# EIAR Volume II

# Main Report

# Chapter 7: Biodiversity

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# 7 BIODIVERSITY

## 7.1 Introduction

### 7.1.1 Purpose of this report

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents and assessment of likely significant effects on biodiversity. A separate assessment that considers the likely significant effects on ornithology is provided in EIAR **Chapter 8 Ornithology.**

This chapter is supported by the following technical appendices in EIAR **Volume III**:

- **Appendix 7.1** – Bat Baseline Report
- **Appendix 7.2** – Aquatic Ecology Baseline Report
- **Appendix 7.3** – Habitat Management Plan
- **Appendix 7.4** – Technical Note on Site Access Track Separation Distances

Biodiversity is addressed as part of the Environmental Impact Assessment (EIA) process This requires consideration of the aspects of the environment that are likely to be significantly affected by the Project, including habitats, flora and fauna. Ecological features are also covered by a variety of legislation and policy documents (both national and local), and these have been reviewed in preparation of this chapter.

The key objectives of the assessment presented in this chapter are to:

- Assess the current ecological baseline characteristics of the wind farm site, including the determination of the importance of ecological features present.
- Evaluate the potential significance of effects from the Project on ecological features, including likely effects during the construction, operational, and decommissioning phases, and likely effects in isolation (i.e., from the Project alone) and in combination with other projects.
- Identify mitigation and enhancement measures to minimise the potential for adverse effects from the Project on ecological features and deliver biodiversity enhancements where possible, to provide an overall gain for biodiversity.

### 7.1.2 Site overview

The site of the proposed wind farm (hereafter referred to as 'the wind farm site') is located in the townlands of Tullacondra, Croughta, Poulnareagha and Ardskeagh (approximately 2 kilometres (km) south of Lisgriffin Cross, Co. Cork). The wind farm site is primarily mixed farmland habitat with hedgerows and occasional areas of scrub, ponds and lakes and man-made drains and ditches. The area in which the turbines will be located, within the setback buffer, ranges in elevation from 133m AOD in the south to 120m AOD in the north.

## 7.2 The Project

The Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements. This chapter includes an assessment of the likely significant effects from both Grid Connection Route (GCR) Options and both Turbine Delivery Routes (TDR) Options.

The site layout plan of the proposed wind farm is shown in **Figure 1.4**, in EIAR **Chapter 1 Introduction**. Further details of the Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR are provided in **Chapter 5 Project Description**.

## 7.3 Legislation, policy, and guidance

### 7.3.1 Legislative context

This EIAR chapter has been prepared with reference to the following legislation:

- The Habitats Directive 92/43/EEC (as amended).
- The EIA Directive 2011/92/EU as amended by Directive 2014/52/EU.
- The EU Water Framework Directive 2000/60/EC (as amended), which is transposed into Irish Law by the European Communities (Water Policy) Regulations 2003 (as amended).
- The European Communities (Birds and Natural Habitats) Regulations 2011 (as amended) (transposes EU Birds directive 2009/147/EC (as amended).
- The Wildlife Acts 1976-2023.

### 7.3.2 Policy framework

Planning policy occurs at the national and local levels and has relevance to environmental design and assessment. A summary of the statutory policy referred to is provided below.

- Project Ireland 2040: National Planning Framework.
- Biodiversity Climate Change Sectoral Adaptation Plan (September 2019).
- County Cork Biodiversity Action Plan 2009 – 2014.
- Biodiversity and the Planning Process, Guidance on the management of biodiversity issues during the planning process, Version 2, April 2022.
- The National Biodiversity Action Plan 2017-2021 (NBAP) and Ireland's 4th National Biodiversity Action Plan - Draft for Public Consultation, September 2022.

- All-Ireland Pollinator Plan 2021-2025.

### 7.3.3 Guidance and resources

This EIAR chapter has been prepared with reference to current key industry standard guidance including the following:

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater Coastal and Marine version 1.1 (CIEEM, 2018)[1].
- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022)[2].
- Best Practice Guidelines for the Irish Wind Energy Industry (Irish Wind Energy Association, 2012)[3].
- Wind Energy Development Guidelines for Planning Authorities, (DHLGH, 2006)[4].
- Bats and onshore wind turbines: survey, assessment, and mitigation, (Scottish Natural Heritage, 2021)[5].
- Wind energy development and Natura 2000 (European Commission, 2011).

## 7.4 Statement of authority

The baseline ecological surveys described in this report were conducted by experienced ecologists from RSK Ireland. This EIAR chapter and accompanying appendices have been prepared by suitably qualified RSK ecologists experienced in ecological impact assessments (Refer to EIAR **Volume II, Chapter 1 Introduction, Table 1.2**). Preparation of the EIAR chapter was led by Nick Henson CEnv MCIEEM and authored by Thomas Webb.

