development Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government, 2006),
- Draft Revised Wind Energy Development Guidelines (Department of the Environment, Heritage and Local Government, 2019),
- Visual Assessment of Wind Farms: Best Practice (Scottish Natural Heritage, 2002).
- Visual Representation of Wind Farms: Version 2.2 (Scottish Natural Heritage, 2017).
- Siting and Designing Wind Farms in the Landscape, Version 3a (Scottish Natural Heritage, 2017).
- Photography and photomontage in landscape and visual impact assessment (Landscape Institute Advice Note 01/11, 2011)
- Visual representation of development proposals (Landscape Institute Technical Guidance Note 02/17, 2017)
- Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' (Department of the Environment and Local Government, 2000)
- Assessing the Cumulative Impact of Onshore Wind Energy Developments (Scottish Natural Heritage, 2012)
- Spatial Planning for Onshore Wind Turbines – natural heritage considerations (Scottish Natural Heritage, 2015)
- Siting and Designing Wind Farms in the Landscape Version 3a (Scottish Natural Heritage, 2017)
- Cumulative Impact of Wind Turbines on Landscape and Visual Amenity (Carmarthenshire County Council, 2013)
- Leitrim County Development Plan 2015-2021 (Leitrim County Council, 2015)
- Landscape Assessment of County Leitrim (Leitrim County Council, 2002)
- Sligo County Development Plan 2017-2023 (Sligo County Council, 2017)
- Roscommon County Development Plan 2014 – 2020, Variation No.1 (Roscommon County Council, 2017)

- Landscape Character Assessment of County Roscommon (Roscommon County Council, 2014)

12.3.3 Baseline Landscape and Visual Information

In order to carry out this assessment, an initial desk study was undertaken which identified:

Landscape Baseline

- Policies and objectives contained in the relevant county development plans pertaining to landscape and wind energy
- Identification of Landscape Receptors based on:
  - Landscape designations in the study area
  - Landscape character of the study area
  - Landscape character of the proposed development site based on
    - Site Surveys undertaken in Winter 2018 and Spring and Summer of 2019
    - Landscape Character Types identified in 'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' (Department of the Environment and Local Government, 2000)

Visual

- Identification of Visual Receptors
- Zone of Theoretical Visibility (ZTV) mapping
- Selection of viewpoints on the ground was assisted by the TrueViewVisuals software

12.3.4 Assessment of Potential Impacts

The methodology includes clearly documented methods based on the GLVIA guidelines, in order to arrive at an assessment of effects. These include consideration of landscape and visual sensitivity balanced with the magnitude of the effect to determine the significance of effects. Mitigating factors are then taken into consideration to arrive at residual landscape and visual effects. Further details on the impact assessment methodology are presented in Appendix 12.1.

12.4 Landscape Baseline

This part of the LVIA focusses on identifying the key landscape receptors that should form part of the assessment. For this purpose, the County Development Plans of Leitrim, Sligo and Roscommon were consulted.

Baseline Landscape Receptors:

- **Landscape Designations** based on:
  - Leitrim County Development Plan 2015-2021
  - Sligo County Development Plan 2017-2023
  - Roscommon County Development Plan 2014-2020
- **Landscape Character of the Proposed Development Site** and its immediate environment based on:
  - Landscape Type identified using DoEHLG Guidelines 2006/ Draft Guidelines 2019
  - Site Visits
- **Landscape Character of the Study Area** based on:

- Landscape Assessment of County Leitrim
- Landscape Character Assessment of County Roscommon
- Provisional Landscape Character Assessment of County Sligo areas within the LVIA study area (prepared by MKO)

12.4.1 Landscape Designations

The County Development Plans (CDPs) of Leitrim, Sligo and Roscommon were consulted to identify landscape designations. Additionally, general landscape policy and landscape policy pertaining to wind energy development identified in the respective CDPs is also listed.

While the policy on designated views and scenic routes is outlined for the respective counties below, the list of views and scenic routes within 20km of the proposed turbines, mapped in Figure 12-1 are set out in Section 12.5 below, as they are in their nature a visual designation. In this section of the landscape and visual impact assessment chapter they are assessed and form part of the basis of viewpoint selection.

12.4.1.1 County Leitrim

Section 3.8.7 of the Leitrim County Development Plan 2015-2021 (CDP) refers to landscape designations including Areas of Outstanding Natural Beauty (AONB), Areas of High Visual Amenity (HVA) and outstanding views and prospects. These designations are all shown on Map 3.12 in the CDP, illustrated on Figure 12-1 of this EIAR. No landscape designations apply to the proposed development site and those falling within the study area as outlined in more detail below.

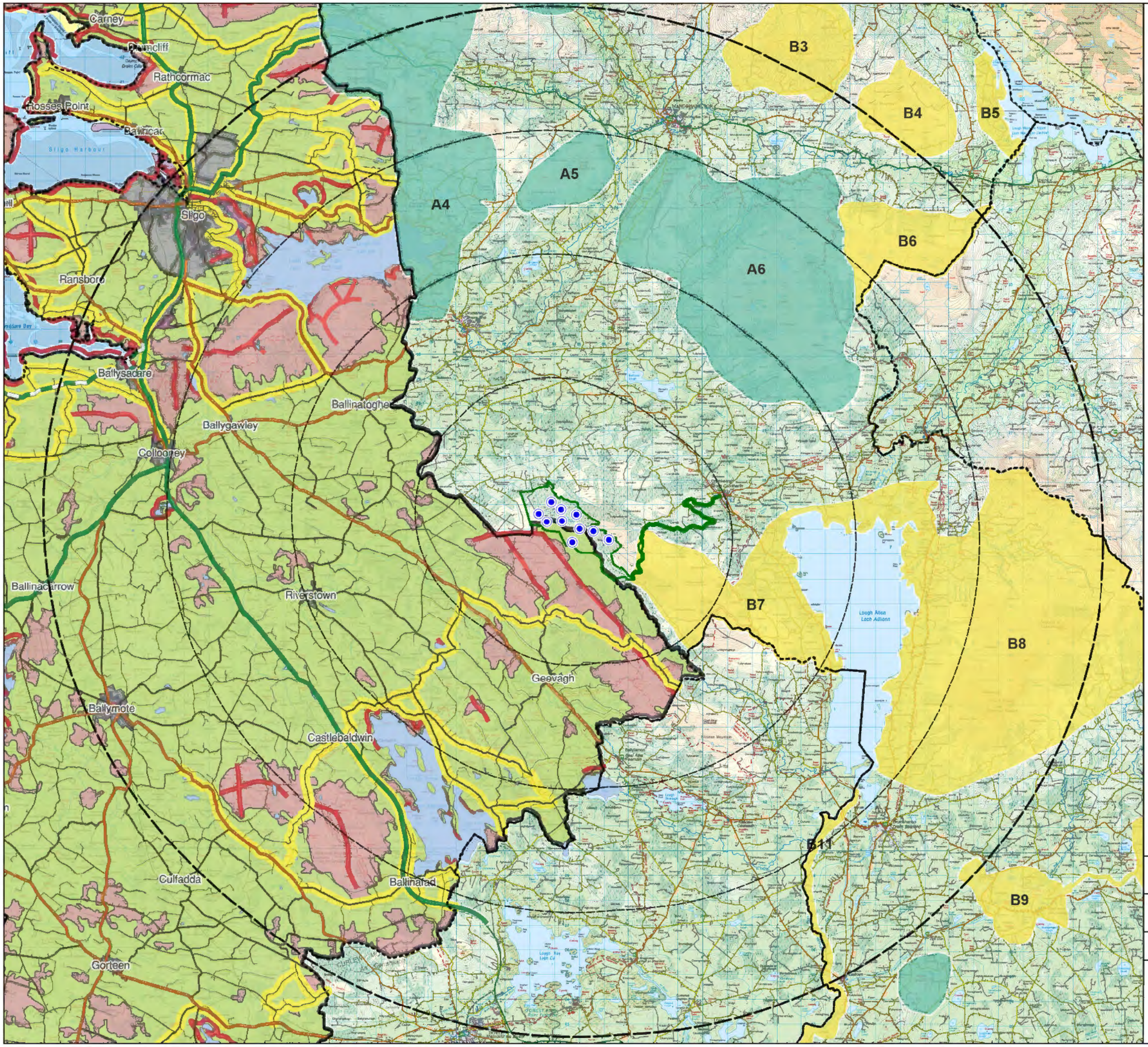
12.4.1.1.1 *Areas of Outstanding Natural Beauty (AONB) and High Visual Amenity (HVA)*

The CDP recognises that *"the capacity to absorb developments varies greatly from one area of AONB/HVA to another AONB/HVA and even within these areas of AONB/HVA also"*. It notes that the *"capacity of the landscape to absorb development will include consideration of the topography, vegetation, and the nature and extent of existing development"*.

To this end 7 AONBs and 14 HVA areas were designated in Co. Leitrim, as set out in objectives 80 and 81 and listed in Tables 18 and 19 of the CPD. Furthermore, the following policies apply to AONBs and HVAs:

> ***Policy 100:*** *It is the policy of the Council to permit development in an Area of Outstanding Natural Beauty where the applicant can satisfy the planning authority that it is not practicable to develop in a less-sensitive location and where it is demonstrated that the development will not impinge in any significant way on the character, integrity or uniformity of the landscape.*
>
> ***Policy 101:*** *It is the policy of the Council to permit development in an area of High Visual Amenity only where the applicant has demonstrated a very high standard of site selection, site layout and design and where the planning authority is satisfied that the development could not be accommodated in a less-sensitive location.*

The proposed development site is neither in an AONB nor a HVA, the closest AONB is *A6 - O'Donnell's Rock and Boleybrack*, located approximately 8.1 kilometres north-east and the closest HVA is *B7 - Corry Mountain*, located approximately1.2 kilometres east of the proposed development site. The ANOBs and HVAs falling within the study area are shown in Fignre 12-1 and listed in Table 12-1 below.



Map Legend

- EIAR Site Boundary
- Landscape Designations Study Area
- Proposed Turbines

County Leitrim Landscape Designations

- Areas of Outstanding Natural Beauty
- Areas of High Visual Amenity

Drawing Title: **12-1 Landscape Designations**

Project Title: **180511 - Croagh Wind Farm EIAR**

Drawn By:	Checked By:	Scale:	Date:	Project No:	Drawing No.:
JM	EM	1:150,000	30/06/2020	180511	Figure 12-1

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Table 12-1 ANOBs and HVAs within 20 kilometres of the proposed development (Co. Leitrim)

Map Ref.	Area
Areas of Outstanding Natural Beauty (AONBs)	
5 to 10 km	
A4	The Doons, Lough Gill and environs
A6	O'Donnell's Rock and Boleybrack
10 to 15 km	
A5	Benbo
15 to 20 km	
A3	Aroo, Glenade, Truskmore, Glencar and environs.
High Visual Amenity Areas (HVAs)	
Up to 5 km	
B7	Corry Mountain
5 to 10 km	
B8	Lough Allen, Sliabh an Iarainn, Bencroy and environs
10 to 15 km	
B6	Cloonclare
B11	River Shannon, Derrycarne and environs
15 to 20 km	
B3	Dough Mountain
B4	Thur Mountain
B9	Lough Scur, St. John's Lough and environs

The CDP proposes to adopt a positive approach to development proposals outside AONBs and HVAs, which support the *'living countryside'* philosophy of Leitrim County Council. However, even here the highest standards of design will be sought, and care must be taken to minimise negative visual impacts.

12.4.1.1.2 *Views and Prospects*

A number of outstanding views and prospects are identified on Map 3.12 and listed in Table 20 in Section 3.8.9 of Chapter 3 of the CPD. Objectives and policies set out in the CPD in relation to views and prospects are as follows:

Policy 102 *- It is the Council's policy to protect these views from intrusive development and enhance them by the removal of dereliction and eyesores. Lay-bys and viewing areas will be developed, as appropriate and as funds allow.*

Objective 82 *- It is an objective of the Council to protect the following Views and Prospects, Table 20 refers.*

Views within 20km of the proposed turbines are mapped in Figure 12-1. As outlined above they are listed in Table 12-5 in Section 12.5 *Visual Baseline* and assessed in that part of the landscape and visual impact assessment chapter.

12.4.1.1.3 Landscape Policy pertaining to Wind Energy

County Leitrim does not currently have a Wind Energy Strategy. However, Sections 3.11.4 and 3.11.5 of the CDP refer to wind farm development. The following objective refers to the council's future plan regarding energy strategy:

> ***Objective 126*** *It is an objective of the Council to prepare an Energy Strategy for the County over the lifetime of the County Development Plan and the Council will have regard to such a Plan in determining applications for developments relating to renewable and other energy projects.*

Section 3.11.4 notes that guidance can be found in the Landscape Character Assessment *"on the integration of wind farms into the landscape"* and further states in Section 3.11.5 that while being disposed towards wind farm development *"strict development management measures will operate and the Council will only permit such developments where it can be clearly demonstrated, to the satisfaction of the Planning Authority, that such developments are in accordance with National and Regional Guidance and in particular the criteria set out herein."*

Furthermore, *"in deciding on the suitability of an area to accommodate windfarm development, the Council will be guided by the Department of Environment, Heritage and Local Government Wind Energy Guidelines 2006 or any updated version of the Guidelines"*. A number of 'environmentally sensitive areas' are listed, these include AONBs, HVAs and Outstanding Views and Prospects. County Leitrim's approach to wind energy is summarised in the CDP as follows:

> *"In summary, development that can clearly demonstrate, to the satisfaction of the Planning Authority, that they would not have a significant adverse impact on the amenities of a dwelling or a building occupied, or capable of being occupied, by people, or would not compromise the integrity of an environmentally sensitive area, will be 'open for consideration'."*

12.4.1.2 County Sligo

12.4.1.2.1 Landscape Characterisation Map

Much of the landscape policy of County Sligo is broadly based on the Landscape Characterisation Map (LC Map), see Figure 12-2 below, based on a study commissioned by Sligo County Council. The LC Map classifies the county according to its visual sensitivity and capacity to absorb new development without compromising the scenic character of certain areas. It designates the following:

> ***Normal Rural Landscapes:*** *areas with natural features (e.g. topography, vegetation) which generally have the capacity to absorb a wide range of new development forms – these are largely farming areas and cover most of the County. At the same time, certain areas located within normal rural landscapes may have superior visual qualities, due to their specific topography, vegetation pattern, the presence of traditional farming or residential structures.*

These areas may have limited capacity for development or may be able to absorb new development only if it is designed to integrate seamlessly with the existing environment.

Sensitive Rural Landscapes: *areas that tend to be open in character, highly visible, with intrinsic scenic qualities and a low capacity to absorb new development – e.g. Knocknarea, the Dartry Mountains, the Ox Mountains, Aughris Head, Mullaghmore Head etc.*

Visually Vulnerable Areas: *distinctive and conspicuous natural features of significant beauty or interest, which have extremely low capacity to absorb new development – examples are the Ben Bulben plateau, mountain and hill ridges, the areas adjoining Sligo's coastline, most lakeshores etc.*

Scenic Routes: *public roads passing through or close to Sensitive Rural Landscapes, or in the vicinity of Visually Vulnerable Areas, and affording unique scenic views of distinctive natural features or vast open landscapes. In addition to remote views, scenic routes have often a distinctive visual character conferred by old road boundaries, such as stone walls, established hedgerows, lines of mature trees, adjoining cottages or farmyards together with their traditional, planted enclosures etc., all of which warrant protection.*

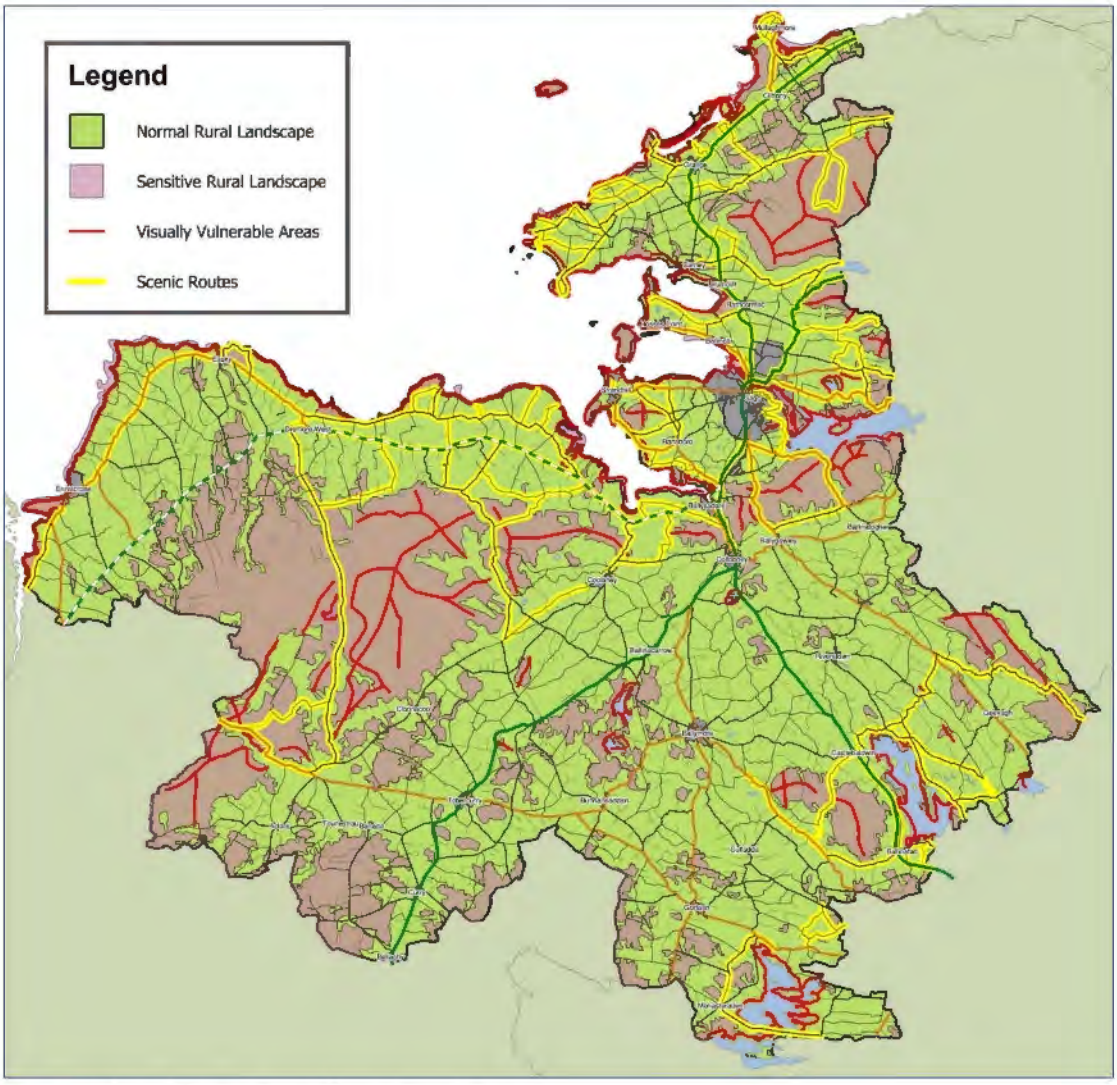


Figure 12-2 County Sligo Landscape Characterisation Map

The part of the proposed development site and the two turbines within County Sligo are within an area of '*Normal Rural Landscape*'. Furthermore, there are '*Visually Vulnerable Areas*' and an area of

'Sensitive Rural Landscape' within one kilometre of the proposed turbines. It should be noted however that these designations refer mainly to the capacity of the land to absorb development within these areas and as the turbines and proposed development site itself are ontside an area of *'Sensitive Rural Landscape'* and away from '*Visually Vulnerable Areas'* the proposal complies with the requirements of the Sligo CDP.

The Sligo CDP also sets out the following landscape policies relevant to this project in Section 7.4:

> ***P-LCAP-1*** *Protect the physical landscape, visual and scenic character of County Sligo and seek to preserve the County's landscape character. Planning applications that have the potential to impact significantly and adversely upon landscape character, especially in Sensitive Rural Landscapes, Visually Vulnerable Areas and along Scenic routes, may be required to be accompanied by a visual impact assessment using agreed and appropriate viewing points and methods for the assessment.*
>
> ***P-LCAP-2*** *Discourage any developments that would be detrimental to the unique visual character of designated Visually Vulnerable Areas.*
>
> ***P-LCAP-4*** *Strictly control new development in designated Sensitive Rural Landscapes, while considering exceptions that can demonstrate a clear need to locate in the area concerned. Ensure that any new development in designated Sensitive Rural Landscapes:*
>
> - *does not impinge in any significant way on the character, integrity and distinctiveness of the area;*
> - *does not detract from the scenic value of the area;*
> - *meets high standards of siting and design;*
> - *satisfies all other criteria with regard to, inter alia, servicing, public safety and prevention of pollution.*
>
> ***P-LCAP-5*** *Protect the historic and archaeological landscapes of the County.*

12.4.1.2.2 Scenic Routes

Appendix E of the Sligo CDP sets out the counties approach to scenic routes and lists the scenic routes in hierarchical order of national primary roads, national secondary roads, regional roads and local roads. Furthermore, the following policy item relates to scenic routes:

> ***P-LCAP-3*** *Preserve the scenic views listed in Appendix E and the distinctive visual character of designated Scenic Routes by controlling development along such Routes and other roads, while facilitating developments that may be tied to a specific location or to the demonstrated needs of applicants to reside in a particular area. In all cases, strict location, siting and design criteria shall apply, as set out in Section 13.4 Residential development in rural areas (development management standards).*

Scenic routes within 20km of the proposed turbines are mapped in Figure 12-1. As outlined above they are listed in

Table 12-5 in Section 12.7 *Visual Baseline* and assessed in that part of the landscape and visual impact assessment chapter.

12.4.1.2.3 Landscape Policy with regard to Wind Energy

Chapter 11 sets out the council's policy with regard to energy. The wind energy policy relevant to landscape is listed below:

SP-EN 1 *Support the sustainable development, upgrading and maintenance of energy generation, transmission, storage and distribution infrastructure, to ensure the security of energy supply and provide for future needs, as well as protection of the landscape, natural, archaeological and built heritage, and residential amenity and subject to compliance with the Habitats Directive.*

SP-EN-2 *Facilitate the sustainable production of energy from renewable sources, energy conversion and capture in forms such as wind power, hydro-power, wave-generated energy, bioenergy, solar technology and the development of Waste to Energy/Combined Heat and Power schemes at appropriate locations and subject to compliance with the Habitats Directive. All such development proposals will be assessed for their potential impact on urban and rural communities, Natura 2000 sites, designated Sensitive Rural Landscapes, Visually Vulnerable Areas, Scenic Routes and scenic views, as well as in accordance with strict location, siting and design criteria.*

SP-EN 5 *Collaborate with urban and rural communities in the development of community level energy efficiency and renewable energy projects, subject to visual landscape, heritage, environmental and amenity considerations and subject to compliance with the Habitats Directive.*

SP-EN 7 *Protect significant landscapes from the visual intrusion of large-scale energy infrastructure.*

SO-EN-2 *Undertake an analysis of suitable areas for wind energy and prepare a map showing County Sligo's Landscape Suitability for Wind Energy Developments, in accordance with Section 3.5 of the Wind Energy Guidelines (2006) and any subsequent revisions.*

12.4.1.3 County Roscommon

12.4.1.3.1 Landscape Policy

The Roscommon County Development Plan 2014-2020 has outlined numerous policies and objectives with regard to its landscape. These are set out below:

Core Policy 2.10: *To identify and protect the unique and diverse natural heritage of County Roscommon in terms of landscape, natural resources such as rivers and lakes and waterways along with the built environment of historical, architectural and cultural value.*

Core Policy 2.9: *To identify and recognise the potential, in economic and social terms, of the county's natural resources such as its arable agricultural land, clean environment, lands with forestry potential, aggregate reserves and tourism opportunities. To support the utilisation of alternative energy provision in a sustainable and harmonious way in terms of impacts on landscapes and habitats over the broad spectrum of its potential sources, including wind, solar, and alternative fuel sources. Any such development will be cognisant of the need to protect, conserve and enhance the county's biodiversity and the requirement for screening to determine if a full Appropriate Assessment of the likely impact on integrity on Natura 2000 sites is required.*

Objective 7.37 *Seek to minimise visual impacts on areas categorised within the Co. Roscommon LCA including "moderate value", "high value" "very high value" and with special emphasis on areas classified as "exceptional value" and where deemed necessary, require the use of visual impact assessment where proposed development may have significant effect on such designated areas.*

Objective 7.38 *Take into account the detailed landscape character analysis which forms part of the Lough Key Local Area Plan when assessing development proposals in this area.*

12.4.1.3.2 Scenic Routes and Scenic Views

While most detail on scenic routes and scenic views is provided in Appendix 1 of the *Landscape Character Assessment of County Roscommon,* the following policies and objectives are included in the Roscommon CDP:

> ***Policy 3.49*** *Assessment of visual impacts of proposals will have regard to the LCA and in particular to; immediate visual impact and long-distance views,* ***Scenic Routes and Scenic Views*** *depicted in Appendix 1 of the LCA report, sites of special value (i.e. the bog land north of Castlerea (LCA 27) and Upper Lough Ree (LCA 6) which has been identified as of particular importance for their sense of isolation and tranquillity.)*
>
> ***Objective 7.40*** *Seek to protect important views and prospects in the rural landscape and visual linkage between established landmarks, landscape features and views in urban areas.*

The County Roscommon scenic routes and scenic views within 20km of the proposed turbines are mapped in Figure 12-1. As outlined above they are listed in

Table 12-5 in Section 12.7 *Visual Baseline* and assessed in that part of the landscape and visual impact assessment chapter.

12.4.1.3.3 Landscape Policy pertaining to Wind Energy

Roscommon bas included the following wind energy policies relevant to landscape in its CDP:

> ***Policy 3.47*** *All Applications for wind farm developments shall have regard to the Wind Energy Planning Guidelines 2006 regarding landscape impact of associated development (including roads and tracks, power lines, the control building, wind measuring mast and the compound.)*
>
> ***Policy 3.51*** *Ensure that applications for wind turbines are assessed in accordance with the SEI Wind Speed Atlas, Accessibility to the National Electricity Transmission and Distribution Grid, the suitability of the site having regard to other land use policies and objectives to protect all aspects of the landscape including visual, cultural, and environmental. All wind turbine proposals, irrespective of size shall be subject to full Environmental Assessment (EIA).*
>
> ***Policy 4.53*** *Encourage the development of renewable energy sources such as wind, biomass and solar energy as well as energy conservation measures such as energy efficient building design and servicing. All such development proposals will be assessed for their potential impact on the environment, Landscape Character Assessment designations, compliance with the habitats directive and other normal planning considerations. Seek to integrate climate change considerations into development proposals.*
>
> ***Policy 4.59*** *Facilitate the sustainable infrastructural development of energy generation and transmission networks, to ensure the security of energy supply and provide for future needs whilst also ensuring the preservation of scenic or otherwise significant landscapes from the visual intrusion of large-scale energy infrastructure.*
>
> ***Objective 4.55*** *Designate areas of the county, as recommended in the LCA, which may be suitable for wind energy development in line with the national guidelines on wind energy, take account of cumulative and in-combination environmental effects and take a proactive role in encouraging applications in these areas.*

12.4.1.4 Summary of Landscape Designations

12.4.1.4.1 County Leitrim

Five Areas of Outstanding Natural Beauty (AONB) and seven High Visual Amenity Areas (HVAs) fall within the 20km study area. County Leitrim also designates views and prospects, which will be assessed in Section 12.5 *Visual Baseline*.

12.4.1.4.2 County Sligo

County Sligo as part of its Landscape Characterisation Map (LC Map), classifies the county according to its visual sensitivity and capacity to absorb new development without compromising the scenic character of certain areas. Classifications are Normal Rural Landscapes, Sensitive Rural Landscapes and Visually Vulnerable Areas as well as Scenic Routes. These areas are more akin to landscape zonings relating to their capacity to absorb development rather than landscape designations that would also be affected by development outside these areas. Scenic Routes are covered in Section 12.5 *Visual Baseline*.

12.4.1.4.3 County Roscommon

County Roscommon has no landscape designations other than scenic views and routes, which will be dealt with under Section 12.5 *Visual Baseline*.

12.4.2 Landscape Character of the Proposed Development Site

12.4.2.1 DoEHLG 'Wind Energy Development Guidelines' (2006)

These gnidelines offer guidance for the siting and design of wind energy developments in various landscape contexts by defining six landscape character types that represent most situations where wind turbines may be proposed. The guidance is intended to be indicative and general and notes that it, represents the 'best fit' solutions to likely situations.

The six landscape character types include Mountain Moorland and Transitional Marginal landscape character types. The guidelines note that where a wind energy development is located in one landscape character type but is visible from another, it will be necessary to decide which might more strongly influence the approach adopted for the assessment.

Despite the fact that the majority of the proposed development site is covered in commercial forestry, the original landcover will have been moorland. Furthermore, as the proposed development site is an upland area the 'mountain moorland' landscape character type applies.

Many areas in the study area can be described as 'hilly and flat farmland' and there are some areas of 'transitional marginal land' particularly on the lower slopes of Carrane Hill and Corry Mountain to the east. In certain areas the turbines will be viewed from these landscapes. It is considered however, that in terms of the siting and design, the 'mountain moorland' landscape type most strongly influences the siting and design of the proposed development. Further details of these landscape character types are provided below.

12.4.2.1.1 Mountain Moorland



Plate 12-1 View showing mountain moorland within the proposed development site

The key characteristics of the mountain moorland landscape type are:

- peaked, ridged or rolling mountains and upland with steep sides or gently formed valleys;
- generally unenclosed;
- landcover comprising blanket bog, a mottling of heather, wild grasses and some rush in wet flushes; and
- a landscape type of relative remoteness and often comprising pristine, unspoilt and remote landscapes.

Most of the landscape's characteristics are described by the text above. However, while there are characteristics of remoteness, it is not regarded as pristine as it comprises areas of coniferous plantation as well as numerous existing wind turbines.

Location

The DoEHLG guidelines state that it may be acceptable to locate wind energy developments on ridges and peaks and, in certain circumstances, on a saddle between two peaks. Another acceptable location is lower down on sweeping mountainsides.

Spatial Extent

Spatial extent is the area covered by a wind energy development within the view or landscape, reflecting the number of turbines involved and their spacing. The DoEHLG guidelines state that the spatial extent of a wind energy development should be balanced and in scale with its landscape context. With regards to areas of mountain moorland, larger wind energy developments can generally be accommodated because they correspond in terms of scale, given the typical extensive areas of continuous unenclosed ground.

Spacing

The guidelines state that all spacing options are usually acceptable within this landscape character type. Where a wind energy development is clearly visible on a crest or ridge, there is considerable scope to vary the rhythm, though on simple ridges, regular spacing maybe more appropriate. On sweeping and continuously even areas of mountain moorland or upland plateaux, regular spacing may be preferable.

Layout

All layout options are usually acceptable within a mountain moorland landscape character type. The DoEHLG guidelines state that the best solutions would either be a random layout, and clustered where located on hills and ridges, or a grid layout on sweeping and continuously even areas of moorland or plateaux.

Height

There is generally no height restriction on mountain moorlands as the scale of the landscape is so great. Shorter turbines may be more appropriate where they are located on small peaks and outcrops in order to maintain an appropriate scale. Profile, whether even or uneven, is dependent on topography: the more rugged and undulating, the more uneven it will be. The profile of the wind energy development should not necessarily run in parallel to that of the topography.

Cumulative Effect

With regards to cumulative effect, the DoEHLG guidelines state that the open expanse of such landscape types as mountain moorland can absorb a number of wind energy developments, depending on their proximity. The cumulative impact will also depend on the actual visual complexity of the landform, whether steeply rolling, undulating or gently sweeping. The more varied and undulating an area is topographically, the greater its ability to absorb and screen wind energy developments. The aesthetic effect of wind energy developments in these landscapes is acceptable where each one is discrete, standing in relative isolation.

The proposed development addresses the above guidance in terms of location (in a saddle between two peaks) spatial extent (moderate and well within keeping of the surrounding landscape scale) spacing (regular), layout (largely clustered) height (in keeping with the landscape scale) and cumulative effect (varied and undulating topography, with the exception of Garvagh Glebe all other existing and permitted wind farms are not in visual proximity with the proposed development).

12.4.2.2 Landscape Character of the Proposed Development Site

The landscape character of the proposed development site is based on site surveys undertaken in Winter 2018 and Spring and Summer of 2019.

12.4.2.2.1 *Topography*

Present-day landscapes owe their form to the geological materials from which they were carved. Topography is the term used to describe the spatial and formal arrangement of landscape components as a natural product of geological and geomorphologic processes in the past.

There are two local upland areas spreading in two long ridges from north-west to south-east, Carrane Hill that merges into Kilronan Mountain towards the south-east and parallel to this Corry Mountain. They are separated by the Arigna River Valley in the south-east that rises north-westwards and culminates in a saddle between these two uplands.

The centre of the proposed development site sits on this saddle and is visually obscured in a number of directions due to the two more elevated and elongated ridges. To the south-east the saddle follows the Arigna River that follows the most southern site boundary. East of the Arigna River the site slopes up steeply on the south-westerly slope of Corry Mountain to the highest point of 338 m O.D. (Ordnance Datum), which is just below the peak of one of the north-westeru foothills of Corry Mountain at just above 340 m OD. Corry Mountain itself is at a height of 428m O.D. and Carrane Hill is at a height of

458 m O.D. Turbine T9 will be the turbine located at the highest level at approximately 323 m O.D, while turbine T2 will be positioned at a ground level of approximately 240 m O.D.

The northern part of the site slopes down in a north-north-westerly direction from the central saddle to the lowest point in the most north-western point of the proposed development site of 186 m O.D.

In the wider landscape away from Carrane Hill and Corry Mountain the land to the north slopes down at first steeply finishing in an undulating plain that very gradually slopes down to Bonet River at aroumd 30 m O.D. in Dromahair Village. To the east the land on the eastern slopes of Corry Hill slopes down to Lough Allen, which is followed to the east by Slieve Anierin and Bencroy Mountains. To the south and west Carrane Hill slopes downwards steeply at first and then levels out around the Feorish River. South westerly of this land rises again before descending to Lough Arrow.

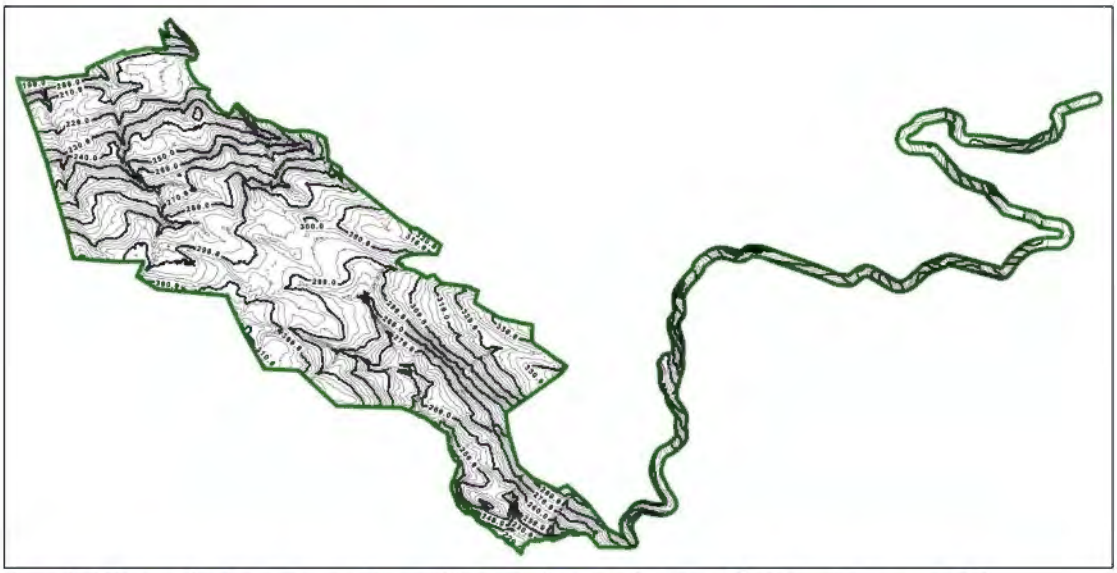


Figure 12-3 Topography: 10-metre contour lines within the site boundary (not to scale for illustrative purposes only)

12.4.2.2.2 Drainage

There are a number of watercourses traversing the site. There is a watershed in the centre of the site, hence in the northern part of the site the general direction of flow is north-westwards and south-eastwards in the south. The southern part of the site can be described as the upper catchment area of the Arigna River with many tributaries of the Arigna crossing this part of the site and the Arigna itself forming the southern site boundary. The Arigna River flows in a valley between Carrane Hill and Corry Mountain and discharges into the southern part of Lough Allen.

There is one small lake, Lough Nacroagh near the centre of site that along with other streams in the northern part of the site drains north-westwards as tributaries to the River Bonet, which discharges into Lough Gill.

12.4.2.2.3 Landcover

Figure 12-4 below shows an aerial view of the proposed development site and gives an overview of the different types of landcover present on site.



Figure 12-4 Aerial Image illustrating landcover (based on aerial imagery taken 2019, not to scale for illustrative purposes only)



Plate 12-2 View of firebreak corridor between two mature stands of coniferous trees

As can be seen in Figure 12-4, overall, the site is predominantly dedicated to commercial coniferous forestry. Sitka spruce and lodgepole pine are the dominant species. The coniferous plantation is dense with occasional access tracks or firebreaks, a typical view of this is shown in Plate 12-2 above. Alongside the forested areas are recently felled or replanted areas as can be seen in Plate 12-3 below.



Plate 12-3 Recently felled area of coniferous plantation

Although the site is relatively ubiquitously covered in conifers, there are some pockets of moorland particularly in the far west as seen in Plate 12-4 below. Figure 12-4 indicates that these areas have not recently been subject to peat cutting.



Plate 12-4 Area of extensive mountain moorland in the western part of the site

Plate 12-5 below shows Lough Nacroagh the only lake on site. The lough is surrounded by coniferous plantation forestry to the north and a wide strip of lake-side vegetation to the south.



Plate 12-5 View of Lough Nacroagh looking north-westwards across the lake

This landscape pattern is replicated in areas surrounding the site. Further afield on the lower slopes of the Carrane Hill and Corry mountain there is primarily agricultural grassland mixed with coniferous plantation and scattered dwellings.

12.4.2.2.4 *Land Use*

As described in Section 12.4.3.6 most of the site is currently used for commercial forestry, There are also some small pockets of open spaces interspersed throughout the forest plantation. The existing uses of the site would continue in conjunction with the proposed wind energy development. Land-use in the wider landscape comprises a mix of agriculture, low density residential development and commercial forestry as well as many existing wind farms.

12.4.3 Indications of Landscape Value

12.4.3.1 Landscape Value

To summarise the findings in the sections above and determine the landscape sensitivity, and ultimately the likely significance of the effects, assessments of landscape value for the proposed development site were assessed (Table 12-2). Landscape value includes designations such as scenic views and sensitivity designations found in development plans, as well as values which are attached to undesignated landscapes. A number of criteria were developed to assess the landscape values of the study area. These, combined with susceptibility, contribnte to the assessment of landscape sensitivity.

Table 12-2 Summary of landscape policy and elements to determine the landscape value and sensitivity of the site

Indicator	Description
Landscape Designations	No landscape designations apply to the proposed development site. Within the study area (20km around the site) there are five scenic views, four AONBs and seven HVAs designated in the Leitrim CDP as well as Sensitive Rural Landscapes and Visually Vulnerable Areas in Co. Sligo, further details can be found in Section 12.4.1 and on Figure 12-1 of this chapter.
Landscape Quality/Condition	This refers to the physical state of the landscape and the condition of individual elements. The undisturbed bog areas are in good condition, otherwise the landscape quality has been degraded visually due to commercial forestry activity.
Aesthetic Qualities	There are some attractive areas around the Lough Nacroagh and on the mountain moorland as well as some good long-distance views.
Wildness/naturalness	The landscape of the site is predominantly used for commercial forestry and as such has been largely modified by human activity, however the areas of mountain moorland are natural areas and have a sense of wildness.
Rarity/ Couservation Interests	There are no visual or landscape desiguatious located within the site. Desiguated areas are located within the wider area around the site. See Chapter 6 on Biodiversity, Flora and Fauna for a description of these sites.
Cultural Meaning/Associations	There are no evident cultural associations or monuments within the site itself, for more details see Chapter 13 Cultural Heritage.
Recreation Value	There is no formal amenity use of the proposed development site, however, onsite tracks may be used for walking. There are also numerous amenity

Indicator	Description
	routes within the study area as outlined in Section 12.5 below and shown in Figure 12-6 of this chapter and some of these may have visibility of the proposed turbines along parts of the routes.

12.4.4 Landscape Character of the Study Area

Landscape character refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how people perceive this. It reflects combinations of geology, landform, soils, vegetation, land use and human settlement, and creates the sense of place found in different areas.

While the appropriate radius for landscape effects on landscape character in the relevant guidelines varies, the 2013 Landscape Institute *Guidelines for Landscape and Visual Impact Assessment* state the study area for landscape effects should '*include the site itself and the full extent of the wider landscape around it which the proposed development may influence in a significant manner*'. As landscape character is primarily reflected by the elements within a certain area rather than those outside it and dne to the nature of landscape character areas covering large areas of land within Comties Leitrim, Sligo and Roscommon, all landscape character areas or parts of falling within 15 kilometres from the proposed wind turbines are included in this assessment.

The *Landscape Assessment of County Leitrim* (2002) and *Landscape Character Assessment of County Roscommon* (2014) have identified Landscape Character Areas (LCAs) and those falling within the LVIA study area will be described below. There is no published Landscape Character Assessment for County Sligo, instead a landscape characterisation and appraisal study was commissioned, which resulted in the County Sligo Landscape Characterisation Map. However, a full landscape character assessment has not been carried out and LCAs were not been identified in County Sligo by Sligo County Council. Therefore, for the purpose of this Landscape and Visual Impact Assessment and in order to have parity in the assessment of landscape character between the three counties, a provisional landscape character assessment for the LVIA study area was carried ont by MKO, which is presented Section 12.4.4.2below.

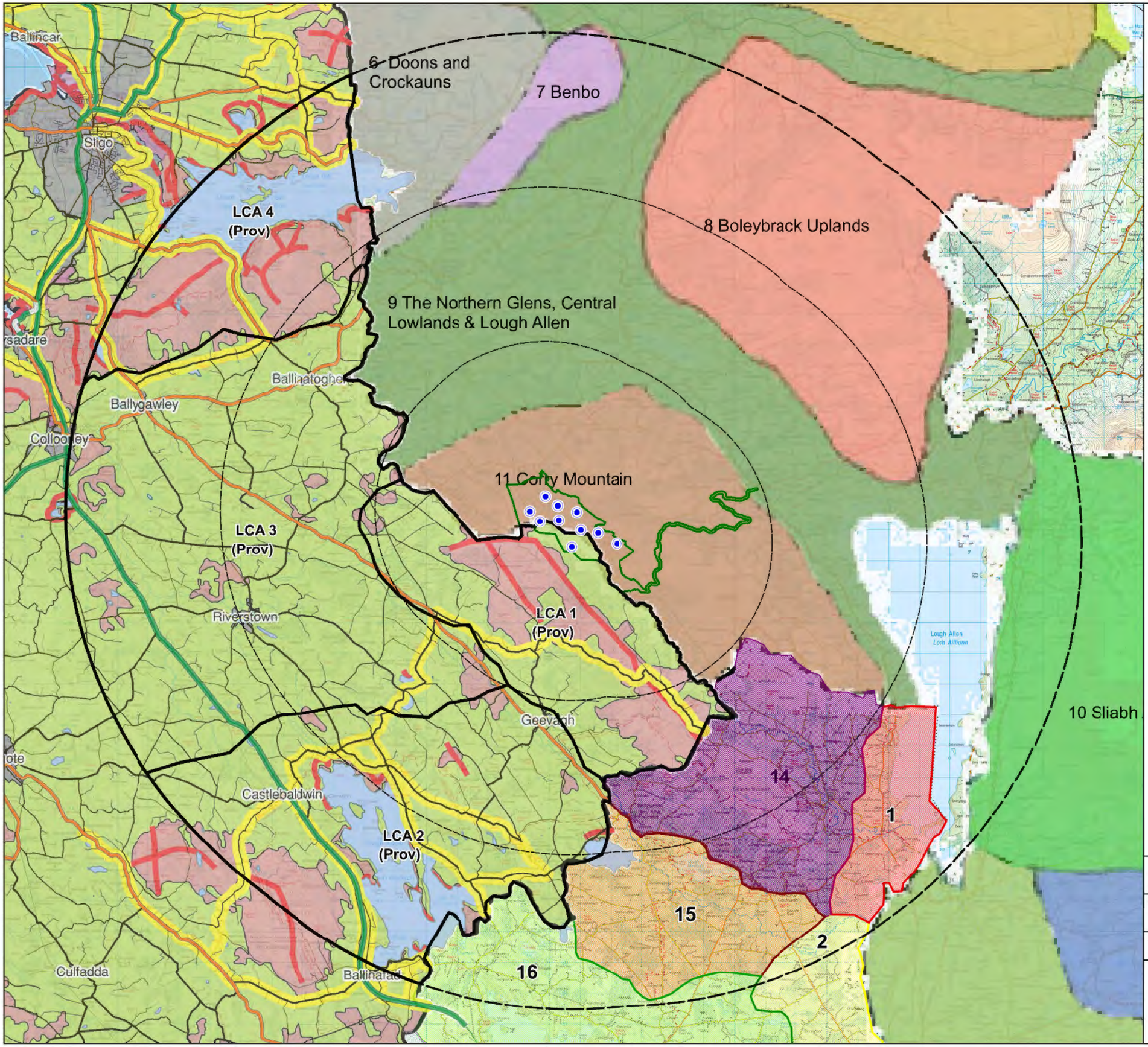
12.4.4.1 County Leitrim Landscape Character Areas

The *Landscape Assessment of County Leitrim* (LLCA) published in 2002 identifies 14 landscape character areas. Eight of the turbines are proposed to be located in *LCA11 Corry Mountain* and LCAs 6, 7, 8, 9 and 10 also fall within the study area. Key characteristics are outlined for each LCA as well as any information given on wind development provided in the LLCA.

12.4.4.1.1 *LCA 11 Corry Mountain*

Key Characteristics:

- Extensive, mountainous uplands bordering Lough Allen.
- Rough grazing on moorland hills and plateau.
- Extensive areas of coniferous forestry.
- Sparsely populated. Small houses associated with outbuildings are evident across many of the lower, gentler farmed slopes.
- Impressive views from higher ground.
- Moorland plateau retains sense of isolation despite access roads and infrastructure.
- Field boundaries create strong patterns on lower hill slopes but show signs of dereliction in places.
- Distinctive upland valleys sheltering small farming communities.
- Semi-natural woodlands on steeper slopes and around farms.



Map Legend

- EIAR Site Boundary
- Landscape Character Study Area
- Proposed Turbines

Drawing Title:	12-5 Landscape Character Areas
Project Title:	180511 - Croagh Wind Farm EIAR

Drawn By:	Checked By:	Scale:	Date:	Project No:	Drawing No.:
JM	EM	1:120,000	30/06/2020	180511	Figure 12-5

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Wind farms are listed as one of three *Key Issues for Corry Mountain* and one of the *Principles for Landscape Management* states that '*site new wind farms/ communication masts close to existing development on the plateau to minimise impact on more remote areas of upland*'. The proposed development is located in a contiguous way to the existing wind turbines on the ridge and is essentially the last potential wind farm site on the ridge.

12.4.4.1.2 LCA 6 Doons and Crockauns

Key Characteristics:

- Varied limestone geology has created distinctive landform features, mountain profiles and scree slopes.
- Contrasting land uses including extensive grazing, coniferous plantations and areas of both upland and lowland peat bog.
- Semi-natural woodlands fringing Lough Gill.
- Sparse settlement pattern of isolated farmhouses amongst areas of rush infested pasture.
- Scrub encroachment and coniferous plantations obscure distinctive landform features.
- Parkes Castle in an attractive lough side setting.
- Lough Gill and its shores noted for their nature conservation value.

12.4.4.1.3 LCA 7 Benboo

Key Characteristics:

- Ancient and hard metamorphic rocks shaped by glacial ice flows form rugged heather-clad hills and a distinctive mountain profile.
- Smooth upland slopes are covered with heath and natural grassland.
- Underlying bedrock is exposed where peaty soils are thinnest.
- Streams occupying shallow valleys drain the hillsides and flow off the lower slopes into rivers which encircle the hard rock outcrop.
- Gorges and streams shelter linear clusters of scrub and woodland.
- The lower slopes are fringed by marginal, rushy pastures largely enclosed by post and wire fences and coniferous plantations. Distinctive low stone walls are evident stretching up some hillsides forming long rectangular fields.
- Roads encircle the mountain along which are located small, isolated farm cottages, often occupying sheltered locations and are surrounded by small copses. There is no settlement on the mountain itself.
- Distinct lack of archaeological monuments.
- Panoramic views over the adjacent lowlands.

12.4.4.1.4 LCA 8 The Boleybrack Uplands

Key Characteristics:

- Extensive, mountainous uplands retain a sense of isolation.
- Rough grazing on moorland hills and plateau.
- Extensive areas of coniferous forestry.
- Sparsely populated. Small houses associated with outbuildings are evident across many of the lower, gentler farmed slopes.
- Impressive panoramic views from higher ground of surrounding mountains and lowlands.
- Field boundaries creating strong patterns on lower hill slopes showing signs of dereliction in places.
- Distinctive upland valley sheltering small farming communities.
- Semi-natural woodlands on steeper slopes above O'Donnell's Rock.

12.4.4.1.5 LCA 9 The Northern Glens, Central Lowlands & Lough Allen

Key Characteristics:

- Undulating, drumlin covered lowlands and glens confined by sharp break in slope and mountainous areas.
- Meandering rivers and loughs fed by streams from the surrounding hills, fringed by trees and extensive areas of wet pasture contrast with the surrounding patchwork of drumlin fields.
- Small blocks of deciduous woodland and some coniferous plantations.
- Linear settlements strung out along roads winding through the lowlands.
- Local geological and topographical conditions give each glen its own particular character.
- Major communication routes through the mountains. Major towns often sited where several routes meet.
- Sense of enclosure within the drumlin swarms with occasional long views to the surrounding uplands providing orientation.
- Castles are important local landmarks and an indication of the strategic importance of these landscapes in history.

12.4.4.1.6 LCA 10 Sliabh An Iarainn

Key Characteristics:

- Extensive, mountainous uplands bordering Lough Allen.
- Rough grazing on moorland hills and plateau.
- Extensive areas of coniferous forestry.
- Sparsely populated. Small houses associated with outbuildings are evident across many of the lower, gentler farmed slopes.
- Impressive views from higher ground.
- Moorland plateau retains sense of isolation despite access roads and infrastructure.
- Field boundaries creating strong patterns on lower hill slopes showing signs of dereliction in places.
- Distinctive upland valleys sheltering small farming communities.
- Semi-natural woodlands on steeper slopes and around farms.
- Concentration of sweathouses on some of the lower farmed slopes.

12.4.4.2 County Sligo Landscape Character Areas (provisionally prepared by MKO)

As stated above for the sake of parity in the assessment of landscape effects on landscape character in the study area, provisional landscape character areas were identified by a qualified landscape architect in the absence of a landscape character assessment for County Sligo.

12.4.4.2.1 LCA1 Carrane Hill

This LCA includes the upland area surrounding Carrane Hill and its south-western slopes. There are extensive mountain moorland areas covering the summit. While it is apparent that Carrane Hill Bog has been subject to turf-cutting there are large areas of undisturbed moorland. Commercial conifer plantation is spread throughout this LCA and fields occupy most of the lower slopes. There are no settlements and it is sparsely populated. There are a number of scenic routes in this LCA.

12.4.4.2.2 LCA2 Lough Arrow and Environs

The shores of Lough Arrow are mainly forested with a mixture of conifer and deciduous trees with generally well-maintained fields beyond. Away from the lough there are pockets of commercial forestry. Either side of Lough Arrow are elevated areas. To the south-west are the Bricklieve Mountains with panoramic views over Lough Arrow from Carrowkeel Megalithic Cemetery. Although the area is not highly populated there is some ribbon development

12.4.4.2.3 LCA3 Eastern Lowlands

Characterised by extensive farmland, the pattern of the landscape is shaped by the tree lines and hedgerows of the filed boundaries. Although, there is also some forestry plantation. This area is a gently undnlating drumlin landscape with many watercourses running through it iucluding the Unshin, Douglas and Owenmore Rivers

12.4.4.2.4 LCA4 Lough Gill and Environs

The banks of Lough Gill are densely forested with mainly broadleaf trees. On the northern shore the land undulates until Crockauns, Keelogyboy and Cope's Mountain. To the south the land rises steeply from the banks of Lough Gill to Killery Mountain, Slieve Dangan and Slieve Daene, where there are panoramic views over the lake. Apart from the lake shore and Lough Gill itself there are also recreation trails in Hazelwood Forest and Union Wood

12.4.4.3 County Roscommon Landscape Character Areas

The *Landscape Character Assessment of County Roscommon* (RLCA) published in 2008 identifies 36 landscape character areas. The closest Roscommon LCA is *LCA14: Arigna Mountains*, however, either all or parts of LCAs 1, 2 15 and 16 also fall within the study area and a description of the LCAs taken from the RLCA is provided below for each LCA.

The RCLA assigned the flowing landscape valnes to each of the LCAs:

- Exceptional Value
- Very High Value
- High Value
- Moderate Value

The values generally refer to the sensitivity of the LCAs to forces of change and development, whereby LCAs of exceptional value would be considered the most sensitive. Due to '*aesthetic and amenity qualities*' LCA 16 has been classified as of exceptional value. LCAs 1 and 2 along the Shannon System have been assigned very high value due to *'high aesthetic and ecological quality'* and the upland LCAs 14 and 15 also fall into this class as they '*provide important scenic amenities'*.

12.4.4.3.1 LCA 1 Lough Allen and Arigna Foothills

This LCA is a quiet, sparsely populated broad valley defined by high mountains overlooking a very large lake.

Value: Very High

12.4.4.3.2 LCA 2 Upper Shannon and Derreenannagh Drumlin Belt

The overall image of this LCA is one of a sparsely populated wooded drumlin landscape sloping down to the Upper Shannon.

Value: Very High

12.4.4.3.3 LCA 14 Arigna Mountains

Arigna Mountains LCA is set on a rugged mountain steeped in mining history and providing some of the best views in the county.

Value: Very High

12.4.4.3.4 LCA 15: Lough Meelagh Drumlins

Lough Meelagh Drumlins LCA is of a gently undulating forested drumlin lakeland.

Value: Very High

12.4.4.3.5 LCA 16 Lough Key and Boyle River Network

The overall image of this landscape is one of an extensive organically shaped lakeland fringed by broadleaf forest.

Value: Exceptional

12.4.5 Landscape Receptor Preliminary Assessment

After identifying the landscape receptors in the study area based on landscape designations derived from the respective CDPs and Landscape Character Areas (LCAs) taken from the Leitrim and Roscommon Character Assessments and compiled for Sligo by MKO, a preliminary assessment is carried out to screen out landscape receptors that will not be impacted by the proposed development.

Using the Zone of Theoretical Visibility mapping shown on Figure 12-6 the landscape receptors that will have no theoretical visibility are screened out as shown in Table 12-3 below.

*Table 12-3 Landscape Receptors Screened Out -**No visibility** indicated by ZTV map*

Landscape Receptor Category	County	Landscape Receptor with no visibility shown on ZTV
Landscape Designations	Leitrim	AONBs: A3 HVAs: B4, B6, B9, B11
Landscape Character Areas	Roscommon	LCA 2 and LCA 15

Following the pre-assessment exercise the landscape receptors shown in Table 12-4 have been selected for full assessment due to their significance with in the study area and the potential landscape effects they may experience due to the proposed wind energy development.

Map Legend

- Proposed Turbine
- EIAR Site Boundary
- Visual Baseline Study Area

Settlements

County Leitrim

- Tier 2A Centres
- Tier 2B Centres
- Tier 3 Centres
- Tier 4 Centres

County Sligo

- Gateway City
- Gateway Sattellites
- Key Support Towns
- Villages

County Roscommon

- Tier 2
- Tier 4

Scenic Routes and Views

County Leitrim

- Protected Views and Prospects

County Sligo

- Scenic Routes

County Roscommon

- Scenic Views
- Scenic Routes

OSi Viewing Points

- Viewing Point marked on OSi map

Routes & Destinations

Walking Routes

- Miners Way
- Sligo Way
- Leitrim Way
- Union Rock Trail / Oak Wood Trail
- Sliabh an Iarainn Loop
- Northern Glens Trail

Cycle Trails

- Northwest Cycle Trail
- Kingfisher Cycle Loop

Scenic Drives

- Wild Atlantic Way Discovery Point
- Wild Atlantic Way
- Lough Gill Scenic Drive
- Lough Allen Scenic Drive

Recreation Destinations

- Recreation Destinations

Transport Routes

Zone of Theoretical Visibility (ZTV)

- 1 to 3 turbines
- 4 to 6 turbines
- 7 to 8 turbines
- 9 to 10 turbines

Drawing Title: Figure 12-6 Half Blade ZTV & Visual Baseline

Project Title: 180511 - Croagh Wind Farm EIAR

Drawn By:	Checked By:	Scale:	Date:	Project No:	Drawing No.:
JM	EM	1:150,000	30/06/2020	180511	Figure 12-6

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Table 12-4 Landscape receptors screened in for full assessment

Landscape Receptor Category	County		Landscape Receptor
Landscape Designations	Leitrim	AONBs	A4
			A5
			A6
		HVAs	B3
			B7
			B8
Landscape of Proposed Development Site	Leitrim/Sligo		Landscape of Proposed Development Site
Landscape Character Areas	Leitrim		LCA 11 Corry Mountain
			LCA 6 Doons and Crockauns
			LCA 7 Benboo
			LCA 8 The Boleybrack Uplands
			LCA 9 The Northern Glens, Central Lowlands & Lough Allen
			LCA 10 Sliabh An Iarainn
	Sligo		LCA1 Carrane Hill
			LCA2 Lough Arrow and Environs
			LCA3 Eastern Lowlands
			LCA4 Lough Gill and Environs
	Roscommon		LCA 1 Lough Allen and Arigna Foothills
			LCA 14 Arigna Mountains

12.5 Visual Baseline

12.5.1 Visual Receptors

The main purpose of establishing the visual baseline is to identify the key visual receptors that should be considered for viewpoint selection. To this end the following have been identified:

- Designated Scenic Routes and Scenic Views
- Settlements and house clusters
- Recreational and Tourist Destinations
- Recreational Routes
  - Waymarked Walking Routes
  - Cycle Routes
  - Scenic Drives
  - Tourist Routes (e.g. Wild Atlantic Way)
- Viewing Points (e.g. marked on OS Maps)
- Transport Routes

These visual receptors are listed in tables in the following sections along with theoretical visibility at those locations indicated by the ZTV maps. All visual receptors are shown on Figure 12-6.

12.5.1.1 Designated Scenic Routes and Scenic Views

The designated scenic routes and views are listed separated by counties and were taken from the respective county development plans. There are no scenic routes or designations on or adjacent the site.

12.5.1.1.1 *County Leitrim*

Protected views and prospects within the study area designated in the Leitrim County Development Plan 2015-2021 are listed in

Table 12-5 below. The table lists the view number, the focus of the view stated in the CDP, whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by the ZTV map.

Table 12-5 Views and Prospects within 20 kilometres (Co. Leitrim)

Map Ref.	View	Theoretical visibility (ZTV)	Direction
Up to 5 km			
V19	View towards Bellhavel Lake from Local Road LT42461	No	No
V20	View from Gleaghnafarnagh from Local Road LT42533	Yes	No
5 to 10 km			
V18	View of Creevelea Abbey from the R288	Partial	Yes
V21	View towards Lough Allen from the R280	No	No
10 to 15 km			

Map Ref.	View	Theoretical visibility (ZTV)	Direction
V12	View of Fivemilebourne and Carrickanurroo	No	No
V13	View of Lough Gill from Carrickanurroo	No	No
V14	View of Lough Gill from R286	No	No
V15	View towards Carrigeencor Lake from Local Roads LS08162 and LS08164	Yes	Yes
V16	View of Benbo, Thur and Dough Mountains from R280	No	No
V17	View from O'Donnell's Rock	Yes	No
V22	View towards Lough Allen from the R200	No	No
	15 to 20 km		
V8	View towards Glencar Lake from Local Road LP04145	No	No
V10	View towards Benbo Mountain from Local Road LP02136	Partial	Yes

Overall, there is limited potential for any effects on Views and Prospects in Co Leitrim.

12.5.1.1.2 County Sligo

The scenic routes listed in Appendix E of Sligo County Development Plan 2017-2023 can be found in

Table 12-6 below and are shown on Figure 12-1 above and Figure 12-6 below. Extracted from the CDP are the view number, the stretch of road the view is located on and the focus of the view. Additionally, there are columns indicting whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by ZTV mapping. It is important to emphasise that there is only one scenic route within 5km of the site and this is on the opposite side of Carrane Hill to the Proposed Development.

Table 12-6 Scenic Routes within 20 kilometres (Co. Sligo)

No.	Location of View	Focus of View	ZTV	Direction
Up to 5 km				
66	L-1101 from north of Conways Cross extending along southside of Carran Hill to Roscommon County boundary	Views of Carran Hill	Partial	Yes
5 to 10 km				
56	Lakeshore drive around Lough Arrow from Castlebaldwin to	Views of Lough Arrow and Bricklieve Mountains	Partial	No

No.	Location of View	Focus of View	ZTV	Direction
	Roscommon County boundary (L-1404, L-1403 & L-1905)			
61	Heapstown Crossroads to Killadoon and Crossroads (L-1901) Bricklieve Mountains	Views of Lough Arrow	No	No
62	Ballindoon Crossroads to Killadoon Crossroads (L-1904)	Views of Lough Arrow and Bricklieve Mountains	No	No
63	Highwood road (L-1904) from Ballindoon Crossroads to junction with L-5902 & L-59021 north of Kilmactranny	Views of Lough Arrow, Bricklieve Mountains and Kesh Corran	No	No
65	Killadoon Crossroads to junction with L-1101 north of Conways Cross (L-1901)	Views of Lough Arrow, Lough Nasool and Lough Bo	Partial	No
10 to 15 km				
3	N4 Castlebaldwin to Ballinafad	Views of Bricklieve Mountains, Lough Arrow and Curlew Mountains	Partial	Partial
12	R284 from Carrowroe to junction with road L-3605 north of Ballygawley	Views of Ballygawley Lough, Slieve Dargan and Slieve Daeane	Partial	Partial
13	R286 from Sligo to Leitrim County boundary	Views of Lough Gill and Colgagh Lough	Yes	Yes
14	R287 from Carrowroe to junction with road L-3605 at Correagh	Views of Lough Gill, Slish Wood, Slieve Dargan, Slieve Daeane and Killery Mountain	No	Partial
23	R278 from Calry (Doonally road junction) to Leitriun County boundary at Carrickoneileen.	Views of Keelogyboy Mountain	Yes	No
37	From junction of L-3409 and R286 at Ballynamona, northwards through Loughanelteen to Keelogyboy (L-3409 & L-7418), then south to R278 via Fermoyle (L-7420 & L-3407)	Views of Keelogyboy Mountain, Cope's Mountain, Lough Anelteen, Killery Mountain, Lough Gill, Ox Mountains, Slieve Daeane, Slieve Dargan, Kings Mountain, Ben Bulben, Knocknarea, the coast, Sligo Bay and Atlantic Ocean	Yes	Yes
55	L-3605, south of Slieve Daeane and Slieve Dargan, between junctions with R284 and R287	Views of Slieve Dargan, Slieve Daeane and Lough Dargan	Yes	Partial

No.	Location of View	Focus of View	ZTV	Direction
57	Old N4 along western shore of Lough Arrow from Aghanagh through Ballinafad village to junction with new N4 south of Ballinafad	Views of Lough Arrow, Bricklieve Mountains and Curlew Mountains	Partial	Partial
60	From Castlebaldwin southwards to junction with R295, southwest of Templevanny Lough (L-1404 & L-5801)	Views of Bricklieve Mountains, Kesh Corran and Lough Arrow	Partial	No
64	L-18011 south of Lough Arrow and L-18012 through Lecarrow (Aghanagh ED) to junction with Curlew Bypass (N4)	Views of Lough Arrow, Bricklieve Mountains and Carran Hill (north-east of Lough Arrow)	Partial	Yes
71	L-1906 from junction with L-1905 to junction with L-5904, north of Kilmactranny	Views of Lough Arrow, Bricklieve Mountains and Keash Corran	No	No
15 to 20 km				
1	N15 from Bunduff Bridge (Leitrim County boundary) to Sligo	Views of Atlantic Ocean, Ben Bulben, Kings Mountain and Benwiskin	No	Partial
2	N16 from Leitrim County boundary to Sligo	Views of Glencar Lake, Ben Bulben and Atlantic Ocean	Partial	No
4	N4 Collooney By-Pass from northern roundabout at Collooney to Carrowroe	Views of Ballysadare Bay, Knocknarea, Union Wood, Slieve Daeane, Slieve Dargan	Partial	Partial
5	N4 Curlew By-Pass from Roscommon County boundary to Ballinafad	Views of Lough Arrow, Bricklieve Mountains and Curlew Mountains	Partial	Yes
6	N59 Beltra to Ballysadare	Views of Ballysadare Bay, Slieveward and Knocknarea	Yes	No
11	R291 from Sligo to Rosses Point	Views of Sligo Bay and Harbour, Coney Island, Knocknarea and Coolera Peninsula, Slieve Dargan, Slieve Daeane, Killery Mountain and Ox Mountains	No	Partial
20	R295 from Carrowmaclenany Crossroads to Carrowcrory Crossroads	Views of Kesh Corran and the Bricklieve Mountains	No	Partial
36	L-3602 along Garvoge River and Lough Gill from Sligo to junction with R287	Views of Garavoge River and Lough Gill	No	Partial

No.	Location of View	Focus of View	ZTV	Direction
38	L-7417 from junction with L-7418 north to junction with L-7416 at Glackbaun and along L-7416 from its eastern extremity near Leitrim County boundary to junction with N16 at Drumkilsellagh	Views of Cope's Mountain, Keelogyboy Mountain, Lough Gill, Slieve Dargan, Kings Mountain, Knocknarea, Ox Mountains, Sligo Bay and Alantic Ocean	Partial	Yes
43	L-6101 from junction with N59 at Corhawnagh Church extending westward to Streamstown and south to N59 via Lisduff	Views of Ballysadare Bay, Knocknarea and Slieveward (Little Ox Mountains)	Yes	Yes
44	L-6101 between junction with N59 at Corhawnagh Church and junction with R290 (old N4) south of Ballysadare	Views of Slieveward (Little Ox Mountains)	Yes	No
54	L-6102 from junction with N59 west of Cooney Lough, continuing on L-2101 to junction with L-2801 south of Tullaghan Hill	Views of Ox Mountains, Atlantic Ocean and Cooney Lough	Partial	Yes
58	Carrowcrory crossroads to Ballinafad (L-1806)	Views of Bricklieve Mountains, Curlew Mountains and Lough Arrow	Partial	Partial

12.5.1.1.3 County Roscommon

The designated scenic routes and views are listed in Appendix 1 of the Landscape Character Assessment of County Roscommon (RLCA). The RLCA distinguishes between proposed and existing scenic routes and views. Within the study area all the scenic routes are proposed new routes, while some of the views are existing with many new views proposed, as shown in Table 12-7 below, which also lists a description of scenic route as well as focus of scenic routes and views. Additionally, there are columns indicting whether the view is directed towards the proposed turbine and if there is theoretical visibility indicated by ZTV mapping. There are no scenic routes or views with the potential for significant effects as shown in Table 12-7.