Nick has more than 18 years' experience of ecological work, including extensive experience with assessing potential ecological effects of wind farm projects in the UK and Ireland. He has a Master's Degree in Environmental Sciences, is a Full Member of the Chartered Institute of Ecology and Environmental Management and a Chartered Environmentalist.

Thomas is an ecological consultant who has over two years' experience of undertaking ecological impact assessments and authoring technical reports, including EIAR chapters. He has a Bachelor of Sciences degree in Zoology and a Master of Science degree in Species Identification and Survey Skills, which included time spent working within the ecology industry. He is a Qualifying member of the Chartered Institute of Ecology and Environmental Management.

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[1] Chartered Institute for Ecology and Environmental Management (CIEEM). 2018. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Version 1.1 – Updated September 2019.

[2] Environmental Protection Agency.2022.Guidelines on the information to be contained in Environmental Impact Assessment Reports.

[3] Irish Wind Energy Association. 2012. Best Practice Guidelines for the Irish Wind Energy Industry.

[4] Department of Housing, Local Government and Heritage. 2006. Wind Energy Development Guidelines.

[5] Scottish Natural Heritage. 2021. Bats and onshore wind turbines: surveys, assessment, and mitigation.

Further details regarding the contributors to this EIAR are provided in EIAR **Chapter 1 Introduction**.

## 7.5 Consultation

A scoping request for the Project was made to the Department of Agriculture, Food and the Marine in October 2022.

Further to the submission of a formal scoping request, a pre-planning meeting was held with Cork County Council on 17 November 2022, where the Project proposals were presented to Council officials, including a high-level overview of the ecological characteristics of the wind farm site. It was acknowledged that no open watercourses are present on the wind farm site and Cork County Council agreed that with good management, the risk to water quality from the Project should be low and the EIAR would give cognisance to all risks to surface and groundwater, identifying any required remediation measures and water quality monitoring programmes during and post development. This is further addressed in section 7.8 of this chapter, where pertinent to aquatic ecology.

It was further stated that most of the wind farm site is contained in the Lisduggan North_10 waterbody & the Blackwater Munster_90 waterbody. These waterbodies make up one of the six pilot catchments in the Waters of Life Integrated Project, which has been given due consideration as part of the Project in section 7.7.5 of this chapter, as well as EIAR **Volume III, Appendix 7.2.**

With regards to terrestrial ecology, it was noted during the pre-planning meeting with Cork County Council that the Project would likely result in unavoidable effects to local features such as hedgerows, particularly at the construction phase. In addition, the principle of biodiversity gain is to be addressed within the application. This is further discussed in sections 7.10 and 0 of this chapter, as well as EIAR **Volume III, Appendix 7.3**.

A second pre-planning meeting was held on 2 August 2023. In attendance from the applicant were members of the consultant team including town planners, the project ecologist and engineer, and members of the Project team. In attendance from Cork County Council were planning officers, and the County ecologist, and engineer.

A third and final pre-application meeting (in person) was held with the Planning Authority on the 11 September 2023. The focus of this discussion was on project design and the avoidance of hedgerow loss.

At both of these pre-planning meetings, an update on the preparation of the EIAR, project design and planning application was presented. In the second pre-application meeting particular focus was on plans for access to the proposed wind farm site, biodiversity net gain, and validation queries.

## 7.6 Assessment approach and methodology

The methods adopted to inform and undertake the assessment presented in this EIAR chapter are described in this section; specifically, the methods for determining the ‘ecological baseline’ of the wind farm site (i.e., the habitats and species populations present within and in close proximity to the wind farm site prior to development), and the methods for identifying and assessing likely effects from the Project. These methods were informed by the best practice guidance described in section 7.3.3.

Further details of methods for the desk study and field surveys to inform the determination of the ecological baseline of the wind farm site are provided in EIAR **Volume III, Appendices 7.1 and 7.2**.

### 7.6.1 Scope of the assessment

The assessment approach prescribed by CIEEM's EcIA guidelines, (CIEEM, 2018)[1], including an explanation of the key terminology is described below. In summary, the guidelines advocate the following approach:

- Prediction of the activities associated with a proposed scheme that are likely to generate biophysical changes which may lead to significant effects (either positive or negative) upon ecological features and resources of importance.
- Identification of the likely Zone of Influence of the Project.
- Scoping to select the ecological features and resources that are likely to fall within the potential Zone of Influence of the Project, to be considered within the assessment.
- Evaluation of ecological features likely to be affected.
- An assessment of the significance of effects on important ecological features.
- Refinement of the proposed scheme to incorporate ecological enhancements, and mitigation for significant adverse effects on important ecological features.
- An assessment of the significance of residual effects and the need for offsetting.
- Advice on the consequence of residual significant effects for decision-making.