Table 12-7 Scenic Routes and Views within 20 kilometres (Co. Roscommon

No.	Description and focus	ZTV	Direction
Scenic Routes			
R1 (Proposed)	Scenic route along R280 with views across Lough Allen and Slieve Anierin and views from R280 up to Kilronan Mountain and the Arigna Mines.	No	No
R2 (Proposed)	Elevated scenic route along third class road overlooking Lough Allen and Slieve Anierin.	Partial	No
R3 (Proposed)	Elevated scenic route along third class road overlooking Lough Key, it's islands and Lough Key Forest & Activity Park.	Partial	No

No.	Description and focus	ZTV	Direction
R4 (Proposed)	Scenic route along third class road overlooking Lough Key, it's islands and Lough Key Forest & Activity Park.	No	No
Views			
V1 (Existing View No 1 in CDP)	Elevated view of Lough Skean and rolling farmland and forestry to the south. Tranquil and sparsely populated.	No	No
V2 (Existing View No 2 in CDP)	Elevated panoramic view over Lough Allen and Slieve Anierin. Long distance views of rolling drumlins and farmland. Sheemore Hill and beyond in far distance.	No	No
V3 (Proposed)	View of Derrynasallagh Lough with naturally occurring birch woodland and heath. Long moorland ridge to north in distance.	No	Yes
V4 (Existing View No 3 in CDP)	Elevated, extended views over Lough Key Forest & Activity Park. Extensive natural woodland, inlets & islands. Castle on islands in distance. Highly sensitive landscape.	No	No
V5 (Proposed)	Elevated, extended views over Lough Key Forest & Activity Park. Extensive natural woodland, inlets & islands. Castle on islands in distance. Highly sensitive landscape.	Partial	No
V6 (Proposed)	View to south west over Lough Key Forest & Activity Park and islands. Intimate viewshed. Highly sensitive.	No	No

12.5.1.2 Settlements

In order to identify which settlements within the study area should be considered for viewpoint selection the settlement strategies and hierarchies set out in the core strategies of the CDPs of Leitrim, Sligo and Roscommon were consulted. The settlement hierarchies are presented by county below.

The hierarchy of towns, villages and other centres within Leitrim is shown in *Map 2.1 - Core Strategy* of Leitrim County Development Plan 2015 - 2021 as follows:

- Tier 1 - Principal Town
- Tier 2A - Key Towns
- Tier 2B – Centres/Support Towns
- Tier 3 Centres
- Tier 4 Centres

The settlement hierarchy for Sligo is listed in section 3.2 and shown in Fig. 3.*A County Sligo – Core Strategy Map* in Sligo County Development Plan 2017-2023 as follows:

- Gateway City
- Gateway Satellites
- Key Support Towns
- Villages sustaining rural communities

The settlement hierarchy listed below was taken from Section 2.3 of the Roscommon County Development Plan 2014-2020 and shown in Map 4 – *Roscommon Settlement Hierarchy*:

- Tier 1 – County Towns
- Tier 2 - Key Support Towns/Settlements
- Tier 3 – Tertiary Growth Centres
- Tier 4 -Serviced & Unserviced Villages and the Countryside

Table 12-8 below lists the settlements identified from the respective CDPs within the LVIA study area also noting their county status within the settlement strategy and whether there is theoretical visibility indicated by the ZTV.

Table 12-8 Significant Settlements within the Study Area

Settlement	County	Settlement Hierarchy	Theoretical Visibility (ZTV)
Up to 5 km			
Drumkeeran	Leitrim	Tier 3	Partial
5 to 10 km			
Ballintogher	Sligo	Village	Full
Ballyfarnon	Roscommon	Tier 4	No
Dromahair	Leitrim	Support Town - Tier 2B	Full
Geevagh	Sligo	Village	No
Killarga	Leitrim	Tier 4	Full
Riverstown	Sligo	Village	Partial
10 to 15 km			
Arigna	Roscommon	Tier 4	No
Ballinagleragh	Leitrim	Tier 4	Full
Ballygawley	Sligo	Village	Full
Castlebaldwin	Sligo	Village	No
Collooney	Sligo	Gateway Satellite	Full
Dowra	Leitrim/Cavan	Tier 4/Tier 6 Small Village	Partial
Keadue	Roscommon	Tier 4	No
15 to 20 km			
Ballinafad	Sligo	Village	Partial
Ballymote	Sligo	Key Support Town	No

Settlement	County	Settlement Hierarchy	Theoretical Visibility (ZTV)
Ballynacarrow (east)	Sligo	Village	No
Ballysadare	Sligo	Gateway Satellite	No
Boyle (east)	Roscommon	Tier 2	No
Cootehall	Roscommon	Tier 4	No
Drumshanbo	Leitrim	Support Town - Tier 2B	Partial
Lurganboy	Leitrim	Tier 4	No
Manorhamilton	Leitrim	Tier 2A	Partial
Sligo	Sligo	Gateway City	No

12.5.1.3 Recreational and Tourist Destinations

The most significant outdoor recreation and tourist destinations were identified after consulting the *Leitrim Recreation Strategy* 2014 and *A growth strategy for tourism in Leitrim* 2015-2021 as well as checking the most popular destinations in counties Leitrim, Sligo and Roscommon on Tripadvisor.ie. Those within the study area shown on Figure 12-6 and listed in Table 12-9 below, however, none are located within 5 kilometres of the proposed development

Table 12-9 Recreational and Tourist Destinations in the Study Area

Destination	Description	County	Theoretical Visibility
5 to 10 km			
Creevelea Abbey	Ruin of medieval Franciscan friary and National Monument	Leitrim	Full
10 to 15 km			
Arigna Mining Experience	Light- and sound-enhanced tours of an underground coal mine, plus a geology and history exhibition	Roscommon	No
Parke's Castle	Plantation era castle situated on the banks of Lough Gill	Leitrim	Partial
Corry Strand, Lough Allen	Recreation area and picnic ground on the shore of Lough Allen	Leitrim	Full
Carrowkeel Megalithic Cemetery	Neolithic era passage tomb cluster	Sligo	Full visibility in the west, none in the east
Killery and Lake Isle of Inishfree	Pier on Lough Gill and Island on Lough Gill described in a Yeats poem	Sligo	Full

Destination	Description	County	Theoretical Visibility
15 to 20 km			
Sligo Abbey	Ruined abbey in Sligo City	Sligo	No
Manorhamilton Castle	17th century plantation castle in Manorhamilton Town.	Leitrim	Partial
Tobernalt Holy Well	A historic religious site with holy statues.	Sligo	No
Carrowmore Megalithic Cemetery	Large group of megalithic monuments on the Cúil Irra peninsula	Sligo	No
Gaelic Chieftain Statue and Lough Key Viewing Point	Sculpture marking the site of the Battle of Curlew Pass, adjacent picnic area with views over Lough Key	Roscommon	Partial

12.5.1.4 Recreational Routes

Waymarked walking routes, cycle routes, scenic drives and tourist routes (e.g. the Wild Atlantic Way) were identified within the study area. None fall within 5km of the proposed development site. The routes are shown on Figure 12-6 and are listed in Table 12-10 below along with theoretical visibility shown on ZTV mapping for the routes.

Table 12-10 Recreational Routes in the Study Area

Route Name	Description	County	Theoretical Visibility (ZTV)
5 to 10 km			
Miners Way	Waymarked Walking Route	Leitrim/Sligo/ Roscommon	Four main stretches of partial visibility otherwise the proposed turbines will not be seen from this trail
Sligo Way	Waymarked Walking Route	Sligo	Full visibility along the majority of the route, with stretches of no visibility along Lough Gill
Northwest Cycle Trail	Cycle Trail	Leitrim/Sligo	A stretch of partial visibility starting on the R287 south of Kilerry Mountain to Manorhamilton otherwise no visibility
10 to 15 km			
Leitrim Way	Waymarked Walking Route	Leitrim	Mainly partial or full visibility with a long stretch of no visibility along the southern part of Lough Allen and north of Dowra

Route Name	Description	County	Theoretical Visibility (ZTV)
Lough Gill Drive	Scenic Drive	Sligo/Leitrim	Full visibility in the north and partial to none in the south
Lough Allen Drive	Scenic Drive	Leitrim/ Roscommon	Mainly full with a long stretch of no visibility along the southern part of Lough Allen
Kingfisher Cycle Loop	Cycle Trail	Leitrim/ Roscommon	Mainly partial to full visibility with a long stretch of no visibility along the southern part of Lough Allen and south of Drumshanbo
15 to 20 km			
Wild Atlantic Way	Tourist Scenic Drive	Sligo	No theoretical visibility except for 1.4 km west of Ballysadare
Union Rock Trail/Oak Wood Trail	Coillte walking trails	Sligo	Full visibility on approx. half the trails
Shannon Blueway	On-water and land-based trails for paddling, walking and cycling.	Roscommon	Only partial visibility in the most northern 2 km
Sliabh an Iarainn Loop	Unmarked walking trail	Leitrim	No visibility except for above 350m OD on western slopes of Slieve Anierin
Northern Glens Trail	Scenic Drive	Leitrim/Sligo	No visibility except for a short section south-west of Manorhamilton and a stretch south and west of Dough Mountain

12.5.1.5 Viewing Points (OSI)

Within the study area there are seven viewing points marked on the OSI map none of which are within 10 km of the proposed development. All are in the vicinity of Lough Gill, six in County Sligo and one in County Leitrim. Although the viewing points are not named or numbered on the OSI map numbers and names have been assigned in Table 12-11 below and these numbers are also shown in Figure 12-6. Table 12-11 below also notes the county the view is located in, whether there is theoretical visibility indicate in the ZTV map and if the view is in the direction of the turbines.

Table 12-11 Viewing points marked on OSI map in the study area

Location	County	ZTV	Direction
10 to 15 km			
1. North Lough Gill	Sligo	Yes	Yes
2. East Lough Gill	Leitrim	Yes	No
3. Traware Bay, Lough Gill	Sligo	Yes	No
15 to 20 km			
4. Garvoge River	Sligo	No	No
5. Colgagh Lough	Sligo	No	No
6. Green Road, Sligo	Sligo	No	Yes
7. Tobernalt Bay	Sligo	No	Yes

12.5.1.6 Transport Routes

For the purpose of viewpoint selection national primary and secondary roads were assessed in detail. Preference was given to viewpoint selection on regional routes in cases where they passed through settlement areas or coincided with scenic routes to increase the number of visual receptors. There are no national primary and secondary routes within 10km of the proposed development. Transport routes within 5 kilometres of the site were assessed as part of the route screening analysis and visibility from these routes is discussed separately in Section 12.7.3.3.3.

Table 12-12 Significant Transport Routes within the Study Area

Transport Route	Theoretical Visibility
10 to 15 km	
N4	No theoretical visibility between Sligo and north of Collooney, then mainly full theoretical visibility until Lough Meenaghan, then partial theoretical visibility until study area boundary
15 to 20 km	
N15	No visibility
N16	No theoretical visibility except two short sectious one NW of Sligo and another around Manorhamilton
N17	Theoretical visibility for approx. 4 kilometres approaching Collooney
N59	Short stretch of full theoretical visibility just west of Ballysadare

12.5.2 Visual Receptor Preliminary Assessment

After identifying the visual receptors in the study area based on designated scenic routes and scenic views, settlements, recreational and tourist destinations, recreational routes, OSI viewing points and transport routes a preliminary assessment will be carried out to screen out visual receptors that will not be impacted by the proposed development.

Using the Zone of Theoretical Visibility mapping shown on Figure 12-6 the visual receptors that will have no theoretical visibility are screened out as shown in Table 12-13 below.

*Table 12-13 Visual Receptors Screened Out -**No visibility** indicated by ZTV map*

Visual Receptor Category	County	Visual Receptor with no visibility shown on ZTV
Designated Scenic Routes and Scenic Views	Leitrim	V8, V12, V13, V14, V16, V19, V21, V22
	Sligo	1, 11, 14, 20, 36, 61, 62, 63, 71
	Roscommon	R1, R4, V1, V2, V3, V4, V6
Settlements	Leitrim	Lurganboy
	Sligo	Ballymote, Ballynacarrow (east), Ballysadare, Castlebaldwin, Geevagh, Sligo
	Roscommon	Arigna, Ballyfarnon, Boyle (east), Cootehall, Keadue,
Recreational and Tourist Destinations	Sligo	Sligo Abbey
		Tobernalt Holy Well
		Carrowmore Megalithic Cemetery
	Roscommon	Arigna Mining Experience
OSi Viewing Points	Sligo	Garvoge River
		Colgagh Lough
		Green Road, Sligo
		Tobernalt Bay
Transport Routes	Sligo	N15

Directions have been indicated for viewpoints shown on OSI maps and designated scenic views and scenic routes by either written text or on accompanying maps in the respective CDPs. Therefore, the viewing points, protected views and scenic routes within the study area, listed in Table 12-14, that are not directed towards the proposed turbines have been screened out from further assessment.

Table 12-14 Designated Scenic Views, Scenic Routes and Viewing Points Screened Out - Direction of View

Visual Receptor Category	County	Views, Scenic Routes and Viewing Points Screened Out
Designated Scenic Routes and Scenic Views	Leitrim	V17, V20
	Sligo	2, 6, 23, 44, 56, 60, 65
	Roscommon	R2, R3, V5
OSi Viewing Points	Sligo	East Lough Gill
		Traware Bay (Lough Gill)

For the remaining visual receptors visibility was assessed on site assisted by the TrueViewVisuals software, which is an iPad-based tool to help visualisation of a project live on the ground before it is built. In the case of the visual receptors shown in Table 12-15, below, views towards the turbines were either entirely screened or substantially screened. This along with in some cases distance to the proposed development site precluded these locations being selected as viewpoints.

Table 12-15 Visual Receptors Screened Out -no visibility found on site

Visual Receptor Category	County	Visual Receptor with no significant visibility found on site
Designated Scenic Routes and Scenic Views	Leitrim	V10, V18
	Sligo	4, 5, 12,13, 37, 38, 43, 54, 55, 57, 58, 64
Settlements	Leitrim	Dowra
	Sligo	Ballinafad, Ballintogher, Ballygawley, Riverstown,
Recreational and Tourist Destinations	Leitrim	Manorhamilton Castle
		Creevelea Abbey
		Killery and Lake Isle of Inishfree
	Roscommon	Gaelic Chieftain Statue and Lough Key Viewing Point
Recreational Routes	Sligo	Wild Atlantic Way, Union Rock Trail/Oak Wood Trail
	Leitrim	Sliabh an Iarainn Loop
	Roscommon	Shannon Blueway
Transport Routes	Sligo/Leitrim	N16, N17 and N59

Following the pre-assessment exercise the visual receptors shown in

Table 12-16 have been selected as viewpoints due to their significance within the study area and the potential visual effects they may experience due to the proposed wind energy development.

Table 12-16 Visual receptors screened in and selected as viewpoints

Visual Receptor Category	Description	Viewpoint
Designated Scenic Routes and Scenic Views	Co. Leitrim Scenic View V15	8
	Co. Sligo Scenic Route 3	2
	Co. Sligo Scenic Route 66	15
Settlements	Ballinagleragh	13
	Dromahair	7
	Drumkeeran	11
	Drumshanbo	14
	Killarga	10
	Manorhamilton	9
	Collooney	4
Recreational and Tourist Destinations	Parkes Castle	6
	Corry Strand	12
	Carrowkeel Megalithic Cemetery	1
Recreational Routes	Lough Gill Drive	5
	Miners Way	1, 11, 14 & 15
	Leitrim Way	9, 13 & 14
	Kingfisher Cycle Trail	13 & 14
	Northern Glens Trail	9
	Sligo Way	7
	North West Cycle Trail	7 & 9
	Lough Allen Drive	11, 13 & 14
OSi Viewing Points	North Lough Gill	5
Transport Routes	N4	2 & 3

Furthermore, two viewpoints within 2 kilometres (Viewpoints 16 and 17) were also included to assess the visual effects closer to the proposed development.

12.6 Cumulative Baseline

In terms of cumulative landscape and visual effects only other wind energy projects have been considered, as only these would be described as very tall vertical elements in the landscape and therefore give rise to significant cumulative effects. Other wind energy developments, within 20km of the proposed development, were identified by searching past planning applications lodged through the various Planning Authorities (Leitrim County Council, Sligo County Council, Roscommon County Council and An Bord Pleanála) online planning portals. The information identified in the initial planning search was then used to verify, by means of a desk-based study and ground-truthing, whether the permitted wind energy developments had been constructed. The list of existing and permitted wind turbines present within the study area are listed in Table 12-17 listed below:

Table 12-17 Existing and Permitted Wind Farms within 20 kilometres

Wind Farm	Status	No of Turbines
Co. Leitrim		
Garvagh Glebe	Existing	13
Black Banks	Existing	12
Corrie Mountain	Existing	8
Monaneenatieve	Existing	5
Spion Kop*	Existing	2
Tullynamoyle	Existing	15
Tullynamoyle Extension	Proposed	4
Carrickheeney	Existing	4
Co. Sligo		
Carrane Hill	Existing	4
Geevagh	Existing	6
Derrysallagh	Under Construction	12
Co. Roscommon		
Altagowlan	Existing	9
Garvagh Tullyhaw	Existing	11
Seltannaveeny	Existing	2
Kilronan	Existing	10

**Permission has been granted for removal of these two turbines and repowering the site with a single turbine.*

The proposed Croagh turbines will be assessed alongside the above turbines to separately determine the cumulative landscape and visual effects.

12.7 Likely or Significant Landscape and Visual Effects

12.7.1 'Do-Nothing' Scenario'

In the Do-Nothing scenario, the proposed development would not take place. The opportunity to harvest the wind resource at the site would be lost. The existing land uses of forestry (including felling and replanting operations) and small areas of turbary would continue at the site. Therefore, there would be no landscape or visual effects in the 'do-nothing' scenario.

12.7.2 Construction Phase Effects

It is estimated that the construction phase of the proposed development will last between approximately 12-18 months. This stage of the development will involve the construction of temporary construction compounds and the construction of site roads, meteorological mast, electricity substation and onsite grid connection as well as the movement of construction and turbine transport vehicles into and out of the site, to allow the construction of the turbines and associated elements.

12.7.2.1 Landscape Effects

During the 12 to 18 months the landscape effects will be only experienced near the construction areas associated with the ancillary project elements within the proposed development site. It will only be towards the end of the construction phase when the turbines are erected that there will be landscape effects experienced in the 20-kilometre study area. Therefore, it is considered that overall, these will be Short-term, Imperceptible, Negative effect landscape effects on the whole study area.

12.7.2.2 Visual Effects

For the same reasons outlined in landscape effects, during the construction phase, the ancillary project elements will give rise to a Short-term Slight, Negative visual effect.

For more details on the visual effects of the ancillary project elements see 'Ancillary Project Elements' in Section 12.7.3 Operational Phase Effects

12.7.3 Operational Phase Effects

12.7.3.1 Landscape Effects

12.7.3.1.1 *Landscape Designations*

While the designated scenic routes and views will be dealt with under visual effects the other landscape designations within the study area are Areas of Outstanding Natural Beauty (AONBs) and High Visual Amenity (HVAs) designated in Leitrim CDP. Of those put forward for full assessment after the Landscape Receptor Preliminary Assessment above the following will experience theoretical visibility:

Table 12-18 ANOBs and HVAs within 20 kilometres (Co. Leitrim)

Map Ref.	Area
Areas of Outstanding Natural Beauty (AONBs)	
A4	Patchy theoretical visibility throughout this AONB

Map Ref.	Area
Areas of Outstanding Natural Beauty (AONBs)	
A5	Theoretical visibility in the southern part of this AONB
A6	Theoretical visibility in the south-western part of this AONB
High Visual Amenity Areas (HVAs)	
B3	Theoretical visibility for the northern half of this HVA is indicated by the half blade ZTV map*
B7	Mainly full visibility in the most western third of the HVA
B8	Extensive theoretical visibility in the centre and northern part of this HVA

12.7.3.1.2 Landscape Character of the Proposed Development Site

The proposed development site is currently predominantly used for commercial forestry.

While the majority of the tree cover will remain, there will be some areas of clear-felling at the turbine bases and to accommodate other ancillary project elements.

The introduction of vertical structures in the proposed development site, although wind turbines are already present in the surrounding landscape, will result in the landscape character of the proposed development site undergoing a local change in character from its present condition. There will also be a minor localised change around the ancillary project infrastructure.

12.7.3.1.3 Landscape Character Areas

An assessment of the effects on landscape character was undertaken for the twelve LCAs within the study area that were identified as having significant theoretical visibility in the Landscape Receptor Preliminary Assessment above and listed in Table 12-4 of the same section. The individual assessments for each LCA are presented in Appendix 12.2 and summarised in Table 12-19 below.

Table 12-19 Landscape character assessment summary

Landscape Character Area (LCA)	County	LCA Sensitivity to Wind Farm Development	Magnitude of Change	Significance of Landscape Character Effect
LCA 11 Corry Mountain	Leitrim	High	Moderate	Significant
LCA 6 Doons and Crockauns	Leitrim	Moderate	Slight	Slight
LCA 7 Benboo	Leitrim	High	Slight	Moderate
LCA 8 The Boleybrack Uplands	Leitrim	High	Slight	Moderate
LCA 9 The Northern Glens, Central	Leitrim	Moderate	Slight	Slight

Landscape Character Area (LCA)	County	LCA Sensitivity to Wind Farm Development	Magnitude of Change	Significance of Landscape Character Effect
Lowlands & Lough Allen				
LCA 10 Sliabh An Iarainn	Leitrim	Moderate	Slight	Slight
LCA1 Carrane Hill	Sligo	High	Slight	Moderate
LCA2 Lough Arrow and Environs	Sligo	Moderate	Slight	Slight
LCA3 Eastern Lowlands	Sligo	Low	Moderate	Not Significant
LCA4 Lough Gill and Environs	Sligo	High	Slight	Moderate
LCA 1 Lough Allen and Arigna Foothills	Roscommon	Moderate	Slight	Slight
LCA 14 Arigna Mountains	Roscommon	Moderate	Slight	Slight
LCA 16 - Lough Key and Boyle River Network	Roscommon	Very High	Negligible	Moderate

Only Leitrim's *LCA 11 Corry Mountain* and the provisional LCA for Sligo *LCA1 Carrane Hill*, in which the proposed turbines are located, would experience direct effects on landscape character as a result of the proposed development. All other LCAs will experience indirect landscape effects, as the proposed development might be visible from a distance within these LCAs, but not located within them.

The greatest landscape effects ("Significant") will be experienced in Co. Leitrim's *LCA 11 Corry Mountain*, where the majority of the turbines will be located. However, extensive tree cover will greatly contribute to screening the proposed turbines from a large part of this LCA, thus mitigating the landscape effects.

Moderate landscape effects are predicted to occur in Co. Leitrim's *LCAs 7* and *8*, Co. Sligo's *LCAs 1* and *4* as well as Co. Roscommon's LCA 16. The magnitude of change in these LCAs was only Slight to Negligible, due to the ZTV mapping showing mainly partial visibility coupled with significant roadside vegetation screening the proposed turbines in the most areas. However, as the landscape sensitivity to wind energy is coupled with the magnitude of change to arrive at the landscape effect, the High or Very High sensitivity ratings of these landscape characters increased the landscape effects.

Furthermore, the residual visual effects from the viewpoints located in these LCAs were considered 'Not Significant' or 'Slight'.

12.7.3.2 Cumulative Landscape Effects

After identifying the cumulative baseline and cumulative status for each LCA it was assessed whether the additional proposed turbines would change the status of the individual LCAs. Although, it was found that the proposed turbines would add to the cumulative landscape status, it would not change the character of any of the individual LCAs in terms of wind energy and therefore the cumulative landscape effects are considered Low.

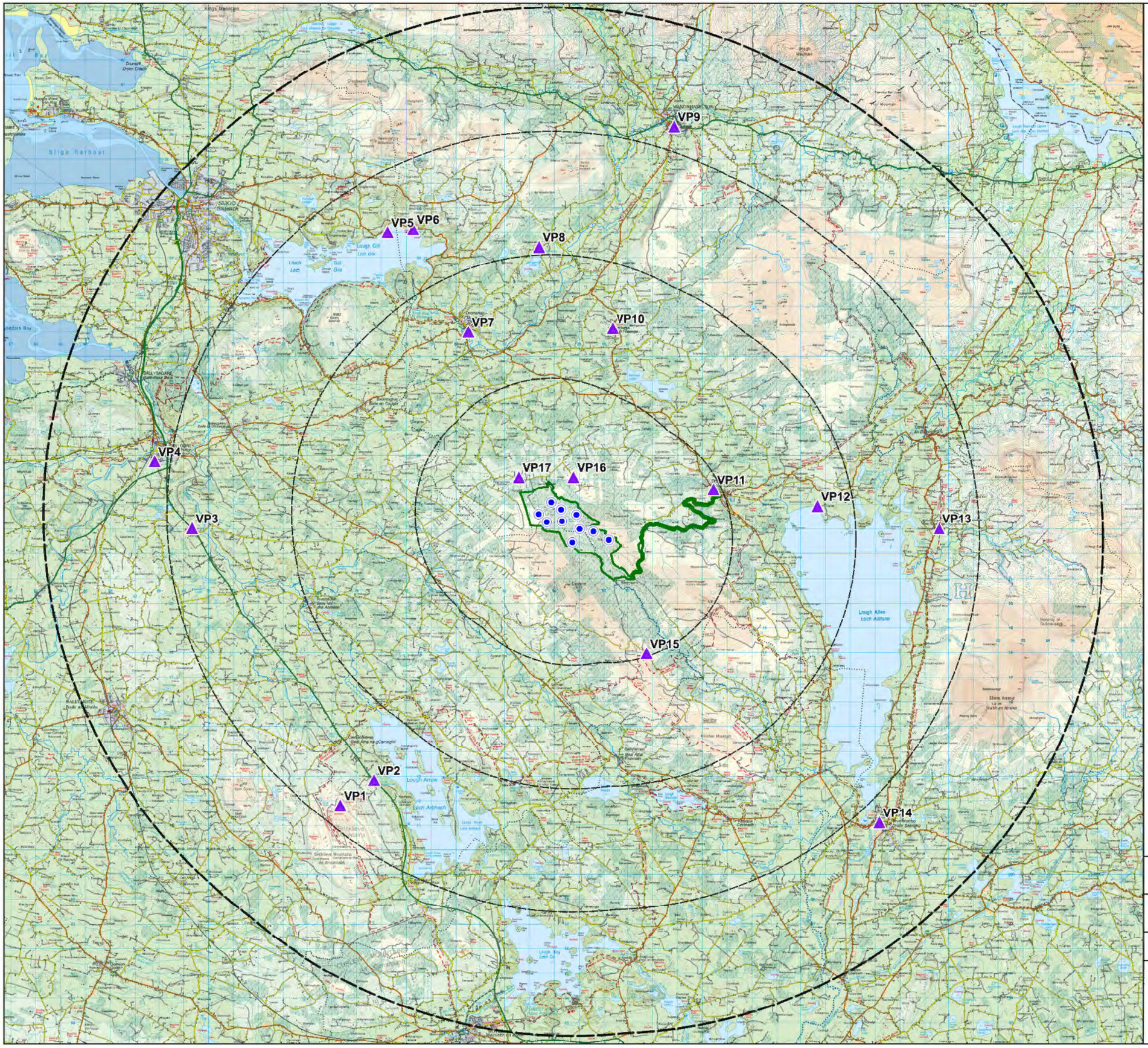
When viewed from the majority of selected viewpoints, the proposed development does not or only slightly extends the vertical or horizontal spatial extent of wind farms in the landscape, due to it being framed by other existing or permitted wind farm developments on both sides. There are no cumulative effects at two viewpoints. At four viewpoints the spatial extent of wind turbines in the view will not increase and at nine viewpoints there will be a slight increase in the spatial extent. At Viewpoints 17 (Killarga) and 21 (townland of Beagh) the spatial extent will increase moderately and significantly, respectively. Hence overall the cumulative landscape effects are not significant.

12.7.3.3 Visual Effects

12.7.3.3.1 *Summary of Viewpoint Assessment*

An assessment of the visual effects of the proposed turbines was undertaken from the 17 viewpoint locations identified in Section 12.5.2 above nsing the assessment methodology described in Appendix 12.1. The locations of these viewpoints are shown in Figure 12-7, below. The individual assessments from the 17 viewpoints are presented in Appendix 12.3 and summarised in Table 12-20 below. Appendix 12.3 and Table 12-20 should be read in conjunction with the photomontage booklet forming Volume 2 of the EIAR.

The visual effect of the proposed wind turbines was assessed from each viewpoint in terms of the sensitivity of the visual receptors, along with the magnitude of change, as recommended in the GLVIA (2013) guidelines. This, in conjunction with a detailed review of the photomontages themselves and the ZTV maps, informed the visual effects assessment.



Map Legend

- EIAR Site Boundary
- LVIA Study Area
- Proposed Turbines
- Viewpoint Location

Drawing Title: **Figure 12-7 Viewpoint Locations**

Project Title: **180511 - Croagh Wind Farm EIAR**

Drawn By:	Checked By:	Scale:	Date:	Project No:	Drawing No.:
JM	EM	1:150,000	30/06/2020	180511	Figure 12-7

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Table 12-20 Viewpoint assessment summary

VP No	Description	Grid Ref.	Approx. distance & direction to nearest turbine	Visual Sensitivity of Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effect
1	View from the summit of Bricklieve Mountain in Carrowkeel Megalithic Cemetery, situated in the townland of Carrowkeel.	E 175,337 N 311,744	14.58 km SW	**High**	**Slight**	**Not Significant**
2	View from the N4 road directly east of Lough Arrow in the townland of Castlebaldwin.	E 176,687 N 312,850	12.28 km SE	**Low**	**Negligible**	**Imperceptible**
3	View from the N4 national road in the townland of Doorly.	E 169,257 N 323,083	14.19 km E	**Low**	**Slight**	**Imperceptible**
4	View from Radharc Na gCaisléan housing estate in the south of Collooney Town in the townland of Rathrippon.	E 167,949 N 325,527	16.26 km W	**Medium**	**Slight**	**Not Significant**
5	View from car park off R286 on Lough Gill Drive marked as a Viewing Point on OS map in the townland of Corwillick.	E 177,241 N 335,006	12.8 km NW	**High**	**Slight**	**Not Significant**
6	View from Parke's Castle between the R286 regional road and Lough Gill. This location is within the townland of Kilmore.	E 178,285 N 335,075	12.89 km NW	**High**	**Slight**	**Not Significant**
7	View from the townland of Dromahair taken on the R288.	E 180,495 N 331,092	8.25 km NW	**Medium**	**Slight**	**Slight**
8	View from a local road in the townland of Carrigeencor, to the north of Carrigeencor Lough. County Leitrim designated view V15.	E 183,367 N 334,416	10.66 km N	**High**	**Slight**	**Not Significant**
9	View from McDermott Terrace housing estate in Manorhamilton Town in the townland of Manorhamilton.	E 188,867 N 339,320	16.03 km NW	**High**	**Slight**	**Not Significant**

VP No	Description	Grid Ref.	Approx. distance & direction to nearest turbine	Visual Sensitivity of Receptor(s) (at viewpoint)	Magnitude of Change	Residual Significance of Visual Effect
10	View from the R280 opposite the villages Catholic Church in the townland of Killarga, County Leitrim.	E 186,354 N 331,126	7.56 km NE	**High**	**Slight**	**Slight**
11	View from the townland of Drumkeeran, taken on the R280 road.	E 190,530 N 324,520	4.52 km NE	**Medium**	**Slight**	**Not Significant**
12	View from Corry Strand on the shore of Lough Allen. This location is situated within the townland of Cavan.	E 194,675 N 323,911	8.77 km E	**High**	**Slight**	**Not Significant**
13	View from a local road opposite a residential development off the R207 road in the townland of Drumreilly.	E 199,891 N 323,043	14.94 km E	**Medium**	**Slight**	**Not Significant**
14	View from the R208 regional road in north of the town of Drumshanbo in the townland of Carriknabrack.	E 197,347 N 311,167	16.05 km SE	**Low**	**Negligible**	**Imperceptible**
15	View from local road designated as Scenic Route No. 66 in Sligo CDP in the townland of Ballynashee.	E 187,753 N 317,957	5.0 km SSE	**Medium**	**Slight**	**Slight**
16	View from a local road in the townland of Beagh.	E 184,766 N 325,113	1.37 km NW	**Medium**	**Moderate**	**Moderate**
17	View from a local road in the townland of Tullynascreen.	E 182,162 N 325,179	1.9 km NW	**Low**	**Moderate**	**Slight**

The assessment of visual effects determined the residual significance of the visual effects to range from 'imperceptible' to 'moderate', with the number of findings at each level of significance listed in Table 12-21.

Table 12-21 Summary of Viewpoint Impact Assessment Results

Significance of Residual Visual Effect	Description	No. of Viewpoints
Profound	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the enviroument	0
Very significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment	0
Significant	An effect, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment	0
Moderate	An effect that alters the character of the environment in a manner consistent with existing and emerging baseline trends	1
Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities	4
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.	9
Imperceptible	An effect capable of measurement but without significant consequences	3

The significance of the residual visual effect was not considered to be "Profound", "Very Significant" or "Significant" at any of the 17 viewpoint locations. A residnal visual effect of "Moderate" was deemed to arise at one of the 17 viewpoint locations. All other viewpoints were assessed as resulting in Slight (3), Not Significant (9) or Imperceptible (4) residual visual effects.

The viewpoint assessment results will be discussed in more detail in the following sections.

12.7.3.3.2 Visual Effects in the overall study area

The ZTV map and the site visits shows that visibility is iinpeded by various significant upland areas as illustrated in Figure 12-8 below. Nearest to the site, the extended ridge of Carrane Hill will screen the proposed turbines from substantial areas to the south and partially to the south-sonth-west. The Bricklieve Mountains to the west of Lough Arrow offers further screening to the south-west. Corry Mountain and related peaks iinpede visibility to the east and south east as the proposed development is at a lower elevation than these areas.

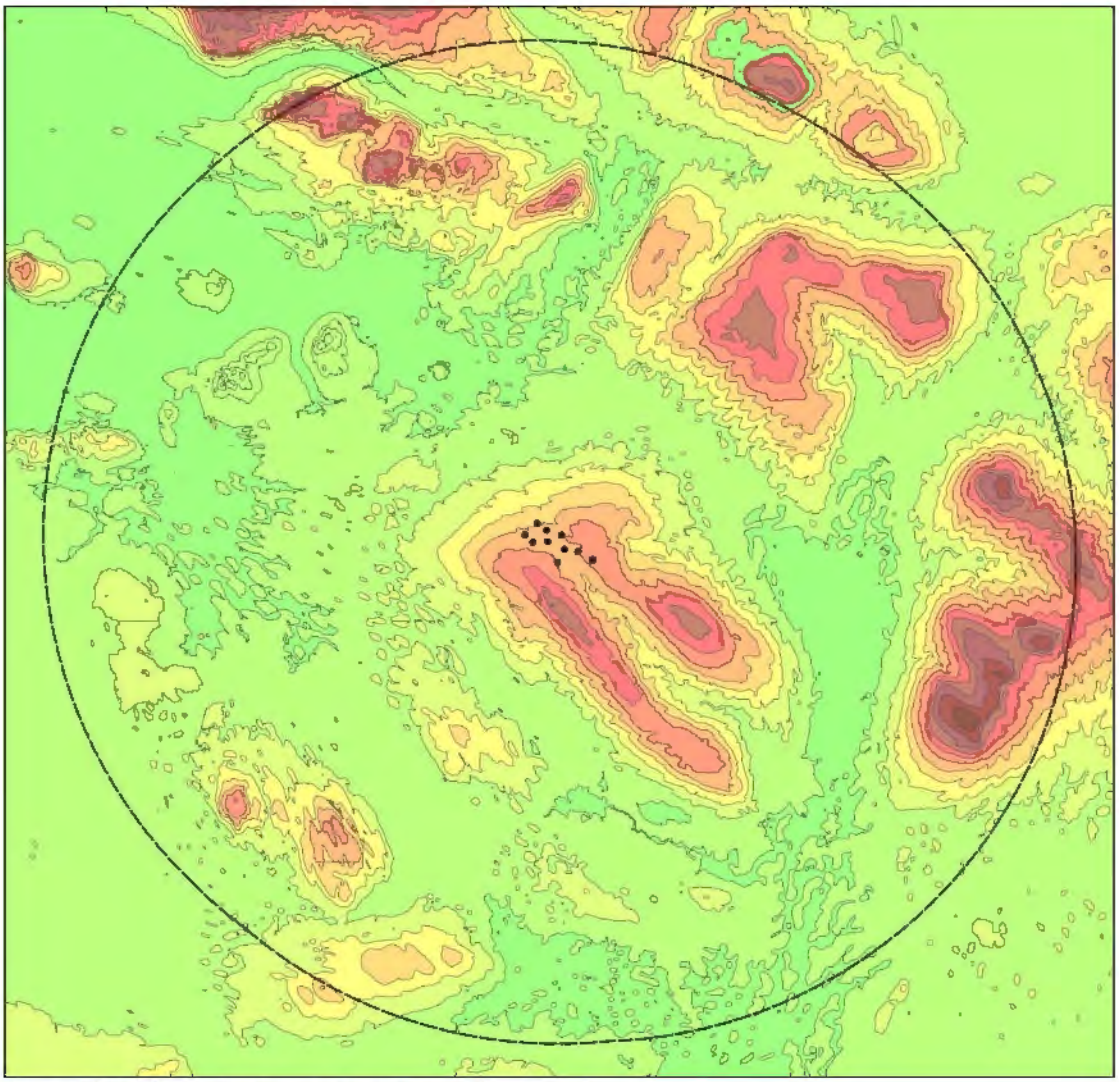

Figure 12-8 Significant upland areas in the study area (50m contours)

Westwards of the site the undulating drumlin landscape creates regular pockets of no visibility. In addition, an extended elevated area approx. 17 km west of the proposed development screens Ballymote and a large area to the north. The range of mountains of Killerry Mountain, Slieve Daeane, Slieve Dargan and finishing at Slieveward screen all of Sligo City and nearly all of the area to the south until Ballysadare as well as the majority of Lough Gill.

Within five to ten kilometres of the site, there are extensive pockets on no visibility created by the undulating landscape. While the upland area stretching eastwards from above Lough Gill including Cope's Mountain, Crockauns, Keelogyboy Mountain, Leean Mountain, Benbo, Larkfield and Boleybrack screen Glencar Lough and the long valley to the east and west as well as a low land area to the east of Manorhamilton.

Eastwards Corry Mountain and its extended ridge provide partial screening around Drumkeeran and extensive screening towards the south-east including the south of Lough Allen.

12.7.3.3.3 Visual effects within five kilometres of the site

In general, the site is on the lower slopes of a saddle between the Carrane Hill ridgeline and the Corry Mountain ridgeline. Both ridgelines remove the potential for any visibility from a large area on the south-westeru slope of Carrane Hill and areas to the west and north-west of Drumkeeran. They are also at significantly higher elevations to the proposed development turbines and so where visibility occurs it

is often partial or intermittent, which is one of the reasons why this site and scale of project was brought forward to seek consent.

ZTV Map

The ZTV map shows that all the area south and west of Carrane Hill summit will have no visibility. North-west of the summit there will be partial visibility. There is also an area with no or very limited visibility on the north-eastern slopes of Corry Mountain stretching into parts of Drumkeeran. Any areas exhibiting theoretical visibility were selected for Route Screening Analysis which will be discussed in the section below.

Route Screening Analysis

Route screening tries to achieve a clearer picture of the actual visibility of the proposed development as opposed to the theoretical ZTV mapping by taking into account the effect that screening such as buildings, hedgerows, trees, small rises in topography etc. In order to comprehensively demonstrate the varying characteristics of the roads and to record the actual visibility in comparison to the theoretical visibility, a methodology was developed termed Route Screening Analysis, and this was undertaken from all roads within a five-kilometre radius of the proposed turbines. The full methodology is outlined in Appendix 12.1 and the categories recorded were as follows:

- Little/no screening – mainly open and with some very light vegetation
- Intermittent/Partial Screening – light deciduous roadside vegetation and vegetation with short gaps which would allow intermittent or partial views
- Dense Screening – vegetation which is dense enough to block views (e.g. coniferous forestry)

Plate 12-6 to 12.9 below show the typical screening that represents the above categories respectively.



Plate 12-6 Example of Route Screening category – little/no screening



Plate 12-7 Example of Route Screening category – intermittent/partial screening



Plate 12-8 Example of Route Screening category – dense screening

Figure 12-9 outlines the route screening survey area within a five-kilometre radius of the proposed development site. This figure indicates that many of the roads within 5 kilometres of the site have intermittent/partial and dense screening, and therefore these roads which fall within the ZTV will have more screening and therefore reduced views, rather than the full visibility that the ZTV suggests. By comparison, relatively few areas have extensive stretches of little or no screening. The presence of roadside screening is particularly important in contexts such as the proposed development site, where the site is at a slightly higher elevation to the surrounding roads, and the presence of screening, particularly higher levels of screening that includes rows of trees and similar vegetation, will contribute to reducing views of the proposed turbines. It should be noted that proposed turbines T2-T10 are within an area of forestry and that there are sections of forestry located in different areas within the site,

Map Legend

- EIAR Site Boundary
- 5km Buffer of Core Site Boundar
- Proposed Wind Turbine Layout
- Little/No Screening
- Intermittent Screening
- Dense Screening
- Little No Screening (Combined Both Sides)
- Intermitten Screening (Combined Both Sides)
- Dense Screening (Combined Both Sides)

MAP TITLE: **Route Screening Assessment**		MAP NO.: **Figure 12.9**	SCALE: **1:50,000**
PROJECT TITLE: **180511 Croagh Wind Farm**			DATE: **06-11-2019**
DRAWING BY: **Stephen Corrigan**	CHECKED BY: **Joanna Mole**		ISSUE NO.: **180511-2019.11.06-F**

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which will also lend to screening of the turbines. This plays an important role in reducing visual effects as turbines bases and towers can be screened, or partly screened.

There are a few roads which occur within 1 kilometre of the proposed development. Most of these are local roads that pass the site to the north and south, specifically the local road running east to west 200m north of the site boundary through the townland of Garvagh Glebe. Within one kilometre of the turbines the roadside vegetation screening types lean towards a mix of 'intermittent/partial screening' and 'dense screening' but change regularly with stretches of "little/no screening". No particular screening type dominates.

Within 1-3 kilometres of the site, intermittent/partial screening becomes the dominant category, with areas of dense screening and sparse sections of little/no screening. Between 1 and 3 kilometres from the site, the route screening includes roads in the townlands of Tullynascreen and Kilavoggy to the north and two unnamed roads which run south away from the site towards Arigna. All roads have a majority of intermittent/partial screening, with some areas with dense and little/no screening.

Between 3 and 5 kilometres, the pattern of screening changes, with the dominant category being intermittent/partial screening with long stretches of dense screening to the east of the site. Within this area is the village of Drumkeeran. The roads entering and leaving the village of Drumkeeran, noted above as the R280 and R200, mainly represent intermittent/partial and dense screening, with the centre of the village also having a section of dense screening. The intermittent and dense screening effects are illustrated by Plate 12-6 to 12-9, which illustrate clearly the effect of screening by vegetation and buildings in Drumkeeran village and along the R280.

Viewpoints (within 5km of the site)

Viewpoint selection within 5km was made difficult by the restricted visibility indicated by the ZTV map and extensive screening illustrated by the Route Screening Analysis. While the forestry plantation is subject to cyclical felling, each section of forestry is at a different level of maturity. Hence, if one area is felled adjacent mature or semi-mature areas of trees will provide continuing screening meaning that is views towards the turbines are opened up, they will be localised over narrow areas. Despite this, two locations were found, Viewpoints 16 and 17, both within 2 kilometres of the proposed turbines. Residual visual effects were found to be *Slight* at Viewpoint 17 due to extensive vegetative screening and low visual receptor sensitivity. Viewpoint 16 was assigned a *"Moderate"* residual visual effect, due to the anticipated visibility of a significant proportion of the proposed turbines, in conjunction with other wind turbines. Mitigating factors are that the turbines are located the other side of a ridgeline which obscures much of the turbines. The ridgeline combined with the forestry plantation means that the turbines do not dominate the view. The spatial alignment of the turbines also reads as a coherent element of the landscape which has avoided any clustering effects. The adjacent Garvagh Glebe turbines are also visible in the Viewpoint 16 and both projects together read coherently in the view. The Garvagh Glebe turbines are situated at a higher ground level to the proposed Croagh wind turbines, meaning that the turbine tips are at comparable levels, ameliorating potential visual effects associated with the Croagh turbines being of a larger scale to the Garvagh Glebe turbines. In this view the Garvagh Glebe turbines do not appear excessively smaller but may be interpreted by some as more distant turbines within the same wind development Furthermore, the turbine design of the existing and proposed turbines is similar. The viewpoints are also at remote locations on roads with either no through-traffic or very low traffic volumes. Wind turbines are already a recognisable element of this landscape and therefore the proposed development is not introducing a new landscape element, either in terms of visibility or land use.

Ancillary Project Elements

For the purposes of this LVIA, a number of individual elements of the proposed development, ancillary to the proposed wind turbines, have been grouped together for the assessment of effects, given the similar nature of the works required. The proposed turbine hardstand areas, meteorological mast,

construction site compounds, electricity substation compound (and ancillary elements thereto) and borrow pit will all require the felling of forestry and its replacement with hard surface areas, giving rise to potentially similar landscape and visual effects.

The keyhole felling to be used to clear the areas for these ancillary elements, will leave adjacent forestry to screen the elements from view from the wider area. However, ancillary project elements will be visible in the immediate surroundings, hence, any visual effects will be localised and predominantly confined to within the proposed development site.

Visnal effects arising from the proposed ancillary project elements will be slight, localised and long-term where seen, but will remain largely unseen from within and outside the site.

Road Construction, Turbine Hardstands and Visitor Car Park
Every use will be made of the existing roads on site used for the extensive on-site forestry operations. Some localised vegetation clearance will occur as a result of the widening of 11.1 kilometres of existing and in the construction of 7.5 kilometres new roadway as part of the proposed development, which will also involve tree felling. Furthermore, a visitor car park will be constructed I the north-eastern corner of the proposed development site. The existing forestry will entirely screen the car park. Details of the required works are contained in Chapter 4. The visual impact of the road construction and turbine hardstands will be localised and not seen from outside the site due to the setting in forestry. The visual effect of the road widening and construction is considered long-term where areas will not be replanted to the edge of the road, localised, but only slight in significance. The effect is partially counteracted by the intention to utilise the on-site roads as walking trails as part of an amenity and resnlt in a long term, neutral to positive impact.

Meteorological Mast
The proposed meteorological mast will be a slender structure 100 metres in height, and in itself will not be an imposing structure in terms of visual impact, and it will also be viewed largely as surrounded by coniferons plantation. The landscape impact will primarily constitute clearance around the base of the mast. The visual effect of the proposed anemometry mast is considered to be long term but Not Significant, in that it will be significantly less visible than any turbine given its slender lattice form and will fade from view at a distance of anything more than a few kilometres.

Electricity Substation
The proposed electricity substation is to be located in the north-eastern part of the proposed development site in an area of forestry. The adjacent forestry will screen the substation from the wider area. Hence, the landscape and visual impact of the proposed electricity substation will be localised, long-term and imperceptible in significance.

Borrow Pits, Peat Repository Areas and Temporary Construction Compound
There are two proposed temporary construction compounds, one in the north between turbines Nos. 2 and 4 and the other in the centre of the site near turbine No. 7. Both are in forested areas and therefore will not be visible beyond their immediate surroundings.

The two proposed peat repository areas will also be located in forested areas and therefore will not be visible beyond their immediate surroundings.

There is one borrow pit proposed between turbines Nos. 9 and 10 as part of the development. There will be no visibility of the borrow pit beyond its immediate surroundings.

Post-construction, the temporary construction compound and borrow pits will be reinstated to previous contours using previously excavated material. The temporary construction compound will be seeded and the borrow pit areas and peat repository will be allowed to naturally revegetate.

Therefore, these three project elements will have localised, long-term and imperceptible landscape and visual impact.

12.7.3.3.4 Visual effects on specific visual receptors

Designated Scenic Routes and Scenic Views

The vast majority of scenic routes and views designated in Counties Leitrim, Sligo and Roscommon will be unaffected by the proposed development.

Although the area around the proposed development was not the focus of any of the 13 protected views and prospects designated in County Leitrim within the study area, three views were generally directed towards the site. Of these three views, V10, V15 and V18, potential visibility could only be established for V15 and hence this was selected as Viewpoint 8. Visual receptor sensitivity was judged to be high due to the designation and some adjacent residential housing and the magnitude of change slight. The residual visual effect was mitigated by screening, intervening distance, the small number of residential visual receptors and the limited spatial extent of the proposed development as well as the designated view being focused on the lake in the foreground.

There were two scenic routes, Scenic Routes Nos. 3 and 66, designated in Sligo CDP, where the focus of the view was towards the proposed development site and where the ZTV indicated sufficient theoretical visibility. These were selected as Viewpoints 2 and 15, respectively. Viewpoint 15 is located on a minor road with no nearby houses and resulting from this coupled with substantial screening and the focus of the designated view being away from the proposed turbines the residual visual effect was considered 'Slight'.

Designated Scenic Route No. 3 is along an approx. 9-kilometre section of the N4. The ZTV shows partial visibility for the whole stretch. On the ground, roadside screening and local topography made it very difficult to establish visibility of the proposed development. Viewpoint 2 was the only location where there was more than a glimpse between roadside vegetation towards the proposed turbines and after taking mitigating factors such as direction of travel versus direction of view, speed of traffic, no adjacent residences, screening and spatial extend due to distance into account the residual visual effect was deemed 'Imperceptible'

The ZTV mapping showed that of the four scenic routes and six scenic views designated in County Roscommon 9 will have no visibility of the proposed turbines and the focus of the single scenic view with theoretical visibility was directed away from the proposed development. Therefore, all scenic routes and views in County Roscommon could be screened out in the *Visual Receptor Preliminary Assessment* as they will not be affected by the proposed development.

Settlements

Again, it was shown on the ZTV mapping and by site visits using TrueView that the majority of settlements will not have visibility of the development.

In the settlements where even pockets of visibility were established, viewpoints were selected. These were:

- Ballinagleragh — Viewpoint 13
- Collooney — Viewpoint 8
- Dromahair — Viewpoint 7
- Drumkeeran — Viewpoint 2
- Drumshanbo — Viewpoint 14
- Killarga — Viewpoint 10
- Manorhamilton — Viewpoint 9

Visibility from each of these settlements was difficult to establish on the ground due to screening by buildings and trees. Finding locations with any views towards the proposed turbines in Dromahair

Manorhamilton and Drumshanbo in particular took extensive investigation during the site visits. Generally only views conld be found in the outskirts of these towns and villages closest to the proposed development or on significantly higher ground, meaning that these viewpoints represent the 'worst case scenario'. Hence, the visual impact on these settlements overall will be very minor. Furthermore, once mitigating factors, such as the view being over a short section of road or the primary views of residential visual receptors being in a different direction, are taken into consideration, the residual visual effects from these viewpoints ranged from 'Imperceptible' to 'Slight'.

Recreational and Tourist Destinations

The three amenity destinations that will have visibility of the proposed turbines are listed below:

- Parkes Castle Viewpoint 6
- Corry Strand Viewpoint 12
- Carrowkeel Megalithic Cemetery Viewpoint 1

The residual visual effect in each case was deemed 'Not Significant' due to mitigation factors such as significant intervening distance, significant screening by landform and vegetation, no residential visual receptors and limited spatial extent of the proposed wind farm within the views. Furthermore, the views will not be the primary focus and visual receptors will be seasonal and limited by weather conditions to a greater or lesser extent at these three locations.

Recreational Routes and Viewing Points

Recreation routes and viewing points that will have visibility of the proposed turbines and for which viewpoints were selected are listed in Table 12-22 below.

Table 12-22 Summary of Residual Visual Effects for Recreation Routes and OSi Viewing Points

Recreation Route or Viewing Point	Viewpoint Nos.	Residual Significance of Visual Effect
Lough Gill Drive and OSi Viewing Point	5	Not Significant
Miners Way	11	Not Significant
	15*	Slight
	14	Imperceptible
	1*	Not Significant
Leitrim Way	9	Not Significant
	13	Not Significant
	14	Imperceptible
Kingfisher Cycle Trail	13	Not Significant
	14	Imperceptible
Northern Glens Trail	9	Not Significant
Sligo Way	7*	Slight

Recreation Route or Viewing Point	Viewpoint Nos.	Residual Significance of Visual Effect
North West Cycle Trail	9	Not Significant
	7	Slight

**While the viewpoint is not directly on the recreation route it is in close proximity to it.*

The individual viewpoints and their respective mitigation factors have been discussed in the preceding sections. However, it can be seen in Table 12-22 above that the greatest residual effect on recreational routes is "Slight", which applies to viewpoints on the Miners Way, Sligo Way and North West Cycle Trail. However, in the case of the Miners Way and North West Cycle Trail residual visual effects were less at other viewpoints.

Hence, overall the 'Not significant' is the most common residual effect that applies to those sections of recreation routes that have greatest visibility of the proposed turbines.

Transport Routes

National primary and secondary routes were assessed in detail. Regional routes were assessed when they fell within settlement areas or coincided with scenic routes and preference was given to viewpoint selection on regional routes in these cases to increase the number of visual receptors.

Of the national routes the ZTV showed no visibility for the N15, while in the case of the N16, N17 and N59 very little theoretical visibility, significant roadside screening or intervening distances of greater than 15 kilometres made it apparent that visual effects on these roads will be insignificant.

For the closest national road, the N4, the ZTV map shows that many sections will have no visibility. Of the stretches with theoretical visibility the majority will experience no visibility due to roadside screening. Two viewpoints, 2 and 3, were selected at two areas where a view of the proposed turbines could be ascertained. Viewpoint 2, which is along a stretch designated as Scenic Route No. 3 in the Sligo CDP has been discussed in Section '*Designated Scenic Routes and Scenic Views*' above. The location of Viewpoint 3 is further north on the N4, just to the south of Collooney. Here the residual effect was deemed 'Imperceptible' after taking mitigation factors such as screening of the proposed turbines, the small number of nearby houses, road users travelling at high speeds broadly perpendicular to the view, intervening distance and very limited spatial extent of the proposed development into consideration.

12.7.3.4 Cumulative Visual Effects

As outlined in the methodology in Appendix 12.1 the cumulative visual effects assessed were increase of the spatial extent of turbines in the view, visual separation from other wind farms and visual disparity caused by other turbines of a different scale and design being seen alongside the proposed turbines. Cumulative visual effects were assessed as part of the Visual Assessment Tables found in Appendix 12.3. Here, an assessment was made whether there was visual separation between existing turbines and the proposed turbines as well as if the difference in scale of existing turbines contrasted adversely to that of the proposed turbines. These two factors were then applied to a matrix to arrive at the cumulative visual effects shown in Table 12-23 below.

Table 12-23 Summary of Cumulative Visual Effects

VP No	Other Turbines Visible	Increase in Spatial Extent	Visual Separation	Difference in Scale
1	Moderate	Slight	Medium	Moderate
2	Slight	Slight	Medium	Moderate
3	Slight	Slight	Medium	Moderate
4	Moderate	Negligible	Medium	Moderate
5	Slight	Slight	Medium	Moderate
6	Slight	Slight	Medium	Moderate
7	Slight	Slight	Medium	Moderate
8	Slight	Slight	Medium	Moderate
9	Negligible	Negligible	N/A	N/A
10	Slight	Moderate	Slight	Moderate
11	Slight/ Moderate	Negligible	Slight	Slight
12	Substantial	Negligible	Slight	Slight
13	Substantial	Negligible	Slight	Slight
14	Moderate/Substantial	Slight	Complete	Negligible
15	Moderate/Substantial	Slight	Medium	Slight
16	Slight/Moderate	Significant	Slight	Slight
17	Negligible	Negligible	N/A	N/A

As can be seen in Table 12-23 in two viewpoints cumulative effects did not arise. The spatial extent was predominantly 'Slight' to 'Moderate' with one viewpoint (16) exhibiting a significant increase in spatial extent of turbines in the view.

While complete visual separation of the proposed turbines from the permitted turbines is achieved in Viewpoint 14, mostly 'Slight' to 'Moderate' separation was seen, but at no viewpoint was there the worst category of 'Negligible' separation.

The assessment of the perceived difference of scale was also predominantly 'Slight' to 'Moderate' with one viewpoint showing a 'Negligible' difference in scale. At no viewpoint was the difference in scale perceived as 'Substantial'. Furthermore, when compared to the nearest existing turbines, the proposed development is at a lower level, thus there is no great difference in terms of tip height between the existing and proposed turbines when seen alongside each other.

A comparative ZTV (Figure 12-10 below) shows that the cumulative visibility over that of the existing and permitted turbines will only increase in a small number of tiny pockets due to the addition of the proposed Croagh turbines. Currently 80.7 % of the study area has theoretical visibility of permitted or existing turbines. The proposed turbines will theoretically be visible in 0.3% of the study area where at present no existing or permitted wind turbines are seen. Therefore, it is considered that the proposed turbines will not have a significant impact on the extent of cumulative visibility of wind turbines over the existing visibility.

Furthermore, the landscape character of the study area is of a large scale which contains open, expansive views, and these assist in allowing the landscape to accommodate a large number of turbines. Considering the sizable amount of wind farm development that has already occurred, the proposed Croagh development will add a limited numbers of additional turbines.

Therefore, the cumulative visual effects are considered acceptable, in terms of increase in spatial extent, visual separation and difference in scale.

12.7.4 Decommissioning Phase Effects

The landscape and visual effects during decommissioning are anticipated to be the same as during the construction phase.

12.8 Conclusion

The site has been well designed, and the design process has been informed by input from the landscape architect.

12.8.1 Landscape Effects

The proposed wind energy development site is located in an area with a long history of wind energy development. Wind turbines have been a feature of this landscape for many decades. Therefore, while the proposed turbines add to the existing wind turbines, they do not introduce an alien landscape element.

There will be no landscape effects on designations in County Roscommon.

The vast majority of scenic routes in Co. Sligo will not be affected by the proposed development. The two routes that will have some visibility of the proposed development, No's. 3 and 66, will experience an 'Imperceptible' and 'Slight' visual effect, respectively.

In County Leitrim the Areas of Outstanding Natural Beauty and High Visual Amenity Areas have theoretical visibility indicated in some areas, but distance and screening mean that the effects will be very minor.

In terms of landscape character only Leitrim's *LCA 11 Corry Mountain* and the provisional LCA for Sligo *LCA1 Carrane Hill*, in which the proposed turbines are located, would experience direct effects on landscape character as a result of the proposed development. Any other effects on other LCAs would be moderate, indirect and a slight increase in visible turbines additional to the existing and permitted turbines, as the proposed development might be visible within the LCAs but located outside those other LCAs and thus be a landscape element seen in the distance.

Map Legend

EIAR Site Boundary

LVIA Study Area

Proposed Turbines

Croagh

Existing Turbines

Atlagowlan

Black Banks

Caranne Hill

Carrickheeney

Corrie Mountain

Garvagh Glebe

Garvagh Tullyhaw

Geevagh

Kilronan

Monaneenatieve

Spion Kop

Seltannaveeny

Tullynamoyle

Derrysallagh

Permitted Turbines

Tullynamoyle Extension

Zone of Theoretical Visibility (ZTV)

Theoretical Visibility of all Existing and Permitted Turbines

Additional theoretical Visibility for the Proposed Croagh Turbines

Drawing Title: Figure 12-10 Comparative ZTV

Project Title: 180511 - Croagh Wind Farm EIAR

Drawn By:	Checked By:	Scale:	Date:	Project No:	Drawing No.:
JM	EM	1:150,000	30/06/2020	180511	Figure 12-10

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12.8.2 Cumulative Landscape Effects

Although, it was found that the proposed turbines would add to the cumulative landscape status, it would not change the character of the individual LCAs in terms of wind energy and therefore the cumulative landscape effects are considered Low.

12.8.3 Visual Effects

Due to the topography of the study area and in particular the upland areas around the site, the turbines will be screened by landform from many areas within the study area as illustrated by ZTV mapping. Additionally, wide-spread mature hedgerow and trees will provide additional screening. The forestry plantation trees while subject to cyclical felling are only felled in limited areas, leaving adjacent mature or semi-mature trees to provide continued screening.

Key visual receptors, such as scenic routes and views, settlements, recreational destinations and routes as well as major transport routes were identified within the study area, after which those where visibility could be excluded due to ZTV mapping or site surveys were screened out. For the remaining visual receptors, viewpoints were selected for which photomontages were prepared to assess the visual effects on the visual receptors. The visual assessment concluded that residual visual effects of "Moderate" was deemed to arise at one of the 17 viewpoint locations. All other viewpoints were assessed as resulting in Slight (3), Not Significant (9) or Imperceptible (4) residual visual effects. None of the visual receptors identified in County Roscommon will be affected.

12.8.4 Cumulative Visual Effects

Cumulative visual effects were assessed in terms of increase in spatial extent of turbines within the views of the selected viewpoints, visual separation of the proposed turbines from the permitted turbines and the perceived difference of scale between the existing/permitted turbines and the proposed turbines.

No cumulative effects will arise at two viewpoints. In the remaining 15 viewpoints it was found that the increase in spatial extent was predominantly 'Slight' to 'Moderate' While complete visual separation of the proposed turbines from the permitted turbines is achieved in one viewpoint, mostly 'Slight' to 'Moderate' separation was seen. The assessment of the perceived difference of scale was also predominantly 'Slight' to 'Moderate' with one viewpoint showing a 'Negligible' difference in scale. At no viewpoint was the difference in scale perceived as 'Substantial'.

A comparative ZTV shows that the cumulative theoretical visibility of wind turbines in the study area over that of the existing and permitted turbines will increase by less than one percent due to the addition of the proposed Croagh turbines.

Therefore, the cumulative visual effects are considered acceptable, in terms of increase in spatial extent, visual separation and difference in scale.

13. ARCHAEOLOGY AND CULTURAL HERITAGE

13.1 Introduction

This archaeological and cultural heritage chapter was prepared by Tobar Archaeological Services. It presents the results of an archaeological and cultural heritage impact assessment for a proposed wind farm near Drumkeeran, Co. Leitrim. The development area predominantly comprises upland blanket peat with some sections of sandstone/shale till. The majority of the site is under forest cover with a network of existing forest roads. The EIAR Site Boundary (Figure 13-1) is located within both County Leitrim and Sligo over an area measuring 670 hectares.

The purpose of this chapter is to assess the potential direct, indirect and cumulative effects of the proposed development on the surrounding archaeological, architectural and cultural heritage landscape. The assessment is based on both a desktop review of the available cultural heritage and archaeological data and a comprehensive programme of field walking of the study area. The report amalgamates desk-based research and the results of field walking to identify areas of archaeological/architectural/cultural significance or potential, likely to be impacted by the proposed development. An assessment of potential effects, including cumulative effects, is presented, and a number of mitigation measures are recommended where appropriate. The visual effect of the proposed development on any newly discovered monuments/sites of significance as well as known recorded monuments is also assessed.

13.1.1 Proposed Development

The proposed development consists of the construction of 10 no. wind turbines and associated site infrastructure. All elements of the proposed development including the grid connection cable route and the proposed turbine delivery route were assessed in the EIAR.

A full description of all elements of the proposed development is presented in Chapter 4.

13.1.2 Statement of Authority

This section of the EIAR has been prepared by Miriam Carroll and Annette Quinn of Tobar Archaeological Services. Miriam and Annette both graduated from University College Cork in 1998 with a Master's degree in Methods and Techniques in Irish Archaeology. Both directors are licensed by the Department of Culture, Heritage and the Gaeltacht to carry out excavations and are members of the Institute of Archaeologists of Ireland. Annette Quinn and Miriam Carroll have been working in the field of archaeology since 1994 and have undertaken numerous projects for both the private and public sectors including excavations, site assessments (EIAR) and surveys. Miriam Carroll and Annette Quinn are directors of Tobar Archaeological Services which has been in operation for 17 years. Tobar Archaeological Services have undertaken numerous EIARs for similar wind farm projects such as Ardderroo, Co. Galway, Cleanrath, Kealkill, Esk, County Cork, Lyrenacarriga, Co. Waterford, (all of which are located in commercial forestry).

13.1.3 Legislation and Guidelines

This chapter has been prepared in compliance with all relevant EIA legislation and guidance (see Chapter 1: Introduction for relevant guidance and legislation).

13.1.3.1 Current Legislation

Archaeological monuments are safeguarded through national and international policy, which is designed to secure the protection of the cultural heritage resource. This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention). This was ratified by Ireland in 1997.

Both the National Monuments Acts 1930 to 2004 and relevant provisions of the Cultural Institutions Act 1997 are the primary means of ensuring protection of archaeological monuments, the latter of which includes all man-made strnctures of whatever form or date. There are a number of provisions under the National Monnments Acts which ensure protection of the archaeological resource. These include the Register of Historic Monuments (1997 Act) which means that any interference to a monument is illegal under that Act. All registered monuments are included on the Record of Monuments and Places (RMP).

The Record of Monuments and Places (RMP) was established under Section 12 (1) of the National Monuments (Amendment) Act 1994 and consists of a list of known archaeological monuments and accompanying maps. The Record of Monuments and Places affords some protection to the monuments entered therein. Section 12 (3) of the 1994 Amendment Act states that any person proposing to carry out work at or in relation to a recorded monument mnst give notice in writing to the Minister (Environment, Heritage and Local Government) and shall not commence the work for a period of two months after having given the notice. All proposed works, therefore, within or around any archaeological monument are subject to statutory protection and legislation (National Monuments Acts 1930-2004).

Under the Heritage Act (1995) architectural heritage is defined to include 'all structures, buildings, traditional and designed, and groups of buildings including street-scapes and urban vistas, which are of historical, archaeological, artistic, engineering, scientific, social or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents...'. A heritage building is also defined to include 'any building, or part thereof, which is of significance because of its intrinsic architectural or artistic quality or its setting or because of its association with the commercial, cultural, economic, industrial, military, political, social or religious history of the place where it is situated or of the country or generally'.