### 7.6.2 Determining the Zone of Influence

The appraisal of ecological baseline information contained within this chapter is based on a study area that incorporates the land within the wind farm site boundaries and wider Zone of Influence (ZoI). The ZoI is defined as 'the area over which ecological features may be affected by biophysical changes as a result of the Project and associated activities', (CIEEM, 2018)[1]. The ZoI may likely extend beyond the wind farm site due to ecological and hydrological links beyond the wind farm site boundary. Additionally, it will encompass different areas in respect of each ecological feature, depending on its location and sensitivity, and the spatial extent of the relevant biophysical change. These biophysical changes will also differ depending on the phase of the development (construction, operational, and decommissioning) and their associated activities and subsequent effects.

In order to determine the ZoI, the spatial and temporal extent of biophysical changes likely to be generated by the different phases of the development with the potential to lead to effects upon ecological features were predicted. The majority of the activities and resultant biophysical changes are unlikely to have an effect beyond the wind farm site boundaries. The exceptions to this include activities associated with the construction and decommissioning of the wind turbines and associated infrastructure that may cause potential disturbance effects to species residing beyond the wind farm site, habitat degradation where downstream hydrological connectivity with the wind farm site exists, and potential mortality of mobile species such as bats, which could collide with the operational turbines when passing through the wind farm site. Taking this into consideration, the ZoI, and the study area, is broadly considered to extend across the wind farm site and up to 15km from it where sensitive habitats that are hydrologically linked to the wind farm site may be present. Significant effects beyond this distance are deemed highly unlikely, due to the likely dilution of waterborne and airborne impacts and since the core sustenance zones of mobile species that are relevant to the wind farm site is unlikely to extend beyond 15km. This determination has been based on the combined professional experience, judgement and discretion of contributors to the field surveys and report authors.

### 7.6.3 Determination of the ecological baseline

*7.6.3.1 Desk study*

To facilitate a broad review of potential ecological constraints, a desk study was undertaken to identify relevant designated sites of conservation interest and records of specially protected and notable species. The study was conducted in July 2022 and included a review of available information from the following data sources:

- Aerial photography
- National Biodiversity Data Centre (NBDC) species records
- National Parks & Wildlife Service (NPWS) Geographical Information Systems (GIS) data
- NPWS protected sites viewer and protected sites shapefiles

Additional data sources were used to collate available information on the potential aquatic ecological constraints within the wind farm site and the wider ZoI. Such sources include:

- The Environmental Protection Agency (EPA)
- The Office of Public Works (OPW)
- Inland Fisheries Ireland (IFI)
- Water Matters website[6]; and Waters of Life Project (Refer to EIAR **Chapter 9 Hydrology and Hydrogeology**, Section 9.2.3)
- Geological Survey Ireland (GSI)

A search was made for information on statutory designated sites (nationally and internationally important sites for biodiversity) and non-statutory designated sites (that are locally or regionally important for biodiversity) within 15km of the wind farm site boundary. Further searches were conducted for un-designated priority habitats within 5km and records of protected and notable species within 10km. Species included within the search parameters include:

- European Protected Species
- Nationally protected species

[6] Available at https://www.askaboutireland.ie/enfo/irelands-environment/water/water-matters/

- Species listed as Critically Endangered, Endangered, or Vulnerable on the International Union for the Conservation of Nature (IUCN) Red list
- Nationally red listed species
- Local Biodiversity Action Plan priority species

A desktop survey was also carried out to determine bat suitability for the tetrad in which the development footprint is proposed, using the bat landscape model published by Bat Conservation Ireland, (Lundy *et al*., 2011)[7].

The following additional resources assisted in the production of this chapter:

- OpenStreetMaps and Bing Aerial photography (1995 – 2020)
- NPWS Mapviewer
- Designated sites conservation objectives and citation documents
- Bat Conservation Ireland
- NBDC online records and maps

#### *7.6.3.2 Field surveys*

Baseline information was collected by RSK Ireland following fieldwork involving a series of ecological surveys conducted in 2022 and 2023. Further details regarding the assessment for bats and aquatic ecology are provided in EIAR **Volume III, Appendices 7.1 and 7.2,** respectively. Those ecological surveys conducted within the wind farm site and its surrounds are listed in **Table 7.1**.