13.1.3.1.1 *Granada Convention*

The Council of Europe, in Article 2 of the 1985 Convention for the Protection of the Architectural Heritage of Europe (Granada Convention), states that 'for the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member State will undertake to maintain inventories of that architectural heritage'. The Granada Convention emphasises the importance of inventories in underpinning conservation policies.

The NIAH was established in 1990 to fulfil Ireland's obligations under the Granada Convention, through the establishment and maintenance of a central record, docmmenting and evaluating the architectural heritage of Ireland. Article 1 of the Granada Convention establishes the parameters of this work by defining 'architectural heritage' under three broad categories of Monument, Groups of Buildings, and Sites:

- Monument: all buildings and structures of conspicuons historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;
- Group of buildings: homogeneons groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest, which are sufficiently coherent to form topographically definable units;
- Sites: the combined works of man and nature, being areas which are partially built upon and sufficiently distinctive and homogenous to be topographically definable, and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The Council of Europe's definition of architectural heritage allows for the inclusion of structures, groups of structures and sites which are considered to be of significance in their own right, or which are of significance in their local context and environment. The NIAH believes it is important to consider the architectural heritage as encompassing a wide variety of structures and sites as diverse as post boxes, grand country houses, mill complexes and vernacular farmhouses.

13.1.3.2 Leitrim County Development Plan 2015-2021

13.1.3.2.1 *Protected Structures*

Development or redevelopment in close proximity to any building or structure listed in the Record of Protected Structures, must respect the setting and character of the Protected Structure. In this regard, the Council will offer advice on conservation.

> ***Policy 104*** *It is the policy of the Council to protect all structures in the Record of Protected Structures.*
>
> ***Objective 84*** *It is an objective of the Council to seek the protection of all structures within the County that are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest.*
>
> ***Objective 85*** *It is an objective of the Council to review the record of Protected Structures during the lifetime of this plan.*
>
> ***Objective 86*** *It is an objective of the Council to seek funding for the conservation and restoration of Protected Structures.*
>
> ***Objective 87*** *It is an objective of the Council to seek the appointment of a Conservation Officer/Heritage Officer to improve the level of expertise available to the Council. However the Council will seek to develop in-house expertise in the interim in the absence of these appointments, having regard to the current embargo on recruitment.*

13.1.3.2.2 *Archaeology*

Sites and monuments of archaeological significance are recorded in the Record of Monuments and Places (RMP). The RMP is compiled by the Archaeological Survey of Ireland and is a statutory inventory of sites and areas with accompanying maps on which sites and monuments are marked and numbered. The Record includes all identified monuments such as megalithic tombs, ring forts and castles in County Leitrim, dating to before 1700 A.D. and some sites postdating 1700 A.D. There are approximately 1,400 sites and monuments identified in the RMP for County Leitrim. Each monument is encircled by a zone of archaeological potential. The duties of the owner of a recorded monument are detailed in the National Monuments (Amendment) Act 1994. The RMP is available for viewing in the Planning Authority Office and in the County Library. It should be noted that any direct impacts on national monuments in State or Local Authority care or subject to a preservation order will require the consent of the Minister for the Environment, Heritage and Local Government under Section 14 of the National Monuments Act 1930 as amended by Section 5 of the National Monuments (Amendment) Act 2004.

Policy 105 It is the policy of the Council to promote public awareness of the rich archaeological heritage that exists in County Leitrim.

The archaeological heritage of County Leitrim includes, according to the European Convention for the Protection of Archaeological Heritage, 1992 (Valetta Convention) structures, constructions, groups of buildings, developed sites, all recorded monuments as well as their contexts, and moveable objects; situated both on land and under water. This means that the archaeological heritage is not confined to

the archaeological sites within the Record of Monuments and Places, but also includes any archaeological site that may not have been recorded yet, as well as archaeology beneath the ground surface, as well as the context of any site. Leitrim has one underwater heritage order in the County (UHO 1/90), which refers to Lough Donogher, located to the north east of Cloone.

Objective 92 *It is an objective of the Council to promote the County's archaeological heritage as a tourism resource, in partnership with key tourism organisations.*

Policy 106 *It is the policy of the Council to secure the preservation (i.e. preservation in-situ or in particular circumstances where the Council is satisfied that this is not possible, preservation by record as a minimum) of all archaeological remains and sites of importance such as National Monuments, Recorded Monuments, their setting and context.*

Objective 93 *It is an objective of the Council to ensure that any development (above or below ground), within the vicinity of a site of archaeological interest shall not be detrimental to the character of the archaeological site or its setting.*

Objective 94 *It is an objective of the Council to require, where appropriate, that an archaeological assessment be carried out by a suitably qualified person prior to the commencement of any activity that may impact upon the archaeological heritage.*

Objective 95 *It is an objective of the Council to protect the zones of archaeological potential, as identified in the Record of Monuments and Places.*

Objective 96 *It is an objective of the Council to protect archaeological sites discovered since the publication of the Record of Monuments and Places.*

13.1.3.3 Sligo County Development Plan 2017-23

13.1.3.3.1 Archaeology - policies

P-AH-1 *Protect and enhance archaeological sites, monuments, their setting, appreciation and amenity within the Plan area, including those that are listed in the Record of Monuments and Places (RMP) or newly discovered archaeological sites and/or sub-surface archaeological remains.*

P-AH-2 *Require archaeological impact assessment, surveys, test excavation and/or monitoring for planning applications in areas of archaeological importance, if a development proposal is likely to impact upon in-situ archaeological monuments, their setting and archaeological deposits.*

P-AH-3 *Require the preservation of the context, amenity, visual integrity and connection of archaeological monuments to their setting. Views to and from archaeological monuments shall not be obscured by inappropriate development. Where appropriate, archaeological visual impact assessments will be required to demonstrate the continued preservation of an archaeological monument's siting and context.*

P-AH-4 *Secure the preservation in-situ or by record of:*

- *the archaeological monuments included in the Record of Monuments and Places as established under section 12 of the National Monuments (Amendment) Act, 1994;*
- *any sites and features of historical and archaeological interest;*
- *any subsurface archaeological features that may be discovered during the course of infrastructural/development works in the operational area of the Plan.*
- *Preservation relates to archaeological sites or objects and their settings.*

- *Preservation in-situ is most effectively achieved by the refurbishment of existing buildings, in situations where it is possible to retain the greater part of existing structures without the need for new foundations.*

P-AH-5 *Protect historic burial grounds that are recorded monuments and encourage their maintenance in accordance with best conservation principles. Development may be restricted or conditions requiring substantial excavation may be imposed in and adjacent to former burial grounds.*

P-AH-6 *Where possible, facilitate and enhance public access to and understanding of the archaeological heritage and disseminate archaeological information and advice to prospective developers and the general public.*

P-AH-7 *Require that all development proposals for industrial buildings and sites of industrial archaeological importance be accompanied by an industrial archaeology assessment of the surrounding environment. New development should be designed in sympathy with existing features and structures.*

P-AH-8 *Protect and preserve the archaeological value of underwater archaeological sites and associated features. In assessing proposals for development, the Council will take account of the potential underwater archaeology of rivers, lakes, intertidal and subtidal environments.*

Cuil Irra Peninsula – Carrowmore, Knocknarea and Carns Hill

P-AH-9 *Refer to the National Monuments Section, DAHG all development proposals within the archaeological and historic landscape of the Cuil Irra Peninsula (which includes the core areas of Knocknarea, Carrowmore and Carns Hill) as identified in Fig. 7.A.*

P-AH-10 *Ensure that Archaeological Impact Assessments are requested at pre-planning and planning application stage for all development proposals within the archaeological and historic landscape of the Cuil Irra Peninsula (which includes the core areas of Knocknarea, Carrowmore and Carns Hill).*

13.1.3.3.2 Archaeology – Objectives

O-AH-1 *Identify and protect internationally important archaeological landscapes such as the Carrowkeel, Inishmurray and the Cuil Irra Peninsula (which includes the core areas of Knocknarea, Carrowmore and Carns Hill), in co-operation with landowners and relevant stakeholders and statutory agencies.*

O-AH-2 *Identify appropriate archaeological sites in the Plan area to which public access could be provided and work to secure public access, where appropriate, in consultation with the landowners.*

O-AH-3 *Prepare and implement conservation plans in partnership with relevant stakeholders for key heritage sites in County Sligo, including, Drumcliffe and the Greenfort, Sligo.*

13.1.3.3.3 Architectural Heritage – Policies

P-ARH-1 Preserve, protect and enhance the architectural heritage of County Sligo for future generations. The area's architectural heritage is of national and regional importance and is central to Sligo's ability to promote itself as a centre for cultural tourism.

P-ARH-2 Ensure that any development, modifications, alterations, or extensions affecting a protected structure, an adjoining structure or a structure within an ACA is sited and designed

appropriately and is not detrimental to the character of the structure, to its setting or the general character of the ACA.

P-ARH-3 *Exempt a development proposal from the normal requirement for the payment of a development contribution if the proposal involves restoration/refurbishment of a protected structure to a high architectural standard.*

P-ARH-4 *Facilitate enabling development to be carried out in conjunction with works to protected structures where consistent with the parameters outlined in subsection Enabling Development.*

P-ARH-5 *Protect important non-habitable structures such as historic bridges, harbours, railways or non-structural elements such as roadside features (e.g. historic milestones, cast-iron pumps and post-boxes), street furniture, historic gardens, stone walls, landscapes, demesnes and curtilage features, in cases where these are not already included in the Record of Protected Structures.*

P-ARH-6 *Promote the retention and re-use of the vernacular built heritage through increasing public awareness of its potential for re-use and its adaptability to change.*

P-ARH-7 *When considering proposals to adapt vernacular buildings to meet contemporary living standards and needs, require applicants to apply the conservation principles and guidelines set out in the ICOMOS Charter on the Built Vernacular Heritage (Mexico 1999) – refer to Appendix H of this Plan.*

13.1.4 Location and Topography

The site of the Proposed Development is situated on relatively high ground at elevations ranging between c. 70 and 330 m OD. The site is situated to the west of Drumkeeran, Co. Leitrim and to the north-east of Drumacool, County Sligo. The site is partially located within both Counties Sligo and Leitrim with two turbines proposed within County Sligo and the remainder within Leitrim. The site is almost entirely comprised of commercial forestry with a network of existing roads within the site.

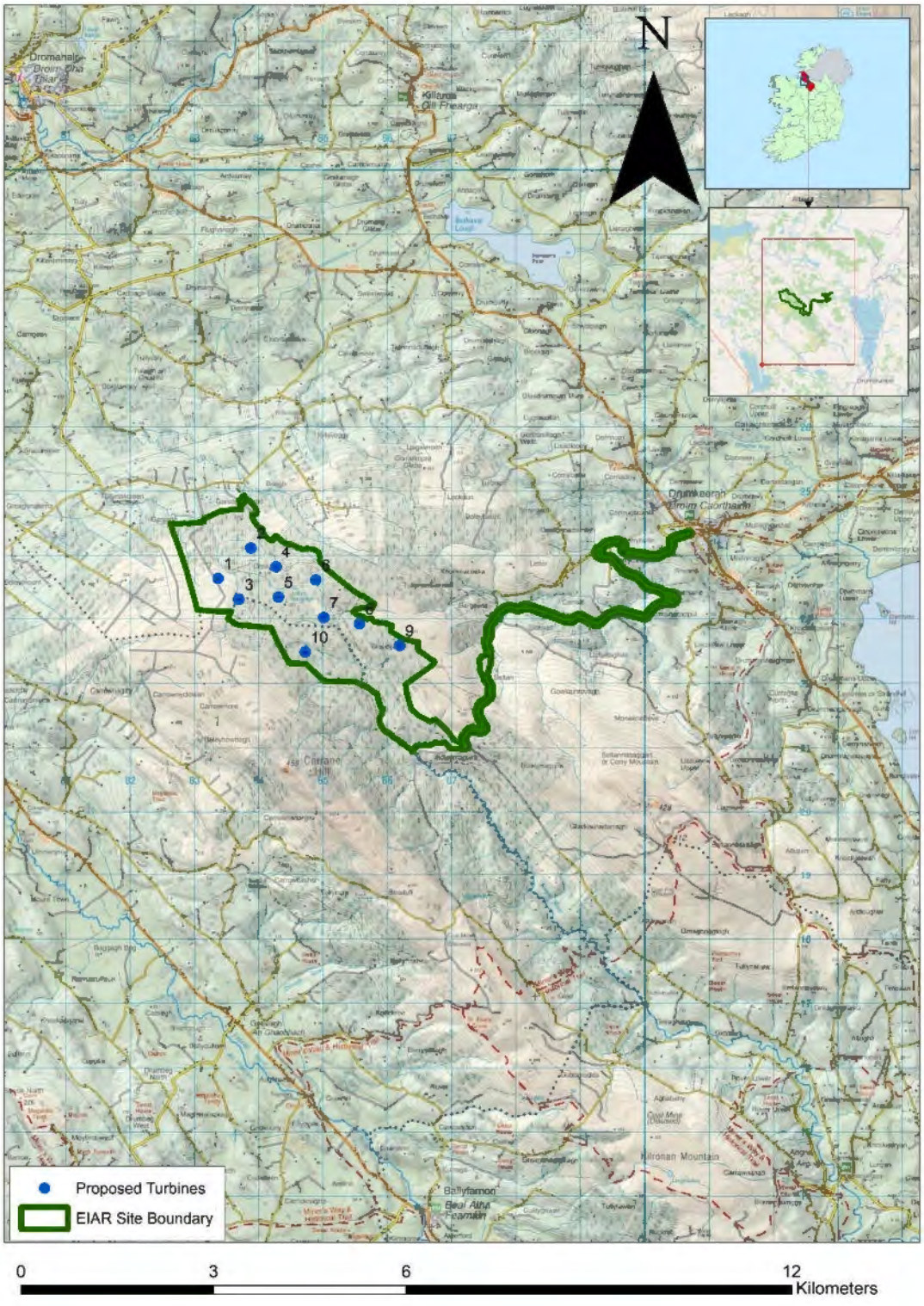

Figure 13-1: Site Location map

13.2 Methodology

The assessment of the archaeology, architecture and cultural heritage of the Proposed Development area included GIS mapping, desk-based research followed by field inspection. A desk-based study of the Proposed Development site was initially undertaken in order to assess the archaeological, architectural and cultural heritage potential of the area and to identify constraints or features of archaeological/cultural heritage significance within or near to the Proposed Development site.

13.2.1 Geographical Information Systems

GIS is a computer database which captures, stores, analyses, manages and presents data that is linked to location. GIS is geographic information systems which includes mapping software and its application with remote sensing, land surveying, aerial photography, mathematics, photogrammetry, geography and tools that can be implemented with GIS software. A geographic information system (GIS) was used to manage the datasets relevant to the archaeological and architectural heritage assessment and for the creation of all the maps in this section of the report. This involved the overlaying of the relevant archaeological and architectural datasets on georeferenced aerial photographs and road maps (ESRI), where available. The integration of this spatial information allows for the accurate measurement of distances of a proposed development from archaeological and cultural heritage sites and the extraction of information on 'monument types' from the datasets. Areas of archaeological or architectural sensitivity may then be highlighted in order to mitigate the potential negative effects of a development on archaeological, architectural and cultural heritage.

ArcGIS ouline viewshed analysis was also used to assess effects on setting of archaeological monuments. The Viewshed tool uses the Esri Elevation Analysis service to determine which areas are visible from specified observer points (the observer points being the monuments). Visibility settings are used to set the height of the observer (1.75m standard), the height of the observed features (turbine height), and the maximum viewing distance of the observer. This tool was utilised to ascertain the potential/theoretical visual effects on Cultural Heritage Assets. The results show the worst-case scenario since the model does not take trees or vegetation into consideration.

13.2.2 Desktop Assessment

A primary cartographic source and base-line data for the assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for Counties Leitrim and Sligo. All known recorded archaeological monuments are indicated on 6 inch Ordnance Survey (OS) maps and are listed in aforementioned records. The 1st (1840s) and 2nd (1900s) edition OS maps for the area were also consulted.

The following sources were consulted for this assessment report:

- The Record of Monuments and Places (RMP)
- The Sites and Monuments Record (SMR)
- National Monuments in State Care in Counties, Leitrim, Sligo and Roscommon
- The Topographical Files of the National Museum of Ireland
- First edition Ordnance Survey maps (OSI)
- Second edition Ordnance Survey maps (OSI)
- Third edition Ordnance Survey Map (Record of Monuments and Places)
- Down Survey maps (www.downsurvey.tcd.ie)
- Aerial photographs (copyright of Ordnance Survey Ireland (OSI)
- Excavations Database
- Leitrim County Development Plan 2015-21, Leitrim County Council
- Sligo County Development Plan 2017-2023, Sligo County Council

- National Inventory of Architectural Heritage (NIAH)
- Record of Protected Structures (Leitrim and Sligo)

13.2.2.1 Record of Monuments and Places

A primary cartographic source and base-line data for the assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for Counties Leitrim and Sligo. All known recorded archaeological monuments are indicated on 6 inch Ordnance Survey (OS) maps and are listed in these records. The SMR/RMP is not a complete record of all monuments as newly discovered sites may not appear in the list or accompanying maps. In conjunction with the consultation of the SMR and RMP the electronic database of recorded monuments and SMRs which may be accessed at www.webgis.archaeology.ie/historicenvironment was consulted.

13.2.2.2 Cartographic Sources and Aerial Photography

The 1st (1840s) and 2nd (1900s) edition OS maps for the area were consulted, where available, as was OSI aerial photography.

13.2.2.3 Topographical Files - National Museum of Ireland

Details relating to finds of archaeological material and monuments in numerous townlands in the country are contained in the topographical files held in the National Mnseum of Ireland. In order to establish if any new or previously unrecorded finds had been recovered from the study area these files were consulted for every townland within and adjacent to the same. The database of topographical files was consulted on www.heritagemaps.ie.

13.2.2.4 Archaeological Inventory Series

Further information on archaeological sites may be obtained in the published County Archaeological Inventory series prepared by the Department of Culture, Heritage and the Gaeltacht. The archaeological inventories present summarised information on sites listed in the SMR/RMP and include detail such as the size and location of particular monuments as well as any associated folklore or local information pertaining to each site. The inventories, however, do not account for all sites or items of cultural heritage interest which are as yet undiscovered.

13.2.2.5 Leitrim and Sligo County Development Plans

The current County Development Plans were consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest which may be affected by the Proposed Development. The development plan also outlines policies and objectives relating to the protection of the archaeological, historical and architectural heritage landscape of County Leitrim and Sligo. The dataset for County Leitrim Record of Protected Structures was obtained from the Heritage section of Leitrim County Council. The Sligo Record of Protected Structures is only available as a PDF in the CDP.

13.2.2.6 Excavations Database

The Excavations Database is an annual account of all excavations carried out under license. The database is available online at www.excavations.ie and includes excavations from 1985 to 2019. This database was consulted as part of the desktop research for this assessment to establish if any archaeological excavations had been carried out within or near to the Proposed Development area.

13.2.2.7 National Inventory of Architectural Heritage (NIAH)

This source lists some of the architecturally significant buildings and items of cultural heritage and is compiled on a county by county basis by the Department of Culture, Heritage and the Gaeltacht. The NIAH database was consulted for all towulands within and adjacent to the study area. The NIAH survey for Leitrim and Sligo has been published and was downloaded on to the base mapping for the Proposed Development (www.buildingsofireland.ie). The National Inventory of Architectural Heritage (NIAH) is a state initiative under the administration of the Department of Culture, Heritage and the Gaeltacht and established on a statutory basis under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999.

The purpose of the NIAH is to identify, record, and evaluate the post-1700 architectural heritage of Ireland, uniformly and consistently as an aid in the protection and conservation of the built heritage. NIAH surveys provide the basis for the recommendations of the Minister for the Enviroument, Heritage and Local Government to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS). The published surveys are a source of information on the selected structures for relevant planning authorities. They are also a research and educational resource. It is hoped that the work of the NIAH will increase public awareness and appreciation of Ireland's architectural heritage.

13.2.3 Field Inspection

An intensive programme of field inspection was undertaken over four days in April and May 2019 as well as a revisit in March 2020. The initial walkover survey was undertaken in good clear weather conditions. The revisit was undertaken in poor weather conditions with snow in some areas of the site. The Proposed Development site and its surrounds were inspected by Annette Quinn and Miriam Carroll of Tobar Archaeological Services on the 29th, 30th April 2019 and the 1st and 2nd May and again on the 11th-13th March 2020. The inspection consisted of a walk-over examination of the site (within the EIAR study area boundary), an assessment of any recorded monuments, architectural, built or cultural heritage items within the site and the potential direct and indirect impacts on those monuments. Any newly discovered archaeological monuments, items of built heritage or cultural heritage value within the study area were also recorded during the field inspection. A full photographic and descriptive record of the site was made.

13.2.3.1 Limitations Associated with Fieldwork

No limitations were encountered during field work although groumd conditions under foot were poor during the re-visit in March 2020.

13.2.4 Assessment of Likely Significant Effects

Significance of effects is usually understood to mean the importance of the outcome of the effects and the consequences of the change. Significance is determined by a combination of scientific and subjective concerns. Professional judgement has been utilised in determining such significance. According to the EPA Guidelines '*Significance is a concept that can have different meanings for different topics.*'. The likely effects on the existing archaeological and cultural heritage environment are assessed nsing the criteria as set out in the EPA guidelines (2017). The following terminology is used when describing the likely effects of the Proposed Development from a Cultural Heritage Perspective.

13.2.4.1 Types of Impact

Direct impacts arise where an archaeological heritage feature or site is physically located within the footprint of the development whereby the removal of part, or all of the feature or site is thus required.

Indirect impacts may arise as a result of subsurface works undertaken outside the footprint of the development, secondary environmental change such as a reduction in water levels and visual impacts.

Cumulative Impacts arise when the addition of many impacts create a larger, more significant impact.

Residual Impacts are the degree of environmental changes that will occur after the proposed mitigation measures have been implemented.

13.2.4.1.1 *Magnitude of Effects (Significance)*

- Profound: Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological site is completely and irreversibly destroyed.
- Very Significant: An effect which by its character, magnitude, duration or intensity significantly alters most of the sensitive aspect of the environment.
- Significant: An effect which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment. An effect like this would be where part of a site would be permanently impacted upon, leading to a loss of character, integrity and data about an archaeological site.
- Moderate: A moderate effect arises where a change to an archaeological site is proposed which though noticeable, is not such that the integrity of the site is compromised and which is reversible. This arises where an archaeological site can be incorporated into a modern-day development without damage and that all procedures used to facilitate this are reversible.
- Slight: An effect which causes changes in the character of the environment which are not high or very high and do not directly impact or affect an archaeological site.
- Not Significant: An effect which causes noticeable changes in the character of the environment but without significant consequences.
- Imperceptible: An effect on an archaeological site capable of measurement but without noticeable consequences.

13.2.5 Methodology for the assessment of impacts on visual setting (indirect effects)

A standardised approach was utilised for the assessment of impacts of visual setting (indirect effects) according to types of monuments and cultural heritage assets which may have varying degrees of sensitivity. The assessment of impacts on visnal setting was undertaken using both the Zone of Theoretical Visibility (ZTV) map in the Landscape and Visual Impact Assessment (LVIA), as presented in Chapter 11 of this EIAR, and also viewshed analysis from specific cultural heritage assets (viewshed analysis is described in Section 13.2.1 above). The viewshed analysis used in the assessment of potential impacts on the visual seting of cultural heritage assets in the wider landscape of 10km and 20km considers the effects of the proposed turbines only. Other lower visibility infrastructure such as roads, grid connection, sub-station etc. are not included in the viewshed analysis. All other infrastructure (proposed roads, grid connection, sub-station, compounds etc) are assessed without the use of viewshed analysis.

While direct physical impacts to a site or monument can easily be assessed in quantitative terms, the assessment of impacts on setting can be subjective and as such is a matter of qualitative, professional

judgement and experience. The distances below used in the assessment of impacts on setting are regarded as appropriate and are based on professional judgement.

Table 13-1: Cultural Heritage Assets considered according to sensitivity

Cultural Heritage Asset	Distance Considered
UNESCO World Heritage Sites (including tentative sites) – if relevant	20km
National Monuments (State Ownership and Preservation Order Sites)	10km
Recorded Monuments, RPS	5km
NIAH structures	5km
Undesignated sites, if relevant	500m from proposed development

13.3 Existing Environment

13.3.1 Archaeological Heritage – The Proposed Wind Farm

Archaeological heritage includes all recorded archaeological monuments listed in the RMP/SMR maps and also includes newly discovered archaeological sites. These monuments are addressed separately for clarity. National Monuments are those recorded monuments which are in the ownership / guardianship of the Minister for Culture, Heritage and the Gaeltacht (DCHG). They are frequently referred to as being in 'State Care'. Archaeological heritage also includes sites which are subject to a preservation order.

13.3.1.1 National Monuments

A review of all National Monuments in State Care was undertaken as part of the assessment in order to ascertain any potential impacts on their setting as a result of the proposed development. No National Monuments are located within the EIAR site boundary and none are located within close proximity, the nearest National Monument being located at 8.3km from turbine 2. These are detailed in Table 13-2.

Table 13-2 National Monuments within 10km of nearest proposed turbine

NM No.	RMP NO.	NAME	DESCRIPTION	Td.	NM No.	RMP NO.	NAME	DESCRIPTION
69	LE014-004001	Creevelea Abbey	Friary (Franciscan)	Creevelea	579804	831396	2	8323
277	SL021-012	Gortlownan	Motte	Gortlownan	577897	830335	2	8599
465	SL035-079	Moytirra East	Court Tomb	Moytirra East	581430	814117	10	8983
152	SL034-128	Heapstown	Cairn	Heapstown	577203	816271	3	9547
277	SL021-028	Castleore	Cashel	Castleore	575360	829074	1	9640
277	SL021-062, SL021-104	Carricknagat	Megalithic Tombs	Carricknagat	573796	826693	1	10004

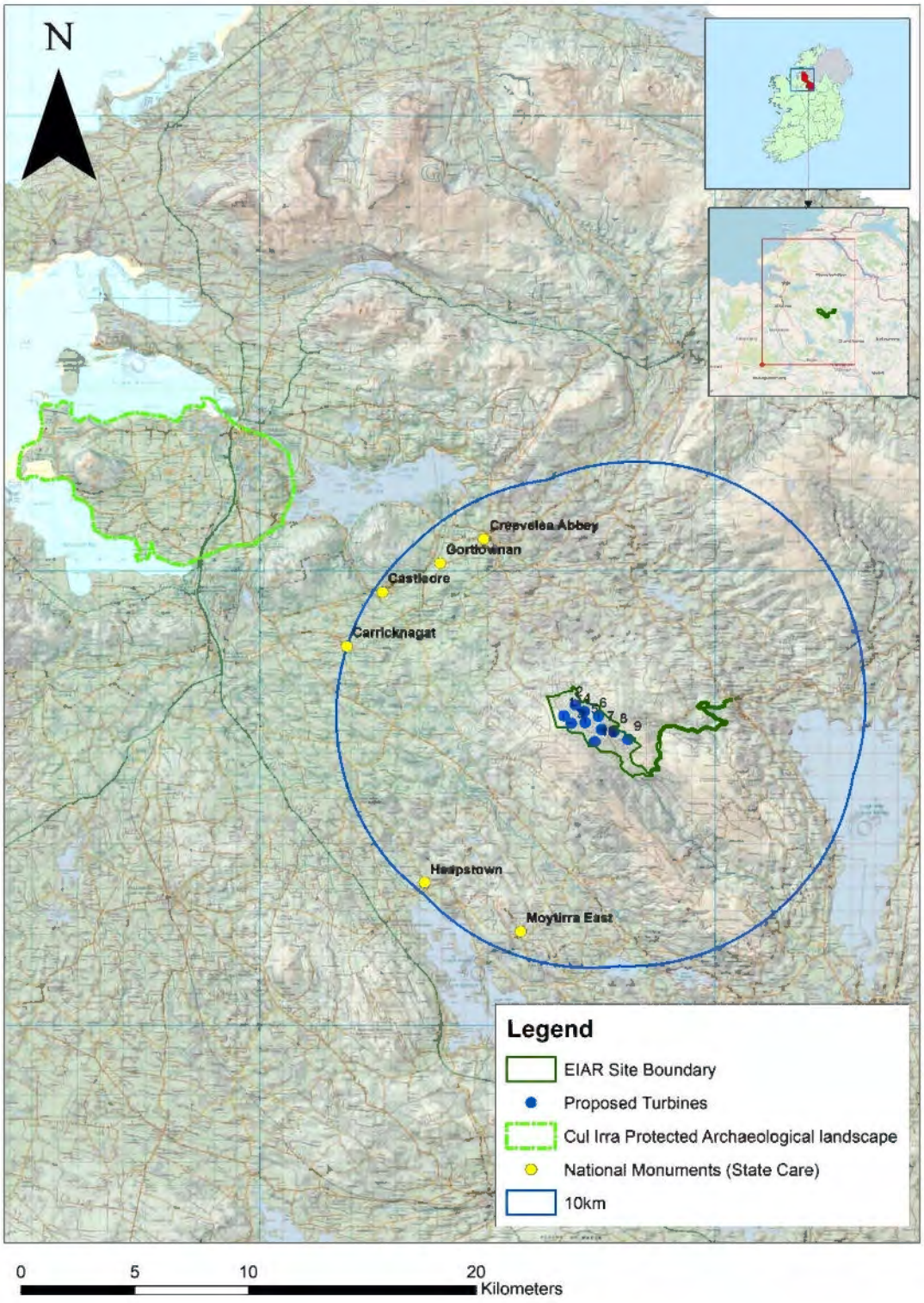

Figure 13-2 National Monuments within 10km of the nearest proposed turbine and in relation to Protected archaeological landscape, Cuil Irra, Sligo.

13.3.1.1.1 *Visibility from National Monuments*

NM 69 LE014-004001 Creevelea Abbey Friary (Franciscan)

Situated on a shoulder overlooking the Bonet River, which is c. 150m to the NE. This is an Observant Franciscan friary founded by Owen O'Rourke and his wife Margaret O'Brien in 1508, the pious couple who commissioned the Shrine of St Caillín of Fenagh (LE025-096001-) in 1526 (Murphy 1892). Creevelea was accidentally burned in 1536 before it was suppressed in 1541, but it continued to be used intermittently by the friars until the end of the 17th century (O'Counell 1937, 137-50). The church, consisting of nave, chancel, tower and S transept, survives almost complete. The cloister and domestic buildings, largely reduced to the ground-floor level and foundations, are N of the church.

The structure is now a National Monument. Archaeological testing to the N failed to record any archaeological features (Crumlish 1994), and testing (03E0166) for an extension of the graveyard to the S had a similar result (Read 2006). (MacKenna and Scott 1898-9; Anon. 1914, 52-63; O'Connell 1937; Leask 1960, vol. 3, 129, 149-51; Conlon 1988, 118-19; Harbison 1970, 211-12; Harbison 2002, 47-50). This is a National Monument in state ownership: No. 69 ('The Archaeological Inventory of County Leitrim' compiled by Michael J. Moore (Dublin: Stationery Office, 2003).

Viewshed analysis (Figure 13-3) from this monument suggests that theoretically two turbines (T4 and T6) may be visible in full and that the remainder of the turbines may theoretically be visible from mid-shaft up. This theoretical visibility does not assume the presence of natural screening, vegetation or forestry and is based on a bare landscape and therefore a worse-case scenario. The Zone of Theoretical Visibility (utilised in the LVIA Chapter 12) suggests that potentially no turbines would be visible from this location.

A site visit to the National Monument, however, shows that the area in the direction of the windfarm (to the south-east) is heavily planted with trees. The distance, together with the intervening tree cover suggests that the impacts on the setting of the National Monument will be 'not significant'.



Plate 13-1 National Monument 69 (Creevelea Abbey)



Plate 13-2 View from National Monument 69 (Creevelea Abbey) in the direction of the proposed windfarm (140 degrees).

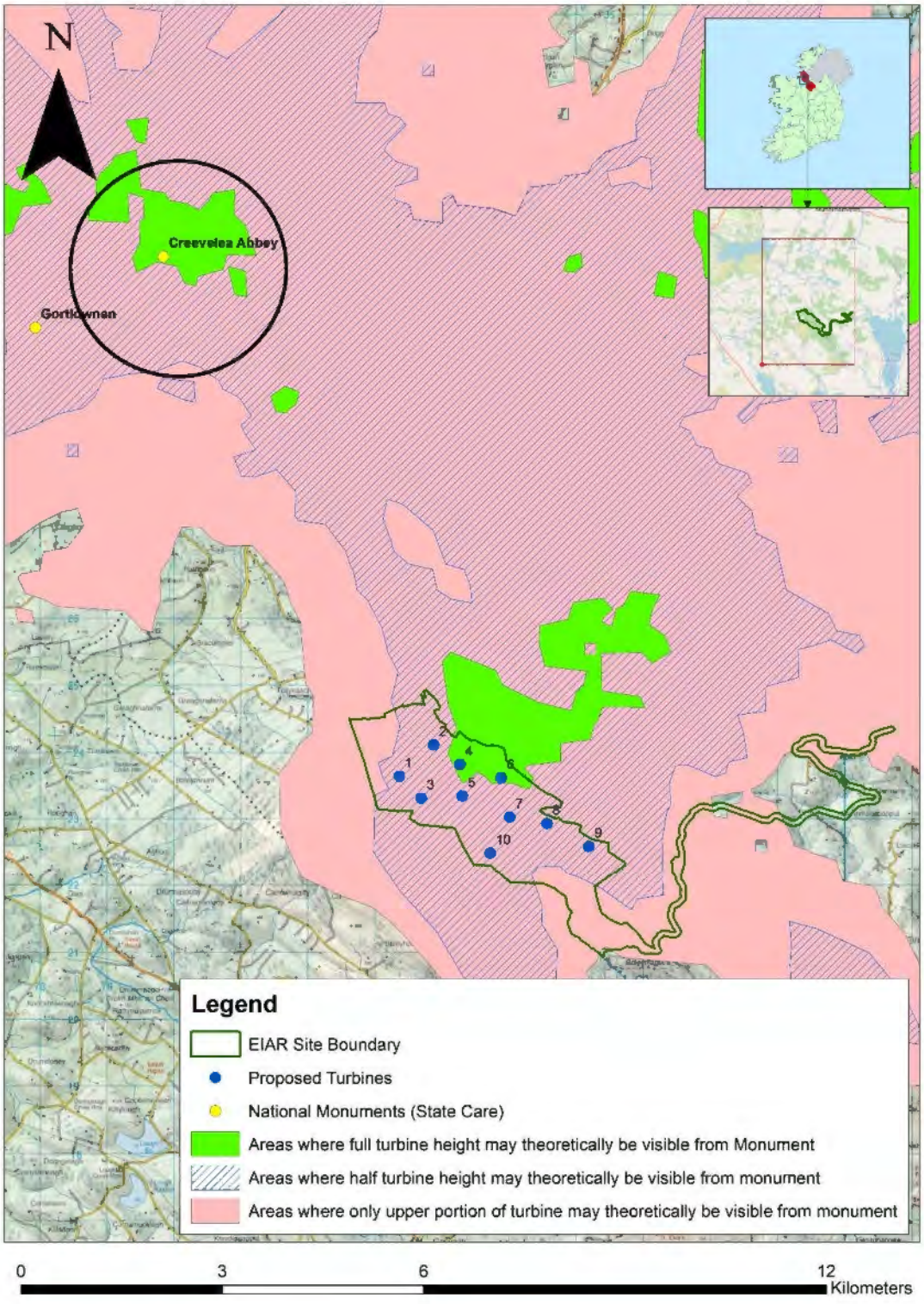

Figure 13-3 Viewshed Analysis showing theoretical visibility from Creevelea Abbey

NM 277 SL021-012 Gortlownan Motte

This motte is described in the Archaeological inventory of county Sligo as 'On the SE side of a broad shallow NE-SW valley of boggy ground, overlooked SE-SW by hilly terrain broken by rock outcrops. A stream, which marks the county boundary between Sligo and Leitrim, skirts the monument E-SE. A conical oval mound (c. 42m NW-SE; c. 35-40m NE-SW; H 5m) with a flat top (15.5m NW-SE; 10m NE-SW) and steeply sloping sides. Occasional large stones protrude randomly around the top edge of the mound, possibly remnants of an enclosing wall. The mound appears to be a modified natural ridge and this fact has cast some doubt on its status as a motte (Glasscock 1975, 109; Graham 1988, 121). The above description is derived from the published 'Archaeological Inventory of County Sligo' compiled by Ursula Egan, Elizabeth Byrne, Mary Sleeman with Sheila Ronan and Connie Murphy (Dublin Stationery Office, 2005).

Viewshed analysis from this monument suggests that theoretically two to three turbines (T2, T4 and T6) may be visible at approximately blade tip height and that the remainder of the turbines would not be visible (Figure 13-4). This theoretical visibility does not assume the presence of natural screening, vegetation or forestry and is based on a bare landscape and therefore a worse-case scenario. The Zone of Theoretical Visibility (refer to Chapter 12 of this EIAR), also based on a bare landscape model shows that Gortlowan Motte is just outside the area where 9-10 turbines may be visible.

A site visit to the roadside adjacent to the National Monument however shows that the area in the direction of the windfarm (to the south-east) is planted with trees and numerous boundaries. Public access to the monument was not possible. The distance, together with the intervening vegetation suggests that the impacts on the setting of the National Monument will be 'Not Significant'.

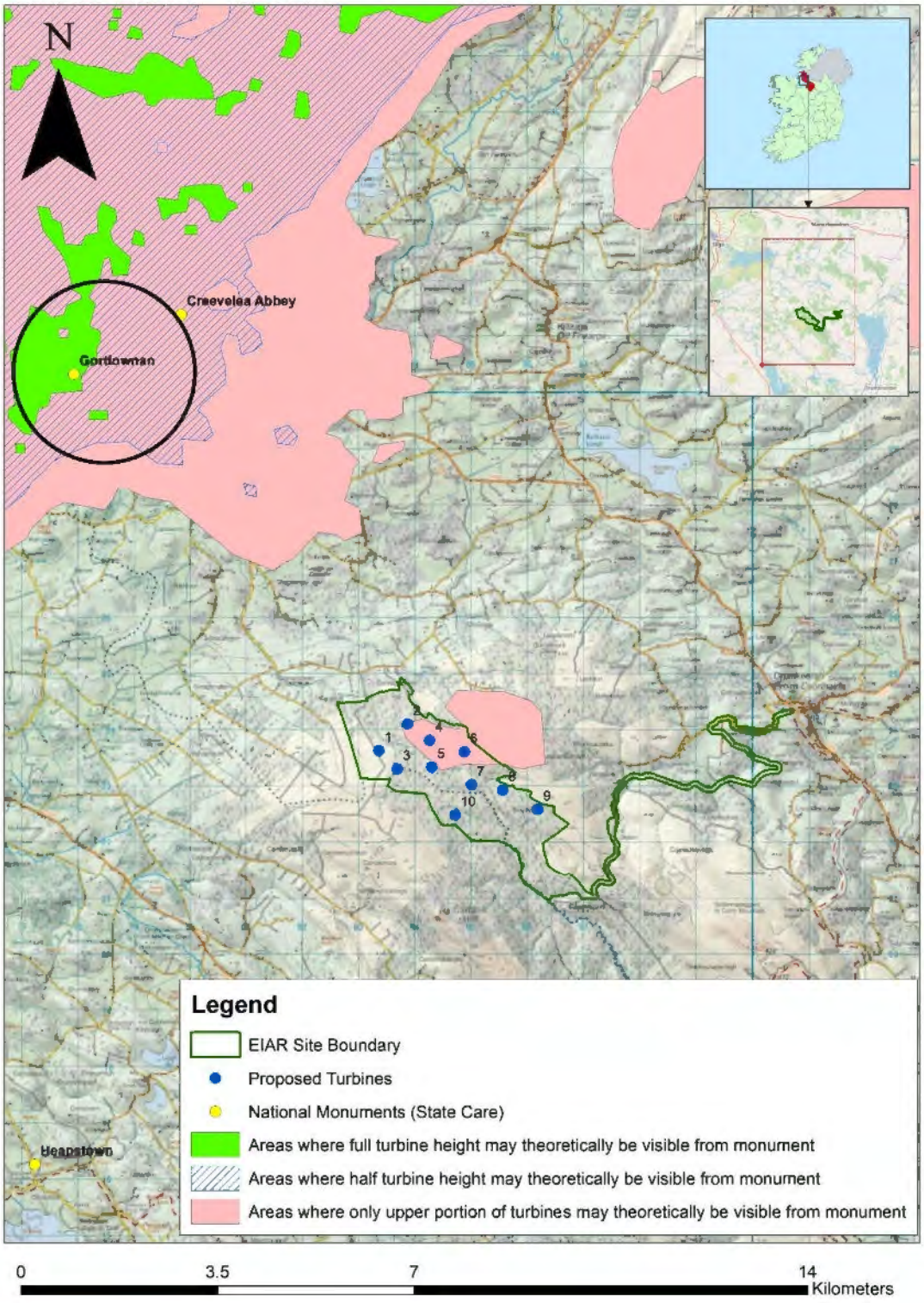

Figure 13-4 Viewshed Analysis showing theoretical visibility from Gortlownan Motte

NM 277 SL021-028 Castleore Cashel

This is described in the Archaeological Inventory of County Sligo as follows: In undulating rocky pasture, on the summit of a small hillock with a stream at its base on the W side. An oval area (21m E-W; 16m N-S) enclosed by a substantial drystone wall (Wth 3m; int. H 1m; ext. H 2.4m). In parts, a low foundation plinth of prostrate slabs protrudes slightly at the base of the external face. This was necessary in order to stabilise the wall, which is built almost at the break of slope at the top of the hillock. The entrance (Wth c. 1.2m) is at ENE and is now partially blocked by large stones displaced from the collapsed S jamb. From the entrance the gentle ramp-like slope of the hillock drops to a spine of elevated ground forming a natural routeway to E. Immediately outside the entrance, slightly to N of the N jamb, there are two large contiguous upright slabs set perpendicular to the cashel wall. Another large upright slab is located c. 5m down slope to ENE, adjacent to a concentration of stones. In the centre of the level grassy interior two large prostrate slabs (max. dim. 1.2-1.7m) are embedded in the ground. A dilapidated field wall (Wth c. 1m; H 0.5m), largely obscured by overgrowth and superseded by a post and wire fence, encloses the base of the hillock NW-SW, continuing to W beyond the cashel. No evidence of a chamber noted by Milligan (1890-91, 577) in the thickness of the wall, which was entered by a small square-headed door (H 2 ft 6 ins [0.76m]; Wth 2 ft [0.6m]) to which access was not gained as it was filled with rubbish and rubble. According to local tradition, the chamber gave access to a secret passage, which led to the bottom of the hill (ibid.). Skeletons were frequently found in the ground outside the cashel (Milligan 1890-1, 577). Recorded in 1836 as 'Badhbun Buidhe' (OSL, 254) and in 1894 as 'The Bauven Crin' (the fortress of Belonna) (Kerr Kirker 1894, 278). Recorded as 'Caisleán Oir or Caisleán Uabhair (castle of pride)' (Faughnan 1943). A possible souterrain (SL021-028001-) is associated with this cashel. Another cashel (SL021-027—) is located c. 120m to W. This is a national monument in State care (no. 277). (Archaeological Inventory of County Sligo' compiled by Ursula Egan, Elizabeth Byrne, Mary Sleeman with Sheila Ronan and Counie Murphy (Dublin Stationery Office, 2005).

Viewshed analysis from this monument suggests that theoretically no turbines would be visible in full, nine turbines may be visible from mid-shaft (50%) (T1-T9) and one turbine may only have its blade tips visible (T10) (Figure 13-5). This theoretical visibility does not assume the presence of natural screening, vegetation or forestry and is based on a bare landscape and therefore a worse-case scenario. The Zone of Theoretical Visibility suggests that 9-10 turbines may be visible.

A site visit to the National Monument, however, shows that the area in the direction of the windfarm (to the south-east) is planted with trees and numerous boundaries (Plate 13-4). The distance, together with the intervening vegetation suggests that the impacts on the seting of the National Monument will be 'not significant'.



Plate 13-3: Interior of Cashel, National Monument 277 at Castleore.



Plate 13-4: View in the direction of the proposed windfarm (south-east) from highest point within the monument.

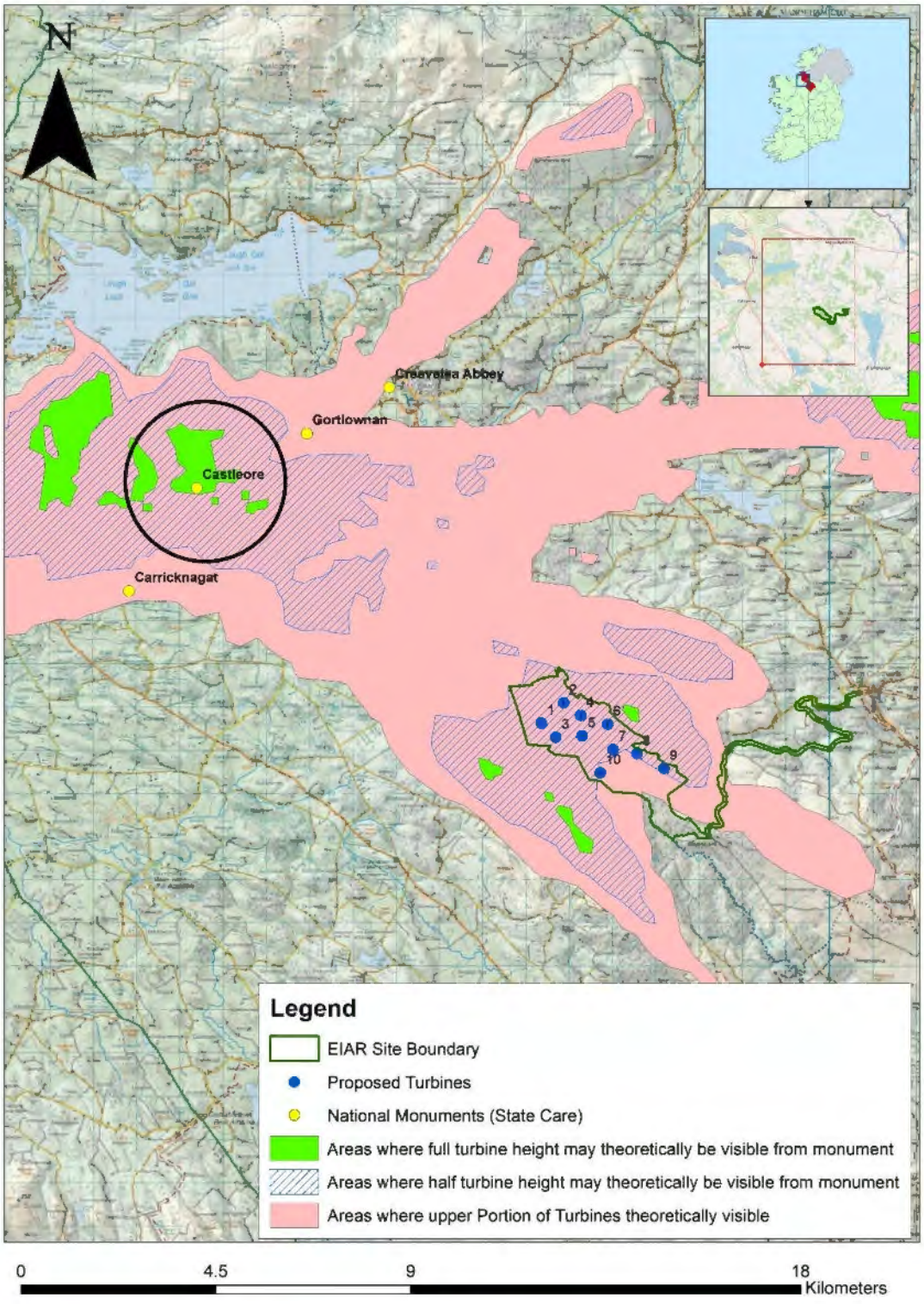

Figure 13-5: Viewshed Analysis showing theoretical visibility from Castleore Cashel

NM 277 Carricknagat Megalithic Tombs SL021-062, SL021-104

SL021-062 is described in the Archaeological Inventory of County Sligo as follows: On a rocky rise, in rush-grown pasture. An orthostat (L 1.3m; T 0.3m; H 1.3m if upright) aligned SW-NE and leaning to the S is the only set stone here. In addition, four large slabs lie at the site. One (max. dim. 2.7m) adjoins the NE end of the orthostat and beyond this is another slab of similar size. Immediately S of the orthostat there is a large slab (max. dim. 2m) and alongside this to the SW there is another. There are also seven smaller prostrate stones at the site. The stones seem to represent the remains of a megalithic tomb or perhaps an abandoned attempt to build one (Ó Nualláin 1989, 53, no. 83). The presence of two large slabs one resting above the other some 15m to the S is cited as support for the view that construction of the monument may not have been completed. A court tomb (SL021-104—) lies c. 50m to ENE. This is a national monument in State care (no. 277).

SL021-104 is described as follows: On a poorly drained low-lying patch of ground about 50m ENE of an unclassified megalithic tomb (SL021-062). The iuner end of a SSE-facing gallery (L 4m; max. Wth 2.6m) is divided by segmenting jambs inset in the gallery walls iuto a well-preserved rear chamber (L c. 2m) and an outer chamber now represented by two opposed sidestones. The status of an upright stone between these two sidestones and crossing the gallery is unclear. Some 2m to the W of the gallery there is a lone kerbstone and 2-3m E of the gallery there are three others. The alignment of these kerbstones suggest that the structure stood in a cairn of trapezoidal plan. There is some cairn fill in the gallery and between it and the kerbstones. There are a number of displaced stones at the site including a group of four large examples just S of the surviving gallery structure. (Ó Nualláin 1989, 53-4, no. 84).

Viewshed analysis from this monument suggests that theoretically one to three turbines (T1, T4 and T5) may be visible in full and that the remainder may be visible from mid-shaft upwards (50%) (Figure 13-6)). This theoretical visibility does not assume the presence of natural screening, vegetation or forestry and is based on a bare landscape and therefore a worse-case scenario. The Zone of Theoretical Visibility suggests that 9-10 turbiues may be visible from this location, not assuming vegetation / tree cover.

No public access to the megalithic tombs could be located. A site visit to the nearest point on the public road suggests that any potential views may be obscured by vegetation. The distance, together with the natural intervening vegetation suggests that the impacts on the setting of the National Monument will be 'not significant'.

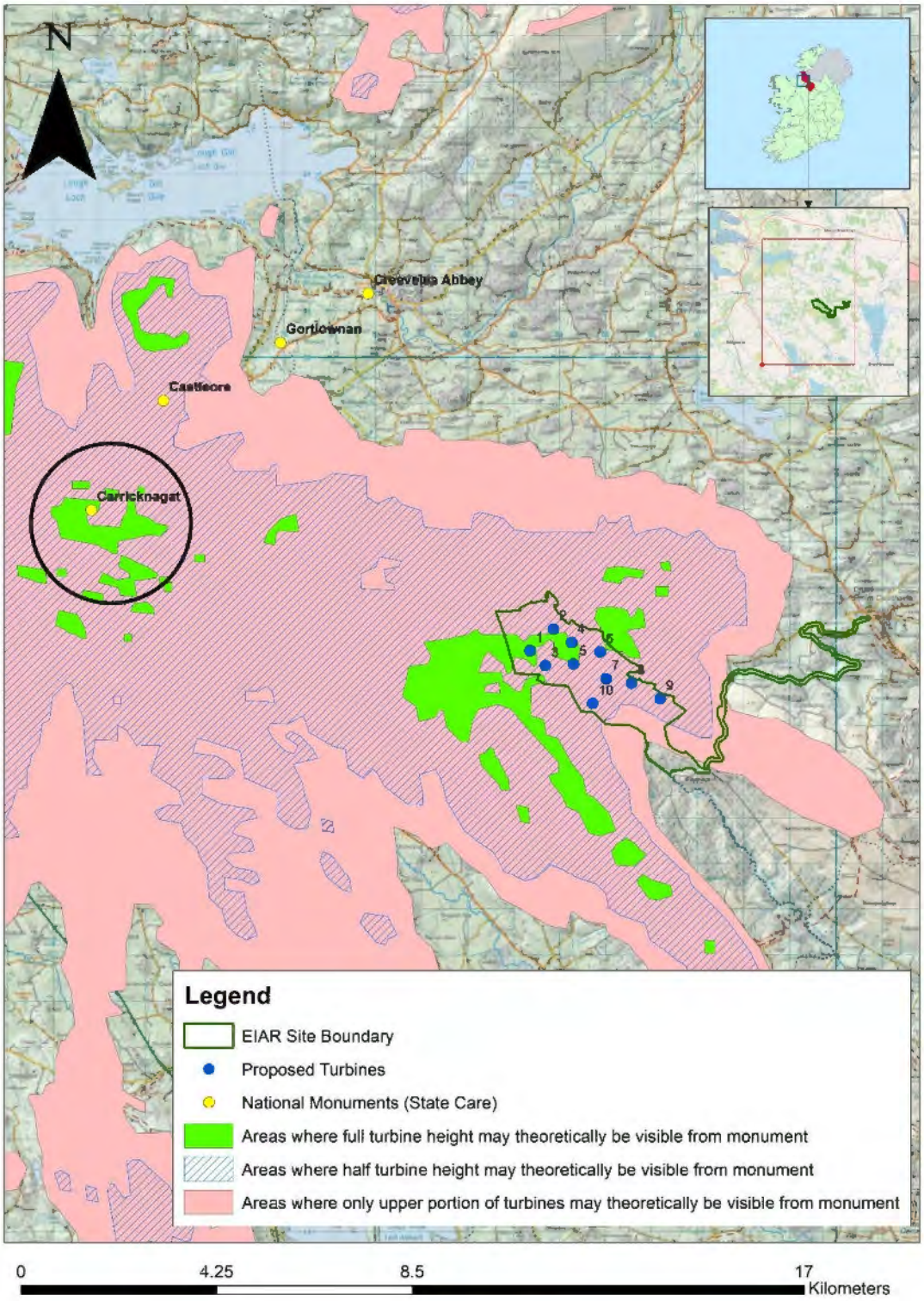

Figure 13-6: Viewshed Analysis showing theoretical visibility from Carrignagat Megalithic tombs

NM 152 Heapstown Cairn SL034-128

In level pasture, 750m N of Lough Arrow. This is a massive round cairn (diam. 62m N-S, 60m E-W; H c. 6m) retained by a kerb of substantial kerbstones. Twenty-three are exposed from S around to NW and seven more are visible from N around to SE. Considerable quarrying has taken place along the perimeter of the site. (Ó Nualláin 1989, 94). A possible rath (SL034-128—) lies c. 90m to NE. This is a national monument (No. 152) in state care.

Viewshed analysis from this National Monument shows no visibility in the direction of the proposed turbines. Views from the adjacent public road shows that this large mound of stones is located to the rear of a small farmhouse and is surrounded by trees on all sides. Intervening topography is such that no visibility of the location of the proposed windfarm is possible from this location. The ZTV also suggests that no turbines would be visible from this location. In this regard the impacts on setting will not occur, therefore.

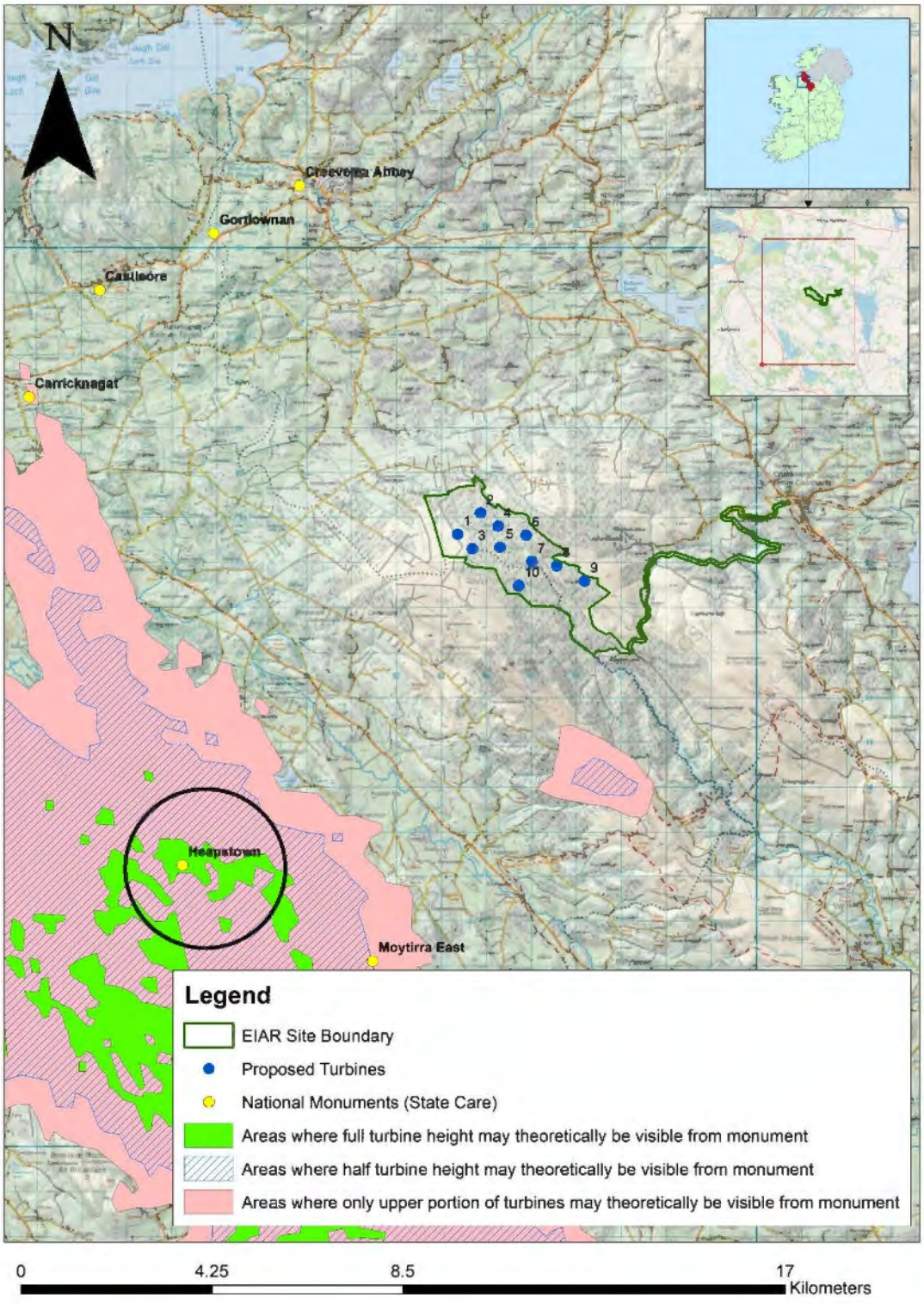

Figure 13-7 Viewshed Analysis showing theoretical visibility from Heapstown Cairn

NM 465 Moytirra Court Tomb SL035-079

On rocky pasture commanding an extensive outlook to the S. A U-shaped open court (L c. 7m) at the NNE leads to a well-preserved gallery (L 13m; Wth 1.5-2.9m) of four chambers. There are some poorly defined traces of mound around the structure. The two entrance jambs of the gallery function as courtstones and, in addition, one orthostat of the more westerly arm of the court survives and two remain on the other side. At the outer end of this side of the court there is a low moss-covered courtstone and just beyond and at right angles to it another low stone, apparently part of the tomb facade. A stone, split in two, and set more or less along the main axis of the structure stands in the gallery entrance and divides it in two. Another stone at right angles to the last closes the easteru half of the entrance gap. The divisions between the first three chambers are marked by single jambs, in each case at the W. The third and fourth chambers are separated by a sillstone. The chamber sidestones and the backstone of the gallery survive intact. There are three blocks of stone of uncertain origin between 1m and 9m beyond the back of the gallery. A stone wall extends NE-SW across the W arm of the court. A large limestone block on top of a smaller stone lies c. 30m to SW and is known locally as the 'Rocking stone'. An unclassified megalithic tomb (SL035-078—) lies c. 200m to W. (Ó Nualláin 1989, 68-9, no. 110). This is a national monument in State care (no. 465).

Viewshed analysis from this monument shows that theoretically only the upper portions of one to four turbines (T1, T3, T5 and T10) may be visible. There may be no visibility of the remainder of the turbines (Figure 13-6). This theoretical visibility does not assume the presence of natural screening, vegetation or forestry and is based on a bare landscape and therefore a worse-case scenario. The Zone of Theoretical Visibility suggests that 1-3 turbines may be visible, a similar conclusion drawn by the Viewshed model.

A site visit to the nearest publicly accessible point to the court tomb on the adjacent road shows that views in the direction of the wind farm are possible towards the north-east and therefore some visibility of turbines may occur. The distance, together with the intervening natural vegetation and topography suggests that the impacts on the setting of the National Monument will be 'not significant'.

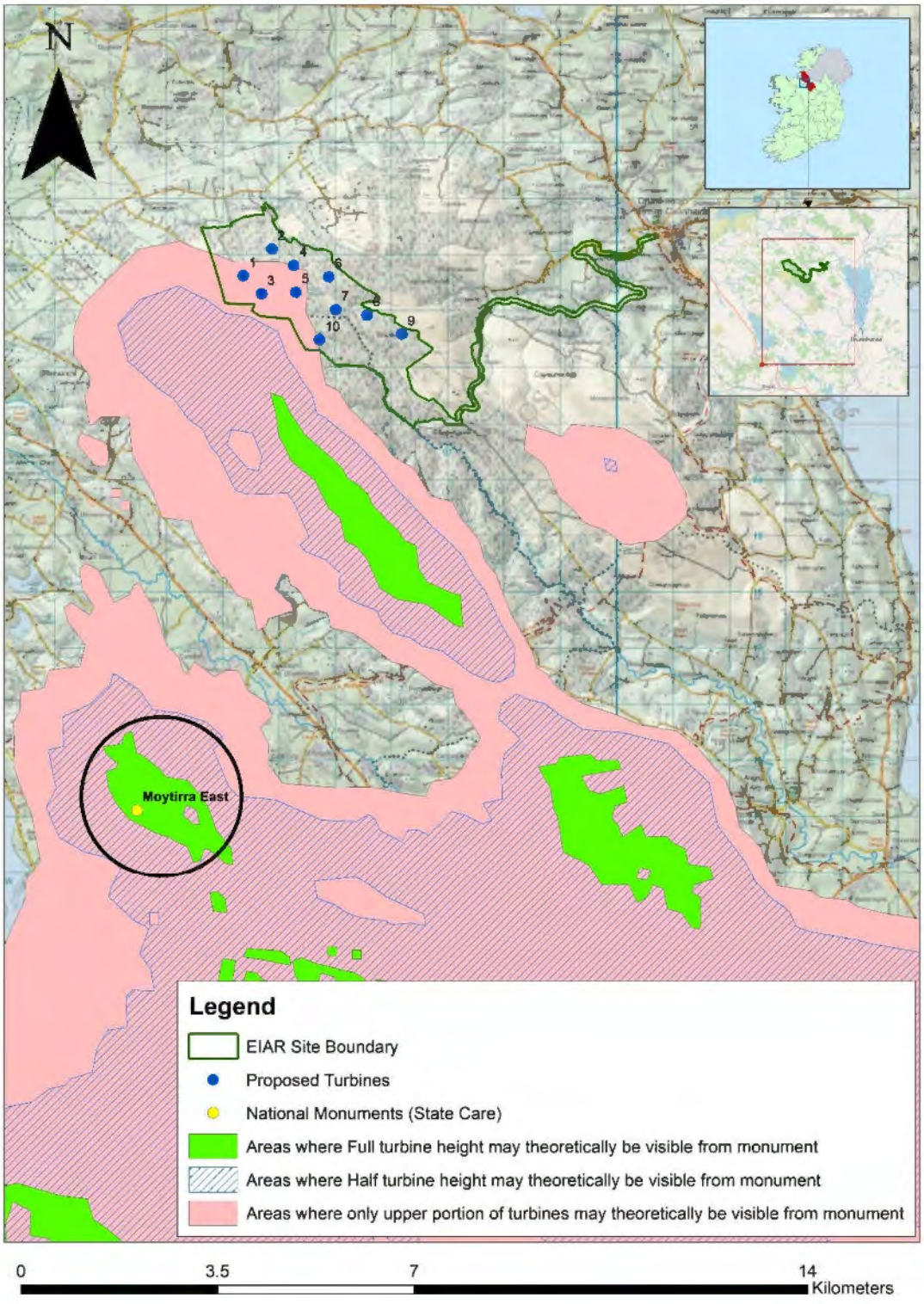

Figure 13-8 Viewshed Analysis showing theoretical visibility from Moytirra Court Tomb

13. .1.2 Recorded Monuments within the site boundary

No monuments subject to statutory protection as defined in the Record of Monuments and Places or Sites and Monument Record are located within the EIAR site boundary for the proposed wind farm. Furthermore none are located adjacent to the EIAR site boundary (Figure 13-9).

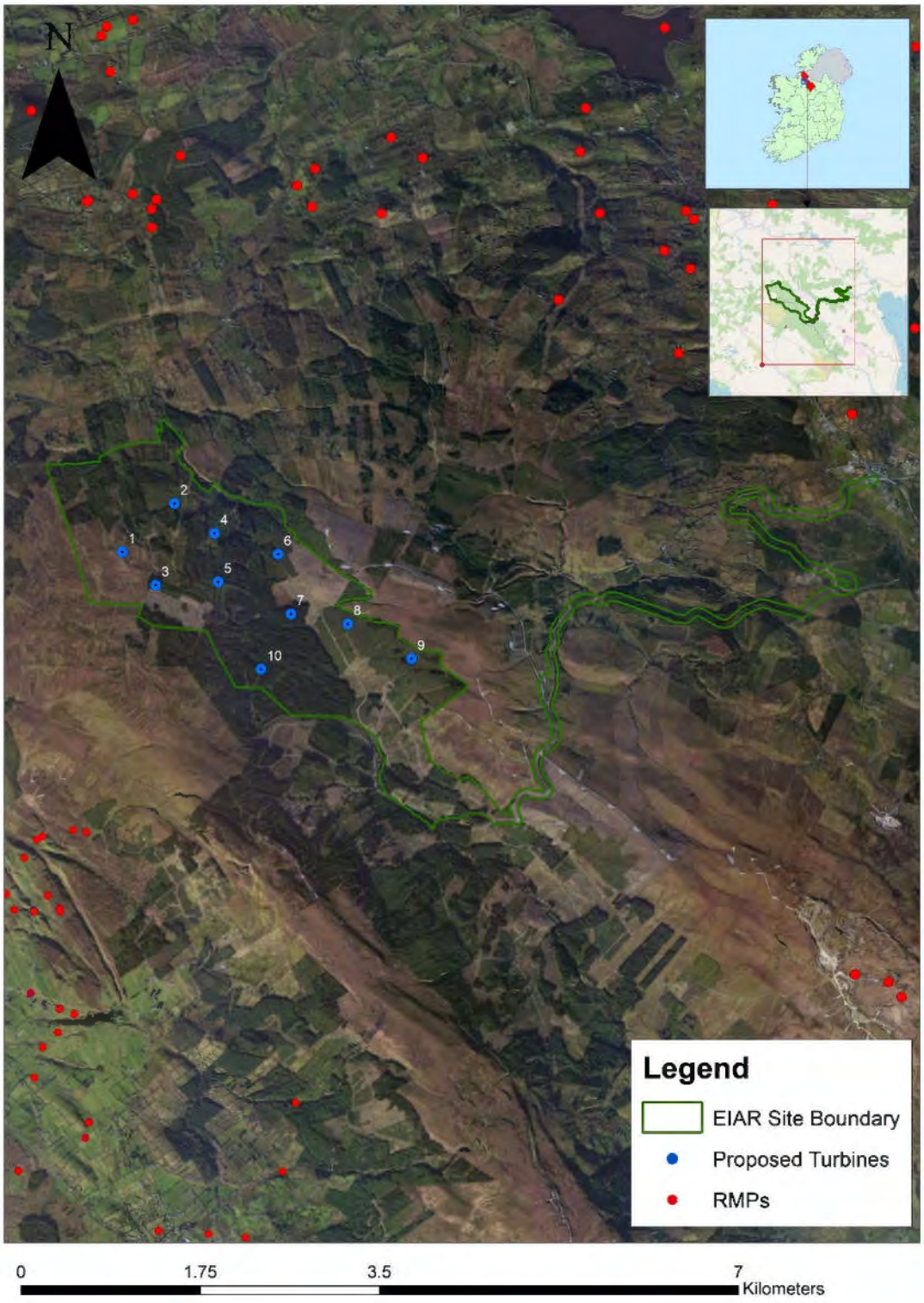

Figure 13-9 Note no RMPs within the EIAR site boundary or immediately adjacent to same.

13.3.1.3 Recorded Monuments within 5km of the proposed Turbines

Ninety-five monuments are located within 5km of the nearest proposed turbine and these are detailed below in

Table 13-3. Monuments within 5km of the nearest proposed turbines are included here for purposes of assessing impact on setting in the wider landscape setting, outside the EIAR site boundary (See Section 13.2.5 for methodology). The monuments are labelled from 1-95 for ease of reference on Figure 13-10. Monuments within 5 kilometres of the proposed turbines are included here for purposes of assessing potential visual impacts in the wider landscape setting. No monuments are located within 1km of the nearest proposed turbines. Only one monument (1%) is located between 1 and 2km of the nearest proposed turbine. Eleven monuments (12%) are located between 2 and 3km with 38 monuments located between 3 and 4km representing 40%. The majority of monuments are located between 4 and 5km representing 47% of the total. The immediate setting of the recorded monuments will not therefore be negatively impacted. Figure 13-10 demonstrates that the majority of the recorded monuments are located at a remove from the proposed turbines with a notable dearth of monuments within close proximity to the site.

Table 13-3: RMPs within 5km of the nearest proposed turbines

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
1	SL035-027	Sweathouse	Ballynashee	584886	817585	10	4912
2	LE015-137	Enclosure	Beagh	583604	826983	2	2880
3	LE017-003	Redundant record	Beagh	583607	826806	2	2703
4	LE015-169	Sweathouse	Beagh	583650	827080	2	2974
5	LE015-134	Ringfort - rath	Caddagh Glebe	582429	827947	2	4083
6	LE015-131	Ringfort - rath	Carrigeen	580935	827354	2	4347
7	SL035-022002	Souterrain	Carrowcashel	583000	818067	10	4733
8	SL035-022001	Ringfort - rath	Carrowcashel	582994	818062	10	4740
9	SL035-023	Ringfort - rath	Carrowcashel	582961	817912	10	4892
10	SL028-006	Ringfort - rath	Carrowmore	582489	820829	3	2742
11	SL028-016001	Moated site	Carrowmore	581526	820011	3	3926
12	SL028-016002	Hut site	Carrowmore	581526	820011	3	3926
13	SL028-017	Ringfort - cashel	Carrowmore	581928	820188	3	3568

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
14	SL035-003	Hut site	Carrowmore	581899	819759	10	3897
15	SL028-023	Cliff-edge fort	Carrowmore	582595	820270	10	3045
16	SL028-009	Redundant record	Carrowmore	582971	820902	10	2332
17	SL028-005	Ringfort - cashel	Carrowmore	582365	820650	10	2956
18	SL028-007	Ringfort - rath	Carrowmore	582544	820859	10	2686
19	SL028-008	Redundant record	Carrowmore	582843	820921	10	2415
20	SL028-018	Redundant record	Carrowmore	582190	820284	10	3326
21	SL028-019	Megalithic tomb - court tomb	Carrowmore	582265	820133	10	3374
22	SL028-020	Redundant record	Carrowmore	582462	820113	10	3251
23	SL028-021001	Ringfort - cashel	Carrowmore	582708	820147	10	3062
24	SL028-021002	Souterrain	Carrowmore	582713	820139	10	3065
25	SL028-021003	Enclosure	Carrowmore	582716	820114	10	3082
26	SL035-002	Ringfort - cashel	Carrowmore	581866	819818	10	3880
27	SL035-004	Ringfort - rath	Carrownadargny	581908	819465	10	4103
28	SL035-005001	Ringfort - cashel	Carrownadargny	582100	819518	10	3935
29	SL035-005002	Souterrain	Carrownadargny	582090	819510	10	3948
30	SL035-006	Ringfort - rath	Carrownadargny	581902	818821	10	4602
31	SL035-007	Ringfort - rath	Carrownadargny	582430	819322	10	3886
32	SL035-008001	Ringfort - cashel	Carrownadargny	582712	819172	10	3858
33	SL035-008002	House - early medieval	Carrownadargny	582712	819167	10	3863

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
34	SL035-009	Redundant record	Carrownadargny	582855	819117	10	3836
35	SL035-010	Ringfort - rath	Carrownadargny	582695	818939	10	4069
36	SL035-011001	Ringfort - rath	Carrownadargny	582544	818792	10	4271
37	SL035-011002	Hut site	Carrownadargny	582545	818798	10	4265
38	SL035-012	Redundant record	Carrownadargny	582462	818500	10	4566
39	SL028-011	Ringfort - rath	Carrownagilty	581134	820065	3	4108
40	SL028-001	Cairn - unclassified	Carrownagilty	582066	822036	3	2034
41	SL028-002	Ringfort - rath	Carrownagilty	581032	820847	3	3596
42	SL028-012	Castle - motte	Carrownagilty	581214	820086	3	4043
43	SL028-013	Graveyard	Carrownagilty	581203	820042	3	4085
44	SL028-014	Castle - motte and bailey	Carrownagilty	581231	820056	3	4057
45	SL028-022002	Hut site	Carrownyclowan	581473	820303	3	3714
46	SL028-022001	Ringfort - cashel	Carrownyclowan	581472	820293	3	3723
47	SL028-010001	Ringfort - cashel	Carrownyclowan	581392	820357	3	3719
48	SL028-003	Redundant record	Carrownyclowan	582129	821314	3	2511
49	SL028-010002	Souterrain	Carrownyclowan	581394	820369	3	3709
50	SL028-004	Ringfort - rath	Carrownyclowan	582069	820737	3	3022
51	SL028-015	Ritual site - holy well	Carrownyclowan	581422	820096	3	3913
52	LE015-145	Ringfort - rath	Cloonagh	587786	827545	6	4910
53	LE015-138	Ringfort - rath	Cloonbannive	583887	827507	2	3395

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
54	LE015-132	Ringfort - rath	Corglancey	581805	827623	2	4054
55	LE015-133	Ringfort - rath	Corglancey	581907	827466	2	3867
56	LE017-001	Ringfort - rath	Corglancey	581442	826597	2	3447
57	LE017-008	Ritual site - holy well	Corralustia	589526	825393	9	4389
58	LE017-012	Burnt mound	Corralustia	588748	825580	9	3961
59	LE015-139	Ringfort - unclassified	Corratimore Glebe	585023	827216	2	3325
60	LE015-140	Ringfort - rath	Corratimore Glebe	585200	827380	2	3543
61	LE015-141	Redundant record	Corratimore Glebe	585170	827009	2	3191
62	LE015-143	Ringfort - rath	Corratimore Glebe	585850	826943	6	3477
63	LE017-009	Burial ground	Derrinurn	589722	825375	9	4531
64	LE017-011	Ringfort - rath	Derrinweer	590437	824981	9	4912
65	LE015-130	Ringfort - rath	Dromore	581052	828194	2	4938
66	LE015-122	Ringfort - rath	Drumany (Drumahaire By.)	583203	828327	2	4262
67	SL027-160001	Ringfort - rath	Drummacool	580362	820145	3	4565
68	SL027-160002	Souterrain	Drummacool	580368	820131	3	4571
69	SL027-128	Sweathouse	Drumnasoohy	579972	821294	1	4089
70	SL027-157001	Sweathouse	Drumnasoohy	579158	821129	1	4862
71	SL027-157002	Well	Drumnasoohy	579233	821141	1	4792
72	SL027-158	Redundant record	Drumnasoohy	579265	820929	1	4879
73	LE015-120	Ringfort - rath	Flughanagh	583168	828767	2	4702

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
74	LE015-121	Ringfort - rath	Flughanagh	583116	828677	2	4621
75	LE015-123	Ringfort - rath	Flughanagh	583422	828834	2	4740
76	LE015-136	Redundant record	Garvagh Glebe	583418	827134	2	3050
77	LE015-146	Ringfort - unclassified	Glasdrumman More	587979	826945	6	4575
78	LE017-005	Designed landscape - tree-ring	Glasdrumman More	588607	826581	9	4686
79	LE017-007	Designed landscape - tree-ring	Glasdrumman More	588864	826403	9	4680
80	SL027-115	Enclosure	Glen	579112	821722	1	4626
81	LE014A002	Ringfort - rath	Greaghnafarna	579391	825832	1	4501
82	LE014A003	Ringfort - rath	Greaghnafarna	579561	825824	1	4350
83	LE015-115	Ringfort - rath	Killeen	581988	828684	2	4929
84	LE017-004001	Ringfort - rath	Lugmeeltan	587575	826096	6	3691
85	LE017-004002	House - indeterminate date	Lugmeeltan	587575	826101	6	3695
86	LE014A001	Ringfort - rath	Rathbaun, Sracurnmer	580292	826810	1	4386
87	SL027-100	Enclosure	Rooghan	578673	822462	1	4796
88	SL035-123	Sweathouse	Straduff	585015	818253	10	4254
89	LE015-142	Ringfort - rath	Sweetwood Upper	585942	827683	2	4148
90	LE015-170	Sweathouse	Treannadullagh	586252	827484	6	4117
91	LE015-135001	Ringfort - rath	Tullycoly	582969	827060	2	3071

Map ID	RMP NO.	DESCRIPTION	Td.	ITM E	ITM N	WTG ID	DISTANCE (M)
92	LE015-135002	Bullaun stone	Tullycoly	582986	827066	2	3072
93	LE017-002	Earthwork	Tullynascreen	581905	825583	1	2406
94	LE017-013	Mass-rock	Tullynascreen	582088	824819	1	1707
95	SL034-063	Ringfort - rath	Ummeryroe	580337	819663	3	4929

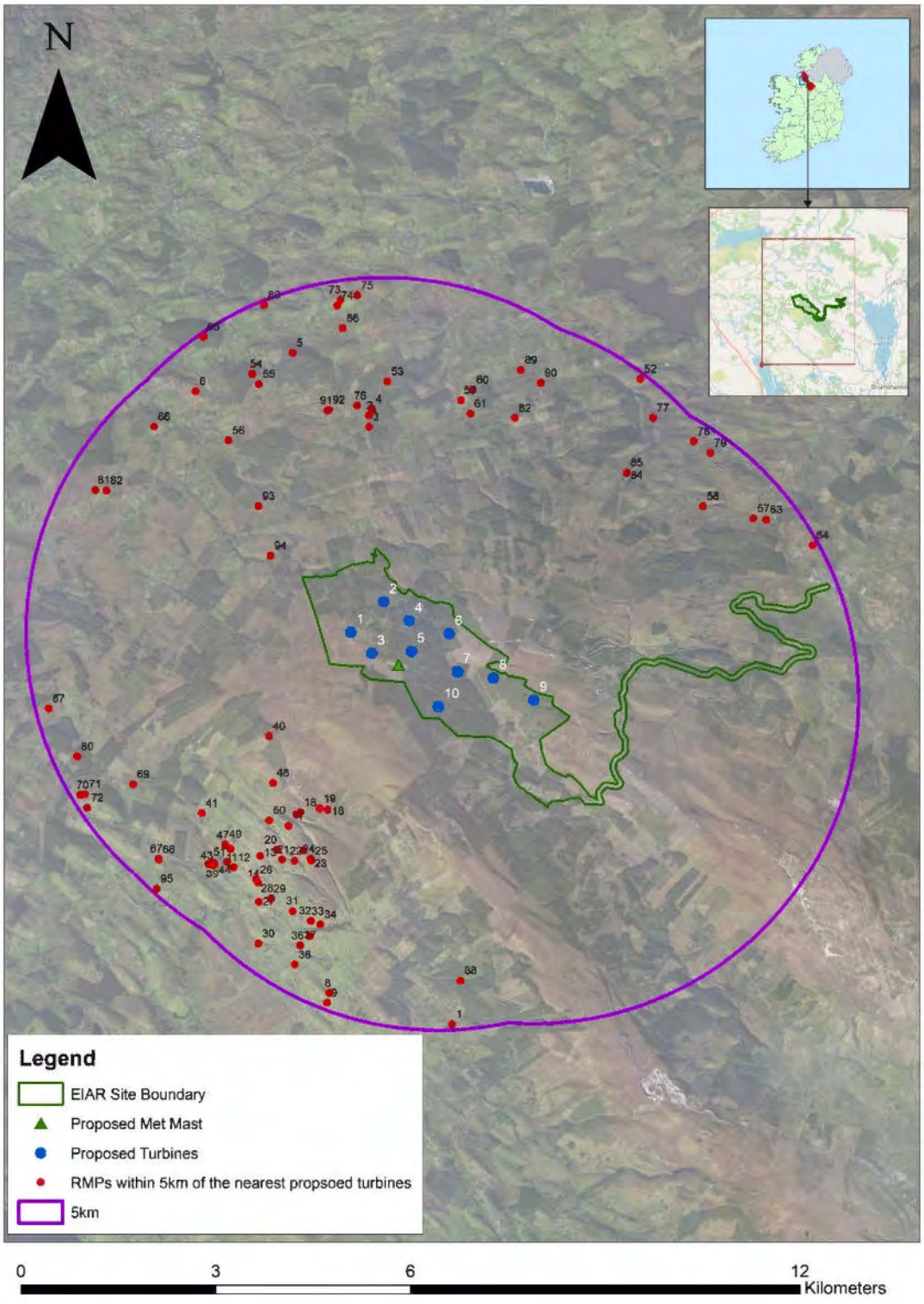

Figure 13-10 RMPs within 5km of the nearest proposed turbine.

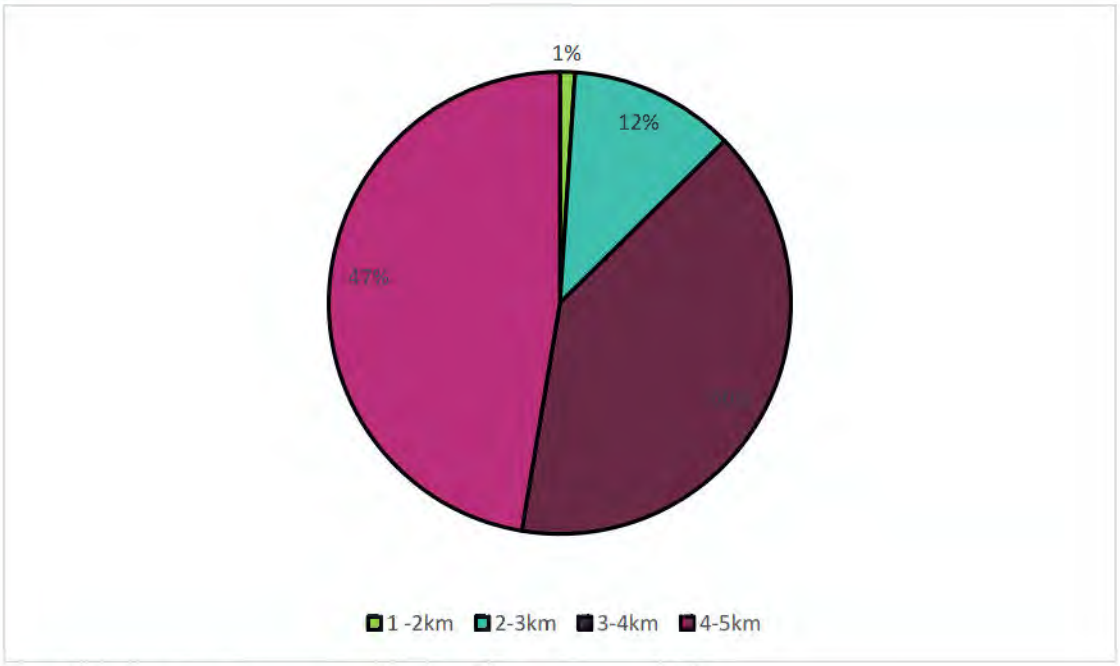

Figure 13-11: Percentages of monuments within 5km of the nearest proposed turbines

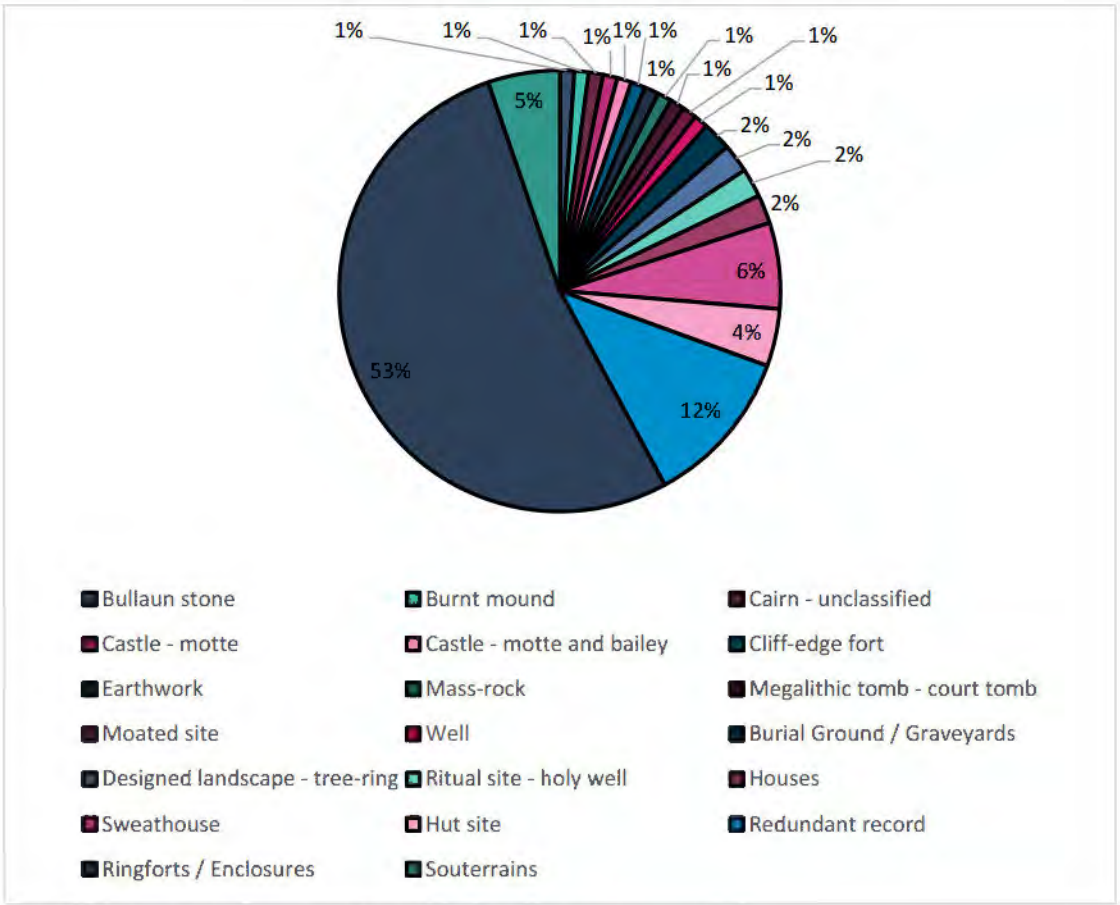

Figure 13-12: Percentages of monuments types within 5km of the nearest proposed turbines

13.3.1.3.1 The Prehistoric Period

The prehistoric period is poorly represented in the 5km study area with only one monument that can definitively be attributed to this period. Megalithic tombs are burial chambers, sometimes with an antechamber or small closed end-chamber. They are roofed by slabs laid directly on the side-walls which often have one or more rows of outer- walling. Unclassified examples of megalithic tombs cannot be classified as a court tomb, portal tomb, passage tomb or wedge tomb. These may date from the Neolithic to the Bronze Age (c. 4000 - c. 500 BC).

The megalithic tomb at Carrowmore is described as being located on a tract of level pasture on the lower W-facing slopes of a hill-range along the boundary between counties Sligo and Leitrim. The tomb is in an oval mound (21m E-W; max. 13.5m N-S; H 0.75m.). A fence runs into the N side of the mound from E and W. The remains of a gallery are preceded at the E by the S arm of an open court (L 6m), represented by four stones, which joins two stones of a flat facade. A single courtstone flanking the gallery entrance survives on the opposite side. Two jambs form the entrance to the gallery. A stone jammed between them is not in situ. The N side of the gallery is represented by an irregular line of stones extending for 5.5m to the W. Three stones at the opposite side of the gallery show that it extended at least 1m further in the same direction. (Ó Nualláin 1989, 59, no. 94).

A number of other monuments may date to the prehistoric period but their dates can span from prehistory through to the Medieval period (

Table 13-3, Figure 13-10 and Figure 13-12). One such site type is Hut sites 4% of which are located within 5km of the turbines. The primary function and date of hut sites is slightly ambiguous. Examples of hut sites are known throughout the country, particularly in upland regions, and are frequently associated with the practice of transhumance or booleying. Transhumance refers to the practice of the seasonal movement of people and their livestock typically to higher pastures in the summer and lower valleys in the winter. In Ireland this practice is known as booleying and is believed to date to the early medieval period, although it continued well into the nineteenth and early twentieth century.

Other uses for hillside huts has been noted at Mount Brandon, County Kerry, where it is suggested that they functioned as temporary habitations for seabourne pilgrims. It is also thought that they were used as habitation sites such as booleying huts during the year when pilgrimage was not taking place. An extensive series of pre-bog walls was also noted on the southern slopes of Mount Brandon. It is noted in that instance that although pre-dating the bog, the peat may still have been growing well into the medieval period. In this regard such walls could be early medieval in date rather than prehistoric (Archaeology Ireland Heritage Guide No. 29). Furthermore, the potentially lengthy chronology of hut sites means that while some may be prehistoric others may date to the early or later medieval period or indeed to more modern times (ibid.).

The site of an earthwork LE017-002 is located at Tullnascreen and is described as being located on a grass and rush-covered plateau, which is at the bottom of a N-facing slope. It is depicted faintly as a small circular area (diam. c. 20m) only on the 1835 edition of the OS 6-inch map. No feature is visible at ground level, and it is possible that a pond was intended. Earthworks are an anomalous earthen structure, usually raised and occurring in a variety of shapes and sizes, that on field inspection was found to possess no diagnostic features which would allow classification within another monument category. These may date to any period from prehistory onwards.

A burnt mound at Corralustia townland is situated in the S bank of a small WSW-ENE stream or drain on a gentle N-facing slope. An area of burnt stone in a black soil matrix (L 5m; T 1m) lies exposed along the bank of the stream. Again, this monument type may span from the Bronze Age (c. 2400-500 BC) to the early medieval period (5th - 12th century AD. They consist of a circular or irregularly shaped mound of material consisting of burnt stones, ash and charcoal with no surface evidence of a trough or depression. Levelled examples can appear as a spread containing burnt stones.

13.3.1.3.2 The Early Medieval Period

The majority of monuments (55%) consist of those which may be definitively attributed to the Early Medieval period and ringforts, enclosures and souterrains dominate the archaeological landscape within the 5km study area. Ringforts comprise earthen monuments while cashels take a similar form to the latter but are constructed using stone. Enclosures may represent the remains of ringforts or cashels but may not retain enough features to classify them as such or fall ontside the acceptable size range for these monuments. Ringforts consist of a circular or roughly circular area enclosed by an earthen bank formed by material thrown np from the digging of a concentric ditch on its outside. Ringforts are usually enclosed by a single bank (univallate) while bivallate or trivallate ringforts i.e. those enclosed by double or triple rings of banks are less common. The number of banks and ditches enclosing these monuments are considered to reflect the status of the site, rather than the strengthening of its defences. Archaeological excavation has shown that the majority of ringforts functioned as enclosed farmsteads, built during the Early Christian period (5th – 9th century A.D.). Excavation within the interior of the monuments has traced the remains of circular and rectangular dwelling houses as well as smaller huts probably used to stall animals. The enclosing earthworks would also have protected domestic livestock from natural predators such as wolves and foxes. Souterrains are frequently associated with ringforts, cashels and enclosures. Souterrains derive their name from the French sous terrain meaning 'under ground' and comprise an underground structure consisting of one or more chambers connected by narrow passages or creepways, usually constructed of drystone-walling with a lintelled roof over the passages and a corbelled roof over the chambers. Most souterrains appear to have been built in the early medieval period by ringfort inhabitants (c. 500 - 1000 AD) as a defensive feature and/or for storage.

Within the study area a number of enclosures are located at Tullynascreen, Beagh, Carrowmore, Glen and Rooghan townlands. Ringforts are located in numerous townlands including Carrowmore, Carrownyclowan, Carrownadargny, Tullycoly, Cloonbannive, Corratimore Glebe, Carrownagilty, Lugmeeltan, Corglancey, Caddagh Glebe, Sweetwood Upper, Drumany, Carrigeen, Greaghnafarna, Rathbaun/ Sracummer, Greaghnafarna, Drummacool, Flughanagh, Carrowcashel, Cloonagh, Derrinweer, Ummeryroe, Killeen, Dromore, Killanummery, Glasdrumnan More and Corralustia thus representing a wide geographic area for settlement.

13.3.1.3.3 Sites with religious or ritual association

A holy well (SL028-015) is located at Carrownyclowan and is located in pasture, at the base of a ridge. A clear spring rises at the base of the ridge and flows S. Modern holy plaques and statues indicate that this well is still visited. A recently bnilt stone wall encloses it. In 1836 it was noted that the Patron day was 25th July and that 'stations' were still performed at it (OSL, 245). In 1942-4 a local tradition was recorded that the well was moved by a local friar from a site beside Geevagh Creamery, c. 3.5km to SE, to its present location after the landowner objected to pilgrims visiting it (ITA). A tree now grows adjacent to the well. These sites comprise a well or spring, though in some unusual cases a natural rock basin, which usually bears a saint's name and is often reputed to possess miraculous healing properties. Holy wells may have their origins in prehistory but are associated with devotions from the medieval period (5th-16th centuries AD) onwards.

A second Holy Well LE017-008 is located at Corralustia and is situated in the valley of a small W-E stream on the N bank and probably at a point E of where a small NW-SE stream joins it. Tober Beoaid is listed amongst the holy places of north Leitrim in a seventeenth century manuscript (Mooney 1946, 67), and it was still frequented in the nineteenth century (O' Flanagan 1929, 134). It was associated with St Beoaidh of Ardcarn, Co. Roscommon (RO006-103002-) (Ó Riain 2011, 103). The well might still be extant, although it was not recognised in 1991.

A bullaun stone (LE015-135002) is located at Tullycoly and is situated on top of a drumlin. A D-shaped stone (dims 0.75m x 0.65m; H 0.15m plus) with a single basin (diam. 0.35m; D 0.12m) is set in the ground c. 4m E of the perimeter of rath (LE015-135001-). The lip of the basin is damaged at one edge. Bullaun stones may also have religious associations. The term 'bullaun' (from the Irish word 'bullán',

which means a round hollow in a stone, or a bowl) is applied to boulders of stone or bedrock with hemispherical hollows or basin-like depressions, which may have functioned as mortars. They are frequently associated with ecclesiastical sites and holy wells and so may have been used for religious purposes. Other examples which do not appear to have ecclesiastical associations can be found in bedrock or outcrop in upland contexts, often under blanket bog, and are known as bedrock mortars. They date from the prehistoric period to the early medieval period (5th-12th centuries AD).

13.3.1.3.4 Miscellaneous Monuments

A number of other site types within various periods are also represented and seem to occur in isolation with ouly one of each monument type represented (Figure 13-12). Eleven of these are now redundant records.

13.3.1.4 Archaeological Investigations undertaken within or adjacent to the proposed EIAR site boundary

Each townland within the proposed development site and adjacent to same was checked in the database of Irish excavations to ascertain if any archaeological investigations produced positive results. Two townlands produced results although no archaeological features were uncovered during monitoring. The following are extracts from the database of excavations.

2008:756 - Garvagh Glebe and Tullynahaw, Leitrim

County: Leitrim Site name: Garvagh Glebe and Tullynahaw
Sites and Monuments Record No.: N/A
Licence number: 08E0770
Site type: No archaeological significance
ITM: E 592203m, N 817549m

'Monitoring was undertaken from August to December 2008 at a development which involves the construction of two wind farms in counties Roscommon and Leitrim. The County Leitrim site, known as Garvagh Glebe, is split into a northern and southern section. The proposals include the construction of seven turbines in the northern section and six in the southern section. Eleven turbines are to be constructed at the Tullynahaw site in Co. Roscommon (see No. 1047 below). Both sites also require the construction of access roads and substations. The wind farm sites are located along a ridge which straddles County Leitrim to the north and County Roscommon to the south and which forms Corrie Mountain.
Monitoring was undertaken during the excavation of the 6m-wide access roads, the 40m by 20m hardstanding areas at the ends of the roads, and the area corresponding to a proposed electrical control building. No archaeological deposits have been encountered at Garvagh Glebe. Groundworks are expected to recommence in 2009 and the associated excavations will be monitored'.

2010:437 - Garvagh Glebe (Leitrim) and Tullnahaw (Roscommon), Leitrim

County: Leitrim Site name: Garvagh Glebe (Leitrim) and Tullnahaw (Roscommon)
Sites and Monuments Record No.: N/A Licence number: 08E0770
Site type: No archaeological significance
ITM: E 583254m, N 824731m
Latitude, Longitude (decimal degrees): 54.171278, -8.256469

'Monitoring was undertaken from August 2008 until July 2010 at a development which involves the construction of two wind farms in County Roscommon and County Leitrim. The County Leitrim site, known as Garvagh Glebe, was split into a northern and southern section. The proposals included the construction of seven turbines in the northern section and six in the southern section. Eleven turbines are to be constructed at the Tullynahaw site in County Roscommon. Both sites also required the construction of access roads and substations. The wind farm sites are located along a ridge which

straddles County Leitrim to the north and County Roscommon to the south and which forms Corrie Mountain. Monitoring was undertaken during the excavations but no archaeological deposits were encountered at either Tullynahaw or Garvagh Glebe and the groundworks have now been completed'.

13.3.1.5 Townlands and administrative boundaries

Townlands and administrative boundaries may indicate the presence of archaeological features within a development site. Administrative counties are subdivisions of pre-established counties which were formed for administrative purposes in the nineteenth and twentieth centuries. Baronies are administrative units larger than civil parishes and originally established as the primary subdivision of counties by the British administration in Ireland. Irish baronies which were formed at the time of the Norman conquest were usually named either after Irish territories, or from places which had been of importance in pre-Norman times. Irish baronies came into existence at different periods. The division of Ireland into counties and baronies was a process which continued down to the reign of James I. The original baronies in Ireland were the domains of the Norman barons; in the final stage of development they were divisions of counties created merely for greater convenience of administration. The word barony is of feudal origin, and was applied to a tenure of a baron, that is, of one who held his land by military service, either directly from the king, or from a superior feudal lord who exercised royal privileges. The origin of the Irish barony (a division of land corresponding to the English hundred) is to be found in the grants of lands which were made to the barons of Leinster and the barons of Meath (Liam Price, 'Ráith Oiun', Éigse VII, lch. 186-7). Civil parishes are administrative units larger than townlands and based on medieval ecclesiastical parishes. Civil parishes, modern Catholic parishes and Church of Ireland parishes may differ in extent and in nomenclature. Counties are administrative units larger than baronies and originally established by the British administration in Ireland between the twelfth and the seventeenth centuries. Some of these were subsequently subdivided into smaller administrative county units.

Townlands are the smallest land units which were determined and established in the Irish administrative system in the first half of the nineteenth century. Many of the townlands were in existence prior to that. Townland names are a valuable source of information, not only on the topography, land ownership and land use within the landscape, but also on its history, archaeological monuments and folklore.

The following townlands are those which are located within the EIAR site boundary for the main core wind farm site.

County	Leitrim
Electoral district -	Garbhach/Garvagh
Barony	Droim Dhá Thiar (Drumahaire)
Civil parish	Cill an Iomaire (Killanummery)
Townland:	Garbhach/Garvagh meaning Rough land. Talamh garbh, rough, uneven land. Coarse soil, or land of a rocky nature.

County	Leitrim
Electoral district -	Garbhach/Garvagh
Barony	Droim Dhá Thiar (Drumahaire)
Civil parish	Cill an Iomaire (Killanummery)
Townland:	Gléib Gharbhach/Garvagh Glebe also meaning Rough land.

County	Sligo
Barony	Tír Oirill/Tirerrill
Civil parish	Seanchuach/Shancough
Townland	Ceathrúin Uí Chlúmháin/Carrownyclowan (sub unit of townland refers to St James Well). According to the Ordnance Parish Namebooks there is a holy well at the south corner of the townland called St James's Well, at which stations are performed by the Roman Catholics. This well is described in Section 13.3.1.3.3 above.

County	Sligeach/Sligo
Electoral district	Seanchuach/Shancough
Barony	Tír Oirill/Tirerrill
Civil parish	Seanchuach/Shancough
Townland	An Cheathrú Mhór/Carrowmore meaning 'great quarter'

County	Sligeach/Sligo
Barony	Tír Oirill/Tirerrill
Civil parish	Seanchuach/Shancough
Townland	Ceathrú na Dairgní/Carrownadargny meaning quarter of the oak grove. There is also a reference to 'Old Forts' in the south of the townland in the Ordnance Survey Parish Namebooks (1836) '*There are two forts and two limestone quarries at the south end of the townland*'.

Although no locational information exists as to where the ringforts are located, a number of ringforts (RMPs) are situated in the southern half of the townland and these are discussed in Section 0 above.

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Buaile Mhig Uidhir/Boleymaguire meaning cattle-fold or summer-pasture or 'Mac Guire's Dairy place'.

The word Booley may suggest the presence of hut sites used for booleying. Examples of hut sites are known throughout the country, particularly in upland regions, and are frequently associated with the practice of transhumance or booleying. None are included in the RMP in the 5km study area however.

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Bráid Pháirce/Braudphark meaning neck or gorge of the park. Field of the gorge or pass. Brágha, means the neck or throat. In place-names it is often applied to a deep glen or deep pass

13.3.1.6 Topographical Museum Files

No finds spots within or immediately adjacent to the proposed development site were noted.

13.3.1.7 Cartographic Evidence

13.3.1.7.1 *Down Survey maps*

The Down Survey is a mapped survey undertaken in the mid-17th century. Using the Civil Survey as a guide, teams of surveyors, mainly former soldiers, were sent out under Petty's direction to measure every townland to be forfeited to soldiers and adventurers. The resulting maps, made at a scale of 40 perches to one inch (the modern equivalent of 1:50,000), were the first systematic mapping of a large area on such a scale attempted anywhere. The primary purpose of these maps was to record the boundaries of each townland and to calculate their areas with great precision. The maps are also rich in other detail showing churches, roads, rivers, castles, houses and fortifications. Most towns are represented pictorially and the cartouches, the decorative titles, of each map in many cases reflect a specific characteristic of each barony.

The Down survey Map for the parish of Killanummery (Leitrim) shows the area of the proposed wind farm as mountainous and bog and depicted as Protestant lands. The section of the site in Sligo (Barony of Tirrarril) is also depicted as boggy and mountainous.



Figure 13-13 Down Survey map (http://downsurvey.tcd.ie/down-survey-maps.php#bm=Drumaheir&c=Leitrim&p=Killarga)

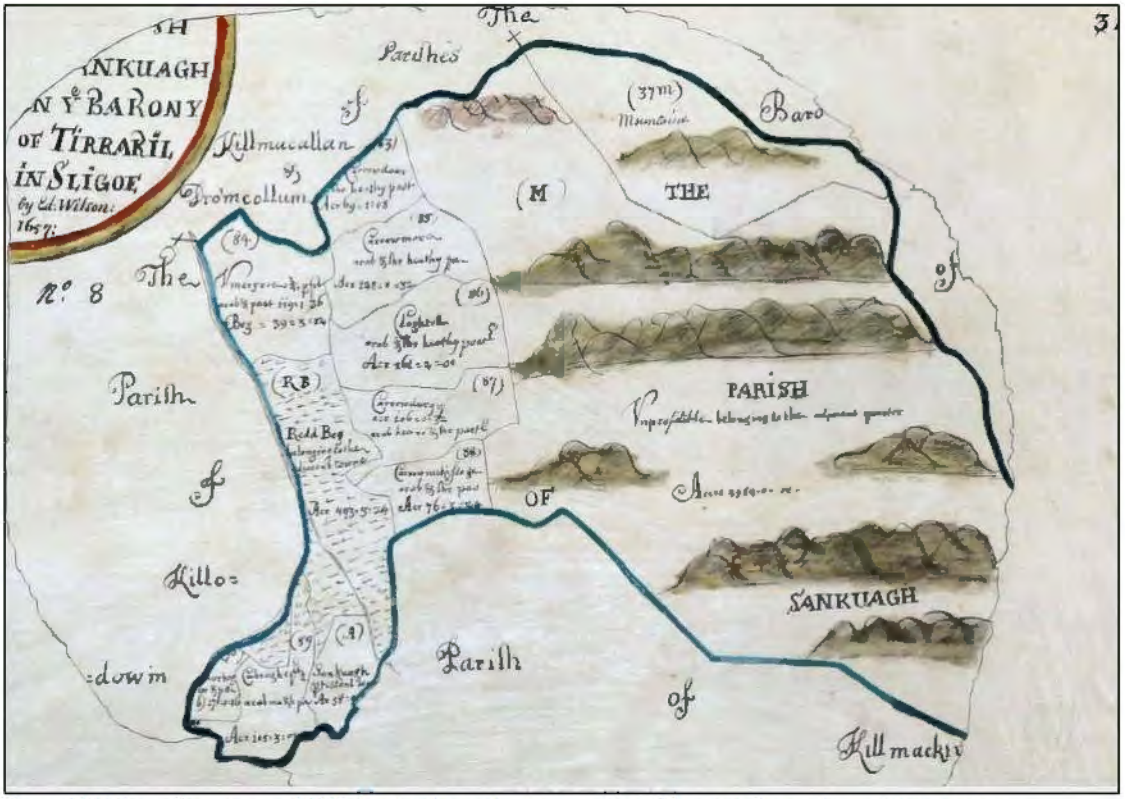

Figure 13-14 Down Survey map of 1657 showing the south-western section of the site in bog and mountainous pasture.

The Barony of Tirrarril (Sligo) is described in the Down Survey as follows: '*The Barony of Tirerill Part of this barony is course Mountaneous Pasture and at the South End thereof hath some wood affording*

Timber for ordinary Buildings. The rest of this Barony consisteth of moist ground there being in every part or hill of Land for the most part Arable Meadow and pasture in some parts healthy and in some parts woody with Red Bog in some parts necessary fore fireing But in other parts too great abundance thereof altogether unprofitable. The East part of the Barony from Killery Southward is fittest for grazeing and sowing of Oates, but the best for all other sorts of Grayne. There is not any considerable River in the barony but the River called Vnshinagh comeing out of Logharnagh and running through the said barony [and meeting the rivers of] Owenmore and Owenslew at the Castle of Cowloong where the two Baronies of Tirerill and Leyney meet together and from thence into the sea being only a mile distant from the place where the two Rivers meet'.

13.3.1.7.2 1st and 2nd Edition OS maps

The Ordnance Survey came to Ireland in 1824 in order to carry-out a precise admeasurement of the country's 60,000 or so townlands as a preliminary to the larger task of reforming Ireland's local taxation system. The townland boundaries were demarcated by a Boundary Commission, and the Ordnance Survey had the task of measuring them. In addition to boundaries the maps are truly topographical in content. Drawn at the large scale of six inches-to-one-mile (1:10,560) it was important to mark all buildings, roads, streams, placenames, etc, that were required for valuation purposes. Ultimately the maps were used as a basis for the rateable valuation of land and buildings in what became known as Griffith's Valuation. Working from north to south, the survey began in Antrim and Derry in 1829 and was completed in Kerry in 1842. It was published as thirty-two county maps between 1832 and 1846, the number of sheets per county varied from 153 for County Cork to 28 for Dublin, each of the 1,994 sheets in the series depicting an area 21,000 by 32,000 feet on the ground. Each county was projected on a different central meridian and so the maps of adjacent counties do not fit neatly together at the edges. Map content stops at the county lines.

The First Edition

The early Ordnance Survey maps are an unrivalled source for the period immediately before the Great Irish Famine (1847-50) when the population was at the highest level ever recorded. The maps depict a densely settled, highly articulated landscape.

The Second Edition

When the original survey began it did not include field boundaries and they did not appear on the maps. This policy was reversed in 1838 after a number of northern counties had been published. Therefore when the country was completed in 1846 the counties of Antrim, Armagh, Derry, Donegal, Down, Fermanagh, Monaghan, and Tyrone were resurveyed to add field boundaries. Subsequently this general revision was extended to other counties because of change in the post- Famine landscape. Survey work was curtailed in 1887 when the government agreed to survey the country at the larger scale of 1:2,500.

The 1st edition OS map was consulted to ascertain the presence or otherwise of additional features of potential archaeological value (not documented thus far). No features were noted and the lands appeared to be largely unenclosed with few features of note. The 2nd edition OS map shows a change within the area of the proposed development with many more boundaries and small settlements within the site.

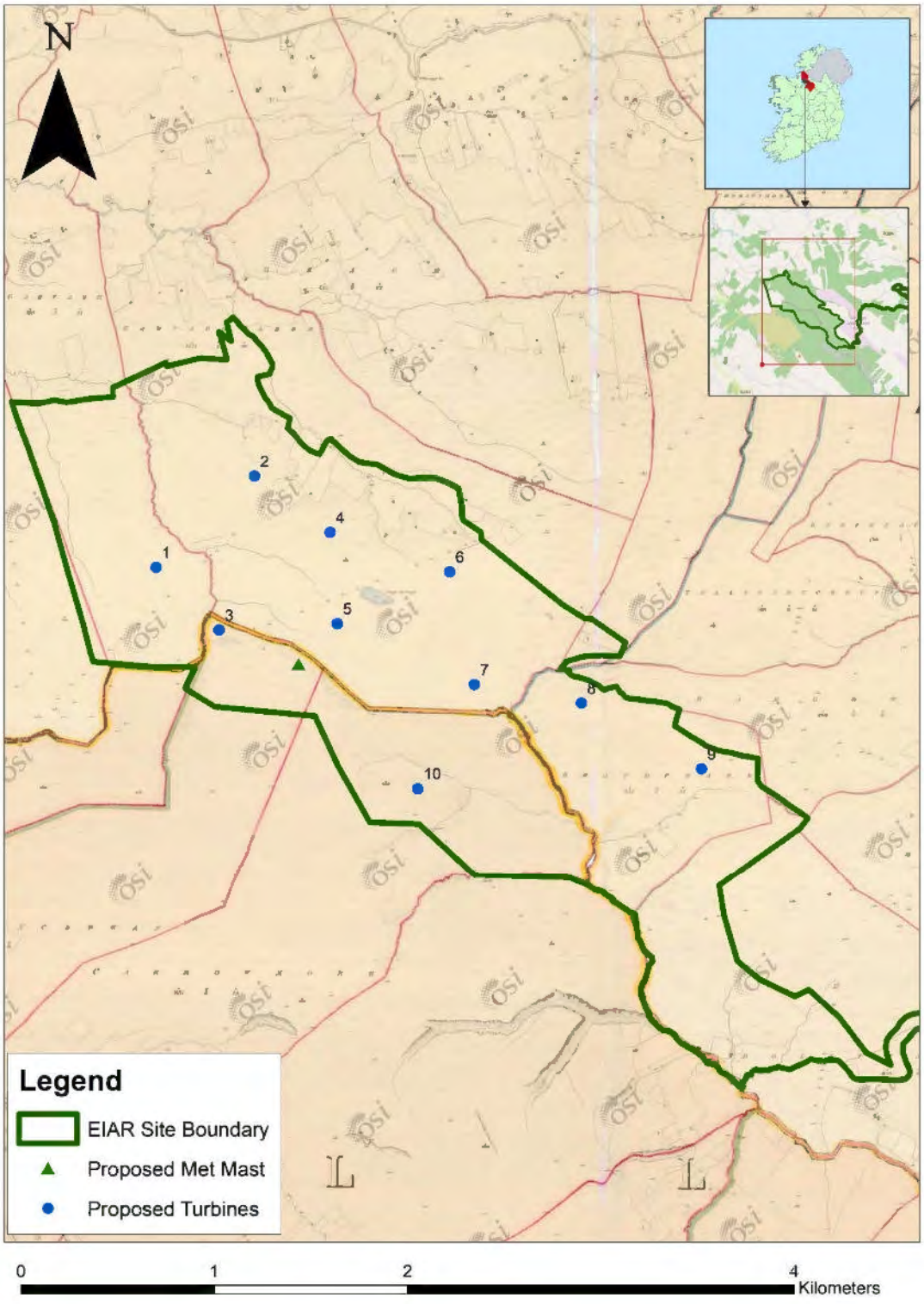

Figure 13-15 1st Edition OS map (1835-6) in the area of the proposed turbines.

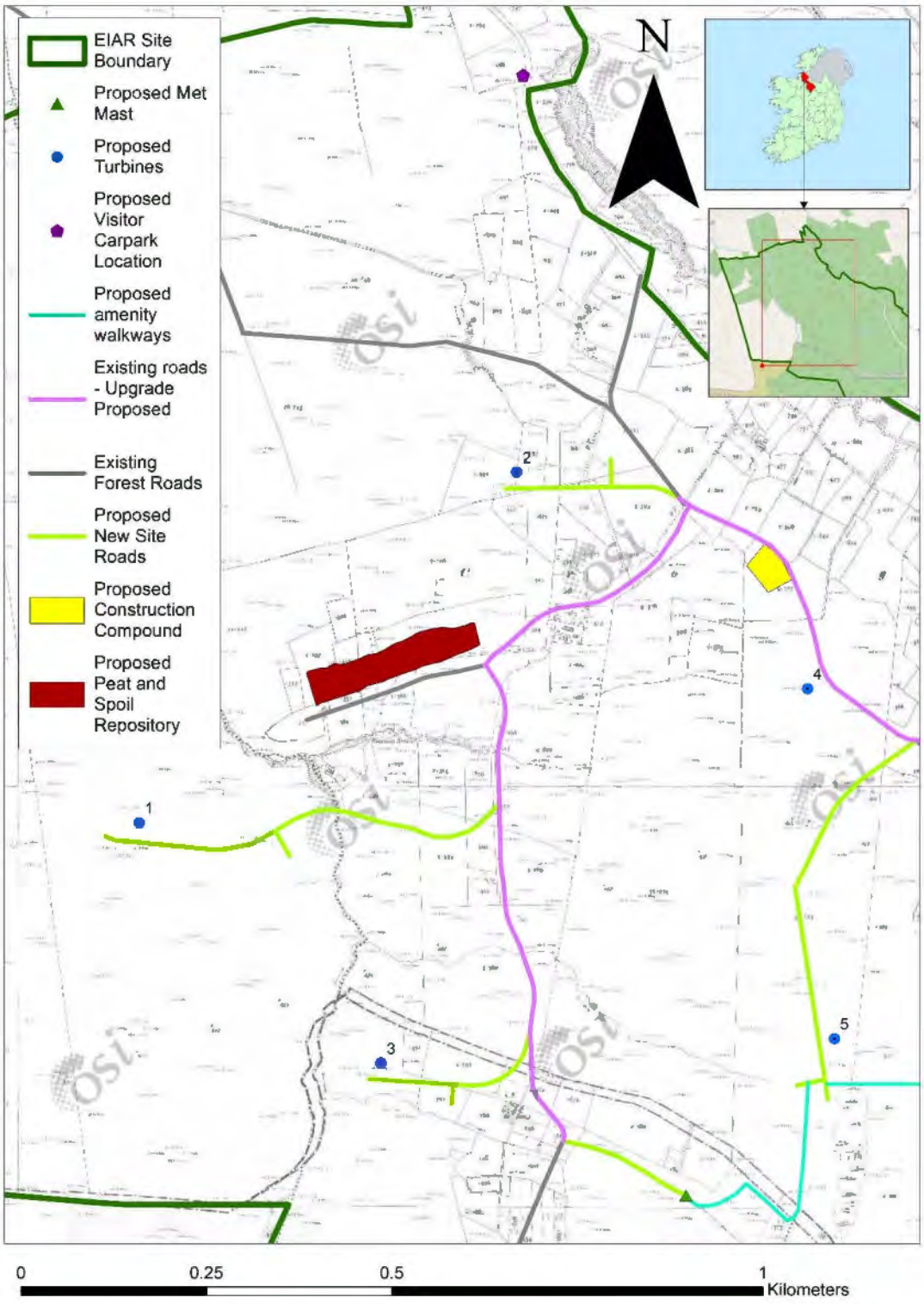

Figure 13-16 2nd edition 25 inch OS map (north-west) (1882-7)

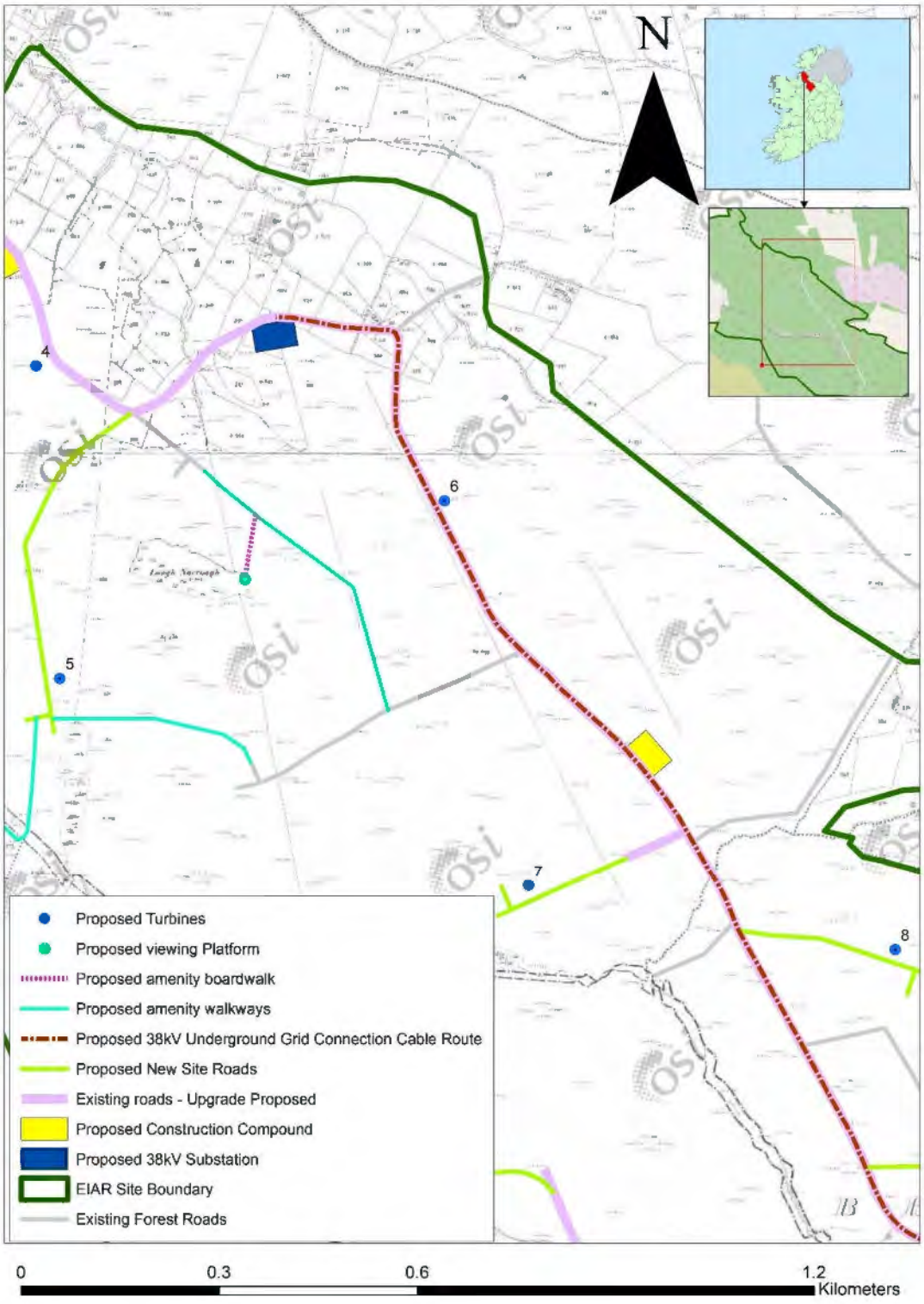

Figure 13-17 25 inch OS map (centre)

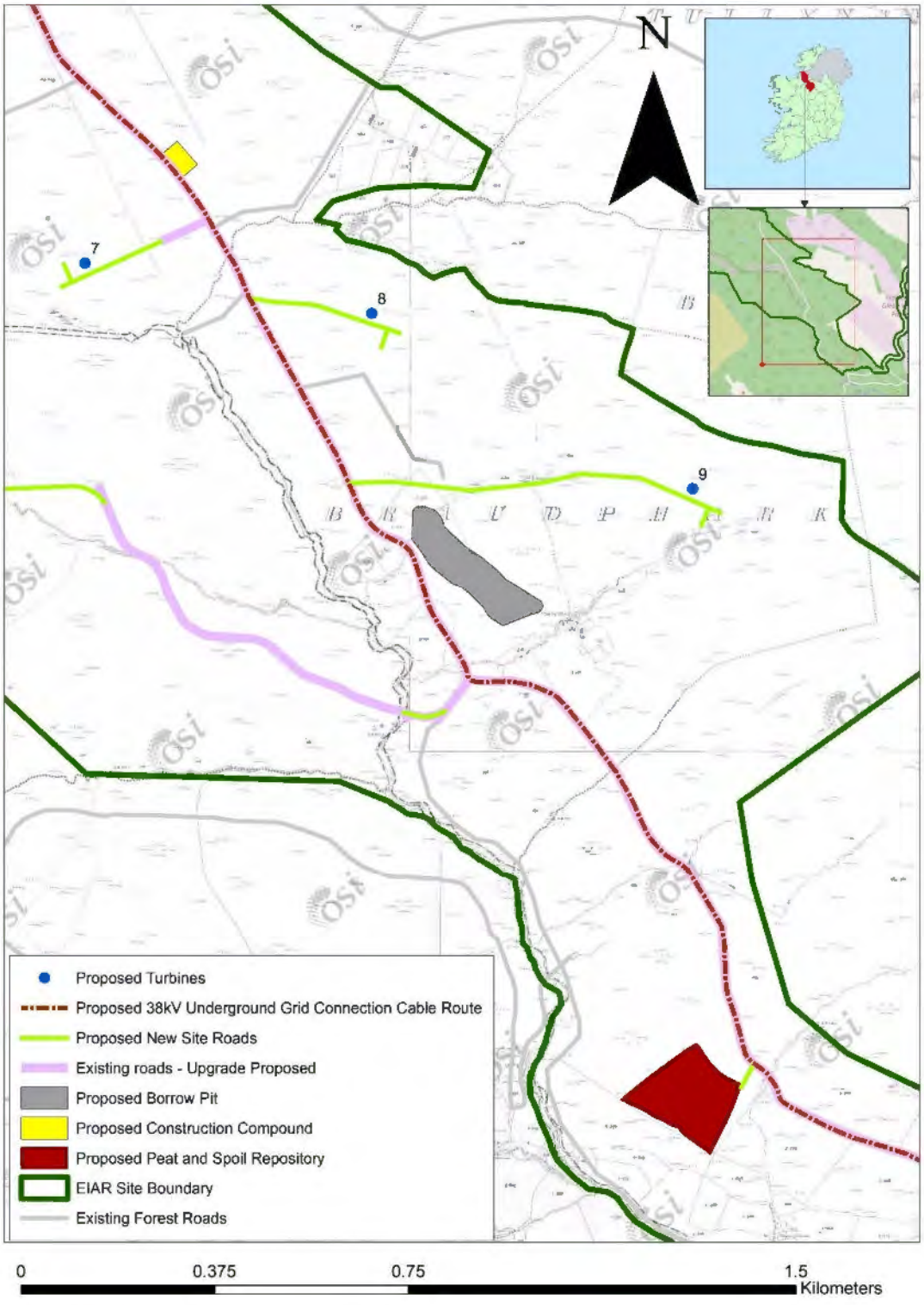

Figure 13-18 25 inch OS map (south-east)

13.3.1.8 Lewis Topographical Dictionary of Ireland

The south-western portion of the site is within County Sligo in the parish of Shancough. One reference to St James Well is mentioned in this description. '*A parish, in the barony of TIRAGHRILL, county of SLIGO, and province of CONNAUGHT, 9 miles (N. by E.) from Boyle, on the road from Sligo to Ballyfarnon; containing 1208 inhabitants. It is situated on the confines of the county of Leitrim, and comprises S909¾ statute acres, as applotted under the tithe act, of which a large portion consists of mountain and bog; some of the land, however, is good; limestone bounds, and iron-ore is supposed to exist in the mountains. It is a vicarage, in the diocese of Elphin, forming part of the union of Kilmactraney; the rectory is inpropriate in Alex. Perceval, Esq. The tithes, amounting to £33. 4. 7½., are payable in equal portions to the impropriator and vicar. In the R. C. divisions also the parish forms part of the union or district of Kilmactrany. A "Patron" is annually held on July 25th at St. James's Well*'.

13.3.1.9 Description of the proposed EIAR study area

It is proposed to upgrade approximately 11.1km of existing roads/tracks and to constrnct approximately 7.5km of new wind farm site roads. The recreation and amenity proposals include the construction of 1.1km of new amenity walkways (3m wide, floating road construction), 100m of wooden board walk leading to a proposed viewing area next to Lough Nacroagh and a proposed visitor car park located adjacent to an existing access road approx.. 540m north of T2. It is proposed that amenity traffic will access the site from the north and that no upgrade is required to the existing junction or access road leading to the car park. The proposed borrow pit measures approximately 20,930 sq. metres, the northerumost peat repository area measures approx. 9,760 sq. metres and the southernmost peat repository measures approx. 24,770 sq. metres (as described in Chapter 4 of the EIAR).

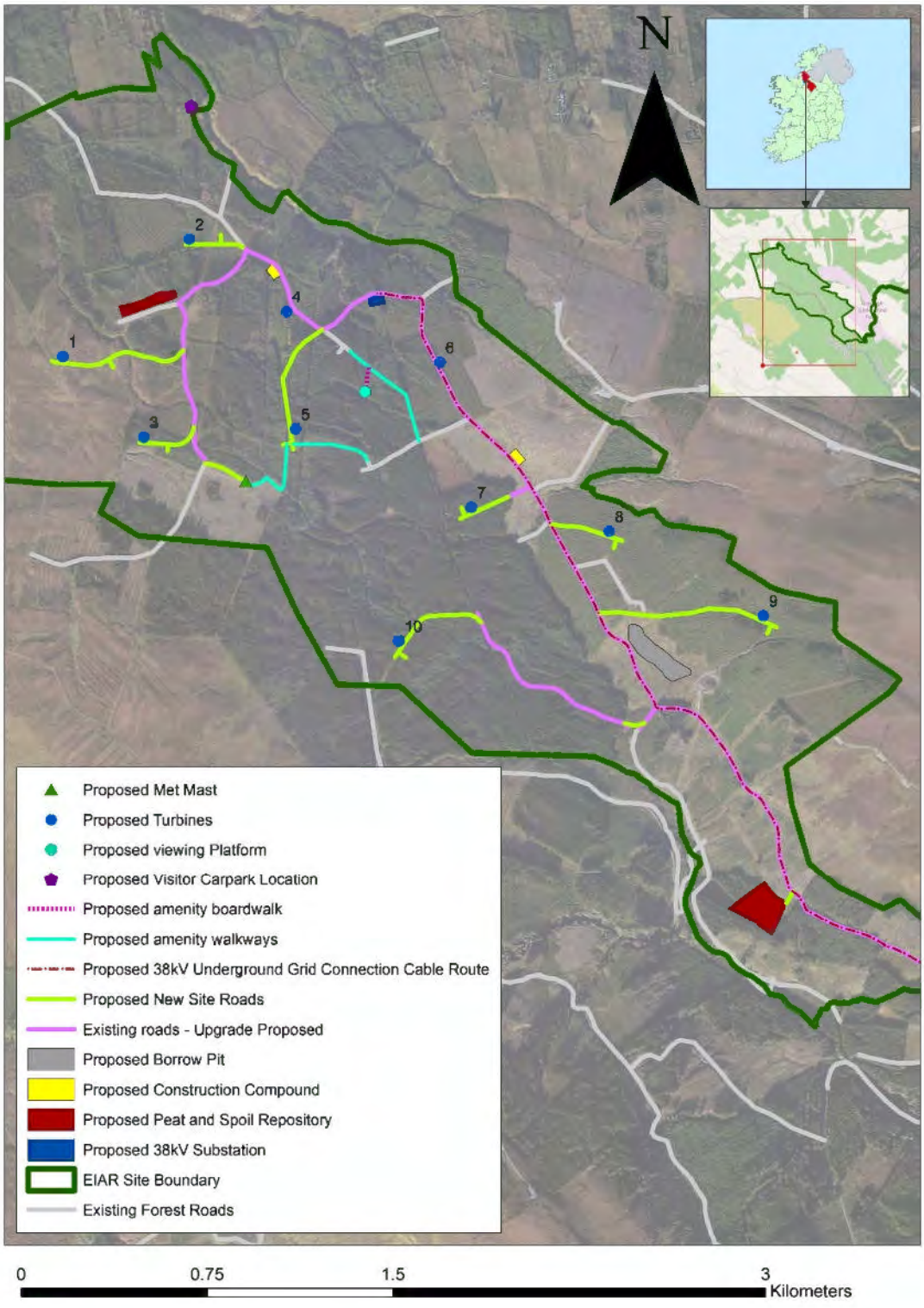

Figure 13-19 Site layout – see descriptions below.

13.3.1.9.1 Turbine 1

This is located in open bog land in the western side of the planning application site boundary. The proposed road extends through open land from forestry further to the east.



Plate 13-5 Location of Turbine 1 looking NW.



Plate 13-6 Area through which new proposed road will extend from forestry as far as Turbine 1.

13.3.1.9.2 Turbine 2

This is located approximately 690m to the north-east of T1 and within forestry.



Plate 13-7 Proposed new road from existing forestry road to T2 looking East.



Plate 13-8 Continuation of new road to T2

13.3.1.9.3 Turbine 3

This is located 460m to the south-east of Turbine 1 and is situated in forested ground. The proposed road also extends through forestry from an existing forest road to the east.



Plate 13-9 Vicinity of Turbine 3 looking south.

13.3.1.9.4 Turbine 4

This is also located in mature forestry and is situated adjacent to an existing forest road to the east.



Plate 13-10 Vicinity of Turbine 4 looking south-west

13.3.1.9.5 Turbine 5

This is located in dense forestry *c.* 470m to the south of T4. Approximately 500m of new road is required to be constructed from the north for access to Turbine 5.



Plate 13-11 Terrain through which new road to T5 is required to be constructed, looking south



Plate 13-12 Clear felled and re-planted ground through which new road to T5 will be constructed, looking West.



Plate 13-13 Proposed location of T5 looking north

13.3.1.9.6 Compounds

Two temporary construction compounds are proposed to be located within the site, one to the north of T4 situated adjacent to an existing forest road and a second to the north-east of T7.



Plate 13-14 Southern construction compound looking north.



Plate 13-15 Southern construction compound towards the centre looking NNW.



Plate 13-16 Northern compound looking W.



Plate 13-17 Southern compound from existing track looking W.

13.3.1.9.7 Turbine 6

This is proposed to be located within forestry to the east of an existing forest road.



Plate 13-18 Existing forest road adjacent to T6. Arrow indicates location of T6 (approx.).

13.3.1.9.8 Borrow Pit

One borrow pit is proposed to be located to the west of T9 turbine.



Plate 13-19 Proposed borrow pit looking south from northern extent.



Plate 13-20 Borrow pit looking south/south-east.



Plate 13-21 Borrow pit looking NE.

13.3.1.9.9 Turbine 7

Turbine 7 is proposed to be located in clear felled ground. The proposed road will extend from an existing forest road to the east/northeast also through clear-felled ground.



Plate 13-22 Proposed road to T7 looking south-west



Plate 13-23 Hardstand of turbine 7 looking southwest.

13.3.1.9.10 Turbine 8

This is located 560m to the east of Turbine 7 on the eastern side of the existing forest road.