**Table 7.1. Summary of ecological surveys undertaken**

| Survey type | Details of surveys | Date completed |
|---|---|---|
| Extended Phase 1 habitat survey | Identification and mapping of broad habitat types and habitat suitability appraisal for protected species following best practice guidance (Smith *et al*. 2010[8] and Fossitt, 2000[9]). Undertaken within land ownership boundary and identified 'pinch points' along the TDR and grid connection routes where land access permitted. | July and August 2022, January 2023 |
| Badger (*Meles meles*) surveys | Site walkover to assess habitats for their potential to support badgers. Badger field signs were searched for and recorded within the land ownership boundary plus a 30m buffer where land access permitted, using camera trapping where necessary. Surveys followed best practice guidance | July and August 2022, January 2023 |

[7] Lundy, M.G., Augheny, T., Montgomery, W.I. & Roche, N. 2011. Landscape for Irish bats & species-specific roosting characteristics. Bat Conservation Ireland.

[8] Smith, G.F., O'Donoghue, P., O'Hara, K. & Delaney, E. 2011. Guidance for Habitat Survey and Mapping. The Heritage Council, Kilkenny.

[9] Fossitt, J.A. 2000. A guide to habitats in Ireland. The Heritage Council, Kilkenny.

| Survey type | Details of surveys | Date completed |
|---|---|---|
| | (Harris *et al*. 1989[10], 1994[11] and National Roads Authority, 2009[12]). | |
| Bat surveys | Habitat appraisal including building and tree inspections within the land ownership boundary. Survey methodology is consistent with published best practice guidance (SNH, 2019[13] and Collins, 2016[14]). | November 2022 |
| | Phase 2 bat surveys including emergence/re-entry surveys, static data collection surveys, and activity surveys. Survey methodology is consistent with subsequently published best practice guidance (Collins 2016[14]; SNH, 2019[13]; NIEA, 2021[15]; Marnell, Kelleher & Mullen, 2022[16]). | July-September 2022 |
| Other mammal surveys | Site walkover to assess habitats for their potential to support protected/red-listed mammal species. Field signs were searched for and recorded. Surveys followed best practice guidance (National Roads Authority, 2009[12]). | July and August 2022, January 2023 |
| Amphibian surveys | Environmental DNA (eDNA) surveys of potentially suitable waterbodies within the site and wider landholding (blueline boundary) to confirm the presence or likely absence of amphibians. | May 2023 |
| Aquatic ecology | A stream walkover on all watercourses that drain the wind farm site and those within the wider ZoI. Assess the habitats for signs of interest and to identify issues pertaining to the aquatic environment. Surveys followed best practice guidance (NRA, 2005[17] and NRA, 2008). | Summer 2022 |
| | Biological water quality analysis to determine the condition of the aquatic environments as part of the Water Framework Directive. | Summer 2022 |
| | White-clawed crayfish (*Austropotamobius pallipes*) surveys to assess presence of such species. | Summer 2022 |

[10] Harris, S., Cresswell, P. & Jefferies, D. 1989. Surveying Badgers. Mammal Society, *Occasional Publications*, 9, London.

[11] Harris, S., Jefferies, D., Cheeseman, C. & Booty, C. 1994. Problems with Badgers? 3rd Edition, RPSCA, Horsham.

[12] National Roads Authority 2009. Guidelines for Assessment of Ecological Impacts of National Roads Schemes Rev. 2. Dublin

[13] Scottish Natural Heritage. 2019. Bats and onshore wind turbines: survey, assessment, and mitigation.

[14] Collins, J. 2016. Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition). The Bat Conservation Trust, London.

[15] NIEA, Natural Environment Division 2021. Guidance on Bat Surveys, Assessment and Mitigation for Onshore Wind Turbine Developments in Northern Ireland. Belfast: Department of Agriculture, Environment and Rural Affairs (Northern Ireland).

[16] Marnell, F., Kelleher, C. & Mullen, E. 2022. Bat Mitigation Guidelines for Ireland. V2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage. Dublin, Ireland

[17] National Roads Authority. 2005. Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. Dublin: National Roads Authority

| Survey type | Details of surveys | Date completed |
|---|---|---|
| | Surveys followed best practice guidance (Peay, 2003)[18]. | |
| | Freshwater pearl mussel (*Margaritifera margaritifera*) surveys to assess presence of such species. Survey followed NPWS guidance (Anon, 2004[19]). | Summer 2022 |
| | Fish surveys to monitor fish population in streams and watercourses and to estimate both relative and total abundance. Surveys followed best practice guidance (Johnson *et al*., 2007[20]). | Summer and winter 2022 |