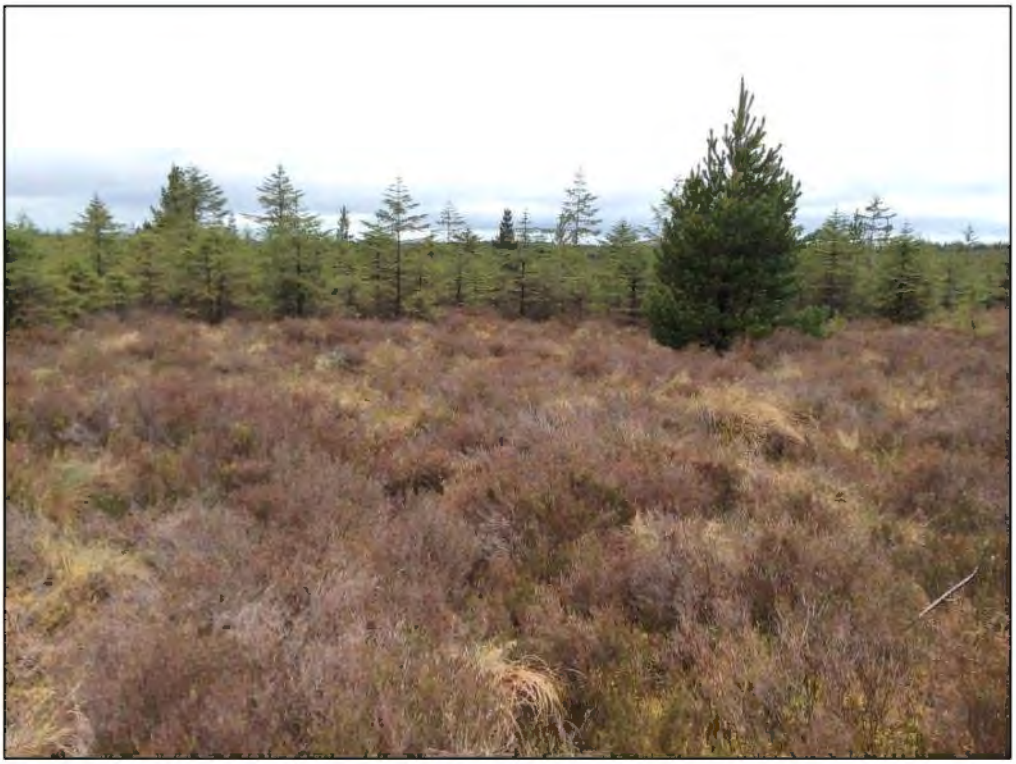

Plate 13-24 Area of proposed road to Turbine 8 looking north-west



Plate 13-25 Continuation of new road through forestry looking south-east



Plate 13-26 Vicinity of proposed turbine looking west.

13.3.1.9.11 Turbine 9

This is located in forestry and is accessed by a new road which will be constructed through forestry also.



Plate 13-27 Location of T9 looking south-east.



Plate 13-28 Hardstand of Turbine 9 looking west.



Plate 13-29 Proposed new road to T9 looking west.



Plate 13-30 Proposed new road to T9 looking west

13.3.1.9.12 Turbine 10



Plate 13-31 View towards Turbine 10 in forest fire-break.

13.3.1.9.13 Proposed peat Repository areas

The northern peat repository area consists of both clear-felled sections and mature forest.



Plate 13-32 Northern Peat Repository looking west.



Plate 13-33 View of western section of proposed peat repository area looking NE.



Plate 13-34 Track to the south of the peat repository area looking E.



Plate 13-35 General context of proposed southern peat repository area looking south consisting of both young and mature forestry.



Plate 13-36 Proposed southern peat repository area from the east looking west.

13.3.1.9.14 Proposed Met Mast

The proposed met mast is located to the south-west of turbine 5 in an area of young forestry.



Plate 13-37 General area of the proposed met mast looking SE from proposed road to the NW.

13.3.1.9.15 Proposed Amenity Areas

A number of amenity walkways and a viewing point are proposed as well as a visitor carpark in the northern section of the EIAR site boundary. The amenity link roads are proposed to be located in the general vicinity of Turbines 4-6.



Plate 13-38 Proposed location of boardwalk looking S



Plate 13-39 Proposed location of viewing platform looking west from eastern side.



Plate 13-40 Proposed location of viewing platform looking west from eastern side.



Plate 13-41 Section of amenity walkway to the east of the viewing platform, looking NW along firebreak.



Plate 13-42 Continuation of proposed amenity walkway in a southerly direction.



Plate 13-43 Proposed amenity track looking north where it meets an existing forest track.



Plate 13-44 Section of proposed amenity track to the SE of T5 through clear-felled forestry looking W.



Plate 13-45 Same section of proposed amenity trail looking East through clear-felled and drained forest.



Plate 13-46 General vicinity of proposed visitor car park in the northern section of the EIAR site boundary.

13.3.1.9.16 *Proposed Electricity Substation*

The proposed electricity substation is located to the south of an existing road which is due for upgrade. The site is largely inaccessible due to mature forestry. Extensive views to the north are possible from this location as some clear-felling has taken place to the north of the existing road.

13.3.2 Architectural and Cultural Heritage – The proposed wind farm

13.3.2.1 Protected Structures and NIAH within the proposed windfarm site boundary

No built heritage structures which are subject to legal protection are located within the wind farm site boundary.

13.3.2.2 Protected Structures and NIAH within 5km of the nearest proposed turbines

The RPS for Counties Leitrim and Sligo are largely based on the NIAH and therefore the NIAH structures within 5km are presented here with their distances to the nearest proposed turbines.

Table 13-4: NIAH within 5km of the nearest proposed turbines

NIAH	NAME	TOWNLAND	ITM E	ITM N	Distance to Turbine
30917001	Glasdrumman House	Glasdrumman More	588720	826734	4.8km to T9
30807001	water pump	Drumkeeran [Drum. By.]	590413	824618	4.8km to T9
30807003	Kelly House	Lugmeen	590642	824410	4.8km to T9
30807005	House (Sheena)	Sheena	590769	824220	4.9km to T9
30807006	Drumkeeran Church of Ireland Church	Sheena	590873	824089	4.9km to T9
30807004	Drumkeeran Court House	Lugmeen	590718	824360	4.9km to T9
32402709	Saint Columbs Roman Catholic Church	Drumnasoohy	579305	820913	4.9km to T3

The distance of the proposed turbines from the structures is such that no direct impacts will occur. The setting of the buildings within Drumkeeran village does not extend beyond the urban limits of village itself. The ZTV suggests that 3 turbines may theoretically be visible from Drumkeeran but this is based on a bare landscape model with no vegetation or tree cover. Impacts on setting are considered to be 'not significant' as discussed in detail in section 13.4.3 below.

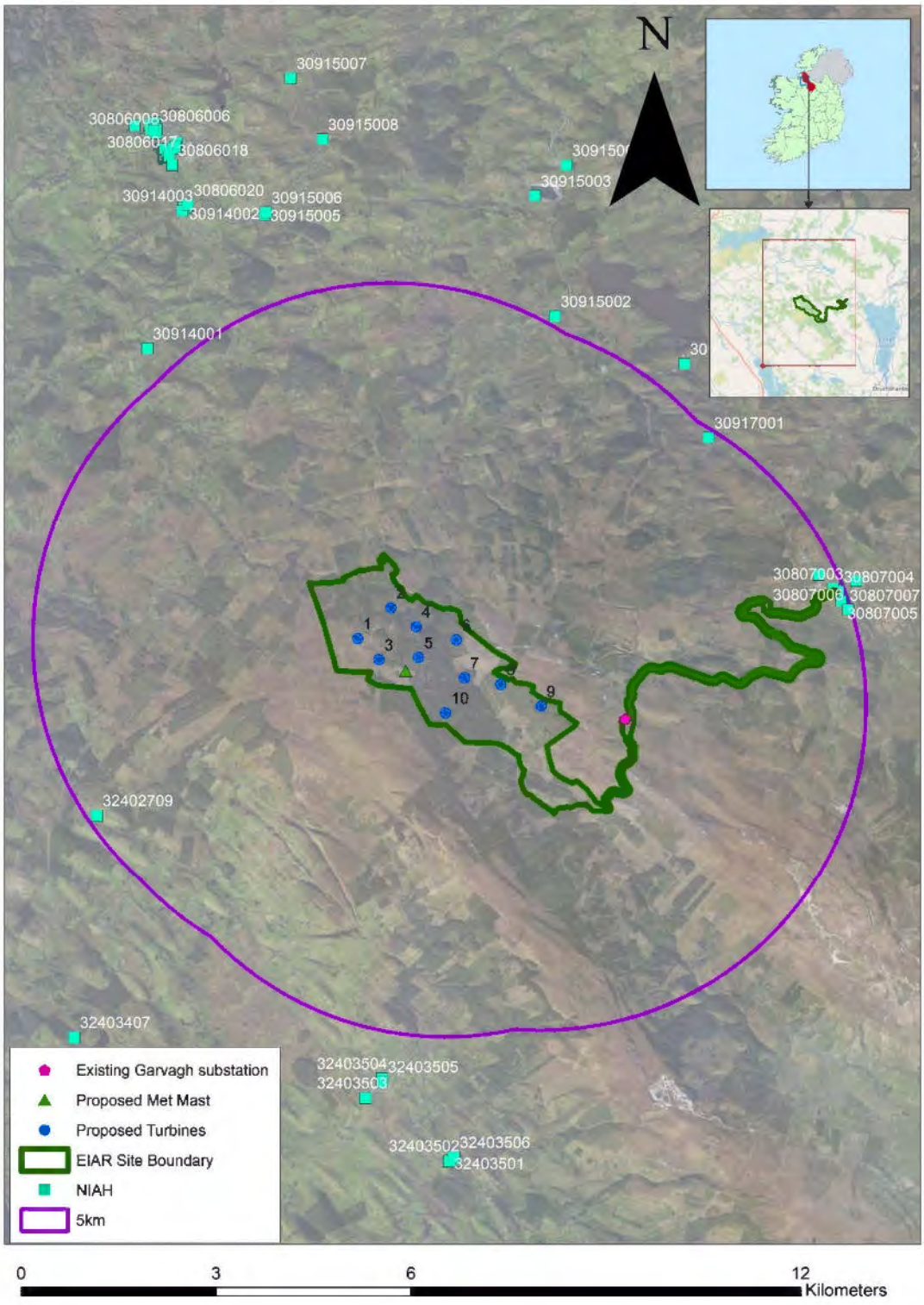

Figure 13-20 Built Heritage within 5km of the nearest proposed turbine

13.3.2.3 Local Cultural Heritage Features

A derelict stone house is located on high ground to the north of the existing road (ITM E586746, N821241) towards the south-eastern end of the site. This structure is marked only on the 2nd edition OS map and not the earlier 6 inch 1st edition. This structure will be preserved in situ as no infrastructure is proposed to be located in the vicinity. No mitigation measures are required.

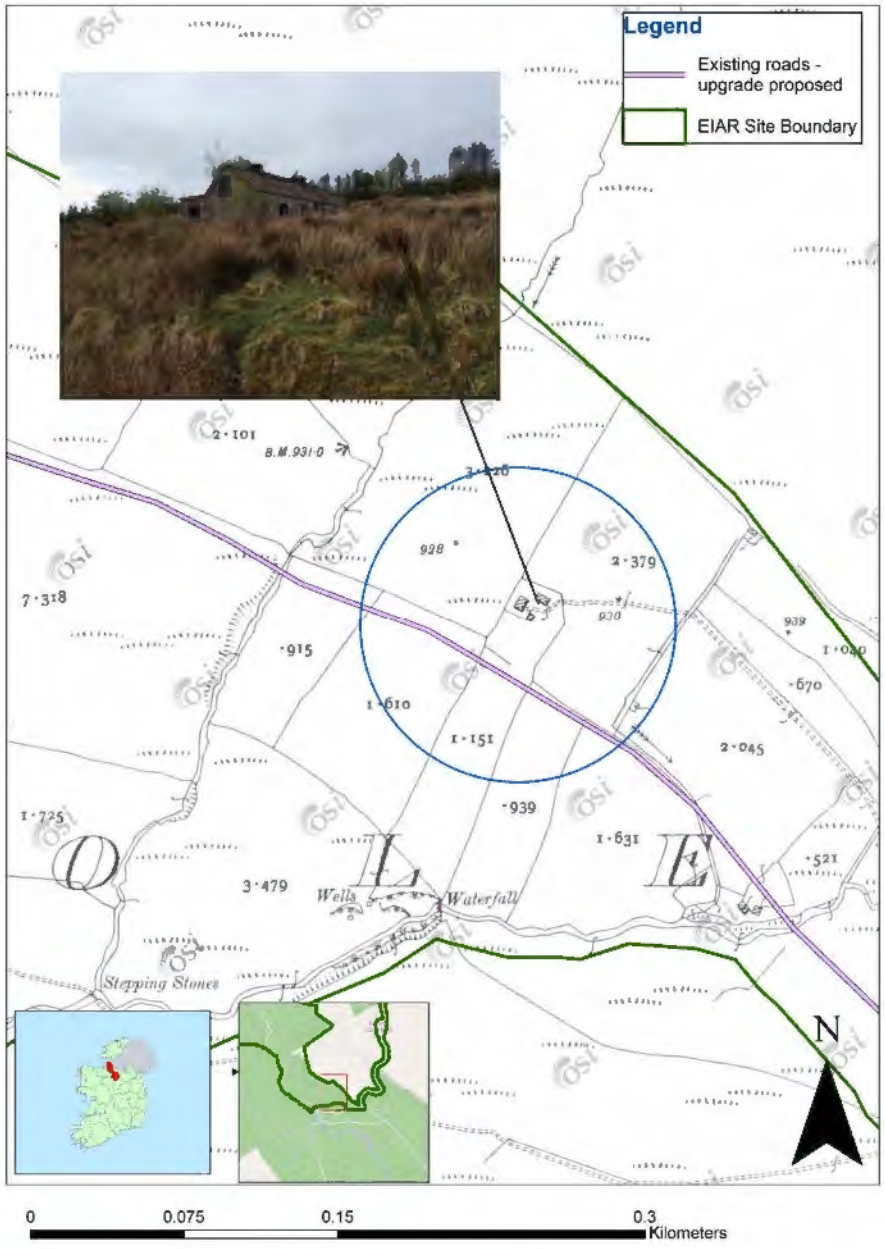

Plate 13-47 House marked on 2nd Edition OS map of late 1800s.

13.3.3 The Proposed Underground Grid Connection Cable Route

A grid connection route was assessed as part of the EIAR and extends from the proposed substation within the EIAR site boundary to the existing substation at Garvagh (to the East of the proposed wind farm). Constraints within 100m of either side of the proposed cable route were considered in the assessment. Monuments whose physical extents are within the 100m study area but whose centre points (National Monuments Service centre point red dots) are outside the 100m are included in the assessment. The route is located in County Leitrim and extends through Boleymaguire, Braudphark, Garvagh Glebe and Seltan townlands.

13.3.3.1.1 *Archaeology*

No National Monuments in State Care or Recorded Monuments are located along the proposed Grid connection cable route. No impacts to the known recorded archaeological resource will occur therefore. The route is located along an existing forest road within the site boundary and thereafter along a public road as far as the existing Garvagh substation.

13.3.3.1.2 *Architectural and Cultural Heritage*

No known structures listed in the statutory list of Protected Structures are located along the proposed grid connection route. Furthermore, no structures listed in the NIAH are located along the route. One structure (19th century house/settlement) is depicted on the 25 inch Historic map in the townland of Garvagh Glebe and is situated just to the north of the existing forest road to the east of the proposed substation site. This area is now under forest cover. The house was not located during survey and it is likely that the structure is no longer extant (Plate 13-56).

13.3.3.1.3 *Description of the route*



Plate 13-48 Existing Garvagh substation looking north



Plate 13-49 Existing road along grid connection cable route looking south



Plate 13-50 same as above looking south



Plate 13-51 Grid connection cable route looking south



Plate 13-52 Continuation of proposed grid connection cable route looking north (within site boundary)



Plate 13-53 Continuation of proposed grid connection cable route looking north (within site boundary)



Plate 13-54 Continuation of proposed grid connection cable route looking north (within site boundary)



Plate 13-55 Continuation north of proposed grid connection cable route looking north (within site boundary)



Plate 13-56 No surface trace of house structure marked on 25 inch historic map

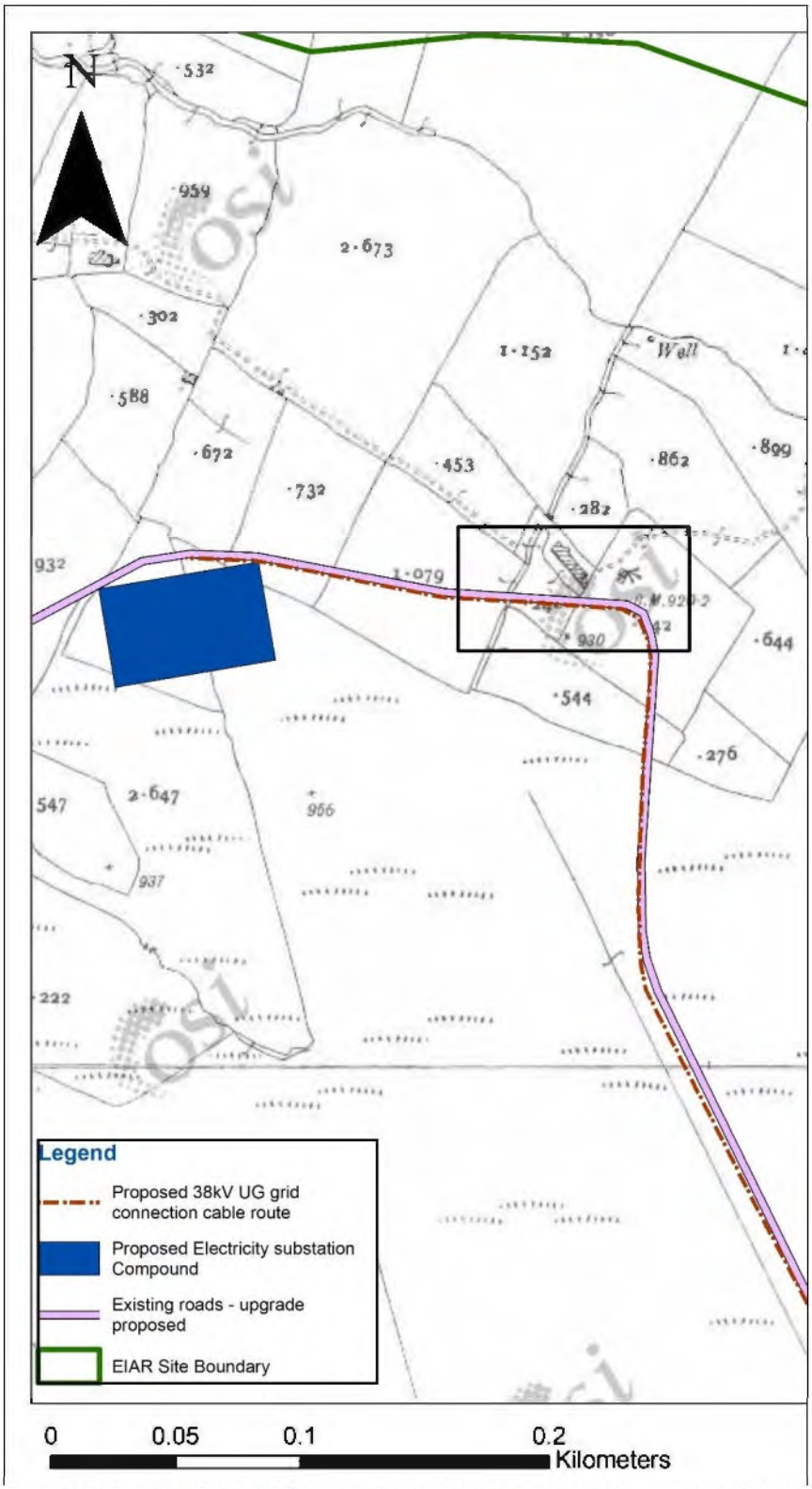

Figure 13-21 Location of 'site of 19th century dwelling house to north of grid connection cable route.



Plate 13-57 Route of proposed grid connection cable route looking west before it reaches the site of the proposed substation

13.3.4 Construction Access Road

HGVs and vehicles delivering large turbine components and other abnormal loads to the site of the proposed development will turn west off the R280, in Drumkeeran village, into an existing farmyard. In this yard, there will be partial demolition of a small agricultural storage building and the removal of the rear wall of the larger, livestock shed to allow vehicles to continne through the yard. Once through the larger shed, the vehicles will continue west on a proposed new road, measuring approximately 260m, through agricultural land before turning south onto the L4282 in the Derryboffin. The vehicles will travel west along the L4282 before turning south at the new proposed construction site entrance in the townland of Derrycullinan. (Note: Road widening works will take place in agricultural land between the two 90-degree bends on the L4282 just before the construction site entrance. This is required to facilitate the delivery of large turbine components and other abnormal loads. The field boundary will be reinstated using stockproof fencing and the hardcore area will be allowed to revegetate)

The vehicles will continue south along a combination of proposed new site roads and existing forestry roads that will be upgraded before turning west in the towuland of Derreens.

The route is also described in detail in Chapter 4 of the EIAR and below.

13.3.4.1 National Monuments in State Care, Recorded Monuments, RPS and NIAH

No documented constraints are located along the section of the proposed access road from the core wind farm site as far as the regional road R280.

13.3.4.2 Townland Boundaries

Townland names can be a valuable source of information, not ouly on the topography, land ownership and land use within the landscape, but also on its history, archaeological monuments and folklore. A number of townland boundaries are located along the route of the proposed construction access road and these are as follows:

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Dereens meaning Little oakwoods

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Barragh Mor meaning great bare land, shorn land

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Drummanacappul (Droimne an Chapaill) meaning ridge of the horse

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Tinnybeg (An Tinne Beag) meaning little field (1836).

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Bargowla (Barr Gabhla) meaning Top of the fork or forked place.

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Seltan (Sailtean) meaning A place of willows or sally trees. Sailtean, according to Dr. Joyce, is a diminutive form of sail, a willow, an osier. "Sailtean – seven townlands in Co. Leitrim named Seltan.

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland:	Lisfuiltaghan (Lios Phuilteacháin) meaning Lios-Fhuilteacháin = Foltaghan's fort or ring-fort of (the) marshy place

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	DERRYCULLINAN (Doire Chuileannáin) meaning O'Cullenan's oak-wood.

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Derryboffin, Doire Bó Finne meaning wood of the white cow

County	Liatroim/Leitrim
Barony	Droim Dhá Thiar/Drumahaire
Civil parish	Inis Mac Rá/Inishmagrath
Townland	Sheena, Siánaigh meaning place of fairy mounds, hillocks. There are references to Folklore in the Schools Collection on Logainmn.ie. There is a reference to forts in the townland of Sheena and Modorragh (to the east of the latter). The forts are described in the following extract '*There are 3 or 4 forts in this district. They are called forts. Number I is in the townland of Sheena. Number II is also near the school in the townland of Madarragh, and is in view of number 1. Number III is in the district of Kilmore in a field belonging to a man called Campbell. It is a long distance from this school, and no person knows the name of the townland Name since found Lisnanerris. Number IV is about 3 miles north west from here on the road leading to Dromahaire in a field belonging to a man the name of Gillooly In the parish of Killargue. they are all circular in shape, there is a hedge around them. No entrance is in the centre or elsewhere, no body has ever gone down through the hole or explored the*

interior. Once there was a man passing by number IV and he was put astray' (The Schools' Collection, Volume 0204, Page 043).

One enclosure (LE018-033) is located 900m to the SE of the proposed construction access road so no impacts will occur.

Impacts are addressed in Section 13.4.2.8 below.

13.3.4.3 Water Crossings

Rivers, streams and their banks have a high level of archaeological potential. Sites adjacent to watercourses have been favoured since prehistoric times for their proximity to food sources (often represented by habitation sites, fulachta fiadh and middens. Rivers and streams also serve as routeways, defences and ritual sites and boundaries. River beds may also contain archaeological features associated with fording sites, early bridge crossings and milling activities such as mill races. Three water crossings are proposed as part of the construction access road and these are largely located at the junction of townland boundaries as detailed above.

13.3.4.4 Description of the proposed construction access road

No documented constraints are located along the proposed construction access road including National Monuments, Recorded Monuments, NIAHs or RPS. The route was examined and assessed for the presence of previously unknown constraints. The route is described below from east to west.



Plate 13-58 Route of proposed construction access road where it commences at the east, looking west.



Plate 13-59 Proposed construction access road to the rear of agricultural sheds, looking west in low-lying marshy ground.



Plate 13-60 Looking NW towards construction access road in low-lying marshy ground.



Plate 13-61 Construction access road from public road to west looking east towards agricultural sheds and Drumkeeran.



Plate 13-62 Section of third-party lands where some road widening will take place, looking north over Derrycullinan Td.



Plate 13-63 Continuation north of section of road widening at Derrycullinan Td.



Plate 13-64 Section of proposed construction access road along existing road looking NW in Derrycullinan townland.



Plate 13-65 Continuation of construction access road looking SE along existing section of road.



Plate 13-66 Section of existing track in Dereens townland where the proposed construction access road enters scrub and forestry (to right of photo).



Plate 13-67 Proposed water crossing at Drummanacappul / Derrycullinan Td.



Plate 13-68 Continuation south of proposed construction access road through forestry, looking E.



Plate 13-69 Proposed Construction Access road through Tinnybeg Td. Looking NE through forestry.

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Plate 13-70 Proposed construction access road through Tinnybeg Td. Looking NW along existing track.



Plate 13-71 Continuation west of proposed construction access road looking west where it extends into mature forest.



Plate 13-72 Proposed construction access road where it extends through forestry from public road at Bargowla Td.



Plate 13-73 Continuation of proposed construction access track in a southerly direction along public road looking north.



Plate 13-74 Continuation of proposed construction access road along public road (some road widening may be required here).



Plate 13-75 Proposed construction access road along existing road where upgrade works are proposed, looking south



Plate 13-76 Continuation south of proposed construction access road looking north.



Plate 13-77 Continuation of proposed construction access road along existing road where upgrade works are required, looking south



Plate 13-78 Proposed construction access road along existing road where upgrade works are required, looking west



Plate 13-79 Entrance into core wind farm site looking north-west.

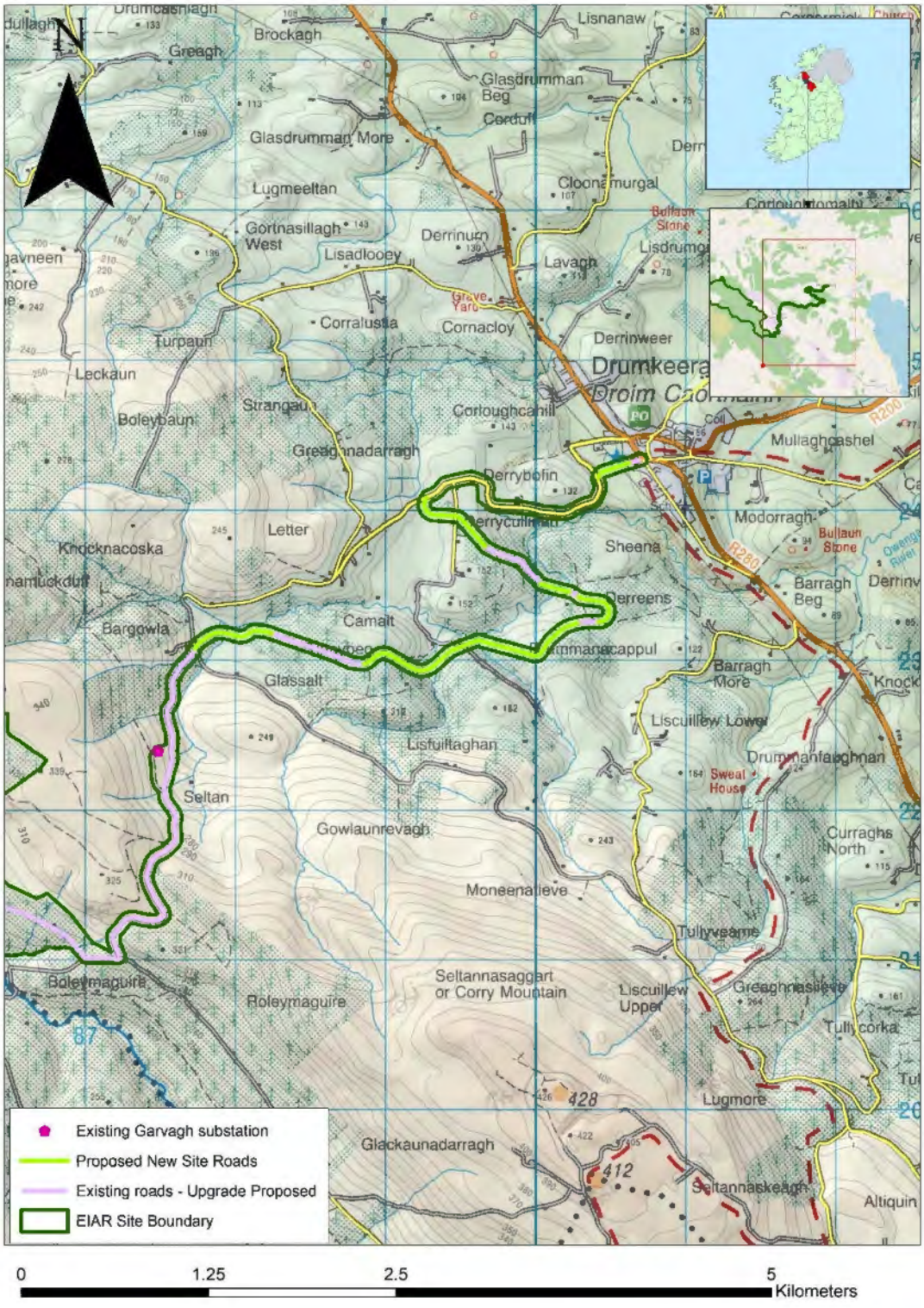


Figure 13-22 Proposed construction access road between R280 Regional road and proposed core wind farm site.

13.4 Likely Significant Effects and Associated Mitigation Measures

13.4.1 Construction Phase Potential Impacts (Indirect)

Indirect effects, in terms of archaeology, architectural and cultural heritage are considered to be those effects which happen away from 'the site'. This includes impacts on visual setting of any cultural heritage asset in the wider landscape. Since these effects are only possible once the proposed turbines are constructed, they are considered operational effects and are therefore discussed in Section 13.4.5 below. No indirect effects were identified which would occur at the construction stage.

13.4.2 Construction Phase Potential Impacts (Direct)

Direct Impact refers to a 'physical impact' on a monument or site. The construction phase of the development consists largely of earthmoving activities such as peat and topsoil removal. The potential impacts on the known and potential archaeological, architectural and cultural heritage of the area are outlined below with the suggested mitigation measures. The impacts are described according to each element of the Proposed Development, turbines, grid connection, delivery route. Where any potential direct impacts do occur they are negated through the use of suitable mitigation measures such as exclusions zones (buffer zones), testing, monitoring, etc.

13.4.2.1 Turbines and Met Mast

13.4.2.1.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Ownership/Guardianship are located within the application site boundary or the footprint of any proposed turbines or met mast therefore no direct impacts on these aspects of the archaeological resource are identified. No recorded monuments are located within the footprint of any proposed turbines or met mast and therefore no construction effects will occur in this regard. Documented built heritage was assessed and included structures listed on the RPS and NIAH. No Protected Structures or NIAH structures are located within the footprint of any proposed turbines or met mast therefore uo direct impacts on these aspects of the architectural and cultural heritage resource will occur.

Proposed Mitigation Measures

Since no direct effects to the known cultural heritage resource were identified mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction and erection of the proposed wind turbines and met mast will have no direct effects on National Monuments, Recorded Monumeuts, Protected Structures or NIAH. The significance of effects is therefore imperceptible.

13.4.2.1.2 *Impact on Townland Boundaries*

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are no instances where a proposed turbine base, hardstand or met mast overlays a townland boundary and therefore there is no impact on any townland boundary.

Proposed Mitigation Measures

Since no direct effects to the townland boundaries as a result of the proposed turbines or met mast will occur mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The construction and erection of the proposed wind turbines or met mast will have no significant direct effects on townland boundaries. The significance of effects is therefore imperceptible.

13.4.2.1.3 *Impact on unrecorded potential sub-surface sites*

The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the turbine bases and hardstands and the met mast may impact on any new sites, if present.

Pre-Mitigation Impact

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The construction and erection of the proposed wind turbines and met mast could have a slight impact on sub-surface archaeological features, if present.

13.4.2.2 Proposed New Roads and Amenity facilities

13.4.2.2.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the application site boundary or the footprint of any proposed new roads or amenity facilities therefore no direct impacts on these aspects of the cultural heritage resource will occur.

Proposed Mitigation Measures

The construction and erection of the proposed roads and amenity facilities will have no significant direct effects on any known cultural heritage assets.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The construction and erection of the proposed roads and amenity facilities will have no significant direct effects on any known cultural heritage assets. The significance of effects is therefore imperceptible.

13.4.2.2.2 *Impact on Townland Boundaries*

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are a number of instances where the proposed new road footprint overlays townland boundaries within the wind farm EIAR boundary and these include Carrowmore, Boleymaguire, Braudphark, Carrownyclowan, Garvagh Glebe and Garvagh. This will result in a direct impact to the townland boundaries where they survive, albeit it, within the width of the proposed road corridor. The impact without mitigation measures is likely to be slight-moderate since only small sections of the boundaries are proposed to be removed where they survive.

Proposed Mitigation Measures

Preservation by record where relevant during construction stage monitoring at the following areas:

- Proposed new road to T1 where it traverses the Garvagh/Garvagh-Glebe townland boundary
- Proposed New road to T3 where it traverses the Garvagh-Glebe/ Carrownyclowan townland boundary

Residual Impact

Residual Impacts after the mitigation measures have been implemented will be slight-not significant.

Significance of Effects

The significance of Effects will be slight-not significant.

13.4.2.2.3 *Impact on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for new roads or amenity facilities may impact on any new sites, if present.

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The potential significance of effects after the mitigation measures is likely to be slight.

13.4.2.2.4 *Impact on Water Crossings*

Pre-Mitigation Impact

Nine new water crossings are proposed as part of the construction of the new roads for the proposed wind farm. Rivers, streams and their banks have a high level of archaeological potential. Sites adjacent to watercourses have been favoured since prehistoric times for their proximity to food sources (often represented by habitation sites, fulachta fiadh and middens. Rivers and streams also serve as routeways, defences and ritual sites and boundaries. River beds may also contain archaeological features associated with fording sites, early bridge crossings and milling activities such as mill races. The impact without mitigation measures is likely to be slight-moderate since only small sections of the watercourses are proposed to be impacted within the confines of the road corridors.

Proposed Mitigation Measures

A licensed metal detection survey of the watercourses that are proposed to be crossed. The metal detection survey could be undertaken concurrently during the construction stage in advance of any works to the rivers/streams. A report on the results should be submitted to the relevant authorities.

Archaeological monitoring of ground works during construction. A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

- Proposed new road to T1 where it traverses the Garvagh/Garvagh-Glebe watercourse at ITM E583591, N823655
- Proposed New road to T10 where it crosses the stream to the north of T10 at ITM E584754, N822568

Residual Impact

Residual Impacts after the mitigation measures have been implemented will be slight-not significant.

Significance of Effects

The significance of effects will be Slight - Not Significant

13.4.2.3 Borrow Pits

13.4.2.3.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

One borrow pit areas were assessed as part of the EIAR. No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the application site boundary or the footprint of the proposed borrow pits therefore no direct impacts on these aspects of the cultural heritage resource will occur.

Proposed Mitigation Measures

Since no direct effects to the known cultural heritage resource as a result of the proposed borrow pits were identified mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed borrow pits will have no significant direct effects on National Monuments, Recorded Monuments, Protected Structures or NIAH. The significance of effects will be imperceptible.

13.4.2.3.2 Impact on Townland Boundaries

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are no instances where a proposed borrow pit will impact on a townland boundary.

Proposed Mitigation Measures

Since no direct effects to townland boundaries as a result of the proposed borrow pits were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed borrow pits will have no significant direct effects on townland boundaries. The significance of effects will be imperceptible.

13.4.2.3.3 Impact on unrecorded potential sub-surface sites

Pre-Mitigation Impact

The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed borrow pits may impact on any new sites, if present. Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The significance of effects could be slight if sub-surface archaeological features are present within the area of the borrow pits.

13.4.2.3.4 *Impact on Water Crossings*

Pre-Mitigation Impact

There are no instances where a proposed borrow pit will impact on a water crossing. No impacts will occur, therefore.

Proposed Mitigation Measures

Since no direct effects water crossings as a result of the proposed borrow pits were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed borrow pits will have no significant direct effects on water crossings. The significance of effects will be imperceptible.

13.4.2.4 Peat Repository Areas

13.4.2.4.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

Two peat repository areas were assessed as part of the EIAR. No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the application site boundary or the footprint of the proposed peat repository areas therefore no direct impacts on these aspects of the cultural heritage resource will occur.

Proposed Mitigation Measures

Since no direct effects to the known cultural heritage resource as a result of the proposed peat repository areas were identified mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed peat repository areas will have no significant direct effects on National Monuments, Recorded Monuments, Protected Structures or NIAH. The significance of effects will be imperceptible.

13.4.2.4.2 *Impact on Townland Boundaries*

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are no instances where a proposed peat repository area will impact on a townland boundary.

Proposed Mitigation Measures

Since no direct effects to townland boundaries as a result of the proposed peat repository areas were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed peat repository areas will have no significant direct effects on townland boundaries. The significance of effects will be imperceptible.

13.4.2.4.3 *Impact on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

The potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed peat repository areas may impact on any new sites, if present. Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The significance of effects could be slight if sub-surface archaeological features are present within the peat repository areas.

13.4.2.4.4 *Impact on Water Crossings*

Pre-Mitigation Impact

There are no instances where a proposed peat repository areas will impact on a water crossing. No impacts will occur, therefore.

Proposed Mitigation Measures

Since no direct effects to water crossings as a result of the proposed peat repository areas were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed peat repository areas will have no significant direct effects on water crossings. The significance of effects will be imperceptible.

13.4.2.5 Electricity Substation

The electricity substation is located in mature forestry.

13.4.2.5.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the application site boundary or the footprint of the proposed substation site therefore no direct impacts on these aspects of the cultural heritage resource will occur.

Proposed Mitigation Measures

Since no direct effects to the known cultural heritage resource as a result of the proposed substation were identified mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed substation will have no significant direct effects on National Monuments, Recorded Monuments, Protected Structures, NIAH. The significance of effects will be imperceptible.

13.4.2.5.2 Impact on Townland Boundaries

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are no instances where the proposed substation will impact on a townland boundary.

Proposed Mitigation Measures

Since no direct effects to townland boundaries as a resnlt of the proposed substation were identified mitigation measures are not required.

Residual Impact

No Residual Impacts.

Significance of Effects

The excavation associated with the proposed substation will have no significant direct effects on townland boundaries. The significance of effects will be imperceptible.

13.4.2.5.3 Impact on unrecorded potential sub-surface sites

Pre-Mitigation Impact

Similar to any other aspect of the proposed development which involves ground disturbance, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed substation site may impact on any new sites, if present. Shonld new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The significance of effects is likely to be Slight.

13.4.2.5.4 *Impact on Water Crossings*

Pre-Mitigation Impact

There are no occurrences where any aspect of the proposed substation site will impact on a water course.

Proposed Mitigation Measures

Since no direct effects to water crossings as a result of the proposed substation were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed substation will have no significant direct effects on water crossings. The significance of effects will be inperceptible.

13.4.2.6 Proposed Temporary Construction Compounds

Two compounds are proposed as part of the development.

13.4.2.6.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Ownership/Guardianship, Recorded Monuments or Built Heritage structures (RPS/NIAH) are located within the application site boundary or the footprint of the proposed compounds therefore no direct inpacts on these aspects of the cultural heritage resource will occur.

Proposed Mitigation Measures

Since no direct effects to the known cultural heritage resource as a result of the proposed compounds were identified mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The excavation associated with the proposed temporary construction compounds will have no significant direct effects on National Monuments, Recorded Monuments, Protected Structures, NIAH. The significance of effects will be imperceptible.

13.4.2.6.2 Impact on Townland Boundaries

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. There are no instances where the proposed compounds will impact on a townland boundary.

Proposed Mitigation Measures

Since no direct effects to townland boundaries as a result of the proposed temporary compounds were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The construction of the proposed temporary construction compounds will have no significant direct effects on townland boundaries. The significance of effects will be imperceptible.

13.4.2.6.3 Impact on unrecorded potential sub-surface sites

Pre-Mitigation Impact

Similar to any other aspect of the proposed development which involves ground disturbance, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. The excavation of topsoil /peat for the proposed compounds may unpact on any new sites, if present.

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The construction of the proposed temporary construction compounds could have a slight impact on sub-surface archaeological features, if present.

13.4.2.6.4 *Impact on Water Crossings*

Pre-Mitigation Impact

There are no occurrences where any aspect of the proposed compounds will impact on a water course therefore no impacts will occur.

Proposed Mitigation Measures

No Impacts were identified and therefore mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The construction of the proposed temporary construction compounds will have no significant direct effects on water crossings. The significance of effects will be imperceptible.

13.4.2.7 Underground Grid Connection Cable Route

This route was assessed as part of the EIAR and is addressed in Section 13.3.3 above.

13.4.2.7.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Care or Recorded Monuments are located along the proposed Grid connection cable route. No impacts to the known recorded archaeological resource will occur therefore. The route is located along an existing forest road within the site boundary and thereafter along a public road as far as the existing Garvagh substation. No known structures listed in the statutory list of Protected Structures are located along the proposed grid connection route. Furthermore, no structures listed in the NIAH are located along the route. One structure (19th century house/settlement) is depicted on the 25 inch OS map in the townland of Garvagh Glebe and is situated just to the north of the existing forest road to the east of the proposed substation site. This area is now under forest cover. The house was not located during survey and it is likely that the structure is no longer extant.

Since no direct effects to the known cultural heritage resource as a result of the proposed Grid route option were identified mitigation measures are not required.

Proposed Mitigation Measures

Since no direct effects to any known cultural heritage assets as a result of the proposed grid connection were identified mitigation measures are not required.

Residual Impact

No residual Impacts will occur.

Significance of Effects

The construction of the proposed underground grid connection will have no significant direct effects on any National Monuments, Recorded Monuments, Protected Structures, NIAH.

13.4.2.7.2 *Impact on Townland Boundaries*

Pre-Mitigation Impact

Townland boundaries are addressed in the Section 13.3.1.5 of the EIAR. Since the proposed grid route option is located along existing roads there are no instances where townland boundaries will require removal. No impacts will occur therefore.

Proposed Mitigation Measures

Since no direct effects to any townland boundaries as a result of the proposed grid connection were identified mitigation measures are not required.

Residual Impact

No Residual Impacts will occur.

Significance of Effects

The construction of the proposed underground grid connection will have no significant direct effects on any townland boundaries.

13.4.2.7.3 *Impact on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

Similar to any other aspect of the proposed development which involves ground disturbance, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be nncovered either within the peat/topsoil and/or at the level of the mderlying natural subsoil. The excavation of topsoil /peat for the proposed grid connection route may inpact on any new sites, if present.

Should new sites or features be present within the site (currently not visible on the surface) the inpact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same.
- Archaeological monitoring of ground works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The construction of the proposed underground grid connection route could have a slight impact on sub-surface archaeological features, if present.

13.4.2.8 Proposed Construction Access Road

13.4.2.8.1 *Impact on National Monuments, Recorded Monuments, Protected Structures, NIAH*

Pre-Mitigation Impact

No National Monuments in State Care, Recorded Monuments, Protected Structures, NIAH are located along the proposed construction access road. No impacts will occur, therefore.

Proposed Mitigation Measures

Since no direct effects to any National Monuments, Recorded Monuments, Protected Structures, NIAH as a result of the proposed access route to the wind farm were identified mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed access road to the wind farm will have no significant direct effects on any National Monuments, Recorded Monuments, Protected Structures, NIAH.

13.4.2.8.2 *Impact on unrecorded potential sub-surface sites*

Pre-Mitigation Impact

Similar to any other aspect of the proposed development which involves ground disturbance, the potential exists for the development area to contain as yet unrecorded sub-surface sites and artefacts. It is possible that such sites may be uncovered either within the peat/topsoil and/or at the level of the underlying natural subsoil. Excavation of topsoil /peat removal which is required at off-road locations along the haul route may impact on any new sites, if present. Mitigation measures are proposed to alleviate any potential negative effects as a result of the groundworks.

Should new sites or features be present within the site (currently not visible on the surface) the impact is likely to be significant negative and permanent (i.e. the excavation by machinery would permanently remove the sites resulting in a significant negative impact).

Proposed Mitigation Measures

- Archaeological monitoring of any geotechnical / engineering trial pits or investigations along the off-road sections of the proposed construction access road and a report detailing the results of same.
- Archaeological monitoring of topsoil/peat removal of **all off-road sections** of the proposed route during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

The sites/features, if detected, during monitoring will be preserved by record (archaeologically excavated) or preserved in-situ (avoidance) and therefore a full record made of same. In this regard, the potential impact after the mitigation measures is likely to be slight.

Significance of Effects

The construction of the proposed construction access route to the wind farm could have a slight impact on sub-surface archaeological features, if present.

13.4.2.8.3 *Impact on water crossings*

Pre-Mitigation Impact

Three of the nine new water crossings are proposed as part of the new construction access road. Rivers, streams and their banks have a high level of archaeological potential. Sites adjacent to watercourses have been favoured since prehistoric times for their proximity to food sources (often represented by habitation sites, fulachta fiadh and middens. Rivers and streams also serve as routeways, defences and ritual sites and boundaries. River beds may also contain archaeological features associated with fording sites, early bridge crossings and milling activities such as mill races. The impact without mitigation measures is likely to be slight-moderate since only small sections of the watercourses are proposed to be impacted within the confines of the road corridors.

Proposed Mitigation Measures

A licensed metal detection survey of the watercourses that are proposed to be crossed will be undertaken. The metal detection survey could be undertaken concurrently during the construction stage monitoring in advance of any works to the rivers/streams. A report on the results should be submitted to the relevant authorities.

Archaeological monitoring of ground works during construction will be undertaken. A report on the results of the monitoring will be compiled and submitted to the relevant authorities on completion of the project.

Residual Impact

Residual Impacts after the mitigation measures have been implemented will be slight-not significant.

Significance of Effects

The significance of effects will be Slight - Not Significant

13.4.2.8.4 *Impact on Townland Boundaries*

Pre-Mitigation Impact

Townland boundaries along the construction access road are addressed in the Section 13.3.4.2 of the EIAR. There are a number of instances where the proposed new road footprint overlays townland boundaries. This will resnlt in a direct impact to the townland boundaries where they survive, albeit, within the width of the proposed road corridor. The impact without mitigation measures is likely to be slight-moderate since only small sections of the boundaries are proposed to be removed where they survive.

Proposed Mitigation Measures

Preservation by record where relevant during construction stage monitoring at the following areas:

- Barraghmore/Dereens townland boundary
- Dereens / Drumnanacappul
- Drumnanacappul / Lisfuiltaghan
- Lisfuiltaghan / Tinnybeg
- Tinnybeg / Seltan
- Seltan / Bargowla
- Sheena / Derryboffin
- Letter / Derrycullinan
- Derrycullinan / Drummanacappnl

Residual Impact

Residual Impacts after the mitigation measures have been implemented will be slight-not significant.

Significance of Effects

The significance of Effects will be slight-not significant.

13.4.3 Operational Phase Potential Impacts (Indirect)

Indirect impacts are where a feature or site of archaeological, architectural heritage merit or their setting is located in close proximity to a proposed development. Indirect impacts here are mainly concerued with impacts on setting. Impacts on settings of sites may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments or any cultural heritage asset. While the Proposed Development may not physically impact on a site, it may alter the setting of a monument or group of monuments. There is no standardised industry-wide approach for assessing the degree of impact to the setting of a monument. Professional judgement and experience are utilised in the assessment of impacts on setting as well as Viewshed Analysis in ArcGIS online.

Potential operational impacts are discussed below according to each element of the proposed development. Those elements of the proposed development which are not capable of impacting on the visual setting of monuments include proposed roads, amenity trails, underground cables etc and those elements which are deemed to be more likely to impact on visual setting which include turbines and substation buildings are discussed below.

13.4.3.1 Impact of Proposed Turbines

13.4.3.1.1 *Impact on National Monuments in State Care*

A review of all National Monuments in State Care was undertaken as part of the assessment in order to ascertain any potential impacts on their setting as a result of the proposed development. No National Monuments are located within the EIAR site boundary and none are located within close proximity, the nearest Monument being located at 8.3km from turbine 2. These are detailed in Table 13-2 above.

Pre-Mitigation Impact

Creevlea Abbey: A site visit to the National Monument shows that the area in the direction of the windfarm (to the south-east) is heavily planted with trees. The distance, together with the intervening tree cover suggests that the impacts on the setting of the National Monument will be 'not significant'.

Gortlowan Motte: A site visit to the roadside adjacent to the National Monument shows that the area in the direction of the windfarm (to the south-east) is planted with trees and numerous boundaries. The distance, together with the intervening vegetation suggests that the impacts on the setting of the National Monument will be 'not significant'.

Castlelore Cashel: A site visit to the National Monument shows that the area in the direction of the windfarm (to the south-east) is planted with trees and numerous boundaries (Plate 13-4). The distance, together with the intervening vegetation suggests that the impacts on the setting of the National Monument will be 'not significant'.

Carrignagat Megalithic tomb: No public access to the megalithic tombs could located. A site visit to the nearest point on the public road suggests that any potential views may be obscured by vegetation. The distance, together with the natural intervening vegetation suggests that the impacts on the setting of the National Monument will be 'not significant'.

Heapstown Cairn: Viewshed analysis from this National Monument shows no visibility in the direction of the proposed turbines. Views from the adjacent public road shows that this large mound of stones is located to the rear of a small farmhouse and is surrounded by trees on all sides. Intervening topography is such that no visibility of the location of the proposed windfarm is possible from this location. The ZTV also suggests that no turbines would be visible from this location. In this regard the impacts on setting will not occur, therefore.

Moytirra Court Tomb: A site visit to the nearest publicly accessible point to the court tomb on the adjacent road shows that views in the direction of the wind farm are possible towards the north-east and therefore some visibility of turbines may occur. The distance, together with the intervening natural vegetation and topography suggests that the impacts on the setting of the National Monument will be 'not significant'.

Proposed Mitigation Measures

It is not possible to mitigate the potential indirect effects of turbines on National Monuments.

Residual Impact

The residual impact is considered to be 'Not Significant'

Significance of Effects

The significance of impacts does not change from the pre-mitigation impacts since it is not possible to mitigate the indirect effects of the turbines in the wider landscape setting. The significance of remains Not Significant.

13.4.3.1.2 *Impact on setting of Recorded Monuments within the EIAR boundary*

Pre-Mitigation Impact

No Recorded Monuments are located within the EIAR site boundary therefore impacts on the immediate setting of recorded monuments will not occur.

Proposed Mitigation Measures

Since no indirect effects on setting to any Recorded Monuments as a result of the proposed turbines were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction and erection of the proposed turbines will have no significant indirect effects on Recorded Monuments within the EIAR site boundary since none are located therein.

13.4.3.1.3 *Impact on Recorded Monuments within 5km*

Pre-Mitigation Impacts

Ninety-five monuments are located within 5km of the nearest proposed turbine and these are detailed above in

Table 13-3. Monuments within 5 kilometres of the proposed turbines are included here for purposes of assessing potential visual impacts in the wider landscape setting. No monuments are located within 1km of the nearest proposed turbines. Only one monument (1%) is located between 1 and 2km of the nearest proposed turbine. Eleven monuments (12%) are located between 2 and 3km with 38 monuments located between 3 and 4km representing 40%. The majority of monuments are located between 4 and 5km representing 47% of the total. The immediate setting of the recorded monuments will not be negatively impacted, therefore. Figure 13-10 demonstrates that the majority of the recorded monuments are located at a remove from the proposed turbines with a notable dearth of monuments within close proximity to the site. The ZTV shows that there will be no visibility from the large cluster of monuments to the south-west of the proposed windfarm. Visibility may be possible from north and north west with limited visibility from the north-east and east.

Potential impact on visual setting of the RMPs within 5km of the proposed development is considered to be slight (An effect which causes changes in the character of the environment which are not high or very high and do not directly impact or affect an archaeological site).

Proposed Mitigation Measures

It is not possible to mitigate the potential indirect effects of turbines on recorded monuments within 5km outside the EIAR site boundary.

Residual Impacts

The residual impact is considered to be 'Slight'

Significance of Effects

The significance of impacts does not change from the pre-mitigation impacts since it is not possible to mitigate the indirect effects of the turbines in the wider landscape setting. The significance of remains Slight.

13.4.3.1.4 *Impact of Turbines on setting of NIAH/RPS structures within the EIAR boundary*

Pre-Mitigation Impact

No built heritage structures which are subject to legal protection are located within the wind farm site boundary or immediately adjacent to same therefore no impacts will occur.

Proposed Mitigation Measures

Since no indirect effects on setting to any NIAH/RPS structure as a result of the proposed turbines were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction and erection of the proposed turbines will have no significant indirect effects on any RPS/NIAH structures.

13.4.3.1.5 *Impact of Turbines on setting of NIAH/RPS structures within 5km of the nearest proposed turbine*

Pre-Mitigation Impact

Seven structures on the NIAH/RPS are located within 5km of the nearest proposed turbine, the majority of which are located on the periphery of the 5km study area boundary. The distance of the proposed turbines from the structures is such that no direct impacts will occur. The setting of the buildings within Drumkeeran village does not extend beyond the urban limits of village itself. The ZTV suggests that 3 turbines may theoretically be visible from Drumkeeran but this is based on a bare landscape model with no vegetation or tree cover. Impacts are considered to be 'Not Significant'.

Proposed Mitigation Measures

It is not possible to mitigate the potential indirect effects of turbines on RPS/NIAH structures within 5km.

Residual Impacts

The residual impact is considered to be 'Not Significant'

Significance of Effects

The significance of impacts does not change from the pre-mitigation impacts since it is not possible to mitigate the indirect effects of the turbines in the wider landscape setting. The significance of remains 'Not Significant'.

13.4.4 Proposed New roads and Amenity Facilities

13.4.4.1.1 *Impacts on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

Proposed new roads and amenity facilities will not have any operational effects (visual impact) on any documented (or otherwise) cultural heritage assets. The nature of the new roads is such that they are not a visually dominant feature capable of any negative effects on setting in the landscape.

Operational Impacts will not occur as a result of new roads

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed new roads were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed new roads will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.4.2 Proposed Borrow Pit and Peat Repository Areas

13.4.4.2.1 *Impacts on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

The borrow pit and peat repository areas, during the operational phase of the Proposed Development, will not impact on the immediate setting of any National Monuments, Recorded Monuments, Protected Structures or NIAH structures or any new constraints identified.

No Impacts will occur therefore.

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed borrow pit and peat repository were identified, mitigation measures are not required.

Residual Impact

No residual iinpacts will occur.

Significance of Effects

The construction of the proposed borrow pit will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.4.3 Electricity Substation

13.4.4.3.1 *Impacts on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

The substation is located within the EIAR site boundary and as no National Monuments, Recorded Monuments, Protected Structures or NIAH strnctures are located therein, no impacts on setting are anticipated.

No Impacts will occur therefore.

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed substation were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed substation will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.4.4 Temporary Construction Compounds

13.4.4.4.1 *Impacts on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

The proposed temporary compounds are located within the EIAR site boundary and as no National Monuments, Recorded Monuments, Protected Structures or NIAH structures are located therein, no

impacts on setting are anticipated. Furthermore, wider landscape setting will not be impacted by the proposed compounds.

No Impacts will occur therefore.

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed temporary compounds were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed temporary compounds will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.4.5 Underground Grid Connection Cable Route

13.4.4.5.1 *Impacts on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

No National Monuments in State Care or Recorded Monuments are located along the proposed grid connection cable route. No known structures listed in the statutory list of Protected Structures are located along the proposed grid counection route. Furthermore, no structures listed in the NIAH are located along the route. Since the grid connection cable route is sub-surface, no operational effects will occur to any cultural heritage assets.

No Impacts will occur therefore.

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed Undergromd Grid Connection Cable Route were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed Underground Grid Comection Cable Route will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.4.6 Proposed Access / Transport Delivery Route

13.4.4.6.1 *Impacts of on setting of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites*

Pre-Mitigation Impact

The haul route will be ntilised to transport components for the wind farm and materials to and from the windfarm site and therefore it is not anticipated that the ternporary use of this delivery route will negatively affect the setting of any cultural heritage asset assessed in this report.

No Impacts will occur therefore.

Proposed Mitigation Measures

Since no indirect effects on setting to any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites as a result of the proposed Access ronte or Haul route were identified, mitigation measures are not required.

Residual Impact

No residual impacts will occur.

Significance of Effects

The construction of the proposed Access Route / Haul Route will have no significant indirect effects on any of National Monuments, Recorded monuments, NIAH/RPS and Local Cultural heritage sites.

13.4.5 Operational Phase Potential Impacts (Direct)

In terms of archaeology, architecture and cultural heritage, since peat removal and groundworks would be complete, no direct effects will occur at the operational stage.

13.5 Cumulative Impacts

Cumulative impact is defined as 'The addition of many small impacts to create one larger, more significant, impact' (EPA 2002, 33). It is also defined as 'impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project' (EC 1999). Cumulative impacts encompass the combined effects of multiple developments or activities on a range of receptors. In this case the receptors are the archaeological monuments and architectural/cultural heritage sites in the immediate vicinity of the Proposed Development. Cumulative Impacts at the Construction and Operational Stages are considered.

13.5.1 Cumulative Impacts (Direct Impacts)

The addition of other projects to the proposed Croagh windfarm project was considered in order to assess Cumulative Impacts. These included all other windfarms in the vicinity, mainly within 10km of the proposed Croagh windfarm. There will be no direct impacts or direct cumulative impacts as a result of the proposed Croagh wind farm project since all potential direct effects are dealt with through mitigation to alleviate or remove the impact altogether. In this regard no direct cumulative impacts will occur.

13.5.2 Cumulative Impacts (Indirect Impact on Setting)

Cumulative impacts on setting are more likely to occur at the operational stage of the development (i.e. post-construction). In this regard in order to assess overall cumulative effects on archaeology and cultural heritage the proposed project is considered in the context of other developments, in particular other permitted and proposed wind farms as shown in Figure 13-23. This map shows the location of existing, permitted and proposed turbines within 20km of the proposed Croagh wind farm. It also shows that the current potential inter-visibility between monuments will not be impacted by the addition of the Croagh wind turbines to other existing, proposed and permitted turbines.

13.5.2.1 National Monuments

Creevlea Abbey: A site visit to the National Monument shows that the area in the direction of the proposed Croagh wind farm has good screening in the form of vegetation and trees. The distance, together with the intervening tree cover suggests that the impacts on the setting as a result of the Croagh turbines alone will be 'not significant'. Viewshed analysis from the monument suggests that the other permitted, existing and proposed turbines will have some level of visibility. In this regard when the Croagh windfarm is added to the other existing, proposed and permitted projects, the potential to see more turbines from the monument may result in a cumulative impact on setting in the wider landscape.

Gortlowan Motte: A site visit to the roadside adjacent to the National Monument shows that the area in the direction of the Croagh windfarm (to the south-east) is planted with trees and numerous boundaries. The distance, together with the intervening vegetation suggests that the impacts on the setting of the National Monument will be not significant. Viewshed analysis shows that only some of the Croagh and Garvagh/Glebe turbines may potentially be visible from the monument. No cumulative impacts would occur therefore.

Castlelore Cashel: A site visit to the National Monument shows that the area in the direction of the windfarm (to the south-east) is planted with trees and numerous boundaries (Plate 13-4). The distance, together with the intervening vegetation suggests that the impacts on the setting of the National Monument arising from the Croagh windfarm will be 'not significant'. Viewshed analysis from the monument suggests that the other permitted, existing and proposed turbines will have some level of visibility from the cashel. In this regard when the Croagh windfarm is added to the other existing, proposed and permitted projects, the potential to see more turbines from the monument may result in a cumulative impact on setting in the wider landscape.

Carrignagat Megalithic tomb: No public access to the megalithic tombs could located. A site visit to the nearest point on the public road suggests that any potential views may be obscured by vegetation. The distance, together with the natural intervening vegetation suggests that the impacts on the setting of the National Monument will be 'not significant'. Viewshed analysis from the monument suggests that the other permitted, existing and proposed turbines will have some level of visibility from the megalithic tomb. In this regard when the Croagh windfarm is added to the other existing, proposed and permitted projects, the potential to see more turbines from the monument may result in a cumulative impact on setting in the wider landscape.

Heapstown Cairn: Viewshed analysis from this National Monument shows no visibility in the direction of the proposed turbines. Views from the adjacent public road shows that this large mound of stones is located to the rear of a small farmhouse and is surrounded by trees on all sides. Intervening topography is such that no visibility of the location of the proposed windfarm is possible from this location. The ZTV also suggests that no turbines would be visible from this location. In this regard the impacts on setting will not occur therefore. The viewshed analysis carried out from the monument also shows that no other proposed, existing or permitted turbines are visible from this location. In this regard no cumulative impacts will occur.

Moytirra Court Tomb: A site visit to the nearest publicly accessible point to the court tomb on the adjacent road shows that views in the direction of the wind farm are possible towards the north-east and therefore some visibility of turbines may occur. The distance, together with the intervening natural vegetation and topography suggests that the impacts on the setting of the National Monument will be 'not significant'. Viewshed from Moytirra Court tomb shows that some permitted, proposed and existing turbines would have some visibility from the monument, mainly those to the south of the Croagh windfarm. In this regard when the Croagh windfarm is added to the other existing, proposed and permitted projects, the potential to see more turbines from the monument may result in a cumulative impact on setting in the wider landscape.

The Viewshed model and ZTVs are based on bare landscape without vegetation, tree cover, boundaries which in reality provide screening in the landscape. The above cumulative impacts are based on theoretical models and site visits and are therefore a worst-case scenario.

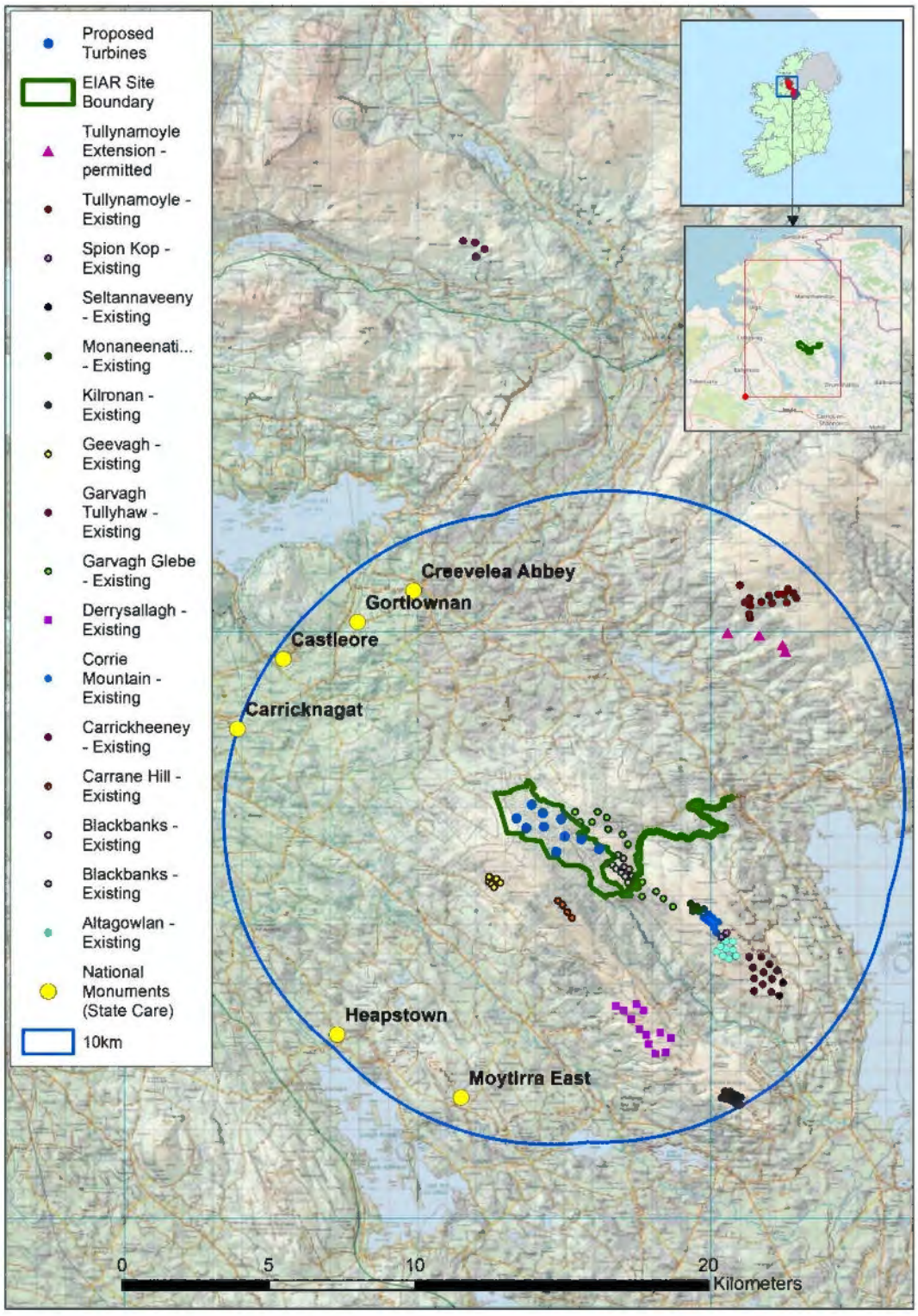


Figure 13-23 Additional projects considered when assessing cumulative impacts

13.5.3 Cultural Heritage Assets within 5km of the proposed Croagh turbines

The indirect effects on setting of RMPs and other cultural heritage sites within 5km of the proposed development has been addressed in this chapter of the EIAR. The ZTV shows that the area to the south-west of the proposed Croagh windfarm which contains a large cluster of recorded monuments will have no views towards any proposed turbines. This view will continue regardless of the addition of any other projects, therefore from this perspective, no cumulative impacts will occur. The ZTV shows that visibility of 9-10 Croagh turbines from the area of the RMPs and any other cultural heritage sites to the north and north-west is possible.

When the Croagh turbines are added to the other permitted, proposed and existing turbines, more turbines may be visible from various monuments within 5km of the windfarm. The ability to see an increased number of turbines will result in a cumulative impact on setting in the wider landscape. No significant cumulative impacts will occur however.

13.6 Decommissioning Phase

There will be no significant potential impacts on the archaeological, architectural and cultural heritage environment during the decommissioning of the development. Any potential direct impacts will already have been resolved through mitigation measures and the established access tracks will be used for the removal of the built features of the wind farm.

14. MATERIAL ASSETS

Material Assets are defined in the '*Advice Notes for Preparing Environmental Impact Statements'* (EPA, Draft 2015) as "*resources that are valued and that are intrinsic to specific places" and in the* 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports' (EPA, Draft 2017) 'as "*built services and infrastructure. Traffic is included because in effect traffic consumes roads infrastructure.*' They may be either of human or natural origin. The cultural assets of Archaeology and Cultural Heritage are addressed in Chapter 13 of this Environmental Impact Assessment Report (EIAR). Economic assets of natural heritage include non-renewable resources such as minerals or soils, and renewable resources such as wind and water. These assets are addressed in Chapter 8: Land, Soils and Geology, Chapter 9: Hydrology and Hydrogeology, and Chapter 10: Air and Climate. Tourism and amenity resources, which are also considered material assets, are addressed in Chapter 5: Population and Human Health.

This chapter of the EIAR addresses the likely significant effects of the proposed development on transportation infrastructure (Section 14.1 Traffic and Transport) and on Telecommunications and Aviation (Section 14.2), which are economic assets of human origin. This chapter of the EIAR has been prepared in accordance with the requirements of the EIA legislation and guidance outlined in Chapter 1: Introduction.

14.1 Traffic and Transport

14.1.1 Introduction

14.1.1.1 Background and Objectives

The purpose of this section is to assess the effects, on roads and traffic, of the traffic movements that will be generated during the construction, operational and decommissioning phases of the proposed Croagh Wind Farm development.

For developments of this nature, the construction phase is the critical period with respect to the traffic effects experienced on the surrounding road network, in terms of both the additional traffic volumes that will be generated on the road network, and the geometric requirements of the abnormally large loads associated with the delivery of wind turbine components. The requirements of the additional traffic and abnormal sized loads generated during the construction stage were assessed on both the external road network and at the junctions of the proposed road that will provide access to the site.

It should be noted that abnormal weight loads are not a feature of the turbine delivery vehicles, they are abnormal in size only. All construction and delivery vehicles for the proposed development will be subject to the standard axle weight requirements set out under Road Traffic (Construction and Use of Vehicles) Regulations 2003 (S.I. No. 5 of 2003)and therefore the loadings from construction traffic will not exceed the relevant standards. Notwithstanding the need to use some specialist vehicles to facilitate turbine delivery, it should be noted that the number of load-bearing axles for any specialist vehicles carrying large loads are designed to ensure that the load on any one axle does not exceed acceptable load bearing statutory limits. Therefore, the structural integrity of the national and regional road network used during the construction of the proposed development is adequate to provide for these accepted loads.

The magnitude of the increase in traffic volumes experienced on the surrounding network is identified during the various construction stages of the proposed development. Traffic management measures are also provided in Sections 14.1.7 and 14.1.10.6 aimed at minimising the traffic impact on the local highway network. Refer also to Appendix 14-2 for the Outline Traffic Management Plan (TMP).

14.1.1.2 Statement of Authority

This section of the EIAR has been prepared by Alan Lipscombe of Alan Lipscombe Traffic and Transport Consultants Ltd. Alan is a competent expert in traffic and transport assessments. In 2007 Alan set up a traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic, including many wind farm developments including the following; Ardderoo, Derryadd, Derrinlough, Knocknamork, Shehy More, Cloncreen, Derrykillew, Coole, Ballyhorgan, Cahermurphy, Lettergull, Barnadivane, Cleanrath and Knocknalough .

Alan has a BEng (hons) Degree in Transportation Engineering (Napier University, Edinburgh, 1989), is a member of Engineers Ireland and of the Institute of Highways and Transportation and is a TII accredited Road Safety Audit Team Member.

14.1.1.3 Guidance and Legislation

This section has been completed in accordance with the guidance set out in Chapter 1 of this EIAR. The assessment uses standard terminology to describe the likely significant effects associated with the proposed development. Further information on the classification of effects used in this assessment is presented in Section 1.8 of this EIAR.

14.1.1.4 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as outlined in Sections 2.6 and 2.7of Chapter 2 of the EIAR, and summarised below.

Transport Infrastructure Ireland

Transport Infrastructure Ireland (TII) responded to Scoping on the 23rd January 2019 in which it provided a list of recommendations to be followed when preparing the EIAR. All relevant TII guidelines and policies have been taken into account in the preparation of this assessment, including the following;

- PE-PDV-02045, Transport Assessment Guidelines, Transport Infrastructure Ireland, May 2014
- PE-PAG-02017, Project Appraisal Guidelines, Unit 5.3, Travel Demand Projections, Transport Infrastructure Ireland, May 2019
- DN-GEO-03060, Geometric Design of junctions, Transport Infrastructure Ireland, April 2017
- TII Automatic Traffic Count Data, N4, N16 2019,

Sligo and Leitrim County Councils

Turbine delivery and potential routes were discussed with both Leitrim and Sligo County Council during pre-planning meetings. No issues were raised by either local authority during the consultation process.

14.1.1.5 Methodology and Section Structure

The traffic and transport assessment takes cognisance of guidance for such assessments set out by Transport Infrastructure Ireland (TII), in the document PE-PDV-02045 '*Traffic and Transport Assessment Guidelines*', (TII, 2014). The geometric requirements of the turbine delivery vehicles were assessed using Autocad and Autotrack.

The Traffic and Transport Section of this chapter is set out as follows:

- A review of the existing and future transport infrastructure in the vicinity of the proposed development, including an assessment of 2019 traffic flows and traffic forecasts during an assumed construction year of 2024 (Sections 14.1.2 - Receiving Environment and 14.1.3 – Existing Traffic Volumes).
- A description of the nature of the proposed development and the traffic volumes that it will generate during the different construction stages and when it is operational (Section 14.1.4 – Proposed Development and Traffic Generation).
- A description of the abnormally sized large loads and vehicles that will require access to the site (Section 14.1.5 – Construction Traffic Design Vehicles).
- A review of the effects of development generated traffic on links and junctions during construction and when the facility is operational (Section 14.1.6 –Traffic effects during construction and during operation).
- Identification of traffic management for large deliveries during construction (Section 14.1.7 – Traffic Management for Large Deliveries).
- A geometric assessment of the route and its capacity to accommodate the abnormal-sized loads associated with the development (Section 14.1.8 – Route Assessment).
- An assessment of the provision for sustainable modes of travel (in this case primarily with respect to the transport of construction staff) (Section 14.1.9 – Provision for Sustainable Modes of Travel).

The description of likely significant effects on the public road network is provided in Section 14.1.10.

14.1.2 Receiving Environment

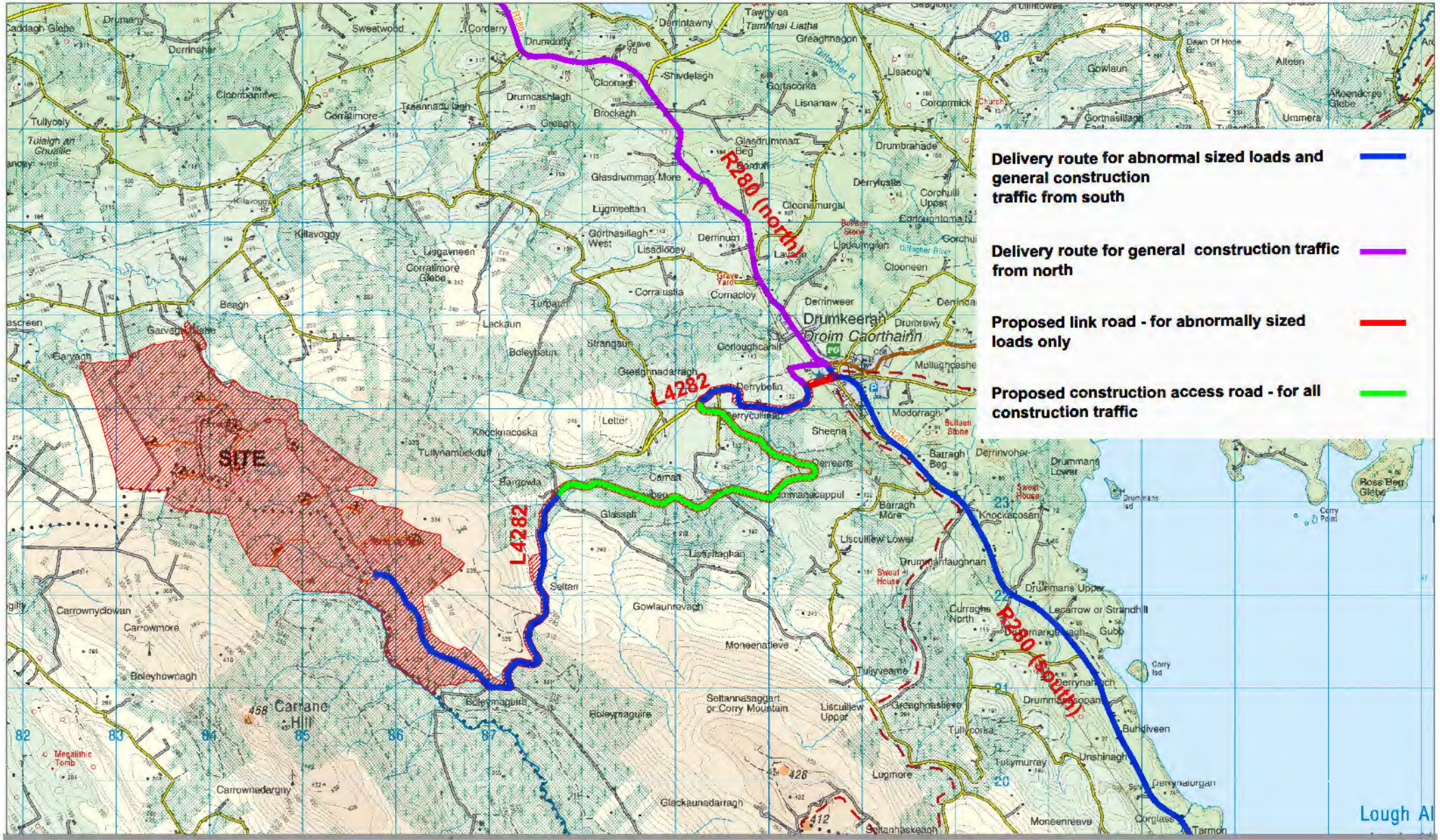
14.1.2.1 Site Location

The Proposed Development, known as Crough Wind Farm, is located in both Co. Leitrim and Co. Sligo, in the townlands listed in Table 1-1 of Chapter 1: Introduction.

The closest settlement to the EIAR site boundary is Drumkeeran, Co Leitrim, which is located adjacent to the eastern extremity of the study area. Other settlements in the area include Dromahair, Co Leitrim (c. 7.3km northwest), Drumshambo, Co. Leitrim (c. 14.3km southeast) and Ballyfaruan, Co. Roscommon (c. 7.2km south). The site location is shown on Figure 1-1 of the EIAR.

14.1.2.2 Proposed Abnormal Size Load Delivery Route

A detailed assessment of the transport route for the abnormally large vehicles was made from a point at which the route turns left off the R280 Regional Road at the southern side of Drumkeeran onto a new link road built for the purpose of providing access to the proposed site for abnormally sized vehicles. The route is shown in Figure 14-1 and is discussed in detail in Section 14.1.8. The delivery route for the abnormal loads will be assessed further afield, from the port of arrival to the R280 south of Drumkeeran, by the delivery company prior to construction. The likely delivery route from the port of Dublin is set out in Section 4.4.2.



NOTES:

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Base mapping provided by MKO

Figure 14.1 Site location and delivery route

PROJECT:	Croagh Wind Farm, County Leitrim		
CLIENT:	Coillte	SCALE:	NTS
PROJECT NO: 7410	DATE: 30.06.20	DRAWN BY:	AL

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The route assessment includes locations 1 to 13 on the access route shown on Figure 14-2a, including the left turn on the R280 approaching Drumkeeran (location 1) followed by the turnoff from the R280 in Drumkeeran village into an existing farmyard where the route passes through an existing shed that will be partially demolished. A new link road approximately 260 metres in length will be constructed through the farmyard to link the R280 to the existing L-4282 at Derryboffin (locations 2 and 3). The route then travels west on the L-4282 for approximately 1.5 kms before turning left onto the proposed construction access road at Derrycullinan (location 5). The proposed construction access road is approximately 4.6 kms long and comprises sections of upgraded forestry road and sections of new road and links back into the L-4282 by means of a new junction at Bargowla (location 6). From there the route follows the L-4282 south for approximately 2.5 kms before heading northwest for approximately 2 kms (locations 7 to 12) to the main site access junction (location 13).

It is noted that the proposed link road passing through the farmyard linking the R280 in the village of Drumkeeran with the L-4282 will be used solely for the purposed of the delivery of abnormally sized loads to the site. All of these deliveries will be made using Garda Siochana escorts and local transient traffic management measures put in place by the haulage company. The link road will be closed at all other times.

14.1.2.3 Proposed Construction Traffic Haul Route

From Drumkeeran the delivery route for general construction traffic, including deliveries and site staff, will be as described previously for abnormally sized loads, with the exception that from Drumkeeran access will be gained from the existing L-4282 at its junction with the R280 and R200, as shown in Figures 14-1 and 14-2a.

From further afield the delivery route for general heavy goods vehicle (HGV) construction traffic may vary depending on the location of the suppliers used for concrete and other materials required to construct the proposed development. Based on the location of suppliers in the vicinity of the Proposed Development, it is estimated that the following proportion of concrete and general construction traffic will travel on the following links;

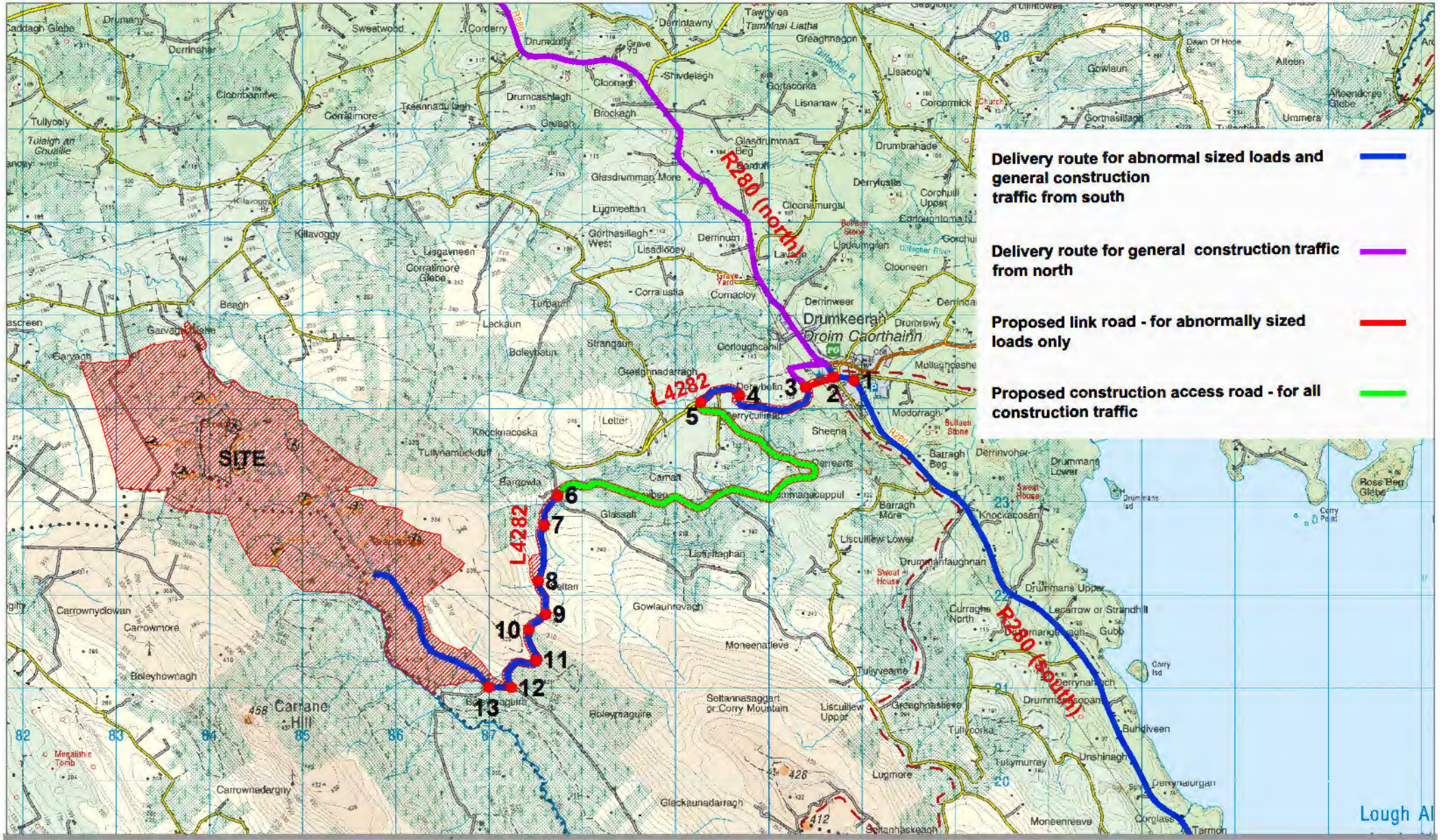
Concrete

- It is not confirmed at this stage where the concrete required for the turbine foundations will be transported from. A worst case scenario based on all traffic approaching the site from the north via the N16 and/or R280 followed by the existing L-4282 and proposed construction access road to the site, or all from the south via the N4 and/or R280, followed by the new proposed construction access road, was therefore tested.

General construction materials

- Similarly, it is not confirmed at this stage where the stone and general construction materials will be transported from. Again a worst case scenario based on all traffic approaching the site from the north via the N16 and/or R280 followed by the existing L-4282 and construction access road to the site, or all from the south via the N4 and/or R280, followed by the L-4282 and new proposed construction access road was tested,

It is noted that while the N16 to the north and the N4 to the south are included in the assessment in order to test a worst case scenario, it is likely in reality that the concrete and stone required during construction, which accounts for over 60% of all deliveries made to the site, will originate from suppliers closer to the proposed site and will therefore not impact on these roads.



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Base mapping provided by MKO

Figure 14.2a Route assessment location plan

PROJECT:	Croagh Wind Farm, County Leitrim		
CLIENT:	Coillte	SCALE:	NTS
PROJECT NO: 7410	DATE: 26.06.20	DRAWN BY:	AL

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All wind turbine deliveries (abnormally sized loads and other components delivered using standard HGVs)

- All will travel to the site from the south via the N4 and R280 followed by the L-4282 and new proposed access road.

The construction of the proposed link road and the construction access road ensures that all wind turbine loads and all other materials delivered to the site will not require to travel on the section of the L-4282 between locations 5 and 6 on which existing residences are situated.

The assessment presented in this section of the EIAR is based on these conservative scenarios.

14.1.2.4 Site Entrance

There is one site entrance proposed for the construction stage of the development in order to transport turbine components, materials and equipment to the site, and it is via the western section of the L-4282 and the existing forestry road that currently accesses the site located in the townland of Boleymaguire at location 13. It is noted that the existing L-4282 provides for up to 100 two-way HGV's for the purpose of tree felling, agriculture and general construction, as observed during a traffic survey discussed subsequently in this Section.

In addition to the proposed new link road and construction access road, upgrade works will be required along the existing L-4282, in the townland of Seltan, in order to accommodate access and egress of turbine delivery and construction vehicles. Following the construction phase of the proposed development, the boundary between the proposed construction access road and the R280 to the east and the L-4282 to the west will be reinstated by erecting fencing. It is noted, however, that they may need to be reopened temporarily during the lifetime of the development should replacement blades or other abnormal loads be required to be delivered to the site.

During the operational stage, access to the amenity carpark will be via the L-8282 local road and existing forestry track that currently provides access to the site from the north, and is separate from the construction delivery routes proposed. The route will not require any upgrade to accommodate amenity traffic. Further information on the proposed amenity elements associated with the proposed development is outlined in Chapter 4 of this EIAR.

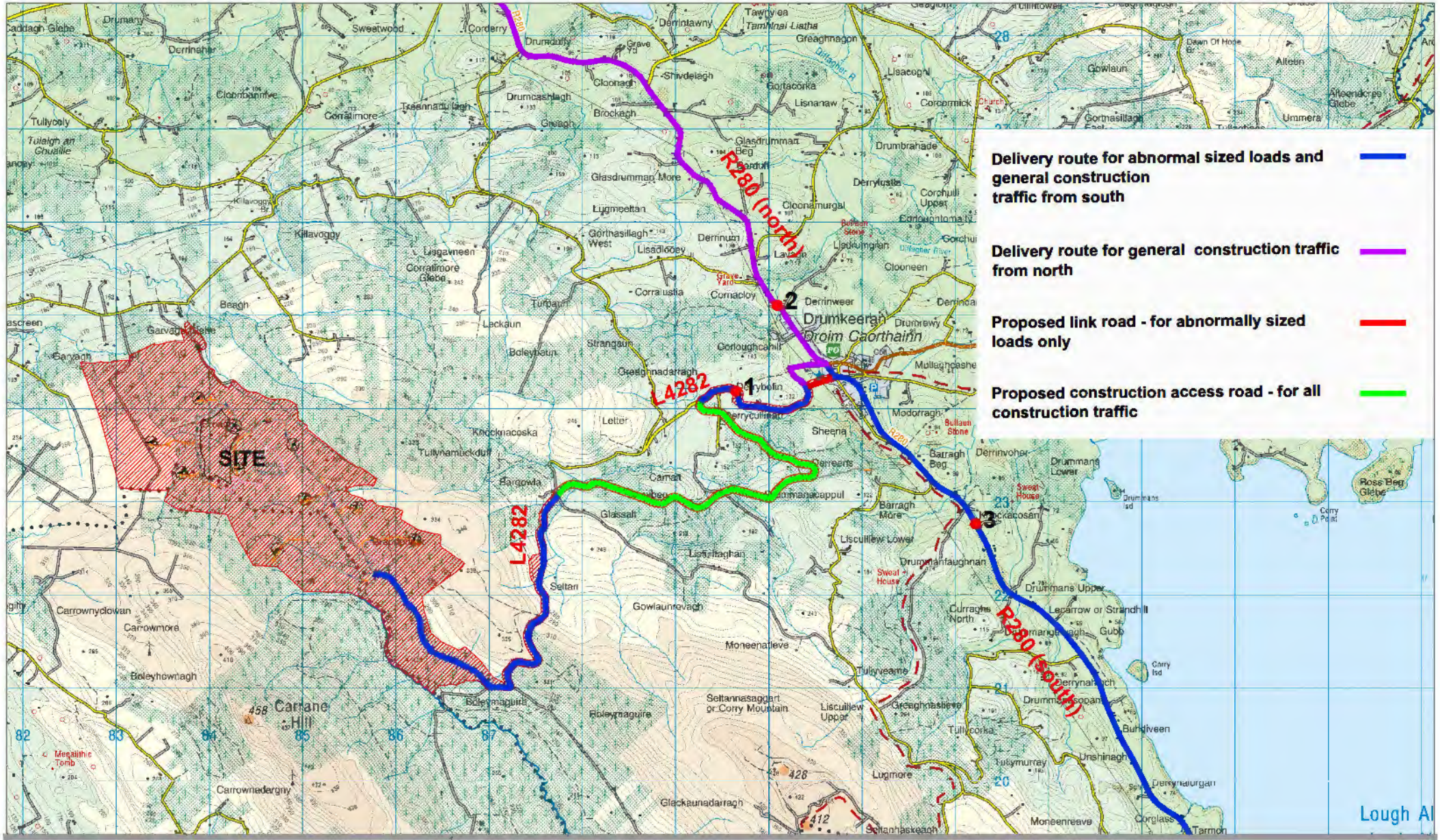
14.1.3 Existing Traffic Volumes

It should be noted that traffic volumes are discussed in terms of vehicles and passenger car units, or PCUs, where each vehicle is expressed in terms of its demand on the network relative to the equivalent number of cars or light goods vehicles (LGV). For example, an articulated HGV was given a factor of 2.4 passenger car units (as per TII Project Appraisal Guidelines for National Roads Unit 5.2), while one of the extended loaders required to transport the wind turbine equipment was assigned a value of 10 PCUs.

14.1.3.1 Background Traffic Flows

The link count locations included in the assessment are shown in Figure 14-2b.

Continuous traffic counters are maintained by TII on the N4 to the east of Carrick-on-Shannon and on the N16 to the west of Belcoo. Traffic data from these sites, together with all day classified counts undertaken at locations in close proximity to the proposed development site, on the R280, at the location of the proposed access junction south of Drumkeeran (also applied to the R280 north of the village), and on the L-4282, to the west of Drumkeeran, were used to provide background traffic volumes on the local public road network. The classified counts were undertaken by Traffinomics Ltd on Wednesday 25th September 2019.



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PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Base mapping provided by MKO

Figure 14.2b Link count locations

PROJECT:	Croagh Wind Farm, County Leitrim		
CLIENT:	Coillte	SCALE:	NTS
PROJECT NO: 7410	DATE: 26.06.20	DRAWN BY:	AL

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Base year 2019 traffic volumes for the link locations shown in Figures 14-2b range from 7,546 vehicles per day on the N4 to the east of Carrick-on-Shannon to 2,781 vehicles on the N16 west of Belcoo and 1,879 vehicles on the R280 south of Drumkeeran, down to 156 vehicles per day on the L-4282 west of Drumkeeran.

Table 14-1 Observed all day flows, year 2019 (2-way vehicles)

Link	2019
1 L-4282	156
2 R280 north	1,879
3 R280 south	1,879
4 N4 east of Carrick-on-Shannon	7,546
5 N16 west of Belcoo	2,781

14.1.3.2 Future Background Traffic Volumes

This section describes the process adopted to produce background traffic forecasts for an assumed construction year of 2024.

Revised guidelines for forecasting annual growth in traffic volumes were produced by TII in May 2019, as set out by county in the 'Project Appraisal Guidelines for National Roads (Unit 5.3)'. The annual growth rates for light vehicles for Co. Leitrim, and factors for the years relevant to this study, are shown in Table 14-2 and Table 14-3. Traffic volumes are forecast to increase during the period from 2019 (the observed traffic count year) to 2024 (the assumed construction year) by 3.0%, assuming a medium growth scenario. All day traffic flows, for the years 2019 and 2024, on the study area network are compared in Table 14-4.

It should be noted that while the assumed construction year of 2024 may vary slightly, this will not alter the forecast outcomes and effects presented in this section of the EIAR. This is due to the annual growth rate for background traffic being just 0.6% (as shown in Table 14-2) and the traffic volumes generated by the Proposed Development will remain unchanged regardless of construction year, as presented subsequently in Section 14.1.4.

Table 14-2 TII Traffic Growth Annual Factors and Indices for County Leitrim

Year	Lights – Annual Factor			Lights (Cars and LGVs) – Cumulative Index		
	Low	Medium	High	Low	Medium	High
2019	1.0044	1.006	1.009	1.000	1.000	1.000
2020	1.0044	1.006	1.009	1.004	1.006	1.009
2021	1.0044	1.006	1.009	1.009	1.012	1.018
2022	1.0044	1.006	1.009	1.013	1.018	1.027
2023	1.0044	1.006	1.009	1.018	1.024	1.036
2024	1.0044	1.006	1.009	1.022	1.030	1.046

Source: TII Project Appraisal Guidelines – Unit 5.3, May 2019

Table 14-3 TII traffic growth rates by growth scenario

Period	New Factors		
	Low	Medium	High
2019 – 2024	1.022	1.030	1.046

Table 14-4 Average all day flows by location and year (2-way vehicles)

Link	2019	2024
1 L-4282	156	161
2 R280 north	1,879	1,935
3 R280 south	1,879	1,935
4 N4 east of Carrick-on-Shannon	7,546	7,772
5 N16 west of Belcoo	2,781	2,864

The TII traffic count data recorded on the N4 and N16, and the classified counts undertaken on the R280 and L-4282 were also used to determine the existing percentage of HGVs on the study area network. The observed percentage of HGVs was observed to vary from 5.1% on the R280 approaching Drumkeeran from the south, 6.3% on the N4, up to 25.0% on the L-4282 to the west of the village. Traffic volumes forecast on the study network for the year 2024 are shown by vehicle type in Table 14-5.

Table 14-5 All day flows, percentage HGVs and flows by vehicle type, year 2024

Link	All day flow (vehs)	% HGV's	Vehicles		PCUs		
			HGVs	Cars / lgvs	HGVs	Cars / lgvs	Total
1 L-4282	161	25.0%	40	121	96	121	217
2 R280 north	1,935	5.1%	99	1,837	237	1,837	2,074
3 R280 south	1,935	5.1%	99	1,837	237	1,837	2,074
4 N4 east of Carrick-on-Shannon	7,772	6.3%	490	7,283	1,175	7,283	8,458
5 N16 west of Belcoo	2,864	5.8%	166	2,698	399	2,698	3,097

14.1.4 Proposed Development and Traffic Generation

14.1.4.1 Development Trip Generation – During Construction

The assessment of the effects of traffic generated during the construction of the proposed development is considered in two stages.

- Stage 1 – Site preparation and groundworks, construction of turbine foundations, cabling, met mast foundations, substation construction, construction of compound and tree felling, and,
- Stage 2 – Turbine component delivery and construction.

For the purpose of the traffic impact assessment, projections based on typical wind farm construction projects regarding the length of the construction phases and work periods etc. must be made to inform the assessment. These projections allow for a worst-case scenario assessment but should not be inferred as prescriptive limitations to the construction phase. There are numerous variables which can affect a construction project programme such as weather for example. The construction phase of the proposed development will be carried out in accordance with the CEMP, which is submitted as Appendix 4.3 of this EIAR.

The construction phase of the proposed development is expected to last approximately 12 months (1 year). While this could increase to 18 months, 12 months was assumed for the purpose of this assessment in order to test the worst-case scenario.

14.1.4.1.1 *Stage 1 – Site Preparation and Ground Works*

For assessment purposes a standard 255 working days per annum was adopted for the 12 month construction period for the site preparation and ground works stage with the total numbers of deliveries made to the site during that period shown in Table 14-6.

During this construction phase, there will be two distinct types of days with respect to trip generation. A total of 10 days will be used to pour the 10 concrete wind turbine foundations. Foundations will likely be poured one per day, with an estimated 75 concrete loads required for each turbine foundation delivered to the site over a 12-hour period. This will result in just over 6 HGV trips to and from the site

per hour. On the remaining 245 working days for this stage, other general materials will be delivered to the site.

During all of Stage 1, based on trip rates typical of wind farm projects, it is estimated that 3,218 two-way trips will be made to the site by trucks and large articulated HGVs, as set out in Table 14-6, with the daily effect on the local road network shown in Table 14-7 and 14-8. The figures show that on the 10 days that concrete will be delivered to the site an additional 360 two-way PCUs will be added to the network (comprising 75 two-way HGV trips or 150 movements, with 2.4 PCUs per movement), as shown in Table 14-7. Similarly, on the 245 days when other materials will be delivered to the site, traffic volumes on the local network are forecast to increase by an average 48 two-way PCUs, as set out in Table 14-8.

Table 14-6 Stage 1 – Site preparation and groundworks – total movements

Material	Total no. Truck Loads	Truck type
Concrete	750	Trucks
Concrete blinding and steel	110	Large artic
Plant / fencing / compound set-up	24	Large artic
Forestry felling	540	Large artic
Crushed rock and stone	1,364	Large artic
Ducting / cabling	294	Large artic
Grid cable laying	25	Large artic
Cranes	11	Large artic
Substation components	79	Large artic
Refuelling / maintenance / misc	22	Large artic
Total	**3,218**	

Table 14-7 Stage 1 – Concrete foundation pouring – total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Concrete	750	Truck	2.4	1,800	180.0	360.0
* Estimation based on 10 concrete pouring days						

Table 14-8 Stage 1 – Site preparation and groundworks – total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Concrete blinding and steel	110	Large artic	2.4	263	1.1	2.1
Plant / fencing / compound set-up	24	Large artic	2.4	57	0.2	0.5
Forestry felling	540	Large artic	2.4	1,296	5.3	10.6
Crushed rock and stone	1,364	Large artic	2.4	3,273	13.4	26.7
Ducting / cabling	294	Large artic	2.4	706	2.9	5.8
Grid cable laying	25	Large artic	2.4	60	0.2	0.5
Cranes	11	Large artic	2.4	26	0.1	0.2
Substation components	79	Large artic	2.4	190	0.8	1.5
Refuelling / maintenance / waste collection / misc.	22	Large artic	2.4	52	0.2	0.4
Total	2,468			5,923	24.2	48.4
* Estimation based on ground work period of 245 working days						

14.1.4.1.2 Stage 2 – Turbine Construction

During the turbine construction stage, including delivery and assembly, some deliveries to the site will be made by abnormally large vehicles, referred to in this section as extended artics, transporting the component parts of the turbines (nacelles, blades and towers). There will also be deliveries made by normal large HGVs, transporting cables, tools and smaller component parts. The types of load and associated numbers of trips made to the site during the turbine construction period are shown in Table 14-9, which summarises that a total of 90 trips will be made to and from the site by extended artics, with a further 40 trips made by conventional large articulated HGVs.

Table 14-9 Stage 2 – Wind turbine plant – total movements

Material	Units	Quantity per Unit	Total Quantity	Quantity per Truck	Total Truck Loads	Truck type
Nacelle	10	1	10	1	10	Extended Artic
Blades	10	3	30	1	30	Extended Artic
Towers	10	5	50	1	50	Extended Artic
Sub total					***90***	
Transformer	10	1	10	1	10	Large Artic
Drive train and blade hub	10	1	10	1	10	Large Artic
Base and other deliveries	10	2	20	1	20	Large Artic
Sub total					***40***	
Total					**130**	

For the purpose of this assessment a delivery period based on previous constructed wind farm sites already constructed, is provided although this may be subject to change. It is assumed that the turbine delivery element will progress at the rate of 5 extended artic trips made by convoy to the site on 2 days per week, resulting in this stage taking approximately 18 days/nights spread over a 10-week period. On a further two days per week, lasting for approximately 11 weeks, the remaining equipment required during this phase will be delivered to the site. The additional traffic movements for these 2 types of days are summarised in Table 14-10 and Table 14-11. In Table 14-10, a PCU equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 100 PCUs on the study network on these 2 days per week, while an additional 14.4 PCUs are forecast to be on the network on two other days per week, as shown in Table 14-11, during the turbine construction phase.

Table 14-10 Stage 2 – Wind turbine plant, extended artics – total movements and volumes per delivery day

Material	Units	Truck Type	PCU Value	Total PCUs	2-way PCUs/ day
Nacelle	1	Extended Artic	10	10.0	20.0
Blades	3	Extended Artic	10	30.0	60.0
Towers	5	Extended Artic	10	50.0	100.0

Material	Units	Truck Type	PCU Value	Total PCUs	2-way PCUs/ day
Total per turbine	9			90.0	180.0
Total per delivery day	5			50.0	100.0
* Based on 5 abnormal sized loads being delivered per day on 2 days per week (total 90 loads will take 18 nights spread over 9 weeks)					

Table 14-11 Stage 2 - Wind turbine plant, normal artic HGVs - total movements and volumes per delivery day

Material	Quantity per Unit	PCU Value	2-way PCUs / day
Transformer	1	2.4	4.8
Drive train and blade hub	1	2.4	4.8
Base & other deliveries	1	2.4	4.8
Total	3		14.4
* based on equipment for 2 turbines being moved per week spread over 2 days			

14.1.4.1.3 Construction Employee Traffic

It is estimated that a maximum of 80 staff members will be employed on the site at any one time during the site preparation and groundworks stage of construction, reducing to a maximum of 40staff at any one tiine during the turbine construction stage. If a worst case is assumed that all staff will travel to / from the site by car, at an average of 2 persons per car, then a total of 80 PCU movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 40 pcu trips during the turbine construction stage.

14.1.4.2 Development Trip Generation – During Operation

It is assumed that the wind farm will be unmanned once operational and will be remotely monitored. Traffic associated with the operational phase of the wind farm will be from the wind farm developers, Eirgrid personnel visiting the substation, and maintenance personnel who will visit individual turbines.

It is estimated that the traffic volumes that will be generated by the development once it is operational will be minimal. The site will be unmanned but will generate maintenance trips, with approximately two maintenance staff travelling to site at any one time. The impact on the network of these trips during the operational stage is discussed in Section 14.1.6.

Once operational the site will also be open to visitors for amenity purposes, with those travelling by car using the carpark provided and accessed via the existing local road network to the north of the site. Based on visitors to existing wind farm sites it is forecast that up to 40 car trips per day will be generated by this use.

14.1.5 Construction Traffic Design Vehicles

14.1.5.1 Construction Traffic Vehicle Types

The delivery of turbine components including blades, tower sections and nacelles is a specialist operation due to the oversized loads involved. The blades are the longest turbine component and in the case of the Proposed Development blades up to 70m long have been considered for the purpose of this assessment.

The actual turbine to be installed on the site will be the subject of a competitive tender process, and could include turbines not amongst those originally considered as part of this assessment because they are not yet available on the market. The worst case scenario of a blade length of 70m has been assessed regardless of the make or model of the turbine eventually selected for installation on site. Aa confirmatory delivery assessment and program will be carried out by the turbine delivery company to ensure the findings of this assessment remain valid for whatever model of turbine is selected.

For the purpose of the assessment set out in this EIAR, it is assumed that the blades, which are the largest turbine components, will be transported using a standard extended arctic. As this method involves transporting the blade in a horizontal position it represents the worst case in terms of the geometric requirements on the road network. It is noted, however, that during the delivery phase consideration will be given to using alternative transportation technologies, including the use of scissor lift adaptors which raise the rear of the blade over existing obstructions, and in extreme cases, the use of blade lift adaptors that can transport blades at an angle to both lift the rear of the blade and shorten the wheelbase of the transporter.

The key dimensions of the vehicles tested are as follows:

Transport of Blades – Super Wing Carrier with blade

Total length	76.0 m
Length of blade	70.0 m
Inner radius	28.0 m

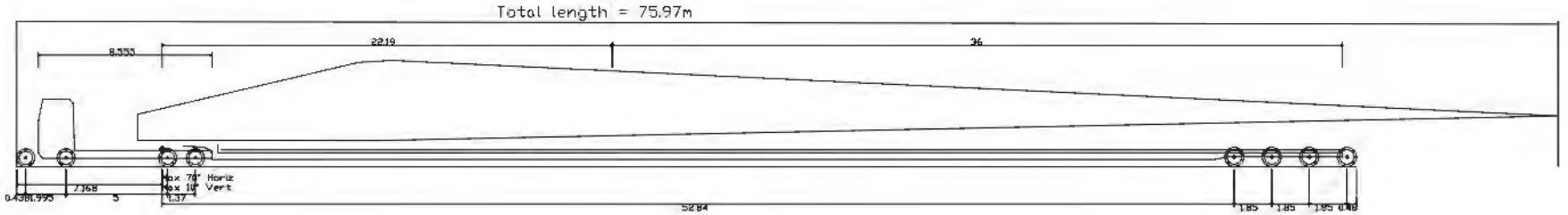
Transport of Tower – Using low-bed or drop deck trailers

Total length (with load)	49.6 m
Length of load	30.0 m
Inner radius	25.0 m

The critical vehicles in terms of size and turning geometry requirements, and used in the detailed route assessment discussed in Section 14.1.8 are the blade and tower transporters. The geometry of the design vehicles are included as Figures 14-4 and 14-5.

The vehicles used to transport the nacelles will be shorter in length compared to the blade and tower transporters.

All other vehicles requiring access to the site will be standard HGVs and will be significantly smaller than the design test vehicles.



70.0 m blade	
Overall Length	75.97m
Overall Width	2.550m
Overall Body Height	4.800m
Min Body Ground Clearance	0.375m
Track Width	2.500m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 14.4 Design blade extended artic profile (70m blade)

PROJECT:	Croagh Wind Farm, County Leitrim		
CLIENT:	Coilte	SCALE:	NTS
PROJECT NO: 7410	DATE: 03.04.20	DRAWN BY:	AL

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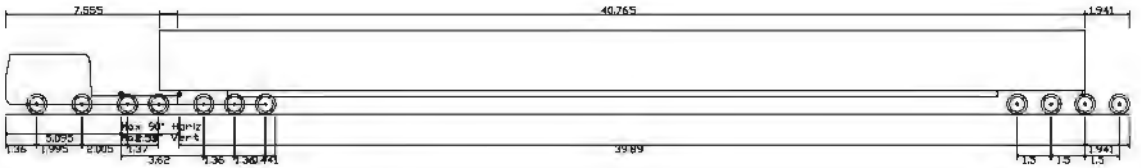

Tower (Final)

Overall Length	49.476m
Overall Width	2.550m
Overall Body Height	3.695m
Min Body Ground Clearance	0.427m
Max Track Width	2.520m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 14.5 Design tower extended artic profile (70m blade)

PROJECT:	Croagh Wind Farm, County Leitrim		
CLIENT:	Coilte	SCALE:	NTS
PROJECT NO: 7410	DATE: 03.04.20	DRAWN BY:	AL

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14.1.6 Traffic Effects During Construction and During Operation

14.1.6.1 Traffic Effect During Construction and During Operation

As detailed below, transportation of large turbine components will be carried out at night when traffic is at its lightest and in consultation with the relevant Roads Authority and An Garda Síochána with deliveries accompanied by Garda escort.

Effect on Link Flows – During Construction

Background traffic volumes, as established previously and set out in Table 14-5, and development generated traffic volumes are shown for the typical construction day scenarios discussed in Section 14.1.4 are set out in Table 14-12 to 14-15, with the traffic effects summarised in Table 14-16 to 14-19. The actual figures presented in the tables, may vary slightly, however they are considered to represent a robust worst case assessment of the likely effects.

In terms of daily traffic flows the potential effects may be summarised as follows:

During Stage 1 – Concrete Pouring

For these 10 days an additional 440 PCUs will travel on the study network.

There are 2 potential options for deliveries of concrete, from suppliers to the north of Drumkeeran, and those to the south.

If solely delivered from the north - On these days, the percentage increase in traffic volumes experienced on the study network will be between 14% on the N16 west of Belcoo, to 21% on the R280 north of Drumkeeran, to more than a 3 fold increase (203%) on the existing L-4282 just to the west of Drumkeeran.

If solely delivered from the south the percentage increase in traffic volumes experienced will be between 5% on the N4 east of Carrick-on Shannon, to 21% on the R280 south of Drumkeeran and a 3 fold increase (203%) on the existing L-4282 just to the west of Drumkeeran.

During Stage 1 - Site Preparation and Groundworks

On average an additional 128 PCUs will travel on the local highway network for each of the 245 days.

If solely delivered from the north - the percentage increase in traffic volnmes experienced on the study network will range from 4% on the N16 west of Belcoo, to 6% on the R280 north of Drumkeeran, to a 59% increase on the existing L-4282 just to the west of Drumkeeran.

If solely delivered from the south - the percentage increase in traffic volumes experienced will be between 2% on the N4 east of Carrick-on Shannon, to 6% on the R280 south of Drumkeeran and a 59% increase on the existing L-4282 just to the west of Drumkeeran.

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During Stage 2 - Turbine Construction Stage – Delivery of large equipment using extended articulated vehicles

As stated previously, all of the deliveries for this stage will approach the site from the south and will utilise the proposed link road through the farmyard linking the R280 with the L4282 at the southern end of Drnmkeeran. Only construction staff trips will therefore nse the existing section of the L-4282 just to the west of Drumkeeranduring this stage.

The additional 140 PCUs (made up of cars and large extended artics) will travel on the study network for 18 days. On the days this impact occurs, volumes will increase by 2% on the N4 to the east of Carrick-on-Shannon, and by 7% on the R280 just south of Drumkeeran. While there will be limited impact on the L-4282 just to the west of Drumkeeran during this delivery phase due to construction staff trips, the section between the link road and the proposed construction access road (between locations 3 and 5 indicated in Figure 14-2a) will provide for the abnormally sized loads, resulting in a 65% increase in traffic volumes.

The most siguificant traffic impact may be experienced during these delivery periods primarily due to the slow speeds, size and geometric requirements of these vehicles. The provision of traffic management measures, including ensuring that these deliveries are made at night as is proposed, (as set out in Sections 14.1.7 and 14.1.10.6 and included in the CEMP), will be required to minimise the impact of development traffic on the study network on these days.

During Stage 2 - Turbine Construction Stage – Other deliveries using conventional articulated HGVs

For 10 days on the delivery route 55 additional PCUs (made up of cars and standard articulated HGV movements to the site and back) will travel on the study network. On these days, the percentage increase on the study network will be between 1% on the N4, to 3% on the R280 approaching Drumkeeran and 25% on the L-4282 towards the site.

Table 14-12 Effects of development traffic during concrete pouring

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 L-4282	121	96	217	80	360	440	201	456	697
2 R280 north	1,837	237	2,074	80	360	440	1,917	597	2,514
3 R280 south	1,837	237	2,074	80	360	440	1,917	597	2,514
4 N4 east of Carrick-on-Shannon	7,283	1,175	8,458	80	360	440	7,363	1,535	8,898
5 N16 west of Belcoo	2,698	399	3,097	80	360	440	2,778	759	3,537

Table 14-13 Development traffic during site preparation and groundworks

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 L-4282	121	96	217	80	48	128	201	144	345
2 R280 north	1,837	237	2,074	80	48	128	1,917	285	2,202
3 R280 south	1,837	237	2,074	80	48	128	1,917	285	2,202
4 N4 east of Carrick-on-Shannon	7,283	1,175	8,458	80	48	128	7,363	1,223	8,586
5 N16 west of Belcoo	2,698	399	3,097	80	48	128	2,778	447	3,225

Table 14-14 Development traffic during turbine construction - extended artics (large turbine components)

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 L-4282	121	96	217	40	100	140	161	196	357
2 R280 north	1,837	237	2,074	40	100	140	1,877	337	2,214
3 R280 south	1,837	237	2,074	40	100	140	1,877	337	2,214
4 N4 east of Carrick-on-Shannon	7,283	1,175	8,458	40	100	140	7,323	1,275	8,598
5 N16 west of Belcoo	2,698	399	3,097	40	100	140	2,738	499	3,237

Table 14-15 Effect of development traffic during turbine construction – other deliveries (small turbine components)

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 L-4282	121	96	217	40	15	55	161	111	272
2 R280 north	1,837	237	2,074	40	15	55	1,877	252	2,129
3 R280 south	1,837	237	2,074	40	15	55	1,917	252	2,129

Link	Background PCUs			Development PCUs			Total PCUs (Background + Development)		
4 N4 east of Carrick-on-Shannon	7,283	1,175	8,458	40	15	55	7,323	1,190	8,513
5 N16 west of Belcoo	2,698	399	3,097	40	15	55	2,738	414	3,152

Table 14-16 Summary effect of development traffic during concrete pouring

Link	Background	Development	Total	% increase	Estimated No. of days
1 L-4282	217	440	657	202.8%	Up to 10
2 R280 north	2,074	440	2,514	21.2%	Up to 10
3 R280 south	2,074	440	2,514	21.2%	Up to 10
4 N4 east of Carrick-on-Shannon	8,458	440	8,898	5.2%	Up to 10
5 N16 west of Belcoo	3,097	440	3,537	14.2%	Up to 10

Table 14-17 Summary effect of development traffic during site preparation and ground works

Link	Background	Development	Total	% increase	Estimated No. of days
1 L-4282	217	128	345	59.0%	Up to 245
2 R280 north	2,074	128	2,202	6.2%	Up to 245
3 R280 south	2,074	128	2,202	6.2%	Up to 245
4 N4 east of Carrick-on-Shannon	8,458	128	8,586	1.5%	Up to 245
5 N16 west of Belcoo	3,097	128	3,225	4.1%	Up to 245

Table 14-18 Summary effect of development traffic during turbine construction – extended artics (large turbine components)

Link	Background	Development	Total	% increase	Estimated No. of days
1 L-4282	217	140	357	64.5%	18
2 R280 north	NA	NA	NA	NA	NA

Link	Background	Development	Total	% increase	Estimated No. of days
3 R280 south	2,074	140	2,214	6.8%	18
4 N4 east of Carrick-on-Shannon	8,458	140	8,598	1.7%	18
5 N16 west of Belcoo	NA	NA	NA	NA	NA

Table 14-19 Summary effect of development traffic during turbine construction – other deliveries (small turbine components)

Link	Background	Development	Total	% increase	Estimated No. of days
1 L-4282	217	55	272	25.4%	10
2 R280 north	NA	NA	NA	NA	NA
3 R280 south	2,074	55	2,129	2.7%	10
4 N4 east of Carrick-on-Shannon	8,458	55	8,513	0.7%	10
5 N16 west of Belcoo	NA	NA	NA	NA	NA

An assessment of the impact on link capacities in the study area was undertaken for the various construction stages as set out in Table 14-20, Table 14-21, and Table 14-22. The capacity for each link in the study area is shown in Table 1420. The capacities range from a daily flow of 11,600 vehicles on the N4 down to 2,200 on the L-4282, and are based on road widths and capacities set out in the TII Standards document DN-GEO-03031 Road Link Design, Table 6/1.

Background, or do nothing traffic flows, are compared to flows forecast for the various construction delivery stages in Table 14-21 with the percentage capacity reached for each link and stage shown in Table 14-22. Based on this assessment the following points are noted;

- On the external network the N4 to the east of Carrick-on-Shannon is the busiest road with the link capacity forecast to operate at 73% for the do-nothing scenario, increasing to a maximum of 77% during the 10 days that the concrete foundations will be poured.
- All other roads leading to the site are forecast to operate well within link capacity for all scenarios.

Table 14-20 Carriageway widths, link type and link capacity

Link	Width (m)	Link type	Link capacity
1 L-4282	approx.5.0m	Local road	2,200
2 R280 north	6.0	Type 3 single	5,000
3 R280 south	6.0	Type 3 single	5,000
4 N4 east of Carrick-on-Shannon	7.0	Type 1 single	11,600
5 N16 west of Belcoo	7.0	Type 2 single	8,600

Table 14-21 Link capacity and summary of link flows by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1 L-4282	2,200	217	657	345	NA	NA
2 R280 north	5,000	2,074	2,514	2,202	NA	NA
3 R280 south	5,000	2,074	2,514	2,202	2,214	2,129
4 N4 east of Carrick-on-Shannon	11,600	8,458	8,898	8,586	8,598	8,513
5 N16 west of Belcoo	8,600	3,097	3,537	3,225	NA	NA

Table 14-22 Link capacity and % of link capacity by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1 L-4282	5,000	10%	30%	16%	16%	12%
2 R280 north	5,000	41%	50%	44%	44%	43%
3 R280 south	5,000	41%	50%	44%	44%	43%
4 N4 east of Carrick-on-Shannon	11,600	73%	77%	74%	74%	73%
5 N16 west of Belcoo	8,600	36%	41%	38%	38%	37%

Substation Construction

It is estimated that an additional 398 HGV trips will be generated to and from the site during the construction of the substation, associated compound and grid connection works. The construction of the substation will take place at the same time as the site preparation and groundworks stage, as set out in Table 14-6 and Table 14-7, with traffic effects included in the assessment for that construction period.

Access Road

All materials (stone and gravel) required to construct the internal access road are included in Tables 14-6 and 14-8 and are included in the assessment presented in Section 14.1.6.1.

Effect on Link Flows – During Operation

Once the wind farm is operational it is estimated that approximately two operation and maintenance staff will access the site at any particular time in order to carry out operational maintenance, with a similar number of vehicle trips. It is considered that the traffic impact during this phase will be imperceptible.

Effect on Junctions – During Construction

Guidance relating to the requirement to undertake a detailed junction capacity assessment at junctions in the proximity of a proposed development is set out in Document PE-PDV-02045 Traffic and Transport Assessment Guidelines, TII, May 2014. The guidance states that a capacity assessment should be undertaken where the proposed development results in an increase in traffic volumes of 10% or greater, in situations where the network is not currently congested. . As the traffic volumes on the L4282 are forecast to increase by greater than this threshold during the construction of the Proposed Development, a detailed capacity assessment was undertaken for the existing R280 / L-4282 junction in Drumkeeran. As the impact on the R280 is below this threshold it is considered that no further junctions were required to be the subject of a detailed capacity assessment.

The capacity of the R280 / L4282 junction was assessed using the industry standard junction simulation software PICADY, which permits the capacity of any junction to be assessed with respect to existing or forecast traffic movements and volumes for a given period. The capacity for each movement possible at the junction being assessed is determined from geometric data input into the program with the output used in the assessment as follows:

- Queue – This is the average queue forecast for each movement and is useful to ensure that queues will not interfere with adjacent junctions.
- Degree of Saturation or Ratio of Flow to Capacity (% Sat or RFC) – As suggested, this offers a measure of the amount of available capacity being utilised for each movement. Ideally each movement should operate at a level of no greater than 85% of capacity.
- Delay – Output in minutes, this gives an indication of the forecast average delay during the time period modelled for each movement.

Scenarios Modelled

While other junctions and links on the network will experience an increase in traffic volumes passing through them, as discussed previously and as set out in Table 14-16 to 14-20 above, the worst-case effect will be experienced during peak hours when, during peak construction periods, up to 80 workers (40 cars) will pass through it. It is noted that deliveries of materials to the site will take place during the day after the workers have arrived on site, and before they leave at the end of the day, and will therefore not occur at the same time.

R280 / Access Road Junction Capacity Test Results

The AM and PM peak hour traffic flows through the R280 / L-4282 junction were calculated from the link flows and are shown for the year 2024 in Figure 14-3a, with background traffic flows for the assumed construction year of 2024 shown in Figure 14-3b. Traffic flows generated by the proposed development during the AM and PM peak hours are shown in Figure 14-3c while the year 2024 traffic flows with development generated traffic are shown in Figure 14-3d.

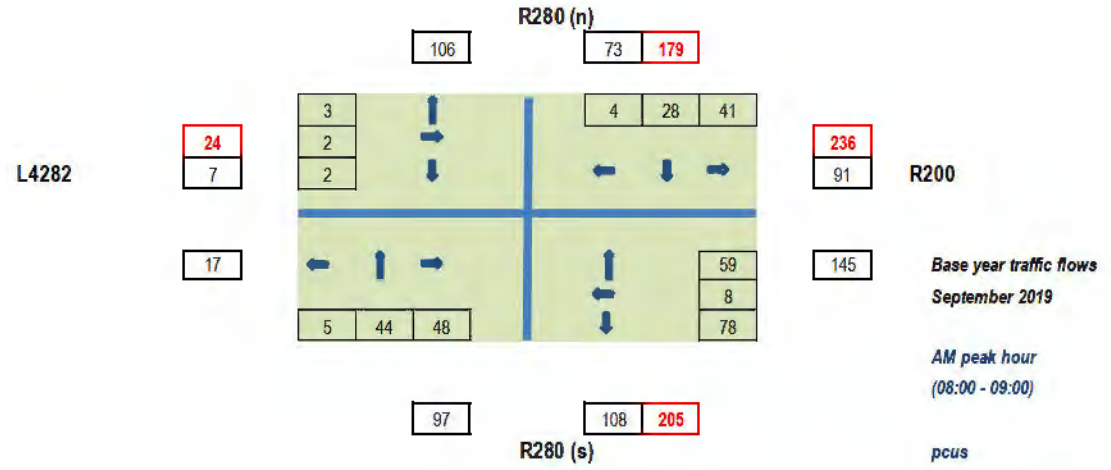
The results of the capacity assessment, as set out in Tables 14-23 and 14-24, show that additional car trips passing through the junction will be accommodated by the existing junction with a maximum ratio of flow to capacity (RFC) forecast to increase from 33.0% from the do nothing scenario to 37.1% with the Proposed Development construction traffic in place during the AM peak hour, with a similar increase from32.7% to 33.0% during the PM peak hour. Of the movements effected the most by the Proposed Development, the right turn from the R280 onto the L-4282 is forecast to increase from 0.9% to 3.9% during the AM peak hour and the exit from the L-4282 onto the R280 from 1.5% to 11.2% during the PM peak hour. All of these movements are forecast to operate well within the acceptable limit of 85%.

Table 14-23 Junction capacity test results, R280 / L4282 junction, , without and with construction staff, year 2024, AM peak

Period	Location	Without construction traffic			With construction traffic		
AM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
	From R200	33.6%	0.50	0.18	37.1%	0.58	0.20
	From L4282	1.7%	0.02	0.13	1.7%	0.02	0.13
	Right turn into R200	11.1%	0.14	0.12	11.2%	0.15	0.12
	Right turn into L4282	0.9%	0.01	0.12	3.9%	0.04	0.13

Table 14-24 Junction capacity test results, R280 / L4282 junction, , without and with construction staff, year 2024, PM peak

Period	Location	Without construction traffic			With construction traffic		
PM		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
	From R200	32.7%	0.48	0.19	33.0%	0.49	0.19
	From L4282	1.5%	0.01	0.13	11.2%	0.13	0.15
	Right turn into R200	13.2%	0.16	0.13	13.4%	0.17	0.13



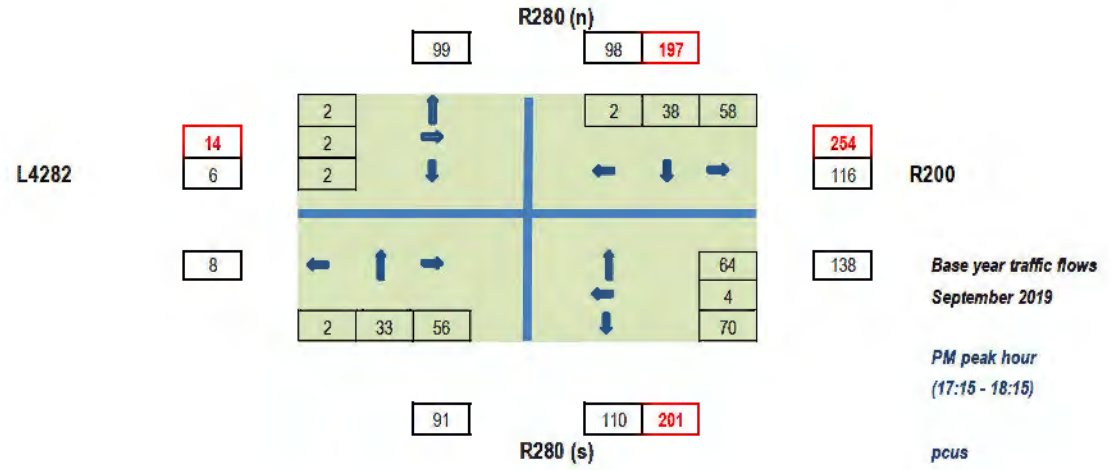


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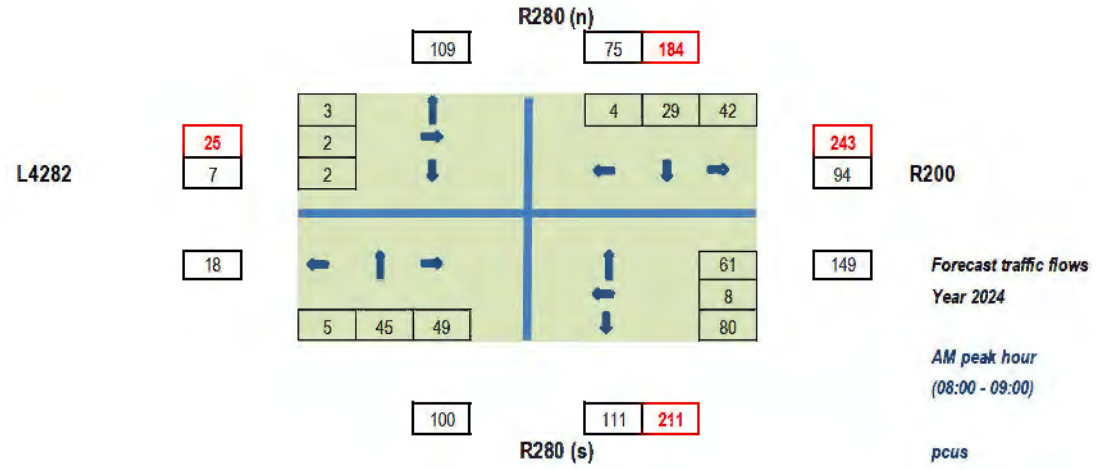
Figure 14.3a Base year traffic flows, AM & PM peak hours, R280 / L4282 junction year 2019 - pcus



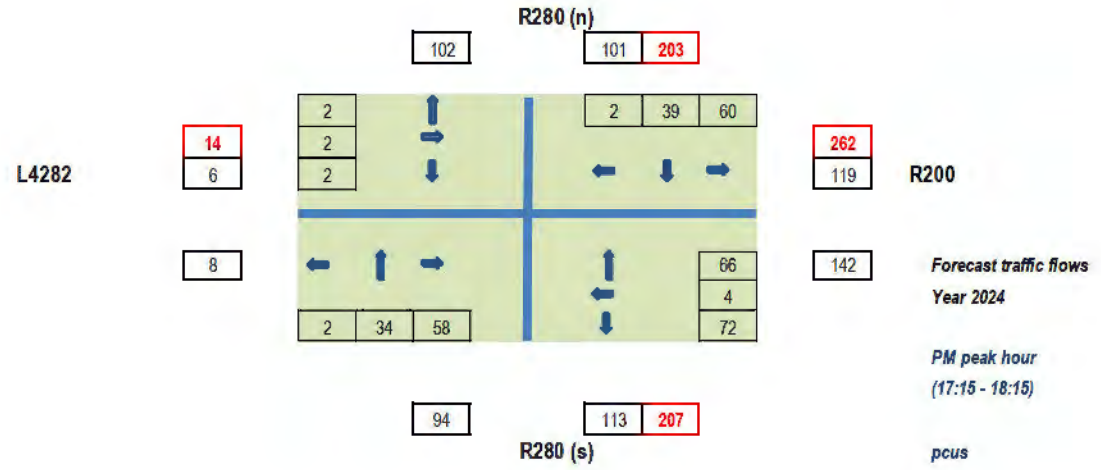


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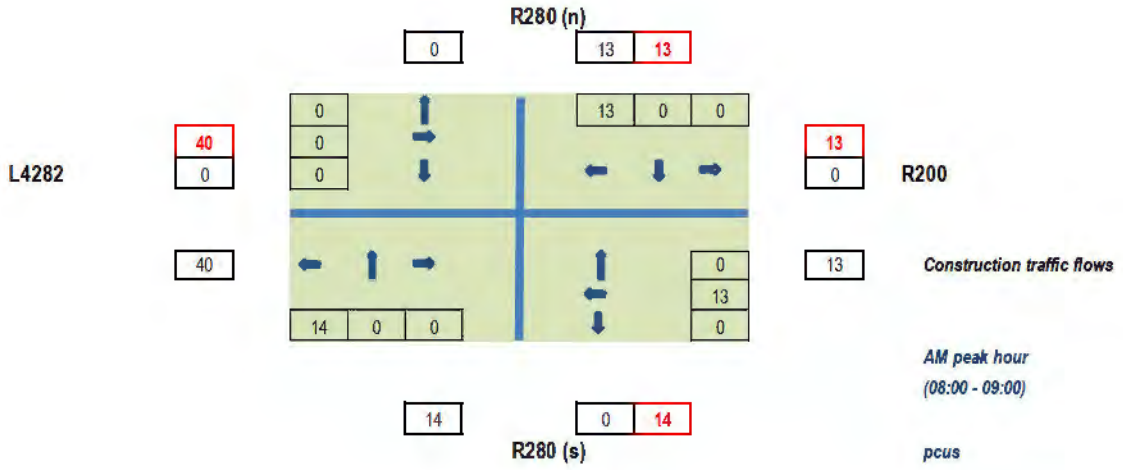
Figure 14.3b Construction year background traffic flows, AM & PM peak hours, R280 / L4282 junction, year 2024 - pcus



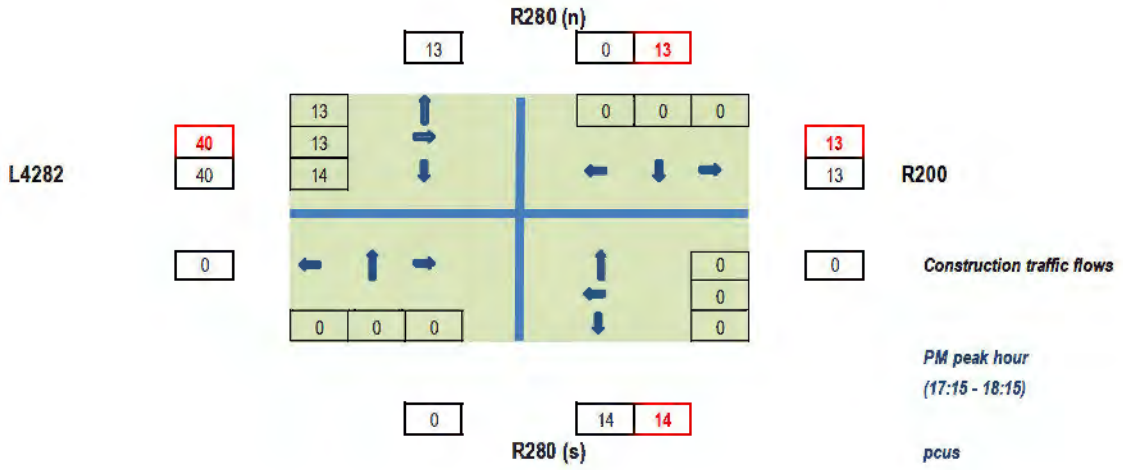


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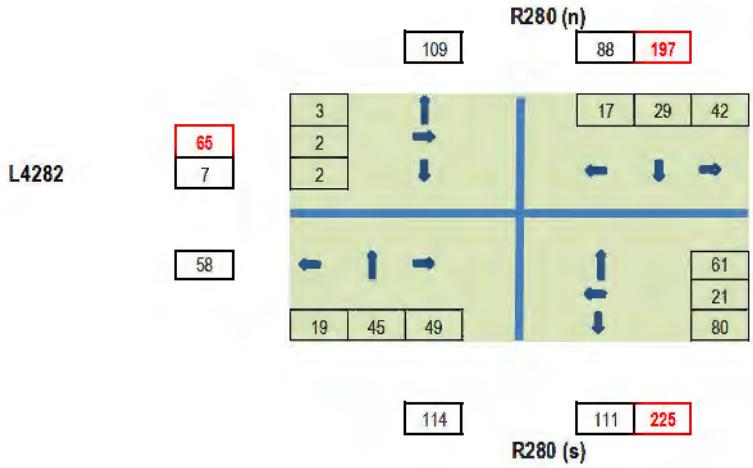
Figure 14.3c Construction traffic flows, AM & PM peak hours, R280 / L4282 junction - pcus



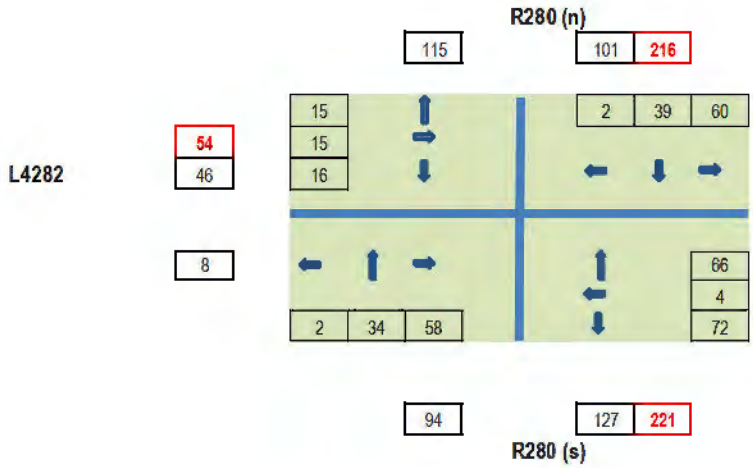


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Figure 14.3d With construction traffic flows, AM & PM peak hours, R280 / L4282 junction, year 2024 - pcus

Period	Location	Without construction traffic			With construction traffic		
	Right turn into L4282	0.4%	0.00	0.12	0.4%	0.00	0.12

Effect on Junctions – During Operation

As discussed in Section 14.1.6 it is forecast that once operational, the development will generate approximately 2 trips per day for maintenance purposes. It is therefore concluded that the development will not have a significant effect on the local network once constmcted.