*7.6.3.2.1 Extended Phase 1 habitat survey*

**Habitat survey**

The wind farm site and wider landholding, as indicated by the blueline boundary were surveyed in accordance with the Heritage Council's Best Practice Guidance for Habitat Survey and Mapping, (Smith *et al*. 2011)[8] along with CIEEM's Preliminary Ecological Appraisal methods, (CIEEM, 2017)[21], with the identification of habitats following Fossitt's Guide to Habitats in Ireland, Fossitt, 2000[9]. Broad habitats are identified as part of the methodology and mapped using standard typology characters indicating habitat types (as indicated in **Figure 7.4**). Target notes were also used to describe features of possible ecological or nature conservation interest.

Vascular plant species were recorded during the survey. Phase 1 habitat survey does not involve exhaustive surveying for individual plant species, and various invasive non-native species may be little in evidence at various times of year (depending on the species). Nevertheless, invasive species such as Japanese knotweed (*Reynoutria japonica*), giant hogweed (*Heracleum mantegazzianum*), Himalayan balsam (*Impatiens glandulifera*), giant rhubarb (*Gunnera tinctoria*) etc., were searched for and recorded when encountered, as were invasive animal species.

**Habitat assessment for protected and notable species**

The wind farm site was assessed for its suitability for the protected or otherwise notable animals that are likely to occur in the area. Obvious signs and incidental sightings of such species were noted where present.

[18] Peay S. 2003. Monitoring the White-clawed Crayfish Austropotamobius pallipes. Conserving Natura 2000 Rivers Monitoring Series No. 1. *English Nature*, Peterborough.

[19] Anon. 2004. *Margaritifera margaritifera*. Stage 1 and Stage 2 survey guidelines. Irish Wildlife Manuals, No. 12. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

[20] Johnson, D.H., Shrier, B. M., O'Neal, J. S., Knutzen, J. A., Augerot, X, O'Neil, T. A., Pearsons, T. N. 2007. Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations. *American Fisheries Society*, Bethesda, Maryland.

[21] Chartered Institute for Ecology and Environmental Management (CIEEM) 2017. Guidelines for Preliminary Ecological Appraisal. Technical Guidance Series. Available at www.cieem.net/gpea.asp

Considering the wind farm site location and habitats present, assessments were carried out for the following species:

- Invertebrates
- Protected/priority amphibian species
- Protected/priority reptile species
- Bats (foraging, commuting, and roosting)
- Badgers
- Otter (*Lutra lutra*)
- Species of principal importance for conservation, including hedgehog (*Erinaceus europaeus*), Irish hare (*Lepus timidus hibernicus*), red squirrel (*Sciurus vulgaris*), and pygmy shrew (*Sorex minutus*).
- Other protected or noteworthy species as dictated by the results of the desk study and conditions found during the survey.

*7.6.3.2.2 Badger and other mammal surveys*

The habitats on the wind farm site were assessed for their potential to support badgers and other notable and protected mammal species. Systematic surveys for badger involved searching for field signs such as setts, foraging signs, paths (runs), and latrines. Individual holes or setts were described using terminology defined by Harris *et al*. (1989)[10], 1994[11]; National Roads Authority, (2009)[12]. Field signs were additionally noted for other mammal species such as red squirrel, otter, pygmy shrew, Irish hare, and hedgehog if encountered. Where field signs were noted, camera traps were deployed where necessary (e.g., for indiscernible mammal tracks) to determine the species. Findings of such surveys are outlined in section 7.7.4 of this report.

*7.6.3.2.3 Bat surveys*

A summary of the bat survey methodology followed for this assessment is provided below. Further details of the individual surveys along with associated figures are provided in the Bat Baseline Report (EIAR **Volume III, Appendix 7.1**).

The desk study included the use of Lundy's *et al*. (2011)[7] bat landscape model to assess the suitability of habitats on the wind farm site for bats. This model is based on a bat habitat suitability index and was used by splitting the wind farm site into two sections. The North and South sections were analysed separately and assigned an overall risk level, relative to their suitability.

The bat survey methodology, where appropriate, followed that as detailed in Scottish Natural Heritage (SNH) guidance: Bats and onshore wind turbines: survey, assessment, and mitigation, (SNH, 2019)[13]. Bat surveys were also undertaken in accordance with Bat Surveys for Professional Ecologists: Good Practice Guidelines, Collins, 2016[14].

A number of survey types for bats were completed, namely the assessments of potential roosting habitats, including trees and buildings; emergence and re-entry surveys; dusk and dawn activity transect surveys; and automated ground-level surveys using static detectors. Surveys at dusk were conducted between June and September 2022, at temperatures of 8°C and greater. These surveys commenced 30 minutes prior to sunset and continued for a minimum of three hours, whilst dawn surveys commenced two hours prior to sunrise and finished at sunset.

Bats were detected, and their calls and echolocation recorded, using Wildlife Acoustics Inc. (Massachusetts, USA) Echo Meter Touch Pro 2's. Identifications were carried out by surveyors in the field, and these identifications were later confirmed using sound analysis of recordings with dedicated software (Wildlife Acoustic's Kaleidoscope Pro; version 2.1.0).

*7.6.3.2.4 Amphibian surveys*

The desk study revealed no records of smooth newt (*Lissotriton vulgaris*) or common frog (*Rana temporaria*) within 10km of the wind farm site boundary, although site walkover surveys carried out in 2022 identified suitable terrestrial habitat and three bodies of standing water deemed potentially suitable for breeding amphibians (see Figure 7.4). The habitats on the wind farm site lack the parcel size and connectivity to support notable populations of amphibians but were nonetheless assessed on a precautionary basis. An eDNA survey of the waterbodies was undertaken in May 2023 to confirm the presence or likely absence of amphibians. At the time of the survey only the two waterbodies within the northern part of the landholding contained water, with the remaining being dry.

The eDNA survey technique involves analysing water samples from the waterbody to confirm the presence or absence of amphibian DNA (which can be shed through skin secretions, excrement etc). Water samples were collected according to strict protocols approved by NPWS and described by NRA (2009)[22] and NIEA (2017)[23]. The samples were sent to ADAS Biotechnology eDNA services for laboratory analysis where they were analysed for traces of amphibian DNA, including that of smooth newt and common frog.

*7.6.3.2.5 Aquatic ecology surveys*

A summary of the aquatic ecology survey methodology followed for this assessment is provided below. Further details of the individual surveys along with associated figures are provided in EIAR **Volume III, Appendix 7.2.**

Following the findings of the initial desk study outlined in section 7.6.3.1, a site walkover was carried out in line with relevant best practice guidelines, NRA, (2005a)[24]; NRA, (2008), which assessed all aquatic features within the site and the surrounding ZoI. The aim of the walkover was to assess the aquatic habitats, the riparian habitats, the physical and hydro-morphological characteristics, look for signs of interest, identify issues pertaining to the aquatic environment and determine their causes and effects wherever possible. Evaluation of the aquatic/fisheries habitats present in terms of their ecological

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[22] National Roads Authority. 2009. Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes. Dublin: National Roads Authority.

[23] Northern Ireland Environment Agency. 2017. Newt Surveys: NIEA Specific Requirements. Belfast: Northern Ireland Environment Agency.

[24] National Roads Authority. 2005. Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes. Dublin: National Roads Authority.

value was assessed using appropriate and relevant criteria (EA, 2003[25]; Maitland, 2003[26]; Gardiner, 2003[27]; Nairn & Fossitt, 2004[28]; Crisp, 2000[29]; NRA, 2009[12]).

Surveys were undertaken to assess the water quality (biological water quality analysis) of watercourses with the potential to be affected as a result of the Project. Attaining a Q-value is the standard methodology of assessing the biological water quality of a watercourse in Ireland. It is the biotic index utilised by EPA staff and sub-consultants to score watercourses as part of the Water Framework Directive (WFD) and is an effective tool for aquatic ecologists in determining the condition of aquatic environments. A standard survey methodology is used to give a specific Q-value, Toner *et* al., 2005 as detailed within **Table 7.2**. A number of survey sites were selected in order to carry out Q-value assessments. The sites were selected based on the footprint of the Project in combination with the topography and hydrology of the area, as well as considering the Project within the context of the greater catchment.

**Table 7.2. Corresponding categories of water quality**

| Q-value | WFD Status | Pollution Status | Condition |
|---|---|---|---|
| Q5 or Q4-5 | High Status | Unpolluted | Satisfactory |
| Q4 | Good Status | Unpolluted | Satisfactory |
| Q3-4 | Moderate Status | Slightly polluted | Unsatisfactory |
| Q3 or Q2-3 | Poor Status | Moderately Polluted | Unsatisfactory |
| Q2, Q1-2 or Q1 | Bad Status | Seriously Polluted | Unsatisfactory |

Surveying for protected and/or priority aquatic species was additionally undertaken, including assessing the presence and populations of white-clawed crayfish, freshwater pearl mussel (FPM), and fish (including salmonids). Surveys followed best practice guidance as detailed within **Table 7.1** and within EIAR **Volume III, Appendix 7.2**. The river condition and habitat features pertaining to each species at every survey stretch were noted, assessing the potential for such species to be present based on best available published documents (Holdich, 2003[30]; Skinner *et al*., 2003[31];) Schedule 4 of the European Communities Environmental Objectives (Freshwater pearl Mussel)

[25] Environment Agency. 2003 Environment Agency's 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'

[26] Maitland PS. 2003. Ecology of the River, Brook and Sea Lamprey.Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough.