Effect on Network of Grid Connection

The grid connection to the Proposed Development will be via the existing 110KV Garvagh substation with the cable layed on approximately 4.7 kms of the improved L4282 leading to the site. With the exception of the transportation of the materials required to construct the cable link, which has been taken into account elsewhere in this section, the construction of the cable link will have no additional impact on traffic on the external road network.

14.1.7 Traffic Management of Large Deliveries

The greatest effect on the road network will likely be experienced on the approximately 18 days during which the 5 large loads comprising the tower sections, the blades and the nacelles are delivered to the site.

Traffic management measures are included in Section 14.1.10.6 and include the following:

- Identification of a delivery schedule,
- Details of the alterations required to the infrastructure identified in Section 141.8 of this report and any other minor alteration identified,
- A dry mn of the ronte using vehicles with similar dimensions.

The transport of large components is challenging and can only be done following extensive route selection, route proofing and consultation with An Garda Síochána and the various local authorities. Turbine components are often transported at night when traffic is lightest and this is done in consultation with the roads authorities / An Garda Síochána and special permits are generally required.

In some cases, temporary accommodation works are required along the turbine delivery route (TDR) such as hedge or tree cutting, temporary relocation of powerlines/poles, lampposts, signage and minor road verge works. Any updates to the road will be carried out in advance of turbine deliveries and following consultation and agreement with the appropriate local authorities.

It is not anticipated that any sections of the local road network will be closed, although there may be delays to local traffic at various locations if the deliveries are made during daylight hours. During these periods, it may be appropriate to operate local diversions for through traffic. It is noted that it is proposed that all deliveries of abnormally sized loads will be made during night time hours, as is the norm for such deliveries.

14.1.8 Route Assessment

A route assessment was undertaken covering the proposed delivery route for the abnormal loads, with the route and assessment locations shown in Figure 14-2a. The route assessment discussed in this section commences at the proposed access junction off the R280 with all locations along the route

referred to in this section highlighted in Figure 14-2a. For these locations, preliminary road and junction /alignments, based on site surveys, were supplied by the project team. A swept path analysis was then undertaken using Autotrack in order to establish the locations where the wind turbine transport vehicles will be accommodated, and the locations where some form of remedial measure, such as local widening, may be required.

The assessment presents the preliminary design of the proposed junctions at the eastern and western ends of the proposed access road (with the R280 at the eastern end and the L-4282 at the western end), and the autotrack assessments for the appropriate vehicle types relevant to each.

The locations discussed are as follows;

- Location 1 – Bend on R280,
- Location 2 - Access Junction A – Link Road / R280,
- Location 3 - Access Junction B – Link Road / L-4282,
- Location 4 – Bends on L-4282,
- Location 5 - Access Junction C – Construction Access Road / L-4282,
- Location 6 - Access Junction D – Construction Access Road / L-4282,
- Locations 7 to 12 on L-4282.
- Location 13 - Access Junction E – Site Access / L-4282.

The following text summarises the findings of the swept path analysis for Locations 1 to 13. All figures referred to in this section are included as Appendix 14-1.

Location 1 – Bend on R280

The autotrack assessment undertaken for the bend on the R280 on the northbound approach to Drumkeeran, indicated as location 1 in Figure 14-2a, is shown in Figures 14-6 and 14-7. The figures show that the existing road will accommodate the abnormally sized vehicles required to transport the turbine blades and towers to the site.

Location 2 – Access Junction A – Link Road / R280

The access proposed at this location will provide for the abnormally sized turbine vehicles only, with all traffic movements made into and out of the link road to / from the R280 made with a Garda escort and temporary traffic management measures. The autotrack assessment shown in Figures 14-8 and 14-9 show the areas that will require to be cleared, and which are available, for the duration of the delivery of the large turbine plant.

Location 3 – Access Junction B – Link Road / L-4282

Similar to Access Junction A, the junction between the proposed link road and the L-4282 will provide for the abnormally sized turbine vehicles only, with all traffic movements made into and out of the link road to / from the L-4282 made with a Garda escort and temporary traffic management measures. The autotrack assessment shown in Figures 14-10 and 14-11 show the areas that will require to be cleared, and are available, for the duration of the delivery of the large turbine plant.

Location 4 – Bends on L-4282

The autotrack assessment undertaken at this location is shown in Figures 14-12 and 14-13. The figures show the extent of local road widening works required to accommodate the abnormally sized vehicles at this location.

Location 5 - Access Junction C – Construction Access Road / L-4282 access road junction

The temporary works required to accommodate the wind farm turbine vehicles, together with the junction layout proposed for the general site works and construction stages, are shown for the Access Junction C in Figures 14-14 to 14-17. The proposed junction layout is designed in accordance with TII guidelines (TII DN-GEO-03060) and the proposed junction markings are as prescribed in the Traffic Signs Manual (Figure 7.35 of manual).

In accordance with Table 26 of Leitrim County Development Plan 2015 – 2021, for a design speed of 60 km/h visibility splays of 2.4 x 70 metres are shown to the west and east along the L-4282 in Figure 14-14. Figures 14-15 to and 14-17 demonstrate that the junction layout proposed for the delivery stage will accommodate all wind farm transport vehicles.

Location 6 - Access Junction D – Construction Access Road / L-4282

Access junction D links the westeru end of the proposed construction access roads with the L-4282.

The proposed layout for Access Junction D as set out in Figure 14-18, complies with current design standards, and the 2.4m x 70m visibility splays shown are in accordance with the Leitrim County Development Plan 2015 – 2021, for a design speed of 60km/h. Figures 14-19 to 14-21 show that the proposed junction geometry will accommodate the largest wind farm turbine transporter vehicles.

Locations 7 to 12 on L-4282

The autotrack assessment undertaken at pinch points, shown as locations 7 to 12 in Figure 14-2a, on the L-4282 and the access road leading to the proposed wind farm site, are shown in Figures 14-22 to 14-33.

The figures show locations where road widening works will be required along the route to accommodate the abnormally sized vehicles required to transport the turbine blades and towers to the site.

Locations 13 – Access Junction E – Site Access on L-4282

Access junction E provides access to the site from the L-4282 for all vehicle types.

The proposed layout for Access Junction E, together with 2.4m x 70m visibility splays are shown in Figure 14-34, while Figures 14-35 to 14-37 show that the proposed junction geometry will accommodate all vehicle types requiring access to the site.

14.1.9 Provision for Sustainable Modes of Travel

14.1.9.1 Walking and Cycling

The provision for these modes is not relevant during the construction stage of the development and travel distances will likely exclude any employees walking or cycling to work.

14.1.9.2 Public Transport

There are no public transport services that currently pass the site although mini-buses may be considered for transporting construction staff to and from the site in order to minimise traffic generation and parking demand on site.

14.1.10 Likely and Significant Effects and Associated Mitigation Measures

14.1.10.1 "Do Nothing" Scenario

If the proposed wind farm does not proceed, there will be no additional traffic generated or accommodation works carried out on the local road network and therefore no direct or indirect effects on roads and traffic.

14.1.10.2 Construction Phase

During the 10 days when the concrete foundations are poured the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 5% on the N4 to a 3 fold increase (203%) on the L-4282 leading to the site. It is noted that the high percentage increase forecast for the L-4282 is due to the low volume of background traffic. The direct effect will be temporary, and will be slight.

During the remaining 245 days for the site preparation and ground works when deliveries to the site will take place, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 2% on the N4, to an increase of 59% on the L-4282 approaching the site. On these days, the direct effect will be temporary and will be slight.

During the 10 days of the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will result in a negative impact on the surrounding road network, increasing traffic levels, ranging from 1% on the N4, to an increase of 3 on the R280 and 3% on the L-4282 leading to the site. The direct effect during this period will be temporary and will be slight.

During the 18 days when the various component parts of the wind turbine plant are delivered to the site using extended articulated HGVs, the effect of the additional traffic on these days will be moderate due to the size of vehicles involved, resulting in increased traffic volumes of between 2.0% on the N4 to 7% on the R280, and 65% on the L-4282 leading to the site, but will be temporary. The direct effect will be reduced to slight if the delivery of the large plant is done at night, as is proposed.

It was determined that all links in the study area and the junction between the R280 and the L-4282 will operate within operational capacity for all days within the construction period.

14.1.10.3 Operational Phase

During the operational phase the direct effect on the surrounding local highway network will be neutral and long term given that there will be approximately two maintenance staff travelling to site at any one time, resulting in typically two visits to the site on any one day made by a car or light goods vehicle.

Should the proposed wind farm be consented and developed, the recreational and amenity proposals set out in Chapter 4 will be implemented which means that there will be some levels of traffic accessing the site for amenity use during the operational stage. This traffic will access the site via the R280 and existing L-8281 where the proposed amenity car park is located. The volumes are likely to be small (up to a maximum of 40 car trips per day) based on information from other similar wind farm developments. Given the capacity of the local highway network there is no significant effects anticipated on roads and traffic.

14.1.10.4 Decommissioning Phase

The design life of the wind farm is 30 years. When the site is decommissioned, cranes will disassemble each turbine tower and all equipment.

All turbine infrastructure including turbine components will be separated and removed off-site for re-use, recycling and waste disposal.

It is proposed that turbine foundations and hardstanding areas will be left in place and covered with soil/topsoil. It is proposed to leave the access roads, visitor car park and walkways in situ at the decommissioning stage . It is considered that leaving the turbine foundations, access tracks and hardstanding areas in situ will cause less environmental damage than removing and recycling them.

The effects on the network during decommissioning will be less significant compared to those during the construction phase as presented in this section of the EIAR as the volume of materials transported to and from the site will be significantly less.

14.1.10.5 Cumulative Effects

A detailed assessment of all developments at varying stages in the planning process (from pre-planning to operational), is set out in Section 2.5 of this EIAR, with an assessment of the potential cumulative traffic effects with the proposed subject wind farm assessed on the following criteria;

- Project status (proposed to operational)
- Degree of overlap with the Proposed Development delivery highway network (low to high)
- Traffic volumes (low to high)

Cumulative impacts of significance will only occur with other wind farms that have yet to be constructed as the traffic generation for existing operational wind farms is very low.

There are 3 proposed developments that could potentially result in cumulative traffic impacts with the proposed Croagh Wind Farm. The first is a permitted extension to the existing Tullynamoyle Wind Farm, comprising an additional 4 turbines, located approximately 8.5kms to the northeast. The second is the permitted decommissioning of 2 existing wind turbines with and the replacement of one larger turbine at the existing Spion Kop wind farm development, located approximately 3.5kms to the south east of the Proposed development. The third is a proposed battery array development proposed off the R280 adjacent to the Corderry Substation, located approximately 4km to the north of Drumkeeran.

As parts of the delivery routes for general construction traffic are common to the 3 development described above and the Proposed Development (R280), in the event that the construction of the Proposed Development coincides with any of these developments, then traffic related cumulative impacts would be negative, temporary and slight given the distance between the sites. The construction phase of the Proposed Development will be scheduled in order that cumulative impacts will be avoided with these developments.

It is noted that all general forestry activity will be curtailed on the site during the construction of the proposed development.

Reference was also made in the preparation of this assessment to other planning applications as set out in Chapter 2.

14.1.10.6 Mitigation Measures

This section summarises the mitigation measures to minimise the effects of the Proposed Development during both the construction operational and decommissioning stages.

Mitigation by Design

Mitigation by design measures includes the following;

- Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles as set out in Section 14.1.8.
- Construction of improvements to the local highway network at locations identified in Section 14.1.8.

Mitigation Measures During the Construction Stage

The successful completion of this development will require significant coordination and planning and it is therefore recommended that the following comprehensive set of mitigation measures will be put in place before and during the construction stage of the project in order to minimise the effects of the additional traffic generated by the proposed wind farm.

Delivery of abnormal sized loads

The following are the main points to note for these deliveries which will take place after peak evening traffic:

- The delivery of turbine components is a specialist transport operation with the transportation of components carried out at night when traffic is at its lightest and the impact minimised.
- The deliveries will be made in consultation with the Local Authority and An Garda Síochána.
- It is estimated that 90 abnormal sized loads will be delivered to the site, comprising 18 convoys of 5, undertaken over 18 separate nights.
- These nights will be spread out over an approximate period of 9 weeks and will be agreed in advance with the relevant authorities
- In order to manage each of the travelling convoys, for each convoy there will be two police escort vehicles that will stop traffic at the front and rear of the convoy of 5 vehicles.
- There will also be two escort vehicles provided by the haulage company for each convoy.

Other traffic management measures

A **Traffic Management Plan (TMP)** is provided specifying details relating to traffic management and as Appendix 14-2 this EIAR. Prior to the commencement of the construction phase of the proposed development a detailed Traffic Management Plan will be prepared by the Contractor for agreement with the local authority and An Garda Síochána. The TMP includes recommendations for the following:

- **Traffic Management Coordinator** – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
- **Delivery Programme** – a programme of deliveries will be submitted to the County Council in advance of deliveries of turbine components to site. Liaison with the relevant local authorities and Transport Infrastructure Ireland (TII) will be carried out

where required regarding requirements such as delivery timetabling. The programme will ensure that deliveries are scheduled in order to minimise the demand on the local network and minimise the pressure on the access to the site.

- **Information to locals** – Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided.
- **A Pre and Post Construction Condition Survey** – Where required by the local authority, a pre-condition survey of roads associated with the proposed development can be carried out immediately prior to construction commencement to record an accurate condition of the road at the time. A post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.
- **Liaison with the relevant local authority** - Liaison with the County Councils and An Garda Síochána, will be carried out during the delivery phase of the large turbine vehicles, when an escort for all convoys will be required. Once the surveys have been carried out and "prior to commencement" status of the relevant roads established, (in compliance with the provisions of the CEMP), the Roads section will be informed of the relevant names and contact numbers for the Project Developer/Contractor Site Manager as well as the Site Environmental Manager.
- **Implementation of temporary alterations to road network at critical junctions** – at locations highlighted in section 14.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers will also be used where deemed practicable.
- **Identification of delivery routes** – These routes will be agreed with the County Councils and adhered to by all contractors.
- **Delivery times of large turbine components** - The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.
- **Travel plan for construction workers** – While the assessment above has assumed the worst case in that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, which will include the identification of routes to / from the site and identification of an area for parking.
- **Additional measures** - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required. These are set out in the CEMP which is contained in Appendix 4.3.
- **Re-instatement works** - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.

Mitigation Measures During Operational Stage

Due to the very low volumes of traffic forecast to be generated during this stage no mitigation measures are required.

Mitigation Measures During Decommissioning Stage

When the proposed development is decommissioned after the 30 years of operation, a decommissioning plan will be prepared for agreement with the local authority, as described in Section 4.11 of Chapter 4. This plan will include a material recycling / disposal plan and traffic management plan and other similar mitigation measures to those implemented during the construction phase. In

terms of traffic effects the decommissioning stage will generally mirror the constructions stage although the effects will be significantly reduced as the volumes of materials removed from the site will be less.

14.1.10.7 Residual Impacts

Construction Stage

During the 12-month construction stage of the Proposed Development, it is forecast that the additional traffic that will appear on the delivery route indicated in Figure 14-2a will have a slight, negative and temporary impact on existing road nsers, which will be minimised with the implementation of the mitigation measures included in the proposed traffic inanagement plan.

Operational Stage

As the traffic impact of the proposed development will be imperceptible during the operational stage, there will be no residual impacts during this stage.

Decommissioning Stage

As stated above, in the event that the wind farm is decommissioned a decommissioning plan will be prepared and implemented in order to minimise the residual impacts during this stage.

14.2 Telecommunications and Aviation

14.2.1 Introduction

This section of the EIAR assesses the likely significant effects of the proposed wind farm on telecommunications and aviation. Section 14.2.3 describes the way in which wind turbines can potentially interfere with telecommunications signals or aviation activities. Section 14.2.4 presents details on how such effects will be avoided, with the likely significant effects assessed (and mitigation measures proposed) in Section 14.2.5.

14.2.1.1 Statement of Authority

This section of the EIAR has been prepared by Eoin McCarthy (B.Sc. Env.), Environmental Scientist with MKO. Eoin has over 8 years' experience in the preparation of EIARs for wind energy developments, including the assessment of likely significant effects on material assets. He has coordinated the scoping and consultation exercise with telecommunications operators and aviation authorities for numerous wind energy developments and prepared the relevant sections of the EIARs.

14.2.2 Methodology and Guidance

This section of the assessment focuses particularly on the scoping and consultation exercise conducted with telecommunications operators and aviation authorities. Scoping was carried out in line with the above EPA guidelines, and the '*Best Practice Guidelines for the Irish Wind Energy Industry*' (Irish Wind Energy Association, 2012), which provides a recommended list of telecommunications operators for consultation.

A full description of the scoping and consultation exercise is provided in Section 2.7 of Chapter 2 of this EIAR. Consultation with the telecommunications operators and aviation bodies informed the constraints mapping process, which in turn informed the layout of the proposed development, as described in Chapter 3 of the EIAR.

The assessment of likely significant effects on material assets uses the standard methodology and classification of impacts as presented in Section 1.8.1 of Chapter 1 of this EIAR. The full project description, including proposed turbine locations and elevations, is provided in Chapter 4.

14.2.3 Background

14.2.3.1 Broadcast Communications

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path.

14.2.3.2 Domestic Receivers

Depending on local topography, a domestic receiver may receive broadcast signals from more than one location. The strength of the signals varies with distance from the transmitter, and the receiver's antenna is generally always directed towards the most local, and usually strongest, broadcasting station.

There are two types of potential electromagnetic interference to domestic receivers, depending on the location of the receiver in relation to a wind farm. 'Shadowed' houses are located directly behind a wind farm, relative to the location from where the signal is being received. In this case, the main signal passes through the wind farm and the rotating blades can create a degree of signal scattering. In the case of viewers located beside the wind farm (relative to the broadcast signal direction), the effects are likely to be due to periodic reflections from the blade, giving rise to a delayed signal.

In both cases, i.e. shadowed houses located behind the wind farm and those located to the side of it, the effects of electromagnetic interference may depend to some degree on the wind direction, since the plane of rotation of the rotor will affect both the line-of-sight blockage to viewers located behind the wind farm and the degree of reflection to receivers located to the side.

14.2.3.3 Other Signal Types

Wind turbines have the potential to affect other signal types used for communication and navigational systems, for example tower-to-tower microwave communication links, and airborne and ground radar systems. Interference with radar systems occurs when wind turbines are located close to an airport or directly in line with the instrument landing approach. The nearest such operational airport to the Proposed Development site is Sligo Airport, located approximately 26 kilometres northwest of the site.. Ireland West Internnational Airport Knock is located approximately 45km southwest of the site. Both airports are are outside the range at which issues would be expected.

Potential effects on broadcast communications are generally easily dealt with by detailed micro-siting of turbines in order to avoid alignment with signal paths or by the nse of repeater relay links out of line with the wind farm.

14.2.4 Preventing Electromagnetic Interference

14.2.4.1 National Guidelines

The '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government, 2006) state that developers are advised to contact individual local and national broadcasters and mobile phone operators to inform them of proposals to develop wind farms.

This consultation has been carried out by MKO as part of the assessment of the proposed development as summarised below; full details are provided in Section 2.5 in Chapter 2 of this EIAR.

The guidelines also state that potential interference with broadcast communications can be overcome by the installation of deflectors or repeators where required.

14.2.4.2 Scoping and Consultation

As part of the EIAR scoping and consultation exercise, MKO contacted the relevant national and regional broadcasters, fixed and mobile telephone operators, aviation authorities and other relevant consultees. Consultation was also carried out with ComReg in order to identify any other additional licensed operators in the vicinity of the proposed site to be contacted, who may not have been on the list of main operators.

The responses received from the telecorumunications and aviation consultees are summarised below in Table 12-25.

Table 14-25 Telecommunications and Aviation Scoping Responses

Consultee	Response	Potential for Interference Following Consultation Exercise
Airspeed	No response received to date	No
Broadcasting Authority of Ireland	No response received to date	No
BT Communications Ireland	Received 15th August 2018	No
ComReg (Commission for Communications Regulation)	Received 15th August 2018	No
Department of Defence	Received 6th February 2019	No
Eir	Received 9th November 2018	Yes – see below
ESB Telecoms	Received 20th September 2018	No
Irish Aviation Authority	Received 3rd January 2019	No
Imagine Group	Received 15th August 2018	No
Ripplecom	Received 16th August 2018	No
RTE Transmission Network (2rn)	Received 20th August 2018	Yes - see below
Tetra Ireland Communications (emergency services)	Received 22nd August 2018	No
Towercom	Received 22nd August 2018	No
Three Ireland Ltd	Received 16th August 2018	Yes – see below
Virgin Media	Received 16th August 2018	No

Consultee	Response	Potential for Interference Following Consultation Exercise
Vodafone Ireland	Received 16th August 2018	No

The scoping responses from the telecommunications and aviation consultees are described below. Relevant copies of scoping responses are provided in Appendix 2-1.

14.2.4.2.1 Broadcasters

RTÉ Transmission Network (operating as 2rn), stated that that there is a risk of disruption to television reception for viewers to the south of the site. To mitigate against interference on viewers' television sets and/or broadcast radio receivers, RTÉ have recommended that a protocol agreement, between 2rn and the developer, be put in place for the wind farm development. The Protocol Document will ensure that the appropriate mitigation is carried out, by the wind farm developer, in the event of any unanticipated broadcast interference arising to RTÉ television or radio reception as a result of the proposed wind farm.

14.2.4.2.2 Other Operators

Of the scoping responses received from telephone, broadband and other telecommunications operators, those who highlighted an initial potential interference risk are addressed below. The final proposed turbine layout does not overlap with any of the telecoms links or clearance zones requested by operators. The remaining consultees who responded to scoping, operate links either outside the proposed development site, and therefore are not subject to any interference risk, or do not operate any links in the area.

Eir

Eir replied to a scoping request from MKO on the 9th November 2018, noting that they had one link in the area of the proposed development and requested that a clearance of 100 metres was to be maintained between the turbines and the Eir link.

It should also be noted that all turbine locations are located in excess of 500 metres from the Eir link and therefore no impact is expected.

Three

Three replied to a scoping request from MKO on the 16th August 2018, noting that they had one link in the area of the proposed development.

It should also be noted that all turbine locations are located in excess of 500 metres from the Three link and therefore no impact is expected.

14.2.4.2.3 Aviation

As noted in Table 14- above, scoping responses were received from the following aviation consultees:

- Department of Defence
- Irish Aviation Authority

Pertinent information has been summarised below, however the scoping responses should be referenced to for further detail:

Department of Defence

In February 2019, a scoping response was received from the Department of Defence (DoD) which set out lighting requirements for turbines, as follows:

1. *Single turbines or turbines delineating corners of a wind farm should be illuminated by high intensity obstacle strobe lights (Red).*
2. *Obstruction lighting elsewhere in a wind farm will be of a pattern that will allow the hazard be identified and avoided by aircraft in flight.*
3. *Obstruction lights used should be incandescent or of a type visible to Night Vision Equipment. Obstruction lighting fitted to obstacles must emit light at the near Infra-Red (IR) range of the electromagnetic spectrum specifically at or near 850 nanometres (NM) of wavelength. Light intensity to be of similar value to that emitted in the visible spectrum of light.*

Irish Aviation Authority

In January 2019, a scoping response was received from the Irish Aviation Authority (IAA). The requirements of the IAA include the following:

1. *Agree an aeronautical obstacle warning light scheme for the wind farm development.*
2. *Provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location.*
3. *Notify the Authority of intention to commence crane operations with a minimum of 30 days prior notification of their erection.*

14.2.5 Likely Significant Effects and Associated Mitigation Measures

14.2.5.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, there would be no change to existing telecommunications and aviation operations in the area.

14.2.5.2 Construction Phase

The potential for electromagnetic interference from wind turbines occurs ouly during the operational phase of the development. There are no electromagnetic interference impacts associated with the construction phase of the proposed development, and therefore no mitigation required.

14.2.5.3 Operational Phase

14.2.5.3.1 *Telecommunications*

Pre-Mitigation Impact

Consultation regarding the potential for electromagnetic interference from the proposed development was carried out with the relevant national and regional broadcasters, fixed line and mobile telephone operators and other operators, which confirmed that no turbines are proposed within the areas requested to be left clear of turbines.

Mitigation Measures

As there is no potential for electromagnetic interference from the proposed development on telecommuncations, there are no mitigation mesaures proposed.

Residual Impact

The proposed development will have no residual impact on the telecommunications signals of any other operator, due to distance from or absence of any links in the area.

Significance of Effects

There will be no significant effect on telecommunications from the proposed development.

14.2.5.3.2 *Aviation*

Pre-Mitigation Impact

The scoping response of the DoD and IAA has requested that standard lighting requirements be used at the proposed wind farm, in line with Air Corps policy on tall structures.

Mitigation Measures

The scoping response from the DoD and IAA set out lighting requirements for turbines as detailed above. These requirements will be complied with and form part of the proposed development.The coordinates and elevations for built turbines will be supplied to the IAA, as is standard practice for wind farm developments.

Residual Impact

The proposed development will have no residual impact on aviation as all lighting requirements will be met by the applicant.

Significance of Effects

There will be no significant effect on aviation operations due to the proposed development.

14.2.5.4 Decommissioning Phase

As stated in Section 14.2.5.2 above, the potential for electromagnetic interference from wind turbines occurs only during the operational phase of the development. There are no electromagnetic interference impacts associated with the construction or decommissioning phases of the proposed development, and therefore no mitigation required.

14.2.5.5 Cumulative Effect

Chapter 2, Section 2.8 of this EIAR describes the methodology used in compiling the list of projects considered in the assessment of cumulative effects, and provides a description of each project, including current status. Although there are seven existing wind farms within 5 kilometres of the proposed Croagh Wind Farm turbines, there will be no cumulative impacts relating to the proposed development and surrounding projects in relation to Telecommunications or Aviation.

During the development of any large project that holds the potential to effect telecoms or Aviation, the Developer is responsible for engaging with all relevant Telecoms Operators and Aviation Authorities to ensure that the proposals will not interfere with television or radio signals by acting as a physical barrier. In the event of any potential impact, the Developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise.

15. INTERACTION OF EFFECTS

15.1 Introduction

The preceding Chapters 5 to 14 of this EIAR identify the potential significant environmental effects that may occur in terms of Population and Human Health, Biodiversity (Flora and Fauna) Ornithology (Birds), Land, Soils and Geology, Water (Hydrology and Hydrogeology), Air and Climate, Noise and Vibration, Landscape and Visual, Cultural Heritage (Archaeological, Architectural and Cultural Heritage) and Material Assets (Roads and Traffic, Telecommunications and Aviation), as a result of the proposed development as described in Chapter 4 of this EIAR. However, for any development with the potential for significant environmental effects there is also the potential for interaction between these potential significant effects. The result of interactive effects may exacerbate the magnitude of the effects or improve them, or have a neutral effect.

A matrix is presented in Table 15-1 below to identify potential interactions of impacts between the various aspects of the environment already assessed in this EIAR. The matrix highlights the potential for the occurrence of positive, neutral or negative effects during both the construction (C) and operational (O) phases. It is considered that the potential effects during the decommissioning phase will be similar to the construction phase effects but of a lesser magnitude. The matrix is symmetric, with each environmental component addressed in the chapters of this EIAR being placed on both axes of a matrix, and therefore, each potential interaction is identified twice.

Table 15-1 Interaction Matrix: Potential for Interacting Impacts

	Phase	Population and Human Health	Biodiversity, Flora and Fauna	Ornithology	Land, Soils and Geology	Water	Air and Climate	Noise and Vibration	Landscape and Visual	Cultural Heritage	Material Assets
Population and Human Health	C										
	O										
Biodiversity, Flora and Fauna	C										
	O										
Ornithology, Birds	C										
	O										
Land, Soils and Geology	C										
	O										
Water	C										
	O										
Air and Climate	C										
	O										
Noise and Vibration	C										
	O										
Landscape and Visual	C										
	O										
Cultural Heritage	C										
	O										
Material Assets	C										
	O										

Legend: **No Interacting Effect:** **Positive Effect:** **Neutral Effect:** **Negative Effect:**

The potential for interaction of impacts has been assessed, throughout this EIAR, as part of the Impact Assessment process. While the work on all parts of the Environmental Impact Assessment Report (EIAR) was not carried out by MKO, the entire project and all the work of all sub-consultants was managed and coordinated by the company. This EIAR was edited and collated by MKO as an integrated report of findings from the impact assessment process, by all relevant experts, and impacts that potentially interact have been assessed in detail in the individual chapters of the EIAR above and summarised in Section 15.2 below.

Where any potential negative impacts have been identified during the assessment process, these impacts have been avoided or reduced by by design and the proposed mitigation measures, as presented throughout the EIAR and highlighted in Section 15.2 below.

15.1.1 Statement of Authority

This chapter of the EIAR was completed by Eoin McCarthy and Michael Watson. Eoin is a Senior Environmental Scientist with MKO with over 8 years of experience in private consultancy and has been involved in the preparation of EIARs for over twenty wind energy projects. Eoin holds B.Sc. (Hons) in Environmental Science from NUI, Galway. Michael Watson is Project Director and head of the Environment Team in MKO. Michael has over 18 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geography, from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland.

15.2 Impact Interactions

15.2.1 Population and Human Health

Population and Human Health, Air and Climate, Noise

As identified in Chapter 5 of this EIAR, the construction phase has the potential to create a short-term, negative effect on human health due to the nuisance caused by construction plant and vehicle noise emissions, should the mitigation measures outlined in Chapter 11 not be implemented.

During the operational phase the proposed development has the potential to generate noise but as identified in Chapter 11, the potential effects on population and human health are not siginificant.

During the operational phase, the energy generated by the proposed development will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate (i.e. slowing the rate of global warming). In doing so, there will be reduced effects from climate change on human health over the 'do-nothing' scenario and continning reliance on generating energy using fossil fuels.

Population and Human Health, Land, Soils and Geology, Air and Climate

The excavation and movement of peat and spoil during the construction phase of the proposed development has the potential to create dust emissions which, consequently, have the potential to have a temporary, slight, negative effect on local air quality and human health. Mitigation measures to reduce dnst emissions generated during the construction phase of the proposed development are presented in Chapter 10.

Population and Human Health and Water

As described in Chapter 9 of this EIAR, the construction phase of the proposed development has the potential to give rise to some water pollution as a result of site activities, and any water pollution could have a potential significant negative effect on the health of other users of that water within the same

catchment. Mitigation measures are presented in Chapter 9 to minimise the potential of any such issues occurring.

Population and Human Health, and Material Assets

Chapter 14 of this EIAR discusses how the construction phase of the project will give rise to traffic movements of abnormal loads and increased traffic volumes on the local road network and, therefore, is likely to create some short-term inconvenience for other road users.. A Traffic Management Plan will be in place to minimise all disruption insofar as possible, as outlined in the Section 14.1 of this EIAR and included as appendix 14.2.

Population and Human Health, and Landscape and Visual

The construction phase of the proposed development will see the temporary introduction of construction machinery and the erection of wind turbines into a natural, but already modified landscape. The erection of the turbines in particular will change the existing landscape. Whether the long-term change in landscape created by the erection of the turbines is deemed to be positive or negative is a subjective matter. What appears to be a positive visual effect to one viewer could be deemed to be a negative effect by another viewer. The landscape and visual impact assessment of the proposed development, included as Chapter 12 of this EIAR, concludes that, from 22 viewpoints assessed, the visual effect will be moderate from seven location and ranges from not significant to slight at the remaining locations. Therefore, it is considered that the overall visual impact of the proposed development will not be significant.

15.2.2 Biodiversity

Biodiversity and Land, Soils and Geology

The removal of forestry, peat and spoil, during construction of the proposed development, is likely to result in some disturbance of flora and fauna in the areas surrounding the proposed works area thereby, potentially causing a long term, slight, negative effect on flora and fauna. Excavated peat and spoil will be used for the restoration of the proposed borrow pit, permanently placed within one of the peat and spoil repositories or used for landscaping.

Biodiversity and Water

Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects (such as disturbance and deterioration of habitat quality) on flora and fauna that use that water within the same catchment. The site activities during the construction phase, and continuing on for the operational phase, will give rise to additional localised drainage, which has the potential to have a significant, long term, negative effect on flora and their associated habitats should the appropriate measures not be implemented. These potential impacts have been assessed in Chapter 6 and Chapter 9 of this EIAR, and the relevant measures outlined in these chapters will be in place to avoid any water pollution and subsequent effect on flora and fauna.

Biodiversity and Air and Climate

During the construction phase of the proposed development, increased vehicular and dust emissions within and around the site have the potential to be a nuisance to flora and fauna, thereby having a temporary, slight, negative effect. The mitigation measures outlined in Chapter 10 of the EIAR will ensure that the potential for negative effects is reduced or eliminated.

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of

global warming and a reduction in air pollution, consequently, could in combination with other renewable energy projects, have a long term, significant positive effect on flora and fauna.

Biodiversity and Noise and Vibration

Site activity during the construction phase could give rise to noise that could be a nuisance for fauna, thereby having a temporary, slight, negative effect. Best practice mitigation measures are included in Chapter 6 and Chapter 11 to minimise the potential negative effect of noise generated during the construction phase on ornithology.

Biodiversity and Landscape

The removal of some vegetation within the development footprint and surrounding areas is likely to result in a change to the visual landscape during the construction phase, which will become part of the normal landscape of the wider area for the duration of the operational phase. The visual effect of this change is considered to be long-term, localised and slight.

15.2.3 Ornithology

Ornithology and Land, Soils and Geology

The removal of forestry, peat and spoil, during construction of the proposed development, is likely to result in some disturbance of flora and fauna, including birds, in the areas surrounding the proposed works area thereby, potentially causing an indirect long term, slight, negative effect on birds.

Ornithology and Water

Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects on birds and their prey species (such as disturbance and deterioration of habitat quality) that use that water within the same catchment. The site activities during the construction phase, and continuing on for the operational phase, are likely to give rise to additional localised drainage, which has the potential to have a significant, negative effect on the habitats of particular bird species and subsequently a long, term, negative effect on oruithology should the measures outlined in Chapter 9 of this EIAR not be implemented.

Ornithology and Air and Climate

During the construction phase of the proposed development, increased vehicular and dust emissions within and around the site have the potential to be a nuisance for birds, thereby having a temporary, slight, negative effect. The mitigation measures outlined in Chapter 10 of the EIAR will ensure that the potential for negative effects is reduced or eliminated.

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of global warming and, consequently, could in combination with other renewable energy projects, contribnte to preventing the loss of bird species from Ireland as a result of climate change.

Ornithology and Noise and Vibration

Site activity during the construction phase could give rise to noise that could be a nuisance for birds that use the site, therefore, causing a temporary, slight, negative effect on ornithology. Best practice mitigation measures are included in Chapter 7 and Chapter 11 to minimise the potential negative effect of noise generated during the construction phase on ornithology.

15.2.4 Land, Soils and Geology

Land, Soils and Geology and Water

As identified in Chapter 9 of this EIAR, the movement and removal of peat and spoil during the construction phase has the potential to have a significant, negative effect on water quality through potentially silt-laden runoff from the proposed works areas. Mitigation measures to ensure there are no significant, negative effects on water quality are presented in Chapter 9.

Land, Soils and Geology and Archaeological, Architectural and Cultural Heritage

The removal of peat and spoil during the construction phase has the potential to have a permanent, significant, negative effect on previously unrecorded sub-surface archaeological site and artefacts. Mitigation measures outlined in Chapter 13 will reduce the potential for negative effects on unrecorded sites and artefacts during excavations.

Land, Soils and Geology and Landscape and Visual

The removal of peat and spoil and the subsequent replacement with crushed stone for the construction of site roads and hardstanding areas within the proposed development site has the potential to alter the local landscape. The visual effect of this change is expected to be long term, localised in nature and slight.

15.2.5 Air and Climate

Air and Climate and Material Assets

The movement of construction vehicles both within and to and from the site has the potential to give rise to dust nuisance effects during the construction phase. This is assessed further in Chapter 10 of this EIAR, and mitigation measures are presented to minimise any potential effects.

15.2.6 Landscape and Visual

Landscape and Visual and Cultural Heritage

As described in Chapter 13 of this EIAR, the proposed development has the potential to change the landscape setting of recorded sites and monuments in the wider area. However, it is concluded in Chapter 13 that any potential, indirect, visual effect of the proposed development on national and recorded monuments would not be significant.

15.3 Mitigation and Residual Impacts

Where any potential interactive negative impacts have been identified in the above, a full suite of appropriate mitigation measures has already been included in the relevant sections (Chapters 5-14) of the EIAR. The implementation of these mitigation measures will reduce or remove the potential for these effects. Information on potential residual impacts and the significance of effects, is also presented in each relevant chapter.

16. SCHEDULE OF MITIGATION

16.1 Introduction

All mitigation measures relating to the pre-commencement, construction and operational phases of the Proposed Development are set out in the relevant chapters of the EIAR submitted as part of the planning permission application.

It is intended that the CEMP will be updated where required prior to the commencement of the development, to inclnde all mitigations measures, conditions and or alterations to the EIAR and application documents should they emerge during the course of the planning process and would be submitted to the Planning Authority for written approval.

All mitigation measures which will be implemented during the pre-commencement, construction and operational phases of the project are outlined in Table 16-1. The mitigation measures have been grouped together according to their environmental field/topic and are presented under the following headings:

- Construction Management
- Drainage Design and Management
- Peat, subsoils and bedrock
- Population and Human Health
- Biodiversity
- Ornithology
- Noise
- Air Quality/Dust
- Traffic
- Cultural Heritage

The mitigation proposals in the below format provides an easy to audit list that can be reviewed and reported on during the future phases of the project. The proposal for site inspections and environmental audits are set out in the Construction and Environmental Management Plan (CEMP) which is included as Appendix 4-4 of this EIAR. The tabular format in which the below information is presented, can be further expanded upon during the course of future project phases to provide a reporting template for site compliance audits.

16.2 EIAR Mitigation and Monitoring Measures

Table 16-1 Schedule of Mitigation Croagh Wind Farm

EIAR Mitigation Measure (MM) Number	Reference Heading	Location	Mitigation Measure
Pre-Commencement Phase			
MM1	Environmental Management	EIAR Chapter 4	The Contractor will be responsible for implementing the mitigation measures specified throughout the EIAR and compiled in the Audit Report which is included in the CEMP. The Contractor will also be responsible for ensuring that all construction staff understand the importance of implementing the mitigation measures. The implementation of the mitigation measures will be overseen by the environmental clerk of works or supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary.
MM2	Environmental Management	EIAR Chapter 4	The Environmental Clerk of Works will maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, an Environmental Clerk of Works or Project Ecologist, Project Hydrologist, Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office.
MM3	Environmental Management	EIAR Chapter 4	A Site Environmental Clerk of Works will oversee the site works and implementation of the Construction Environmental Management Plan (CEMP), and provide on-site advice on the mitigation measures necessary as necessary to ensure the project proceeds as intended. The level, detail and frequency of reporting expected from the Site Environmental Clerk of Works for the

			Construction Manager, developer's project manager, and any Authorities or other Agencies, will be agreed by parties where required prior to commencement of construction, and may be further adjusted as required during the course of the project.
MM4	Environmental Management	EIAR Chapter 4	An Ecological Clerk of Works (ECoW) or Project Ecologist will be appointed. Duties will include: › Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. › Inform and educate on-site personnel of the oruithological and ecological sensitivities within the proposed development site. › Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise › Provide guidance to contractors to ensure legal compliance with respect to protected species onsite. Liaise with officers of consenting authorities and other relevant bodies where required with regular updates in relation to construction progress.
MM5	Site Drainage Plan	EIAR Chapter 4	› The Project Hydrologist/Design Engineer will assist in preparing a site drainage plan before construction commences.
MM6	Preparative Site Drainage Management,	EIAR Chapter 4	All materials and equipment necessary to implement the drainage mitigation measures will be brought on-site in advance of any works commencing. The drainage measures outlined in the EIS/EIAR will be installed prior to, or at the same time as the works they are intended to drain. An adequate amount of clean stone, silt fencing, stakes, etc. will be kept on site at all times to implement the drainage design measures as necessary.
MM7	Biodiversity	EIAR Chapter 6	Pre-construction surveys for Badger and Otter will be undertaken prior to the commencement of works
MM8	Biodiversity	EIAR Chapter 6	On a precautionary basis, prior to the commencement of any site works, a badger sett disturbance licence will be sought from the National Parks and Wildlife Service.

MM9	Biodiversity	EIAR Chapter 6 and Chapter 4	A detailed drainage maintenance plan for the proposed development is provided in Chapter 4 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development
MM10	Biodiversity	EIAR Chapter 6	The implementation of the Biodiversity Management has been provided which will ensure that any Upland blanket bog habitat that is lost to facilitate the proposed infrastructure will be replaced within the site The proposed development has the potential to result in enhancement of the surrounding areas through habitat rehabilitation management which is outlined in the Biodiversity Management Plan.
MM11	Ornithology	EIAR Chapter 7	A breeding bird survey will be undertaken between April and July. Monitoring will be undertaken by a suitably qualified ornithologist. The survey will include a thorough walkover survey to a 500m radius of the development footprint and/or all works areas, where access allows. If breeding activity of birds of high conservation concern is identified, the nest site will be located, and earmarked for monitoring at the beginning of the first breeding season of the construction phase. If it is found to be active during the construction phase no works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) in line with best practise. No works shall be permitted within the buffer until it can be demonstrated that the nest is no longer occupied.
MM12	Traffic Management Plan, Delivery Programme, pre-commencement road works	EIAR Chapter 14	A **Traffic Management Plan (TMP)** is provided specifying details relating to traffic management and as Appendix 14-2 this EIAR. Prior to the commencement of the construction phase of the proposed development a final Traffic Management Plan, incorporating all the mitigation measures set out in the TMP will be prepared by the Contractor for agreement with the local authority and An Garda Síochána. The TMP includes recommendations for the following › Traffic Management Coordinator – a competent Traffic Management Co-ordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management. › Delivery Programme – a programme of deliveries will be submitted to the County Councils in advance of deliveries of turbine components to site. Liaison with the relevant local authorities and Transport Infrastructure Ireland (TII) will be carried out where required regarding requirements such as delivery timetabling. The

			programme will ensure that deliveries are scheduled in order to minimise the demand on the local network and minimise the pressure on the access to the site. › Information to locals – Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-ordinator, who will be the main point of contact for all queries from the public or local authorities during normal working hours. An "out of hours" emergency number will also be provided. › A Pre and Post Construction Condition Survey – Where required by the local authority, a pre-condition survey of roads associated with the proposed development can be carried out immediately prior to construction commencement to verify and record the condition of the road at the time. A post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers. › Liaison with the relevant local authority - Liaison with the County Councils and An Garda Síochána, will be carried out during the delivery phase of the large turbine vehicles, when an escort for all convoys will be reqnired. Once the surveys have been carried out and "prior to commencement" status of the relevant roads established, (in compliance with the provisions of the CEMP), the Roads section will be informed of the relevant names and contact numbers for the Project Developer/Contractor Site Manager as well as the Site Environmental Manager. › Implementation of temporary alterations to road network at critical junctions – at locations highlighted in section 14.1.8. In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers will also be used where deemed practicable. › Identification of delivery routes – These routes will be agreed with the County Councils and adhered to by all contractors.

			› Delivery times of large turbine components - The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage. › Travel plan for construction workers – While the assessment above has assumed the worst case in that construction workers will drive to the site, the construction company will be required to provide a travel plan for construction staff, › Additional measures - Various additional measures will be put in place in order to minimise the effects of the development traffic on the surrounding road network including wheel washing facilities on site and sweeping / cleaning of local roads as required. These are set out in the CEMP which is contained in Appendix 4.3. › Re-instatement works - All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers.
MM13	Information to Local Residents	EIAR Chapter 14	Locals in the area will be informed of any upcoming traffic related matters e.g. temporary lane/road closures (where required) or delivery of turbine components at night, via letter drops and posters in public places. Information will include the contact details of the Project Co-Ordinator, who will be the main point of contact for all queries from the public or local authority during normal working hours. An "out of hours" emergency number will also be provided. The Coillte CLO, in place since June 2018 will also be liaising wityh all local residents and near neighbours.
Construction Phase			
Construction Management			
MM14	Health and Safety	EIAR Chapter 5	During construction of the Proposed Development, all staff will be made aware of and adhere to: › Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005); › Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007), as amended; › Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. 291 of 2013), as amended; and

			› Safety, Health and Welfare at Work (Work at Height) Regulations 2006 (S.I. No. 318 of 2006). This will encompass the use of all necessary Personal Protective Equipment and adherence to the site Health and Safety Plan which will include measures to exclude members of the public from certain areas of the site during construction.
MM15	Health and Safety	EIAR Chapter 4	Stock-proof fencing will be erected around the borrow pit and peat and spoil repositories if deemed necessary to prevent uncontrolled access to this area. Appropriate health and safety signage will also be erected on this fencing and at locations around the site
MM16	Health and Safety	EIAR Chapter 5	The scale and scope of the project requires that a Project Supervisor Design Process (PSDP) and Project Supervisor Construction Stage (PSCS) are required to be appointed in accordance with the provisions of the Health & Safety Authority's 'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006'. The PSDP appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): › Identify hazards arising from the design or from the technical, organisational, planning or time related aspects of the project; › Where possible, eliminate the hazards or reduce the risks; › Communicate necessary control measures, design assumptions or remaining risks to the PSCS so they can be dealt with in the Safety and Health Plan; › Ensure that the work of designers is coordinated to ensure safety; › Organise co-operation between designers; › Prepare a written Safety and Health Plan; › Prepare a safety file for the completed structure and give it to the client; and › Notify the Authority and the client of non-compliance with any written directions issued.

MM17	Health and Safety	EIAR Chapter 5	The PSCS appointed for the construction stage shall be required to perform his/her duties as prescribed in the Safety, Health and Welfare at Work (Construction) Regulations. These duties include (but are not limited to): › Development of the Safety and Health Plan for the construction stage with updating where required as work progresses; › Compile and develop safety file information › Reporting of accidents / incidents; › Weekly site meeting with PSCS; › Coordinate arrangements for checking the implementation of safe working procedures. Ensure that the following are being carried out: › Induction of all site staff including any new staff enlisted for the project from time to time; › Toolbox talks as necessary; › Maintenance of a file which lists personnel on site, their name, nationality, current Safe Pass number, current Construction Skills Certification Scheme (CSCS) card (where relevant) and induction date; › Report on site activities to include but not limited to information on accidents and incidents, disciplinary action taken and PPE compliance; › Monitor the compliance of contractors and others and take corrective action where necessary; and › Notify the Authority and the client of non-compliance with any written directions issued.
MM18	Refuelling,	EIAR Section 4, 6, 8, 9	On-site refuelling will be carried out using a mobile double skinned, bunded fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will he used during the construction of the proposed wind farm development. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction when not in use. Refuelling operations will be carried out only by designated trained and competent operatives under a Permit to Refuel process. Mobile anti-

			pollution measures such as drip trays and fuel absorbent mats will be used during all refuelling operations
MM19	Reinstatement	EIAR Chapter 4	Some overburden material will be stored temporarily adjacent to the works areas for reinstatement when the main construction activities are completed. Soil will be backfilled outside the drainage channels along track-sides and vegetated sods replaced over the surface, bedded-in, regraded, etc., to re-constitute a stable and settled ground surface on which the natural vegetation can recover and will be resistant to erosion.
MM20	Plant and Equipment Inspections	EIAR Chapter 8.	A programme for the regular inspection of plant and eqnipment for leaks and fitness for purpose will be developed at the outset of the construction phase.
MM21	Environmental Management- Invasive Species	EIAR Chapter 6	Best practice measures in relation to invasive species are described below: › All earthworks machinery will be thoroughly pressure-washed prior to arrival on site and prior to their further use elsewhere. › Care will be taken not to disturb or cause the movement of invasive species fragments, either intentionally or accidentally. › Stands of Knotweed will be clearly demarcated by temporary fencing and tracking within them will be strictly avoided. A minimum buffer of seven metres will be applied to avoid disturbance of lateral Knotweed rhizomes. › Where works occur within 7m of a Knotweed stand these will be carried out under the supervision of a suitably qualified ecologist. › Should removal of Knotweed off site be required this will be done so under the supervision of an ecologist in line with NPWS licencing. › The machinery must be thoroughly cleaned down under supervision of an ecologist prior to moving away from the Knotweed contaminated area. › All contractors and staff will be briefed about the presence, identification and significance of Knotweed before commencement of works. › Good construction site hygiene will be employed to prevent the spread of these species with vehicles thoroughly cleaned down prior to leaving any site with the potential to have supported invasive species. All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned

			down on site to prevent the spread of invasive plant species such as Knotweed. All clean down must be undertaken in areas with no potential to result in the spread of invasive species. › When working at locations in proximity to natural watercourses, a suitable barrier will be erected between the watercourse and the stand of invasive species. This will assist in preventing the spread of any invasive species into the watercourse during their removal. › Any material that is imported onto any site will be verified by a suitably qualified ecologist to be free from any invasive species listed on the 'Third Schedule' of Regulations 49 & 50 of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). This will be carried out by searching for rhizomes and plant material. › Any soils or subsoils contaminated with invasive species will sent for disposal to an authorized waste facility under licence from NPWS. The treatment and control of invasive alien species will follow guidelines issued by the National Roads Authority - The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads (NRA 2010) and Irish Water (2016) Information and Guidance Document on Japanese Knotweed.
Drainage Design and Management			
MM22	Clear Felling of Coniferous Plantation	EIAR Chapter 9	A self-imposed buffer zone of 50 metres will be maintained for all streams. The large distance between most of the proposed felling areas (which are outside the 50m buffer) and sensitive aquatic zones means that potential poor-quality runoff from felling areas will be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. The following mitigation measures will be employed during tree felling. Additional measures are indicated for felling inside the 50m buffer zone. Mitigation measures which will reduce the risk of entraiument of suspended solids and nutrient release in surface watercourses comprise best practice methods (from the guidance listed above) which are set out as follows:

			› Machine combinations (i.e. hand-held or mechanical) will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance; › Trees will be cut manually inside the 50m buffer and using machinery to extract whole trees only; › Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works; › Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour; › Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. Where possible, all new silt traps will be constructed on even ground and not on sloping ground; › In areas particularly sensitive to erosion or where felling inside the 50 metre buffer is required, it will be necessary to install double or triple sediment traps. › Double silt fencing will also be put down slope of felling areas which are located inside the 50 metre buffer zone; › All drainage channels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils, silt traps will be installed at the end of the drainage channels, to the outside of the buffer zone; › Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain

			alignment, spacing and depth will ensure that erosion and sediment build-up are minimized and controlled; › Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall; › Timber will be stacked in dry areas, and outside a local 50 metre watercourse buffer. Straw hales and check dams to be emplaced on the down gradient side of timber storage/processing sites; › Works will be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off; › Checking and maintenance of roads and culverts will be on-going through the felling operation; › No crossing of streams by machinery will be permitted and only travel perpendicular to and away from stream will be allowed; › Refuelling or maintenance of machinery will not occur within 100m of a watercourse. Mobile bowser, drip kits, qualified personnel will be used where refuelling is required; › A permit to refuel system will be adopted at the site; and, › Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.
MM23	Silt Traps	EIAR Chapter 9	Silt traps will be strategically placed down-gradient within forestry drains near streams. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner.
MM24	Drain Inspection and Maintenance	EIAR Chapter 9	The following items shall be carried out during pre-felling inspections and after:

			› Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines; › Inspection of all areas reported as having unusual ground conditions; › Inspection of main drainage ditches and outfalls. During pre-felling inspections, the main drainage ditches shall be identified. Ideally the pre-felling inspection shall be carried out during rainfall; › Following tree felling all main drains shall be inspected to ensure that they are functioning; › Extraction tracks nears drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground; › Culverts on drains exiting the site will be unblocked; and, › All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from watercourses to ensure that it will not be carried back into the trap or stream during subsequent rainfall.
MM25	Surface Water Quality Monitoring	EIAR Chapter 9	Sampling will be completed before, during (if the operation is conducted over a protracted time) and after the felling activity. The 'before' sampling should be conducted within 4 weeks of the felling activity, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown). The felling surface water monitoring data will also be compared with the EIAR baseline water quality sampling data. Criteria for the selection of water sampling points include the following: › Avoid man-made ditches and drains, or watercourses that do not have year-round flows, i.e. avoid ephemeral ditches, drains or watercourses; › Select sampling points upstream and downstream of the forestry activities; › It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry;

			› Where possible, downstream locations should be selected: one immediately below the forestry activity, the second at exit from the forest, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location); and, › The above sampling strategy will be undertaken for all on-site sub-catchments streams where tree felling is proposed. › Daily surface water monitoring forms will be utilised at every works site near watercourses. These will be taken daily and kept on site for record and inspection.
MM26	Earthworks	EIAR Chapter 9	› Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded. › Apart from interceptor drains, which will convey clean runoff water to the downstream drainage system, there will be no direct discharge (without treatment for sediment reduction, and attenuation for flow management) of runoff from the proposed wind farm drainage into the existing site drainage network. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion; › Silt traps will be placed in the existing drains upstream of any streams where construction works / tree felling is taking place, and these will be diverted into proposed interceptor drains, or culverted under/across the works area; › During the construction phase of the wind farm, runoff from individual turbine hardstanding areas will be not discharged into the existing drain network but discharged locally at each turbine location through stilling ponds and buffered outfalls onto vegetated surfaces; › Buffered outfalls which will be numerous over the site will promote percolation of drainage waters across vegetation and close to the point at which the additional runoff is generated, rather than direct discharge to the existing drains of the site; and, › Drains running parallel to the existing roads that requiring widening will be upgraded, widening will be targeted to the opposite side of the road. Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the upgrade construction

			works. Regular buffered outfalls will also be added to these drains to protect downstream surface waters.
MM27	Check dams	EIAR Chapter 9	Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be installed at regular intervals along interceptor drains to restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam as per the drainage design.
MM28	Level Spreaders	EIAR Chapter 9	A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site.
MM29	Vegetation filters	EIAR Chapter 4	Vegetation filters, that is areas of existing vegetation, accepting drainage water issuing from level spreaders as sheet flow, will remove any suspended sediment from water channelled via interceptor drains or any remaining sediment in waters channelled via swales and settlement ponds.
MM30	Settlement ponds	EIAR Chapter 9	Settlement ponds, placed either singly or a pair in series, will buffer volumes of run-off discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to water courses as per the drainage design.
MM31	Silt Fences	EIAR Chapter 9	Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to water courses of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase. Double silt fences will be placed within drains down-gradient of all construction areas inside the hydrological buffer zones.
MM32	Water Treatment Train	EIAR Chapter 9	A water treatment train such as a "Siltbuster" if required. If the discharge water from construction areas fails to be of a high quality during the daily inspections then a filtration treatment system (such

			as a 'Siltbuster' or similar equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.
MM33	Silt Bags	EIAR Chapter 9	Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, the majority of the sediment is retained by the geotextile fabric allowing filtered water to pass through. Silt bags will be used with natural vegetation filters or sedimats Sediment entrapment mats, consisting of coir or jute matting, will be placed at the silt bag location to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes/pegs. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

MM34	Potential Release of Hydrocarbons	EIAR Chapter 9	› All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on site; › On-site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer or truck will be re-filled off site and will be towed/driven around the site to where machinery are located. The 4x4 jeep/fuel truck will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site under a Permit to refuel process. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations; › Fuels stored on site will be minimised. Any storage areas will be located within the temporary construction compounds and be bunded appropriately for the fuel storage volume for the time period of the construction; › The electrical control building will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor; › An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM35	Release of Cement-Based Products	EIAR Chapter 9	› No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place. › the use of pre-cast elements for culverts and concrete works will beprioritised. › Where concrete is delivered on site, only the chute will be cleaned, nsing the smallest volume of water practicable. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water will be undertaken at lined cement washout ponds. › Weather forecasting will be used to plan dry days for pouring concrete.

			› The pour site will be kept free of standing water and plastic covers will be ready in case of sudden rainfall event.
MM36	Morphological Changes to Surface Water Courses & Drainage Patterns	EIAR Chapter 9	› All proposed new stream crossings will be bottomless culverts or clear span structures and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no direct impact on the stream at the proposed crossing location; › Where the proposed underground cabling route follows an existing road or road proposed for upgrade, the cable will pass over or below the culvert within the access road; › Any guidance / mitigation measures required by the OPW or the Inland Fisheries Ireland during consultation/consenting process (such as Section 50 Applications as defined below) will be incorporated into the design of the proposed crossings; › As a further precaution, near stream construction work, will ouly be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Easteru Regional Fisheries Board (2004) guidance document "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites", i.e., May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses (any deviation from this will be done in discussion with the IFI); › During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas; and, › All new river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

MM37	Plant and equipment inspections	EIAR Chapter 8	Site plant will be regularly inspected for leaks and fitness for purpose; and, an emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan. Spill kits will be available to deal with accidental spillages.
MM38	Wastewater Disposal	EIAR Chapter 4	Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by an appropriately consented waste collector to wastewater treatment plants.
MM39	Concrete Deliveries and Management	EIAR Chapter 4	No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products will be used and where possible, pre-cast elements for culverts and concrete works will be used.
MM40	Concrete Deliveries and Management	EIAR Chapter 4	No washing out of any plant used in concrete transport or concreting operations will be allowed on-site.
MM41	Concrete Deliveries and Management	EIAR Chapter 4	Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed into a dedicated lined washout area. This lined area will be removed from site once the construction phase is complete.
MM42	Concrete Deliveries and Management	EIAR Chapter 4	Weather forecasting will be used to plan dry days for pouring concrete. Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event
MM43	Concrete Deliveries and Management	EIAR Chapter 4	The nse of pre-cast elements for culverts and concrete works will beprioritised.

Peat, Subsoils and Bedrock			
MM44	Topsoil/Peat and Subsoil Excavation	EIAR Chapter 8	› Placement of turbines and associated infrastructure in areas with shallow peat during the design phase; › Use of the existing road network to reduce peat excavation and borrow pit volumes; › Use of floating roads (where acceptable to do so) to reduce peat excavation volumes; › The peat and subsoil which will be removed during the construction phase will be localised to the Proposed Development infrastructure; › No turbines or related infrastructure will be constructed near or on any designated sites such as NHAs or SACs; › A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design; › The bedrock at the site is classified as "Medium" importance; and, › The peat deposits and mineral soil at the site is classified as "Low" importance as the blanket bog is already degraded by forestry works and drainage.
MM45	Peat Instability and Failure	EIAR Chapter 8	› Appointment of experienced and competent contractors; › The site will be supervised by experienced and qualified personnel; › Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement); › Prevent undercutting of slopes and unsupported excavations; › Maintain a managed robust drainage system; › Prevent placement of loads/overburden on marginal ground as detailed in the peat stability assessment report; › Set up, maintain and report findings from monitoring systems; › Ensure construction method statements are followed or where agreed modified/ developed; and, › Revise and amend the Geotechnical Risk Register as construction progresses.
MM46	Contamination of Soil by Leakages and Spillages and	EIAR Chapter 8	› Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station;

	Alteration of Peat/Soil Geochemistry		› On site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages; › On site re-fuelling will be undertaken by suitably trained personnel only under a permit to refuel system; › Fuels stored on site will be minimised. Storage areas located at the temporary compounds where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor; › The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor; › The plant used during construction will be regularly inspected for leaks and fitness for purpose; › All waste tar material arising from the chipping and resurfacing of the public road portion of the temporary construction access road will be removed off-site and taken to licenced waste facility; › An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (Appendix 4-4 of this EIAR). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.
MM47	Erosion of Exposed Subsoils and Peat During Construction of Infrastructure	EIAR Chapter 8	› Peat removed from turbine locations and access roads will be used for landscaping, placed alongside designated access roads, used to reinstate the 1 no. proposed borrow pits or placed in 2 no. repositories. Where possible, the acrotelm shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the borrow pits. Re-seeding and spreading/planting of heather and moss cuttings will also be carried out in these areas. These measures will prevent erosion of stored peat in the long term. A full Peat and Spoil Management Plan for the development is included as Appendix 4-2. › Any excess temporary mounded peat in storage for long periods will be sealed using the back of an excavator bucket. This will prevent erosion of soil. Silt fences

			will be installed around stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works. › In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods as defined in the Chapter 9 of this EIAR (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase. › During tree felling, brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.
Biodiversity			
MM48	Potential Effects on Rivers and Streams, Open Waterbodies and Sensitive Aquatic Faunal Species	EIAR Chapter and Chapter 9	› A detailed drainage maintenance plan for the proposed development is provided in Section 4.7.11 of this EIAR. This plan provides details of how water quality will be protected during the construction of the proposed development. In addition to this, specific mitigation is provided in relation to water quality in Chapter 9 of this EIAR. In addition, the Construction Environmental Management Plan (CEMP) that is provided as Appendix 4-4 of the EIAR, provides the details of exactly how the measures will be implemented during construction. › In relation to watercourse crossings, Inland Fisheries Ireland (IFI) will be consulted a minimum of four weeks in advance of the installation of clear-span bridges .
MM49	Potential Effects on Peatlands and Associated Habitats	EIAR Chapter 6	› The proposed development has been deliberately designed to minimise loss of Upland blanket bog (PB2). Where the development footprint does occur on this habitat at Turbine 1, the proposed development provides for the replacement of peatland habitat through the restoration of forestry (WD4) back to peatland, located adjacent to Turbine 7. This is fully described in the site-specific Biodiversity Management Plan (BMP), provided in Appendix 6-5 of the EIAR. The BMP aims to ensure that there will be no net loss of peatland habitat

			associated with the proposed development. This has been further developed by the inclusion of an additional peatland enhancement area comprising of degraded Upland blanket bog (PB2) located to the north of Turbine 7. It is proposed to undertake enhancement of this area of peatland through drain blocking and the removal of encroaching conifers (establishing as a result of natural seed dispersal). The location and extent of the habitat replacement and enhancement areas located adjacent to T7 are mapped in the Biodiversity Management Plan, Appendix 6-5 of the EIAR
MM50	Fauna	EIAR Chapter 6	› An exclusion zone will be put in place along the section of haul road during the construction phase to ensure works are not undertaken within 30 metres of a known badger sett on site (known to be approx. 40 metres from the proposed footprint). › No works should be undertaken within 150m of any holts at which breeding females or cubs are present. › No wheeled or tracked vehicles (of any kind) should be used within 20m of active, but non-breeding, otter holts. Light work, such as digging by hand or scrub clearance should also not take place within 15m of such holts, except under licence (TII, 20061). › All of the above works will be undertaken or supervised by an appropriately qualified ecologist.
MM51	Bats	EIAR Chapter 6	› Construction best practice will be employed to minimise general noise and disturbance potential. Plant machinery will be turned off when not in use and all plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).
MM52	Invasive Species	EIAR Chapter 6	› All earthworks machinery will be thoroughly pressure-washed prior to arrival on site and prior to their further use elsewhere.

[1] *NRA, 2006. Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes. Dublin: Transport Infrastructure Ireland. Available at: www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Otters-prior-to-the-Construction-of-National-Road-Schemes.pdf*

			› Care will be taken not to disturb or cause the movement of invasive species fragments, either intentionally or accidentally. › Stands of Knotweed will be clearly demarcated by temporary fencing and tracking within them will be strictly avoided. A miuimum buffer of seven metres will be applied to avoid disturbance of lateral Knotweed rhizomes. › Where works occur within 7m of a Knotweed stand these will be carried out under the supervision of a suitably qualified ecologist. › Should removal of Knotweed off site be required this will be done so under the supervision of an ecologist in line with NPWS licencing. › The machinery must be thoroughly cleaned down under supervision of an ecologist prior to moving away from the Knotweed contaminated area. › All contractors and staff will be briefed about the presence, identification and significance of Knotweed before commencement of works. › Good coustruction site hygiene will be employed to prevent the spread of these species with vehicles thoroughly cleaned down prior to leaving any site with the potential to have supported invasive species. All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down on site to prevent the spread of invasive plant species such as Knotweed. All clean down must be undertaken in areas with no potential to result in the spread of invasive species. › When working at locations in proximity to natural watercourses, a suitable barrier will be erected between the watercourse and the stand of invasive species. This will assist in preventiug the spread of any invasive species into the watercourse during their removal. › Any material that is imported onto any site will be verified by a suitably qualified ecologist to be free from any invasive species listed on the 'Third Schedule' of Regulations 49 & 50 of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). This will be carried out by searching for rhizomes and plant material. › Any soils or subsoils contaminated with invasive species will sent for disposal to an authorized waste facility under licence from NPWS. › The treatment and control of invasive alien species will follow gnidelines issued by the National Roads Authority - *The Management of Noxious Weeds and Non-*

			native Invasive Plant Species on National Roads (NRA 2010) and Irish Water (2016) *Information and Guidance Document on Japanese Knotweed.*
Ornithology			
MM53	Ornithology	EIAR Chapter 7	Taking a precautionary approach, it is proposed that construction works will commence outside the bird nesting season (1st of March to 31st of August inclusive). Pre-commencement surveys will be undertaken prior to the initiation of works at the wind farm.
MM54	Ornithology	EIAR Chapter 7	› Following from the pre-commencement surveys, if a nest site of a high conservation species is found to be active during the construction phase no works shall be undertaken within a 500m buffer (Forestry Commission Scotland 2006; Ruddock & Whitfield 2007) in line with best practise. No works shall be permitted within the buffer until it can be demonstrated that the nest is no longer occupied. › The removal of woody vegetation will be undertaken in accordance with Section 40 of the Wildlife Act 1976 as amended. › During the construction phase, noise limits, noise control measures, hours of operation (i.e. dusk and dawn is high faunal activity time) and selection of plant items will be considered in relation to disturbance of birds. › Plant and machinery will be turned off when not in use. › All plant and equipment for use will comply with the Construction Plant and the European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001 (S.I. No. 632 of 2001) other relevant legislation. › An Ecological Clerk of Works (ECoW) will be appointed and will operate for the duration of construction works. Duties will include: ○ Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. ○ Inform and educate on-site personnel of the ornithological and ecological sensitivities within the Proposed Development site. ○ Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise. ○ Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.

			○ Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.
Noise & Vibration			
MM55	BS 5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Noise*	EIAR Chapter 5 and Chapter 11	The proposed development is predicted to comply with the identified criteria for the construction phase. While no specific mitigation measures are required to achieve construction noise criteria, best practice mitigation measures below will be complied with. › limiting the hours during which site activities likely to create high levels of noise or vibration are permitted; › establishing channels of communication between the contractor/developer, Local Authorities and residents; › appointing a site representative responsible for matters relating to noise and vibration; › monitoring typical levels of noise and vibration during critical periods and at sensitive locations; keeping site access roads even to mitigate the potential for vibration from lorries; › selection of plant with low inherent potential for generation of noise and/ or vibration; › placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints, and; › regular maintenance and servicing of plant items. › No plant used on site will be permitted to cause an on-going public nuisance due to noise. › The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations. › All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract. › Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers. › Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.