[27] Gardiner, R. 2003. Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4. Peterborough: English Nature.

[28] Nairn, R. & J. Fossitt. 2004. The Ecological Impacts of Roads, and an Approach to their Assessment for National Road Schemes. In: J. Davenport and J.L Davenport (eds) The Effects of Human Transport on Ecosystems: Cars and Planes, Boats and Trains, 98-114. Dublin. *Royal Irish Academy.*

[29] Crisp, D.T., 2000. Trout and Salmon. Ecology, Conservation and Rehabilitation. *Blackwell Science*: Oxford

[30] Holdich D. 2003. Ecology of the White-clawed Crayfish. Conserving Natura 2000 Rivers Ecology Series No. 1. *English Nature*, Peterborough.

[31] Skinner, M. Young, L. Hastie. 2003. Ecology of the Freshwater Pearl Mussel Conserving Natura 2000 River Ecology Series No. 2. *English Nature*, Peterborough (2003).

Regulations, 2009, as updated by the European Union Environmental Objectives (Freshwater Pearl Mussel) (Amendment) Regulations 2009 to 2018.

### 7.6.4 Assessment methodology

*7.6.4.1 Likely effects associated with wind farm development*

Wind farms present the following potential risks to ecological features:

- Direct habitat loss and fragmentation: through construction and decommissioning of wind farm infrastructure.
- Disturbance and displacement: the construction, operational, and decommissioning phases of the wind farm could cause disturbance to ecological features within/near to the wind farm. This may lead to certain species avoiding the wind farm and its surrounding area (displacement). Displacement may also include barrier effects in which species are deterred from using normal routes to feeding, breeding, or roosting grounds.
- Death/injury through collision or interaction with turbine blades and other infrastructure, including barotrauma of bats flying in close proximity to the operational turbines.
- Pollution of habitats from construction and decommissioning related activities.

For each of these risks, the detailed knowledge of ecological features' characteristics and distribution within and surrounding the wind farm site has been utilised to predict the likely effects. Effects are assessed with regard to the construction phase, the operational phase, the decommissioning phase, and cumulatively in consideration with other plans and projects.

*7.6.4.1.1 Likely effects to aquatic ecology*

Effects from the construction, operational, and decommissioning phases of the Project on aquatic ecology include:

- Input of silt – as well as directly affecting fish though their gills, the input of silt has the medium/long-term effect of settling on the riverbed smothering coarse patches of sediment with fine particles, this depletes oxygen levels within the sediment by reducing through-flow within the sediment and causing direct mortality of eggs and early life stages of various fish and other aquatic species.
- Input of cement – the introduction of cement into an aquatic environment can change the chemistry of the water (particularly pH and dissolved oxygen) as well as adding suspended solids, and as such has the potential to cause significant adverse effects on the watercourse.
- Input of hydrocarbons and chemicals – spillage of hydrocarbons and their chemicals into the aquatic environment, depending on its character and magnitude, has the potential to cause biotic mortality through physiochemical reactions or direct toxicity.

- Input of nutrients – excessive nutrients drive up productivity and causes excessive plant and algal growth from increased nitrogen and phosphorus. This causes ambient dissolved oxygen levels to fall and leads to eutrophication.
- Hydro-morphological changes – results from direct mechanical disturbance to the river, or significant changes within the catchment.

*7.6.4.2 Assessment of the importance/value of ecological features*

The importance of the ecological features relevant to this assessment was evaluated based on the methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes', (NRA, 2009)[12]. These guidelines and the CIEEM, (2018)[1] guidelines set out the context for the determination of value on a geographic basis. They provide a basis for determination of whether any particular site is of importance at the following scales:

- International importance
- National importance (i.e., important in an Irish context)
- County/district importance (i.e., important in the context of County Cork)
- Local importance (Higher or Lower) (i.e., locally important populations/assemblages of bird species and/or protected and/or priority species/habitats).