			› Any plant, such as generators or pumps, which is required to operate outside of general construction hours will be surrounded by an acoustic enclosure or portable screen. › During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Section 11.3.2.1.1 . using methods outlined in British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise. › The hours of construction activity will be limited to avoid unsociable hours where possible. Construction operations shall generally be restricted to between 7:00hrs and 19:00hrs weekdays and between 7:00hrs and 14:00hrs on Saturdays. However, to ensure that optimal use is made of good weather periods or at critical periods within the programme (i.e. concrete pours, rotor/tower deliveries) it will be necessary on occasion to work outside of these hours.
MM56	*BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Vibration*	EIAR Chapter 5 and Chapter 11	Specific to blasting the following mitigation measures will be employed to control the impact during blasts › Trial blasts may be undertaken to obtain scaled distance analysis; › Ensuring appropriate burden to avoid over or under confinement of the charge; › Accurate setting out and drilling; › Appropriate charging; › Appropriate stemming with appropriate material such as sized gravel or stone chipping; › Delay detonation to ensure small maximum instantaneons charges; › Decked charges and in-hole delays; › Blast monitoring to enable adjustment of subsequent charges; › Good blast design to maximise efficiency and reduce vibration; › Avoid using exposed detonating cord on the surface.
MM57	*BS 5228-1:2009+A1:2014 Code of practice for noise and vibration*	EIAR Chapter 5	Where rock breaking is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities:

	control on construction and open sites – Noise; Vibration		› Fit suitably designed muffler or sound reduction equipment to the rock hreaking tool to reduce noise without impairing uachine efficiency. › Ensure all leaks in air lines are sealed. › Use a dampened bit to eliminate ringing. › Erect acoustic screen between compressor or generator and noise sensitive area. When possible, line of sight between top of machine and reception point needs to be obscured. › Enclose breaker or rock drill in portable or fixed acoustic enclosure with suitable ventilation.
MM58	*BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise; Vibration*	EIAR Chapter 5 and Chapter 11	Where blasting is employed in relation to the proposed borrow pit location, the following are examples of measures that will be employed, where necessary, to mitigate noise emissions from these activities: › Restriction of hours within which blasting can be conducted (e.g. 09:00 – 18:00hrs). › Notification to nearby residents before blasting starts (e.g. 24-hour written notification). › The firing of blasts at similar times to reduce the 'startle' effect. › On-going circulars informing people of the progress of the works. › The implementation of an onsite documented complaints procedure. › The use of independent monitoring by external bodies for verification of results. › Trial blasts in less sensitive areas to assist in blast designs and identify potential zones of influence.
Air Quality/Dust			
MM59	Dust Emissions	EIAR Chapter10	› In periods of extended dry weather, dust suppression may be necessary along haul roads, site roads, substation and construction compounds and aroumd the borrow pit area to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads, borrow pit and site compounds to prevent the generation of dust where required. Water bowser

			movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff. › All plant and materials vehicles shall be stored in dedicated areas (on site). › Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction. › Turbines and construction materials will be transported to the site on specified haul routes only. › The agreed hanl route roads adjacent to the site will be regularly inspected for cleanliness and cleaned as necessary. › The transport of construction materials which may have the potential to generate dust will be undertaken with tarpaulin cover or similar, where necessary. › The transport of dry excavated material from the on-site borrow pit which may have potential to generate dust will be avoided. If necessary, excavated material will be dampened prior to transport from the borrow pits.
MM60	Exhaust Emissions	EIAR Chapter 10	› All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. › All machinery will be switched off when not in use. › The majority of aggregate materials for the construction of the proposed development will be obtained from the borrow pit on site. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.
MM61	Greenhouse Gas Emissions	EIAR Chapter 10	› All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise. › Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority. › Aggregate materials for the construction of site access tracks and all associated infrastructure will all be locally sourced, where possible, which will further reduce potential emissions.

Traffic			
MM62	Traffic Management Co-Ordinator	EIAR Chapter 14	A competent Traffic Management Coordinator will be appointed for the duration of the project and this person will be the main point of contact for all matters relating to traffic management.
MM63	Liaison with the relevant local authority	EIAR Chapter 14	Liaison with the relevant local authority including the roads section of local authorities that the delivery routes traverse and An Garda Síochána, during the delivery phase.
MM64	Travel Plans for Construction Workers	EIAR Chapter 14	The construction company will be required to provide a travel plan for construction staff, which will include the identification of a routes to / from the site and identification of an area for parking.
MM65	Temporary traffic signs	EIAR Chapter 14	As part of the traffic management measures temporary traffic signs will be put in place at all key junctions, including the access junction on the N15. All measures will be in accordance with the "Traffic Signs Manual, Chapter 8 – Temporary Traffic Measures and Signs for Road Works" (DoT now DoTT&S) and "Guidance for the Control and Management of Traffic at Roadworks" (DoTT&S). A member of construction staff (flagman) will be present at key junctions during peak delivery times.
MM66	Delivery of abnormal sized loads	EIAR Chapter 14	The following are the main points to note for these deliveries which will take place after peak evening traffic: › The delivery of turbine components is a specialist transport operation with the transportation of components carried out at night when traffic is at its lightest and the impact minimised. › The deliveries will be made in consultation with the Local Authority and An Garda Síochána. › It is estimated that 90 abnormal sized loads will be delivered to the site, comprising 18 convoys of 5, undertaken over 18 separate nights. › These nights will be spread out over an approximate period of 9 weeks and will be agreed in advance with the relevant authorities › In order to manage each of the travelling convoys, for each convoy there will be two Garda escort vehicles that will stop traffic at the front and rear of the convoy of 5 vehicles.

			› There will also be two escort vehicles provided by the haulage company for each convoy › Implementation of temporary alterations to road network at critical junctions – at locations highlighted in section 14.1.8. › In addition, in order to minimise the impact on the existing environment during turbine component deliveries the option of blade adaptor trailers will also be used where deemed practicable.
MM67	Telecommunications	EIAR Chapter 14	The Department of Defense and Irish Aviation Authority (IAA) set out lighting requirements for turbines. These requirements will be complied with and form part of the proposed development. The coordinates and elevations for built turbines will be supplied to the IAA, as is standard practice for wind farm developments.
Cultural Heritage			
MM68	Impact of excavation works on unrecorded potential sub-surface sites	EIAR Chapter 13	› Archaeological monitoring (under licence from the National Monuments Service) of any further geotechnical / engineering trial pits or investigations and a report detailing the results of same. › Archaeological monitoring of ground works during construction works. The National Monuments Service will be informed of such findings to discuss how best to proceed. If archaeological finds, features or deposits are uncovered during archaeological monitoring, the developer will be prepared to provide resources for the resolution of such features whether by preservation by record (excavation) or preservation in situ (avoidance).Once the project is completed, a report on the results of the monitoring will be compiled and submitted to the relevant authorities. › Preservation of Townland boundaries by record where relevant during construction stage monitoring at the following areas: ○ Proposed new road to T1 where it traverses the Garvagh/Garvagh-Glebe townland boundary

			○ Proposed New road to T3 where it traverses the Garvagh-Glebe/ Carrownyclowan townland boundary › A licensed metal detection survey of the watercourses that are proposed to be crossed. The metal detection survey will be undertaken concurrently during the construction stage in advance of any works to the rivers/streams. A report on the results should be submitted to the relevant authorities. › Archaeological monitoring of any geotechnical / engineering trial pits or investigations and a report detailing the results of same. › Archaeological monitoring of any geotechnical / engineering trial pits or investigations along the off-road sections of the proposed construction access road and a report detailing the results of same. › Archaeological monitoring of topsoil/peat removal of all off-road sections of the proposed route during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.
MM69	Felling Licence	EIAR Chapter 4	› Felling will be carried out under the terms of a licence application to the Forest Service, as per the Forest Service's policy on granting felling licenses for wind farm developments
MM70	Clear felling of Coniferons Plantation	EIAR Chapter 4	› Works will be overseen by an ECoW as described above. › The extent of all necessary tree felling will be identified and demarcated with markings on the ground in advance of any felling commencing. › All roads and culverts will be inspected prior to any machinery being brought on site to commence the felling operation. No tracking of vehicles through watercourses will occur. Vehicles will only use existing road infrastructure and established watercourse crossings. › Existing drains that drain an area to be felled towards surface watercourses will be blocked, and temporary silt traps will be constructed to ensure collection of all silt within felling areas. These temporary silt traps will be cleaned out and backfilled

			once felling works are complete. This ensures there is no residual collected silt remaining in blocked drains after felling works are completed. No direct discharge of such drains to watercourses will occur from within felling areas. › New collector drains and sediment traps will be installed during ground preparation to intercept water upgradient of felling areas and divert it away. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities. › All silt traps will be sited outside of buffer zones and have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones. › All new collector drains will taper out before entering the aquatic buffer zone to ensures the discharging water gently fans out over the buffer zone before entering the aquatic zone. › Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance; › Mechanised operations will be suspended during and immediately after heavy rainfall. › Where brash is required to form brash mats, it is to be laid out at harvesting stage to prevent soil disturbance by machine movement. › Unused Brash may be moved within the site to facilitate the creation of mats in more demanding locations. › Felling of trees will be pointed directionally away from watercourses. › Felling will be planned to minimise the number of machine passes in any one area. › Extraction routes, and hence brash mats, will be aligned parallel to the ground contours where possible. › Harvested timber will be stacked in dry areas, and outside any 50-metre watercourse buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage sites. › Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed but removing of natural debris deflectors will be avoided

Operational Phase			
Health and Safety			
MM71	Health & Safety	EIAR Chapter 5	Access to the turbines is through a door at the base of the structure, which will be locked at all times outside maintenance visits. Signs will be erected at suitable locations such as, amenity access points and carparks, setting out the conditions of public access under the relevant legislation and providing normal hours (and out of hours) contact details. Staff associated with the project will conduct frequent visits, which will include inspections to establish whether any signs have been defaced, removed or are becoming hidden by vegetation or foliage, with prompt action taken as necessary. Signs will also be erected at suitable locations across the site as required for the ease and safety of operation of the wind farm. These signs include: › Buried cable route markers at 30m (maximum) intervals and change of cable ronte direction; › Directions to relevant turbines at junctions; › "No access to Unauthorised Personnel" at appropriate locations; › Speed limits signs at site entrance and junctions; › "Warning these Premises are alarmed" at appropriate locations; › "Danger HV" at appropriate locations; › "Warning – Keep clear of structures during electrical storms, high winds or ice conditions" at site entrance; › "No nnanthorised vehicles beyond this point" at specific site entrances; and › Other operational signage required as per site-specific hazards.
MM72	Health & Safety	EIAR Chapter 5	An operational phase Health and Safety Plan will be developed to fully address identified Health and Safety issues associated with the operation of the site and providing for access for emergency services at all times.

			The components of a wind turbine are designed to last up to 30 years and are equipped with a number of safety devices to ensure safe operation during their lifetime. During the operation of the wind farm regular maintenance of the turbines will be carried out by the turbine manufacturer or appointed service company. A project or task specific Health and Safety Plan will be developed for these works in accordance with the site's health and safety requirements.
Biodiversity			
MM73	Bats	EIAR Chapter 6	In order to reduce the value of the habitat for bat species in the areas surrounding the turbines, a buffer of at least 50m between the tip of the blade and any trees or other tall vegetation that could provide high quality foraging habitat for bat species will be implemented. Details of this mitigation and how it is calculated is provided in Appendix 6-2. In addition to this, ongoing monitoring of bat activity will be undertaken for at least 3 years' post construction of the wind farm. This will provide data and information on the actual recorded impact of the wind turbines on the local bat populations. Full details of the proposed monitoring programme are provided in Appendix 6.2 and include measurement of bat activity, weather conditions and any correlation between the two. The monitoring will also include corpse searching in the areas surrounding the turbines to gather data on any actual collisions. If, following monitoring, there are significant effects recorded, a range of measures are proposed to ensure that any such effects are fully mitigated. These measures include blade feathering, curtailment of turbines during certain conditions and increase of buffers surrounding the turbines. Any or all of the above measures may be employed following actual monitoring of the impact of the operating turbines on bats to ensure that no potential for significant effects on bat species remains.
Traffic Management			
MM74	Roads	EIAR Chapter 14	**A Post Construction Condition Survey** – Where required by the local authority, a post construction survey will be carried out after works are completed to ensure that any remediation works are carried out to a satisfactory standard. Where required the timing of these surveys will be agreed with the local authority. All road surfaces and boundaries will be re-instated to pre-development condition, as agreed with the local authority engineers

Population and Human Health			
MM75	Shadow Flicker	EIAR Chapter 5	Where daily or annual shadow flicker exceedances are experienced at buildings, a site visit will be undertaken to determine the level of occurrence, existing screening and window orientation. The shadow flicker prediction data will be used to select dates on which a shadow flicker event could be observed at one or multiple affected properties and the following process will be adhered to. 1. *Recording the weather conditions at the time of the site visit, including wind speeds and direction (i.e. blue sky, intermittent clouds, overcast, moderate breeze, light breeze, still etc.).* 2. *Recording the house number, time and duration of site visit and the observation point GPS coordinates.* 3. *Recording the nature of the sensitive receptor, its orientation, windows, landscaping in the vicinity, any elements of the built environment in the vicinity, vegetation.* 4. *In the event of shadow flicker being noted as occurring the details of the duration (times) of the occurrence will be recorded.* In the event of an occurrence of shadow flicker exceeding guideline threshold values of 30 minutes per day at residential receptor locations, mitigation options will be discussed with the affected homeowner, including: 1. *Installation of appropriate window blinds in the affected rooms of the residence;* 2. *Planting of screening vegetation;* 3. *Other site-specific measures which might be agreeable to the affected party and may lead to the desired mitigation.* If it is not possible to mitigate any identified shadow flicker limit exceedance locally using the measures detailed above, wind turbine will be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence of shadow flicker at properties surrounding the wind farm.

Ornithology			
MM76	Bird monitoring programmes	EIAR Chapter 7	A detailed post-construction Bird Monitoring Programme has been prepared for the operational phase of the Proposed Development, please refer to Appendix 7-7 for further details. The programme of works will monitor parameters associated with collision, displacement/barrier effects and habituation and these surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 & 15 of the life-time of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009). The following individual components are proposed for monitoring years: › Monthly flight activity surveys: vantage point surveys › Distribution and abundance surveys: breeding wader to a 500m radius of the development area, breeding hen harrier surveys and winter hen harrier roost surveys to a 2km radius of the development area. › Targeted bird collision surveys (corpse searches) will be undertaken with training dogs. The surveys will include detection and scavenger trials, to correct for these two biases and ensure the resulting data is robust.
Drainage Management Plan			
MM77	Progressive Replacement of Natural Surface with Lower Permeability Surfaces	EIAR Chapter 9	› Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed to areas where it can be re-distributed over the ground by means of a level spreader; › Swales/road side drains will be used to collect runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to settlement ponds for sediment settling; › On steep sections of access road transverse drains ('grips') will be constructed in the surface layer of the road to divert any runoff off the road into swales/road side drains; › Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;

			› Settlement ponds, emplaced downstream of road swale sections and at turbine locations, will buffer volumes of runoff discharging from the drainage system during periods of high rainfall, by retaining water until the storm hydrograph has receded, thus reducing the hydraulic loading to watercourses; and, › Settlement ponds will be designed in consideration of the greenfield runoff rate.
Noise & Vibration			
MM78	Turbine Programming	EIAR Chapter 11	› The predicted operational noise levels of the proposed development will be within the relevant best practice noise criteria curves for wind farms at all but one noise sensitive location. Therefore, on a very limited basis, curtailment of turbine operation in certain wind speeds and directions will be required to achieve the noise criteria Modern wind turbines can be programmed to run in reduced modes of operation (or low noise modes) in order to achieve the calculated attenuation required in the specific wind conditions (i.e. wind speed and direction). Operating the turbines in reduced noise modes is generally referred to as curtailment. › Low Frequency Noise: In the unlikely event of low frequency noise, a detailed investigation will be undertaken following guidance outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). › Amplitude Modulation (AM): In the unlikely event of AM, an independent Aconstic Consultant will assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) or subsequent revisions (August 2016).
MM79	Noise Monitoring	EIAR Chapter 11	Commissioning noise surveys will be undertaken to ensure compliance with any noise conditions applied to the development. In the unlikely instance that an exceedance of these noise criteria is identified, the assessment guidance outlined in the IoA GPG and Supplementary Guidance Note 5: Post Completion Measurements (July 2014) should be followed and relevant corrective actions will be taken. For example, implementation of noise operational modes resulting in curtailment of

BIBLIOGRAPHY

Introduction

Department of the Environment, Coinmnnity and Local Government (2013). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. DoEHLG, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Government (August 2018) Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. DHPLG, Dublin.

Department of Housing, Planning and Local Government (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, Dublin.

Department of Housing, Planning and Local Government (2013) Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review. DHPLG, Dublin.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements). EPA, Wexford.

Environmental Protection Agency (2003) Advice Notes on Current Practice in the Preparation of Enviromnental Impact Statements. EPA, Wexford.

Environmental Protection Agency (2002) Gnidelines on Information to be Contained in Environmental Impact Statements. EPA, Wexford.

European Union (2014). Directive 2014/52/EU. European Parliament and European Conncil.

European Union (2011). Directive 2011/92/EU. European Parliament and European Conncil.

Irish Statute Book (2018). European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 (S.I. No. 296 of 2018).

Irish Statute Book (2001). Planning and Development Regulations (as amended) S.I. No. 600 of 2001. Stationery Office, Dublin.

Irish Statute Book (2000). Planning and Development Acts 2000 to 2019. Stationery Office, Dublin.

Background to the Proposed Development

Council of the European Union (2014). 2030 Climate and Energy Policy Framework, Brnssels.

Council of the European Union (2009). Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC), Brussels.

Climate Action Network Europe (2018). Off Target Report, Brussels.

Climate Change Advisory Council (2019). Annual Review 2019, ISBN: 978-1-84095-848-5
Eurostat- https://ec.europa.eu/eurostat/documents/2995521/10335438/8-23012020-AP-EN.pdf/292cf2e5-8870-4525-7ad7-1888864ba0c29

Commission for Regulation of Utilities (2018) Enduring Connection Policy Stage 1 (ECP-1). Dublin

Department of Climate Change, Action & Environment (2019). Climate Action Plan 2019

Department of Climate Change, Action & Environment. Renewable Energy Support Scheme

Department of Climate Change, Action & Environment (2018). National Adaptation Framework - Planning for a Climate Resilient Ireland 2018.

Department of Climate Change, Action & Environment (2017) National Mitigation Plan 2017

Department of Climate Change, Action & Environment (2017). Fourth Progress Report on the National Renewable Energy Action Plan.

Department of Climate Change, Action & Environment (2016). Draft Renewable Electricity Policy and Development Framework.

Department of Climate Change, Action & Environment (2016). Code of Practice for Wind Energy Development in Ireland - Guidelines for Community Engagement 2016.

Department of Climate Change, Action & Environment (2014). National Policy Position on Climate Action and Low Carbon Development.

Department of Climate Change, Action & Environment (2015). Climate Action and Low Carbon Development Act 2015.

Department of Climate Change, Action & Environment (2012). National Climate Change Adaptation Framework.

Department for Commnnications, Marine and Natural Resources (2007). Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020.

Department of Communications, Energy & Natural Resources (2015). White Paper on Energy Policy in Ireland 2015-2030, Dublin.

Department of Communications, Energy and Natural Resources (2012). Strategy for Renewable Energy 2012 – 2020

Department of the Environment, Heritage and Local Government (2006). Wind Energy Guidelines 2006.

Department of Honsing, Planning, Commnnity and Local Government (2017). Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change.

Department of Housing, Planning, Commnnity and Local Government (2017). Department Circular PL5/2017

Department of Housing, Planning, Commnnity and Local Government (2019) Draft Revised Wind Energy Development Guidelines

Department of Climate Change, Action & Environment. Renewable Energy Support Scheme
Department of Agriculture, Food and Marine. Forest Service Guidelines.

EirGrid (2019) All Island Generation Capacity Statement 2019 – 2028, Dublin.

Environmental Protection Agency (2019). Irish Climate Futures: Data for Decision-making

Environmental Protection Agency (2008). Climate Change – Refining the Impacts for Ireland

European Commission (2010). Europe 2020 Strategy.

European Commission (2017). Report from the Commission to the European Parliament, the Council, the

European Economic and Social Committee and the Committee of the Regions, Brussels.

Environmental Protection Agency (2019). Ireland's Greenhouse Gas Emission Projections 2018-2040.

Government of Ireland (2000). Strategy for Intensifying Wind Energy Development', Department of Commnnications, Energy and Natural Resources, ISBN 0-7076-9225-3

Government of Ireland (2018). Project Ireland 2040 National Planning Framework

Irish Wind Energy Association (2015). Data-Centre Implications for Energy Use in Ireland

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry.

Irish Wind Energy Association (2013). Best Practice Principles in Community Engagement and Community Commitment 2013.

Irish Wind Energy Association (2018). IWEA Community Engagement Strategy 2018

Joint Committee on Climate Action (2019). Climate Change: A Cross-Party Consensus for Action.

Leitrim County Development Plan 2015-2021

Leitrim County Council Climate Adaptation Strategy 2019-2024

Leitrim County Council (2002) Landscape Assessment of County Leitrim

Northern and Western Regional Assembly (2018). Regional Spatial and Economic Strategy, Northern and Western Region, 2018

Sligo County Council (2017) Sligo County Development Plan 2017 – 2023

Sligo County Council Draft Climate Adaption Strategy 2019-2024

Sustainable Energy Authority of Ireland (2019), National Energy Projections

Sustainable Energy Authority of Ireland (2019), Energy in Ireland 2019 Report.

Sustainable Energy Authority of Ireland (2017), Energy in Ireland 1990 – 2016

United Nations (1992). United Nations Framework Convention on Climate Change

United Nations (1997). Kyoto Protocol to the United Nations Framework Convention on Climate Change

United Nations (2012). Doha Amendment to the Kyoto Protocol
United Nations (2015). COP21 Paris Agreement, Paris.

United Nations (2019). COP25 Climate Change Conference, Madrid.

Consideration of Reasonable Alternatives

Department of Housing, Planning and Local Government (September 2017). Ireland 2040 – Our Plan. Dublin

Environmental Protection Agency (2017): Draft Guidelines on the Information to be contained in Environmental Impact Assessment Reports.

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Leitrim County Council (2015) County Development Plan 2015-2021

Leitrim County Comcil (2019) Leitrim County Council Climate Adaptation Strategy 2019-2024

Sligo County Council (2017) Sligo County Development Plan 2017 – 2023

Sligo County Council Draft Climate Adaption Strategy 2019-2024

Sustainable Energy Authority of Ireland (April 2013) Methodology for Local Authority Renewable Energy Strategies. RPS, Ireland.

Description of the Proposed Development

California Stormwater Quality Association (2003). Best Management Practice Handbook EC-9 Earth Dikes and Drainage Swales. CASQA, California.

CIRIA Construction Industry Research and Information Association (2006). CIRIA C648: Control of water pollution from linear construction projects -Technical guidance. CIRIA London.

CIRIA Construction Industry Research and Information Association (2001). CIRIA C532: Control of water pollution from construction sites - Guidance for consultants and contractors. CIRIA London.

City of Houston; Harris County; Harris County Flood Control District (2006). Stormwater Management Handbook for Construction Activities. Houston.

Department of Communications, Climate Action and Environment (2018) Renewable Electricity Support Scheme (RESS) 1. DCCAE, Dublin.

Department of Agriculture, Fisheries and Food, Kildare. Environmental Protection Authority (2007). ACT Environmental Protection Guidelines for Constrnction and Land Development in the ACT.

Department of the Environment, Heritage and Local Government (2006) Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Environmental Protection Agency Ireland (2009) Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses. EPA, Wexford.

Environmental Protection Agency Ireland (1999) Wastewaster Treatment Manuals - Treatment Systems for Small Communities, Business, Leisure Centres and Hotels. EPA, Wexford.

Institute of Geologists Ireland (2007) Gnide for Drilling Wells for Private Water Supplies. IGI, Dublin.
Irish Statute Book (2007) Waste Management (Collection Permit) Regulations, 2007 as amended (S.I. No. 820 of 2007)

Office of Public Works Coustruction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945. Available at: https://www.gov.ie/en/publication/957aa7-consent-requirements-constructionalteration-of-watercourse-infrastru/

McAulay, I., TJP Envision Limited, Department of Trade and Industry, New and Renewable Energy Programme (1999) The Influence of Colour on the Aesthetics of Wind Turbine Generators (ETSU, London).

Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms Commissioned Report No. 591/ SNH, Stirling.

State of Oregon Department of Environmental Quality (2006). Best Management Practices for Storm Water Discharges Associated with Construction Activities. Oregon.

Siltbuster Concrete Wash Unit. Available at: http://www.siltbuster.com. Accessed 09.03.2020.

Population and Human Health

American Wind Energy Association and Canadian Wind Energy Association (2009). Wind Turbine Sound and Health Effects - An Expert Panel Review, USA and Canada.

Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health (2010). A Rapid Review of the Evidence. Australia.

Baringa (2019) Wind for a Euro: Cost-benefit analysis of wind energy in Ireland 2000-2020

BiGGAR Economics (2016). Wind Farms and Tourism Trends in Scotland. Midlothian, Scotland.

Centre for Economics and Business Research (2014) The effect of wind farms on house prices. Renewable UK, London.

Central Statistics Office Ireland (2018). Census Results 2011 & 2016. www.cso.ie

Central Statistics Office Ireland (2012). Census of Agriculture 2010 Detailed Results. www.cso.ie

Climate and Health Alliance (2012). Position Statement on Health and Wind Turbines. Australia.

Department of Communicatious, Climate Action and Environment (2019) Climate Action Plan (CAP).

Department of the Environment, Heritage and Local Government (2007). National Climate Change Strategy 2007 – 2012. Stationery Office, Dublin.

Department of Housing, Planning and Local Goverument (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Goverument (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, 2017.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Discover Ireland www.discoverireland.ie

ESB (2017) EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland (https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0).

Fáilte Ireland (September 2019). Tourism Facts 2018. Fáilte Ireland. Available at: www.failteireland.ie

Fáilte Ireland (2012). Visitor Attitudes on the Environment - Wind Farms. www.failteireland.ie

Environmental Protection Agency (2017). Draft Guidelines on the Information to be Contained in Environmental Impact Statements. EPA, Wexford.

Helimax Energy (2008). Shadow Flicker Analysis. Stantec, Ontario.

Heblich, Dr. S. et al (2016) Impact of wind Turbines on House Prices in Scotland. Climate Xchange

HSE Public Health Medicine Environment and Health Group (2017) Position Paper on Wind Turbines and Public Health. Ireland.

Health & Safety Authority (2006) Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations.

Irish Wind Energy Association (January 2020) Interactions Opinion Poll on Wind Energy. Ireland

Irish Wind Energy Association (2014). "An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland, Siemens Limited, Dublin.

Irish Wind Energy Association (2009). Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy. Deloitte, Ireland

IWEA (2009) Jobs and Investment in Irish Wind Energy – Powering Ireland's Economy'

Lawrence Berkley National Laboratory (2013). The Impact of Wind Power Projects on Residential Property Values in the United States: A multi-Site Hedonic Analysis. US Department of Energy

Lawrence Berkley National Laboratory (2013) A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States.

Massachusetts Institute of Technology (2014) Wind Turbines and Health, A Critical Review of the Scientific Literature, Journal of Occupational and Environmental Medicine Vol. 56 (11).

Massachusetts Departments of Environmental Protection and Public Health (2012). Wind Turbine Health Impact Study -Report of Independent Expert Panel. USA.

Massachusetts Institute of Technology (2014). 6. Wind Turbines and Health, A Critical Review of the Scientific Literature, USA.

Met Éireann (2013). 30 Year Averages. https://www.met.ie/climate/30-year-averages

Noble Environmental Power LLC (2006). Wind Fact Sheet #4: Shadow Flicker. Noble Environmental Power, Connecticut.

Pőyry (2014) The Value of Wind Energy to Ireland A report to Irish Wind Energy Association. Cambridge Economics.

Renewable UK (2010). Wind Turbine Syndrome - An independent review of the state of knowledge about the alleged health condition. London, UK.

Siemens (2014) An Enterprising Wind" An economic analysis of the job creation potential of the wind sector in Ireland

Sustainable Energy Ireland (2003). Attitudes Towards the Development of Wind Farms in Ireland'. SEI, Dublin.

UK Department of Energy and Climate Change (2010). Update of Shadow Flicker Evidence Base. DECC, London.

Warren, C.R. et al (2005). Green on Green: Public Perceptions of Wind Power in Scotland and Ireland. Journal of Environmental Planning and Management 48(6): 853-875.

Biodiversity

Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn.). The Bat Conservation Trust, London.

Bailey, M. and Rochford J. (2006) Otter Survey of Ireland 2004/2005. Irish Wildlife Manuals, No. 23. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Crowe, O., Wilson, J., Aznar, I. and More, S.J. (2009). A review of Ireland's waterbirds, with emphasis on wintering migrants and reference to H5N1 avian influenza. Irish Veterinary Journal 62, 800–811.

Crowe, O. (2005) Ireland's Wetlands and their Waterbirds: Status and Distribution. BirdWatch Ireland, Rockingham, Co. Wicklow.

EC (2007b) Interpretation Manual of European Union Habitats. Version EUR 27. European Commission, DG Environment.

EPA 2017, Draft Guidelines On The Information To Be Contained In Environmental Impact Assessment Reports, Online, Available at: https://www.epa.ie/pubs/advice/ea/EPA%20EIAR%20Guidelines.pdf, Date accessed: 01/04/2019

EPA, 2019, Water status data. Online, Available at http://www.epa.ie, Accessed: 01/04/2019.

European Communities (Environmental Impact Assessment) Regulations, 1989 to 2001.

European Communities (Natural Habitats) Regulations, SI 94/1997, SI 233/1998 & SI 378/2005 – http://www.irishstatutebook.ie.

Fossitt, J. A. (2000). A Guide to Habitats in Ireland. Dublin: The Heritage Council.

Habitats Directive (92/43/EEC).

CIEEM (2016) Institute of Ecology and Environmental Management Draft Guidelines for Ecological Impact Assessment: Terrestrial, Freshwater and Coastal

CIEEM (2018) Institute of Ecology and Environmental Management Draft Guidelines for Ecological Impact Assessment: Terrestrial, Freshwater and Coastal

Marnell, F., Kingston, N. & Looney, D. (2009) Ireland Red List No. 3: Terrestrial Mammals, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

NPWS (2008) The Status of EU Protected Habitats and Species in Ireland. Conservation Status in Ireland of Habitats and Species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC.

NPWS Protected Site Synopses and maps available on http://www.npws.ie/en/ProtectedSites/.

NPWS (2019), Natural Heritage Areas (NHA), Online, Available at: https://www.npws.ie/protected-sites/nha, Accessed: 01/09/2019

NPWS (2019), Online map for protected bryophytes, http://dahg.maps.arcgis.com/apps/webappviewer/index.html?id=71f8df33693f48edbb70369d7fb26b7e, Online, Accessed: 01/06/2020.

TII (2004) Environmental Impact Assessment of National Road Schemes – A Practical Gride, National Roads Authority, Dublin.

TII (2004) Guidelines for the Treatment of Noise and Vibration in National Road Schemes (1 ed.). Dublin: National Roads Authority.

TII (2005) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, During and Post-Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2006) Guidelines for the Treatment of Bats during the Construction of National Road Schemes. Dublin: National Roads Authority.

TII (2008). Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan. Dublin: National Roads Authority.

TII (2009) Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes. Dublin: National Roads Authority.

O'Neill et al. (2009) Irish Semi Irish Semi-natural natural Grasslands Survey Annual Report No. 2: Counties Cavan, Leitrim, Longford & Monaghan. Bec Consultants

Smal, C. (1995) The Badger and Habitat Survey of Ireland. Unpublished Report to the Department of Agriculture and the National Parks & Wildlife Service.

Stace, C. A. (1997). New Flora of the British Isles. Cambridge: Cambridge University Press.

Stone, E.L. (2013) Bats and lighting: Overview of current evidence and mitigation guidance.

TII (2010b) Guidelines on management of noxious weeds and non-native invasive plant species on national roads. National Roads Authority.

Calhoun, K. and Cummins, S. (2014). Birds of Conservation Conceru in Ireland 2014-2019. BirdWatch Ireland.

NPWS (2019). The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitat Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill

Ornithology

Anon., (2003). Recommended methodology for assessment of impacts of proposed windfarms on breeding Hen Harrier within the known range of the species in Ireland. National Parks and Wildlife Service, BirdWatch Ireland, Irish Raptor Study Group.

Anon., (2005). Survey methods for use in assessing the impacts of onshore windfarms on bird communities. SNH Guidance document. Scottish Natural Heritage.

Alerstam, T., Rosen M., Backman J., G P., Ericson P & Hellgren O. 2007. *Flight Speeds among Bird Species: Allometric and Phylogenetic Effects.* PLoS Biol, 5, 1656-1662. DOI: 10.1371/journal.pbio.0050197

Balmer, D.E., Gillings, S., Caffrey, B.J., Swann, R.L., Downie, I.S. and Fuller, R.J. (2013*). Bird Atlas 2007-11: the breeding and wintering birds of Britain and Ireland.* BTO Books, Thetford, UK.

Band, W., Madders, M. and Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. In: Birds and wind power: risk assessment and mitigation. M. De Lucas, G.F.E. Janss and M. Ferrer, Eds.: 259-275. Quercus, Madrid.

Barrios, L. and Rodríguez, A. (2004). Behavioural and environmental correlates of soaring bird mortality at on-shore wind turbines. Journal of Applied Ecology, 41(1): 72-81.

Barton, C., Pollock, C., Norriss, D.W., Nagle, T., Oliver, G.A. and Newton, S., (2006). *The second national survey of breeding Hen Harriers (Circus cyaneus) in Ireland 2005.* Irish Birds 8(1): 1-20.

Beintema, A. & Visser, G.H. (1994). - Factors affecting growth and survival of lapwing Vanellus vanellus chicks. – Pp. 39-40 in: Tucker, G.M., Davies, S.M.& Fuller, R.J. (eds.) The ecology and conservation of lapwings Vanellus vanellus. – Joint Nature Conservation Committee (UK Nature Conservation No. 9).

Berg, Åke & Lindberg, Thore & Kallebrink, K.G. (1992). *Hatching Success of Lapwings on Farmland: Differences between Habitats and Colonies of Different Sizes.* Journal of Animal Ecology. 61. 469-476. 10.2307/5337.

Berg, Å. (1993). - Habitat selection by monogamous and polygamous Lapwings on farmland – The importance of foraging habitats and suitable nest sites. – Ardea 81: 99-105.

Bibby, C.J., Burgess, N.D. & Hill, D.A. & Mustoe, S. (2000) *Bird Census Techniques (Second edition).* Academic Press, London.

Birds Directive (2009/47/EC) http://ec.europa.eu/environment/naturelegislation/birdsdirective /index _en.htm

BirdLife International, 2004. *Birds in the European Union: a status assessment*, Wageningen, The Netherlands.

Boland, H. & Crowe, O., (2012). Irish Wetland Bird Survey: Waterbird Status and Distribution 2001/02 -2008/09, Kilcoole, Wicklow.

Boland, H. et al., (2010). Whooper Cygnus cygnus and Bewick's C. columbianus bewickii Swans in Ireland: results of the International Swan Censns, January 2010. Irish Birds, 9(1), pp.1–10.

Bord na Móna (2016) – Biodiversity Action Plan 2016 – 2021

British Trust of Ornithology (BTO) online BirdFacts. Available at https://www.bto.org/about-birds/birdfacts

Brazil, M. (2003) *The Whooper Swan.* First Edition. Poyser Monographs; T. & A.D. Poyser.

Brown, A.F.& Shepherd, K.B. (1993) *A method for censusing upland breeding waders.* Bird Study, 40: 189-195

Burke, B., Lewis, L. J., Fitzgerald, N., Frost, T., Austin, G. & Tierney, T. D. (2018) *Estimates of waterbird numbers wintering in Ireland*, 2011/12 – 2015/16. Irish Birds No. 41, 1-12.

CEC, The Council of the European Communities (1979). Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds. Official Journal of the European Communities No. L 103/1: 25.

Chamberlain, D., Freeman, S.N., Rehfisch, M.M., Fox & Desholm, M. (2005). *Appraisal of Scottish Natural Heritage's Windfarm collision risk model and its application.* BTO Research Report No. 401. 52pp.

Chamberlain, D.E., Rehfisch, M.R., Fox, A.D., Desholm, M., Anthony, S.J. 2006. The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis 148: 198–202.

CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

Colhoun, K. and Cummins, S. (2013). *Birds of Conservation Concern in Ireland 2014 2019.* Irish Birds 9(4): 523-544.

Craig, G.R., White, G.C, Enderson, J.H. (2004). *Survival, Recruitment, and Rate of Population Change of the Peregrine Falcon Population in Colorado.* The Journal of Wildlife Management. Vol. 68, No. 4, pp. 1032-1038.

Cramp, S. (1993) *Handbook of the Birds of the Western Palaearctic*, Oxford University Press, Oxford.

Crowe, O., Coombes, R.H., O'Sulliavn, O, Tierney, T.D., Walsh, A.J. and O'Halloran, J. (2014). *Countryside Bird Survey Report 1998-2013*, BirdWatch Ireland, Wicklow.

Crowe, O. & C. Holt. 2013. Estimates of waterbird numbers wintering in Ireland 2006/07 – 2010/11. Irish Birds 9, 545-552
Crowe, O., McElwaine, J.G., Boland, H., Enlander, I.J. (2015). Whooper Cygnus cygnus and Bewick's C. columbianus bewickii Swans in Ireland: resnlts of the International Swan Censns, January 2015. Irish Birds 10(2): 151-158.

Dewitt, A. L. & Langston, R.H.W. (2008) *Collision effects of wind - power generators and other obstacles on birds.* Annals of the New York Academy of Sciences, 1134 (1): pp. 233 - 26 6(34).

DoEHLG (2013). Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. Department of the Environment, Community and Local Government (where relevant).

Drewitt, A. L. & Langston, R.H.W. (2006). *Assessing the impacts of wind farms on birds.* Ibis. 148: 29 – 42.

EPA (2002). Guidelines on the information to be contained in Environmental Impact Statements. Environmental Protection Agency (where relevant).

EPA (2003). Advice notes on current practice (in the preparation of Environmental Impact Statements (where relevant).

EPA (2017). Draft revised guidelines on the information to be contained in Enviroumental Impact Statements. Environmental Protection Agency.

Emropean Commission (2002). Assessment of plans and projects significantly affecting Natura 2000 sites.

European Commission (2011). Wind energy development and Natura 2000. Guidance docnment.

Emropean Commission (2017). Environmental Impact Assessment of Projects.

Evans P.R., Pienkowski M.W. (1984). *Population Dynamics of Shorebirds.* In: Burger J., Olla B.L. (eds) Shorebirds. Springer, Boston, MA.

Fernández-Bellon, D., Wilson, M.W., Irwin, S., O'Halloran, J. (2018) Effects of development of wind energy and associated changes in land use on bird densities in upland areas.

Fernley, J., Lowther, S. & Whitfield P. 2006. *A Review of Goose Collisions at Operating Wind Farms and Estimation of the Goose Avoidance Rate.* Unpublished Report by West Coast Energy, Hyder Consulting and Natural Research.

Galbraith, H. (1988). - Effects of agriculture on the breeding ecology of Lapwings Vanellus vanellus. – J. Appl. Ecol. 25: 487-503.

Gibbons, D.W., Reid, J.B. & Chapman, R.A. (1993) The new atlas of breeding birds in Britain and Ireland: 1988-1991.
Gilbert, G., Gibbons, D.W. & Evans, J. (1998) *Bird Monitoring Methods.* RSPB

Gillings and Fuller (1999). *Winter Ecology of Golden Plovers and Lapwings: A Review and Consideration of Extensive Survey Methods.* BTO Research Report No. 224. British Trust for Ornithology, The Nunnery, Thetford, Norfolk, IP24 2PU, UK.

Hafner, Heinz & Kayser, Yves & Boy, V. & Fasola, Mauro & Prevot, Anne-Caroline & Pradel, Roger & Cézilly, Frank. (1998). *Local Survival, Natal Dispersal, and Recruitment in Little Egrets Egretta garzetta.* Journal of Avian Biology. 29. 216. 10.2307/3677103.

Hardey, J., Crick, H., Wernham, C., Riley, H. & Thompson, D. (2009): *Raptors: a field guide to survey and monitoring. 2nd Edition* Edinburgh: The Stationery Office.

Hardey, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. (2013). *Raptors: a field guide to survey and monitoring (3rd Edition).* The Stationery Office, Edinburgh.

Heery, S. (editor) (2018). *Birds in Central Ireland – Sixth Mid-Shannon Bird Report.* 2012-2016. BirdWatch Ireland.

Hötker, H., Thomsen, K.-M. & Jeromin, H., 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats - facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation, Bergenhusen, Germany.

Huntley, B., Green, R.E., Collingham, Y.C. and Willis, S.G. (2007). *A climatic atlas of European breeding birds.* Durham University, The RSPB and Lynx Edicions, Barcelona.
Irish Wildlife Acts 1976 to 2018.

Johnson, W.P., Schmidt, P. M and Taylor, D.P. (2014). *Foraging flight distances of wintering ducks and geese: a review.* Avian Conservation and Ecology 9(2)

Joys, A.C. & Crick, H.Q.P (2004). Breeding periods for selected bird species in England. BTO Research Report No. 352. British Trust for Ornithology, The Nunnery, Thetford, Norfolk IP24 2PU, U.K.

Ketzenberg, C. et al., 2002. *Einfluss von Windkraftanlagen auf brütende Wiesenvögel.* Natur und Landschaft, 77, pp.144–153

Kunz, T.H., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D. and Szewczak, J.M. (2007). *Assessing impacts of wind-energy development on nocturnally active birds and bats: a guidance document.* Journal of Wildlife Management 71(8): 2449-2486.

Lack, P. (1986). The atlas of wintering birds in Britain and Ireland. T & A.D. Poyser Ltd. (for the British Trust for Oruithology and the Irish Wildbird Conservancy), Calton.

Langgemach, Torsten & Bellebaum, Jochen. (2005). *Prädation und der Schutz bodenbrütender Vogelarten in Deutschland.* VOGELWELT. 126. 259-298.

Langston, R.H.W. and Pullan, J.D. (2003). Windfarms and Birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. BirdLife International on behalf of the Bern Convention, Strasbourg, 58 pp.

Larsen, J.K. and Madsen, J. (2000). Effects of wind turbines and other physical elements on field utilization by pink-footed geese (Anser brachyrhynchus): A landscape perspective. Landscape Ecology, 15(8): 753 764.

Lauder, C. & Donaghy, A. (2008). Breeding Wader in Ireland 2008: A Review and Recommendations for Future Action. Unpublished report to the NPWS

Lusby, J., Corkery, I., McGuiness, S., Fernández-Bellon, D., Toal, L., Norriss, D., Breen, D., O'Donaill, A., Clarke, D., Irwin, S., Quinn, J.L., & O'Halloran, J. (2017): *Breeding ecology and habitat selection of Merlin Falco columbarius in forested landscapes,* Bird Study

Madden, B. and Porter, B., (2007). Do wind turbines displace Hen Harriers (Circus cyaneus) from foraging habitat? Preliminary results of a case study at the Derrybrien Wind Farm, County Galway. Irish Birds 8(2): 231-236.

Madders, M. & Whitfield, P.D. (2006). *Upland Raptors and the Assessment of Wind Farm Impacts.* Ibis (2006), 148, 43-56.

McCluskie, A. (2006). Hen Harriers and wind farms. Powerpoint presentation for Natural Research Ltd., U.K. Meredith, C., Venosta, M. & Ressom, R. 2002. *Cordington Wind Farm Avian Avoidance Behaviour Report 2002.* Biosis Research Project.

McGuinness, D., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. (2015). Bird Seusitivity Mapping for Wind Energy Developments and Associated Infrastrncture in the Republic of Ireland. Guidance Document. Birdwatch Ireland.

McLoughlin, D. and Cotton, D. (2008). *The status of Twite Carduelis flavirostris in Ireland 2008.* Irish Birds 8(3): 323-330.

Murray, T., Clotworthy, C. & Bleasdale, A. (2013) *A Survey of Red Grouse (Lagopus lagopus scoticus) in the Owenduff/Nephin Complex Special Protection Area.* Irish Wildlife Manual, No. 77. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

National Biodiversity Data Centre Website (www.biodiversityireland.ie)

National Parks and Wildlife Services (2015). Hen Harrier Conservation and the Forestry Sector in Ireland.

Norriss, D.W., Marsh, J., McMahon, D. and Oliver, G.A., (2002). *A national survey of breeding Hen Harriers Circus cyaneus in Ireland* 1998-2000. Irish Birds 7(1): 1-12.

NRA (2009a). Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2). National Roads Authority.

NRA (2009b) Environmental Impact Assessment of National Road Schemes –A Practical Guide

NRA (2009c) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. National Roads Authority.

Peach, W.J., Thompson, P.S. & Coulson, J.C. 1994. Annual and long-term variation in the survival rates of British lapwings Vanellus vanellus. J. Anim. Ecol. 63: 60–70.

Pearce-Higgins, J.W., Stephen, L., Dowse, A. and Langston, R.H.W. (2012). Greater impacts of wind farms on bird populations during construction than subsequent operation: results of multi-site and multi-species analysis. Journal of Applied Ecology 49: 386-394.

Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. and Bullman, R. (2009). *The distribution of breeding birds around upland wind farms.* Journal of Applied Ecology 46: 1323-1331.
Percival, S.M. (2003). Birds and wind farms in Ireland: A review of potential issues and impact assessment. Ecological Consulting.

Prévot-Julliard, A.C., Lebreton, J.D., Pradel, R. (1998). Re-Evaluation of Adult Survival of Black-Headed Gulls (Larus Ridibundus) in Presence of Recapture Heterogeneity, The Auk, Volume 115, Issue 1, Pages 85–95.

Renou-Wilson, F., Keane, M., and Farrell, E. P. (2008). Establishing oak woodland on cutaway peatlands: effects of soil preparation and fertilization. Forest Ecology and Management 255:728-737.

Ruddock, M. & Whitfield, D.P. (2007). *A review of disturbance distances in selected bird species.* A report from Natural Research (Projects) Ltd. to Scottish Natural Heritage.

Ruddock, M. & Dunlop, B.J., O'Toole, L., Mee, A. and Nagle, T. (2012). *Republic of Ireland National Hen Harrier Survey 2010.* Irish Wildlife Manual, No. 59. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

Ruddock, M. et al., 2011. *Republic of Ireland Hen Harrier Survey, 2010*, Dublin, Ireland.
Ruddock, M., Mee, A., Lusby, J., Nagle, A., O'Neill, S. & O'Toole, L. (2016). *The 2015 National Survey of Breeding Hen Harrier in Ireland.* Irish Wildlife Manuals, No. 93. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Ireland.

Sandercock, B.K. (2003). Estimation of survival rates for wader population: A review of mark-recapture methods. Wader Study Group Bulletin 100:163-174.

Scott, D. (2000). Marking a decade of tree nesting by Hen Harriers Circus cyaneus in Northern Ireland, 1991-2000. Irish Birds 6(4): 586-589.

Scott, D. (2005). The diet of Hen Harriers Circus cyaneus in Northern Ireland 1991-2005. Irish Birds 7(4): 597-599.

Scott, D. and Clarke, R. (2007). Comparing the success of Hen Harrier Circus cyaneus tree nests and ground nests in the Antrim Hills, 1990-2006. Irish Birds 8(2): 315-318.

Scott, D. and McHaffie, P. (2003). What impact do Buzzard Buteo buteo and Goshawk Accipiter gentilis have on other raptors in coniferous forest? – preliminary findings. Irish Birds 7(2): 267-269.

Scott, D. and McHaffie, P. (2008). Hen Harrier Circus cyaneus killed at windfarm site in County Antrim. Irish Birds 8(3): 436-437.

Scott, D., Clarke, R. and Shawyer, C.R. (1991). *Hen Harriers breeding in a tree-nest. Irish Birds* 4(3): 415-417.

Sharrock, J.T.R. (1976). *The Atlas of Breeding Birds in Britain and Ireland.* British Trnst for Ornithology, Tring.

SNH (2000). Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action. SNH Guidance Note.

SNH (2006). Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Sites. Scottish Natural Heritage.

SNH (2009). Monitoring the impact of onshore wind farms on birds. Scottish Natural Heritage.

SNH (2012). Assessing the Cumulative Impact of Onshore Wind Energy Developments. Scottish Natural Heritage.

SNH (2014). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage.

SNH (2017). Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage.

SNH (2016) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK.

SNH (2018) Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model. Scottish Natural Heritage, Edinburgh, UK. http://www.snh.gov.uk/docs/B721137.pdf].

SNH (2016) Wind farm proposal on afforested sites- advice on reducing suitability for hen harrier, merlin and short-eared owl. Scottish Natural Heritage.

SNH (2016). Assessing Connectivity with Special Protection Areas (SPAs). Scottish Natural Heritage.
Snow, D.W. & Perrins, C.M., 1998. *The Birds of the Western Palearctic Vol. 1: Non-passerines*, Oxford, UK: Oxford University Press.

Sovacool, B.K. (2009). Contextualizing avian mortality: a preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity. Energy Policy 37: 2241–2248.

Stewart, G.B., Coles, C.F. and Pullin, A.S. (2005). Effects of Wind Turbines on Bird Abundance. Effects of Wind Turbines on Bird Abundance. Systematic Review No. 4. Birmingham, U.K., Centre for Evidence-Based Conservation.

Thaxter, C. B., Lascelles, B., Sugar, K., & Cook, A. S.C.P., Roos, S., Bolton, M., Langston, R. H.W., Burton, N. H.K. (2012). *Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas.* Biological Conservation. 156. 10.1016/j.biocon.2011.12.009.

Thomas, P. S., Baines D., Coulson J. C. & Longrigg G. (2008) Age at first breeding, philopatry and breeding site-fidelity in the Lapwing Vanellus vanellus. Ibis 136(4):474 - 484

Thompson, Patrick & Baines, David & COULSON, JOHN & LONGRIGG, GEOFF. (2008). *Age at first breeding, philopatry and breeding site-fidelity in the Lapwing Vanellus vanellus.* Ibis. 136. 474 - 484. 10.1111/j.1474-919X.1994.tb01124.x.

Village, A. (1990). *The Kestrel.* First Edition. T. & A.D. Poyser.

Winkelman, J.E., 1992. *The Impact of the SEP Wind Park near Oosterbierum (Fr.), the Netherlands, on Birds*, Vol. 1: Collision Victims [in Dutch]. RIN-report 92/2, Arnhem, Netherlands.
Winkelman, J.E., 1989. Birds at a Wind Park near Urk: Bird Collision Victims and Disturbance of Wintering Ducks, Geese and Swans [in Dutch]. RIN-Rapport 89/15, Arnhem, Netherlands.

Whitfield, D.P. & Madders, M., 2006. Flight Height in the Hen Harrier Circus Cyaneus and its Incorporation in Wind Turbine Collision Risk Modelling. Natural Research Information Note 2, Banchory, Aberdeenshire.

Whitfield, D.P. and Madders, M. (2006). *A review of the impacts of wind farms on Hen Harriers Circus cyaneus and an estimation of collision avoidance rates.* Natural Research Information Note 1 (revised). Banchory, UK, Natural Research Ltd. 32pp.

Whitfield, D.P. & Urquhart, B. (2015) *Deriving an avoidance rate for swans suitable for onshore wind farm collision risk modelling.* Natural Research Information Note 6. Natural Research Ltd, Banchory, UK.

Wilson, M., Fernández-Bellon, D., Irwin, S., O'Halloran, J. (2015). *The interactions between Hen Harriers and wind turbines. WINDHARRIER Final project Report.* School of Biological, Earth & Environmental Sciences, University College Cork, Ireland.

Land, Soils and Geology

British Standards Institution (BSI). (2015) BS5930 - Code of Practice for Site Investigations.

Department of Housing, Planning and local Government (2018) Guidelines for Planning Anthorities and An Bord Pleanála on carrying out Environmental Impact Assessment.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements). EPA, Wexford.

Environmental Protection Agency (2003). Advice Notes on Current Practice in the Preparation of Environmental Impact Statements. EPA, Wexford.

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Fehily Timoney and Company (FT) (2020) Geotechuical & Peat Stability Assessment Report for Croagh Wind farm Co. Leitrim/Sligo

Geological Survey of Ireland (GSI). (1996) Geology of Sligo - Leitrim, 1:100,000 scale Bedrock Geology Series, Sheet 7.

Institute of Geologists Ireland (2013) Gnidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Envirounental Impact Statements, (IGI, Dublin).

Scottish Natural Heritage (2013) Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms SNH, Stirling.

Transport Infrastructure Ireland (TII) (formerly National Roads Authority (NRA)) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.

Hydrology and Hydrogeology

CIRIA, 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).

CIRIA, 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.

COFORD, 2004: Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.

Coillte, 2009: Forest Operations & Water Protection Guidelines.

DoHLG, 2006: Wind Farm Development Guidelines for Planning Authorities.

EPA (2017) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports – Draft.

EPA (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements) where relevant.

EPA (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements where relevant.

EPA, 2003: Advice Notes on Current Practice (in the preparation on Environmental Impact Statements) where relevant.

Forest Services (Draft, undated): Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.

Forest Service, 2000: Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford.

Forestry Commission, 2004: Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.

GSI, 2016: Establishment of Groundwater Zones of Contribution – Raheen Road Group Water Scheme, GSI/NFGWS/i.e. Engineering, January 2016.

GSI, 2016: Establishment of Groundwater Zones of Contribution – Bodyke Group Water Scheme, GSI/NFGWS/i.e. Engineering, April 2016.

IFI, 2016: Guidelines on Protection of Fisheries during Construction Works in and Adjacent to Waters, Inland Fisheries Ireland (2016).

IGI, 2013: Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements, (Institute of Geologists Ireland, 2013).

NRA, 2005: Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes, (National Roads Authority, NRA, 2005).

PPG1 - General Guide to Prevention of Pollution (UK Guidance Note).

PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note).

SNH, 2010: Scottish Natural Heritage report (SNH): Good Practice During Wind Farm Construction.

SNH, 2013: Scottish Natural Heritage report (SNH): Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms.

Air and Climate

Burck et al., 2020 Results 2020. Climate Change Performance Index. New Climate Institute, Bonn.

Climate Action Network Europe (2018). Off Target Report, Brussels.

Council of the European Union (2008) Council Directive 2008/50/EC on ambient air quality and cleaner air for Enrope. Official Journal of the European Union No. L152.

Council of the European Union (2004) Council Directive (2004/107/EC) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air. Official Journal of the European Union No. L23/3.

Council of the European Union (2002) Council Directive (2002/3/EC) relating to ozone in ambient air. Official Journal of the European Union No. L67/14.

Council of the European Union (2000) Council Directive 2000/69/EC relating to limit values for benzene and carbon monoxide in ambient air. Official Journal of the European Union No. L313.

Council of the European Union (1999) Council Directive 1999/30/EC relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. Official Journal of the Enropean Union No. L163/41

Department of Communications, Climate Action and Environment (2019) Climate Action Plan (CAP).

Department of the Environment, Heritage and Local Government (2007) National Climate Change Strategy 2007 – 2012. Stationery Office, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities (Revised). Stationery Office, Dublin.

Department of Climate Change, Action & Environment. Renewable Energy Action Plan (NREA) Submitted under Article 4 of Directive 2009/28/EC

Department of Climate Change, Action & Environment National Energy Efficiency Action Plan (NEEAP)

Department of Public Expenditure and Reform (2018) National Development Plan 2018-2027. Dublin.

European Commission (2019) COP25 Climate Change Conference. Available at: https://ec.europa.eu/clima/events/cop25-climate-change-conference_en

European Commission (2015). COP21 Paris Agreement. Available at: https://ec.europa.eu/clima/policies/international/negotiations/paris_en

Enropean Commission (2010) Europe 2020 Strategy A European strategy for smart, sustainable and inclusive growth. Brussels.

European Environment Agency (2019) Air Quality in Europe- 2019 Report. EEA

Enropean Environment Agency (2017). Air Quality in Europe – 2017 Report. European Environment Agency, Denmark.

Environmental Protection Agency (2019) Air Quality in Ireland 2018. EPA, Ireland.

Environmental Protection Agency (June 2019) Ireland's Greenhouse Gas Emissions Projections 2018-2040. EPA, Ireland.

Environmental Protection Agency (2018). Ireland's Greenhouse Gas Emissions Projections 2017 – 2035. EPA, Wexford.

Environmental Protection Agency (2007) Ambient Air Monitoring at Sligo, January 2003 – 2nd October 2003'. Available at: https://www.epa.ie/pubs/reports/air/monitoring/EPA_air_assessment_Sligo.pdf

European Union (2017) Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU).

Environmental Protection Agency (2017). Irelands Environment 2017 – As Assessment. EPA, Wexford.

Eurostat (2018), Smarter, greener, more inclusive? Indicators to Support the Europe 2020 Strategy. European Union, Luxembourg.

Met Éireann www.met.ie

United Nations (2015) Transforming our World: the 2030 Agenda for Sustainable Development. Available at: https://sustainabledevelopment.un.org/sdgs

United Nations (2012). Doha Amendment to the Kyoto Protocol. United Nations Framework Convention on Climate Change.

United Nations (1998). Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations Framework Convention on Climate Change, Boun.

Wilson et al., (2016) Multiyear greenhouse gas balances at a rewetted temperate peatland.

Wilson et al., 2016; Greenhouse gas Emission Factors.

Wilson et al. (2015) Derivation of GHG emission factors for peatlands managed for extraction in the ROI and the UK.
Wilson, D. and Farrell, E.P., (2007) The Effect of Management Strategies on Greenhonse Gas Balances in Industrial Cutaway Peatlands in Ireland (The CARBAL Report).

Noise and Vibration

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.

BS 7385 (1993) Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration.

BS 5228-2:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration.

Birgitta Berglund, B., Lindvall, T., Schwela, D. H., (1995) Community Noise. World Health Organisation (WHO), Geneva.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Environment Food and Rural Affairs, the Department of Business, Enterprise and Regulatory Reform and the Department of Communities and Local Government (2007) Research into Aerodynamic Modulation of Wind Turbine Noise.

Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication (1996) The Assessment and Rating of Noise from Wind Farms.

DIN 45680:2013-09 (2013) Draft Measurement and Assessment of Low-frequency Noise Immissions.

Environmental Protection Agency (August 2017): Draft Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. EPA, Wexford.

Environmental Protection Agency (2016) Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4).

Environmental Protection Agency (2011) Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3).
Health Canada (2014) Wind Turbine Noise and Health Study: Summary of Results. Government of Canada.
Highways England, Transport Scotland, The Welsh Government and The Department of Infrastructure (2019) Design Manual for Roads and Bridges (DMRB).

Institute of Acoustics (2016) Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) document A Method for Rating Amplitude Modulation in Wind Turbine Noise. IOA, Milton Keynes.

Institute of Acoustics document (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. IoA, Milton Keynes.

ISO 1996 (2017) Acoustics – Description, measurement and assessment of environmental noise.
ISO 9613 (1996) Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation.

McCunney et al (2014) Wind Turbines and Health: A Critical Review of the Scientific Literature. Journal of Occupational and Environmental Medicine. Vol 56, pp. 108-130.
National Health and Medical Research Council (2015) Evidence on Wind Farms and Human Health. Australian Government.

RenewableUK AM project (2013) Wind Turbine Amplitude Modulation: Research to Improve Understanding as to its Cause and Effect. Renewable UK

South Australian Environment Protection Authority (2013) Infrasound levels near windfarms and in other environments. Resonate Acoustics, Adelaide.

State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Württemberg (2016) Low Frequency Noise Incl. Infrasound from Wind Turbines and Other Sources.

Transport Infrastructure Ireland (TII 2004) (formerly National Roads Authority (NRA 2004)) document Guidelines for the Treatment of Noise and Vibration in National Road Schemes.
UK Health Protection Agency (2010) Health Effects of Exposure to Ultrasound and Infrasound, Report of the Independent Advisory Group on Non-ionising Radiation.

Landscape and Visual

Carmarthenshire County Council (2013) Cumulative Impact of Wind Turbines on Landscape and Visual Amenity.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of the Environment, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of the Environment and Local Government, 2000 Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities' DoEHLG, Dublin.
Landscape Institute (2017) Visual Representation of Development Proposals. Guidance Note 02/17. London.

Landscape Institute (2011) Photography and photomontage in landscape and visual impact assessment. Advice Note 01/11. London.

Landscape Character Assessment of County Roscommon (Roscommon County Council, 2014)

Landscape Assessment of County Leitrim (Leitrim County Council, 2002)

Leitrim County Council, (2015), Leitrim County Development Plan 2015-2021, Online, available at: http://www.leitrimcoco.ie/eng/Services_A-Z/Planning-and-Development/Development-Plans/County-Development-Plan/County_Development_Plan_2015-2021/Written-Statement.html

Roscommon County Development Plan 2014 – 2020, Variation No.1 (Roscommon County Council, 2017)

Scottish Natural Heritage (2017) Siting and Designing Wind Farms in the Landscape, Version 3a. SNH, Stirling.

Scottish Natural Heritage (2017) Visual Representation of Wind Farms: Version 2.2 SNH, Stirling.

Scottish Natural Heritage (2015) Spatial Planning for Onshore Wind Turbines – natural heritage considerations. SNH, Stirling.

Scottish Natural Heritage (2012) Assessing the Cumulative Impact of Onshore Wind Energy Developments. SNH, Stirling.

Scottish Natural Heritage (2002) Visual Assessment of Wind Farms: Best Practice SNH, Stirling.

Sligo County Council, (2017), Sligo County Development Plan 2017-2023, Online, available at: https://www.sligococo.ie/cdp/Volume1_MainWrittenStatement.pdf

Archaeological and Cultural Heritage

Department of the Arts, Heritage and the Gaeltacht (2011) Architectural Heritage Guidelines for Planning Authorities. Dublin Stationary Office.

Bennett, I. (ed.) Excavations.ie, database of Irish excavation reports. Available at http://www.excavations.ie.

Department of Culture, Heritage and the Gaeltacht National Monuments Service. Available at: www.webgis.archaeology.ie/historicenvironment

Department of Culture, Heritage and the Gaeltacht Database of Irish Excavation Reports. Available at: www.excavations.ie

Department of Culture, Heritage and the Gaeltacht National Inventory of Architectural Heritage. Available at: www.buildingsofireland.ie

Department of Arts, Heritage, Gaeltacht and the Islands, 1999, Framework and Principles for the Protection of the Archaeological Heritage, 1999.

Guidance on Setting and the Historic Environment, Historic Envirooument Division, February 2018

Guidelines on the information to be contained in Environmental Impact Statements, EPA 2017.

Leitrim County Council, (2015), Leitrim County Development Plan 2015-2021, Online, available at: http://www.leitrimcoco.ie/eng/Services_A-Z/Planning-and-Development/Development-Plans/County-Development-Plan/County_Development_Plan_2015-2021/Written-Statement.html

Record of Monuments and Places (RMP) for County Leitrim 1995. Available at: https://www.archaeology.ie/sites/default/files/media/pdf/Archaeology-RMP-Leitrim-Manual-(1995)-0026.pdf

Record of Monnments and Places (RMP) for County Sligo 1995. Available at: https://www.archaeology.ie/sites/default/files/media/pdf/Archaeology-RMP-Sligo-Manual-(1995)-0044.pdf

Rialtas na hÉireann Irish Placenames database. Available at: www.logainm.ie

Sligo County Council, (2017), Sligo County Development Plan 2017-2023, Online, available at: https://www.sligococo.ie/cdp/Volume1_MainWrittenStatement.pdf

1st Edition 6-inch OS maps (1835)

2nd Edition 25-inch OS maps (1903)

Material Assets

Department of the Envirooument, Community and Local Government (2013). Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment. DoEHLG, Dublin.

Department of the Envirooument, Heritage and Local Government (2006). Wind Energy Development Guidelines for Planning Authorities. DoEHLG, Dublin.

Department of Housing, Planning and Local Government (December 2019) Draft Revised Wind Energy Development Guidelines. DHPLG, Dublin.

Department of Housing, Planning and Local Government (August 2018) Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment. DHPLG, Dublin.

Department of Housing, Planning and Local Government (June 2017) Review of the Wind Energy Development Guidelines 2006 – Preferred Draft Approach. DHPLG, Dublin.

Irish Wind Energy Association (2012). Best Practice Guidelines for the Irish Wind Energy Industry.

Leitrim County Council, (2015), Leitrim County Development Plan 2015-2021, Online, available at: http://www.leitrimcoco.ie/eng/Services_A-Z/Planning-and-Development/Development-Plans/County-Development-Plan/County_Development_Plan_2015-2021/Written-Statement.html

National Roads Authority (2011). Project Appraisal Guidelines, Unit 5.5 Link Based Traffic Growth Forecasting. NRA, Dublin.

National Roads Authority (2011). NRA TD 41-42/11 Geometric Design of Major/Minor Priority Junctions and Vehicular Access to National Roads. NRA, Dublin.

National Roads Authority (2007). Traffic and Transport Assessment Guidelines. NRA, Dublin.

National Roads Authority (2003). Future Traffic Forecasts, 2002 to 2040. NRA, Dublin.

Sligo County Council, (2017), Sligo County Development Plan 2017-2023, Online, available at: https://www.sligococo.ie/cdp/Volume1_MainWrittenStatement.pdf

TII (May 2019) Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections PE-PAG-02017, Transport Infrastructure Ireland.

TII (October 2016) Project Appraisal Guidelines for National Roads Unit 5.2 – Data Collection PE-PAG-02016, Transport Infrastructure Ireland.

TII (May 2014) Traffic and Transport Assessment Guidelines PE-PDV-02045. Transport Infrastructure Ireland.

			turbine operation can be implemented for specific turbines in specific wind conditions to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind farm operations. For post-commissioning of the proposed turbine units, the noise monitoring be repeated with consideration of the guidance outlined in the IoA GPG and Supplementary Guidance Note 5.
Decomissioning Phase			
MM80	Ornithology	EIAR Chapter 7	The following measures are proposed for the decommissioning phase: › During the decommissioning phase, disturbance limitation measnres will be as per the construction phase, e.g. commencing works outside the bird nesting season (1st of March to 31st of August inclusive). › Plant machinery will be turned off when not in use. › All plant and equipment for use will comply with the Construction Plant and Equipment Permissible Noise Levels Regulations (SI 359/1996).