The evaluation criteria for these scales of importance is provided in **Table 7.3** below:

**Table 7.3. Ecological features evaluation criteria**

| Value of ecological features | Example criteria |
|---|---|
| International importance | An internationally designated site or candidate/proposed site Special Area of Conservation (SAC), candidate SAC and/or Ramsar site.<br>A sustainable area of a habitat listed in Annex I of the Habitats Directive or smaller areas of such habitat which are essential to maintain the viability of the larger whole.<br>Sustainable population of an internationally important species or site supporting such a species (or supplying a critical element of their habitat requirement) i.e.: IUCN Red List species that is listed as critically endangered, endangered, or vulnerable; or<br>Species listed in Annex IV of the Habitats Directive; or<br>Sites that support 1% or more of a biogeographic population of a species. |
| National importance | Nationally designated sites (National Heritage Area (NHA) or pNHA, Statutory Nature Reserve of National Park)<br>Sustainable population of a nationally important species or site supporting such a species (or supplying a critical element of their habitat requirement), i.e.: Refuge for fauna and flora protected under the Wildlife Acts. Resident or regularly occurring populations (assessed to be important in an Irish context) of the following:<br>- Species protected under the Wildlife Acts; and/or |

| Value of ecological features | Example criteria |
| --- | --- |
| | - Species listed on the relevant Red Data list.<br>- Sites supporting 1% or more of a national population. |
| County/district importance | Area of Special Amenity/ area subject to a Tree Preservation Order.<br>Population of a species listed in a Regional BAP or relevant Natural Area on account of its regional rarity or localisation; or<br>Resident or regularly occurring populations (assessed to be important at the regional context) of the following:<br>- Species protected under the Wildlife Acts; and/or<br>- Species listed on the relevant Red Data list.<br>- Sites supporting 1% or more of a regional population. |
| Local importance (higher value) | Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP.<br>Resident or regularly occurring populations (assessed to be important at the Local level) of the following:<br>- Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.<br>- Species protected under the Wildlife Acts; and/or<br>- Species listed on the relevant Red Data list. |
| Local importance (lower value) | Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; and/or<br>Sites of features containing non-native species that are of some importance in maintaining habitat links. |

Features assessed as being of less than Local importance were considered to be of 'Negligible' importance and were scoped out of the detailed assessment of effects, since these would not be a material consideration for planning.

*7.6.4.3 Identification of Key Ecological Features*

The methodology for assessment followed a precautionary screening approach with regard to the identification of ecological features that will be carried forward for impact assessment (i.e., Key Ecological Features). Therefore, any feature which is assessed as being of Local importance (at the higher value) has been brought forward for assessment of effects, unless it can be proven without any reasonable scientific doubt that effects would be negligible. Other features of lower importance (Local importance (lower value), and Negligible importance) may also be carried forward, particularly where there may be legislative requirements pertaining to these features not necessarily associated with their ecological importance.

*7.6.4.4 Methodology for assessing effects*

The assessment of likely effects from the Project on ecological features has taken consideration of the following factors:

- The quality of the effect: assessing the effect as either positive (a change which improves the quality of the environment), neutral (no effects or effects that are imperceptible), or adverse (a change which reduces the quality of the environment).

- The duration of the effect: assessed as either 'short-term' (up to one year), 'medium-term' (one to ten years) or 'long-term' (more than ten years).
- The sensitivity of the feature: i.e., the likelihood of the ecological feature being significantly affected by a potential effect source, considered on a scale of negligible, low, medium or high.
- The magnitude of change: i.e., the extent of change in the baseline conditions of the ecological feature as a result of the Project, in terms of size, amount, intensity and volume. Expressed in absolute terms where possible and considered on a scale of negligible, low, medium or large.
- Frequency and timing: i.e., the number of times an activity may occur to influence the resulting effect.
- Extent: i.e., the spatial or geographical area over which the effect may occur under a suitably representative range of conditions.
- Reversibility: an irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Following the classification of an effect based on the factors described above, a clear statement is made as to whether the effect is "significant" or "not significant". In accordance with CIEEM, (2018)[1] guidelines, the significance of an effect on an ecological feature has been determined based on analysis of the factors that characterise the effect.

A significant effect is defined as "an effect that either supports or undermines biodiversity conservation objectives for important ecological features or for biodiversity in general". The assessment considers whether an effect has the potential to affect the conservation objectives of a site or positively or negatively affect the conservation status of habitats, species or species assemblages.

For 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.

The conservation status of a species or species assemblage is defined as "the sum of the influences acting on it which may affect its long-term distribution and abundance, within the geographical area of interest". Conservation status is considered to be favourable under the following circumstances:

- Population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitats.
- The natural range of the species is not being reduced, nor is it likely to be reduced for the foreseeable future.
- There is (and probably will continue to be) a sufficiently large habitat to maintain its population on a long-term basis.

Terminology regarding the significance of effects described in this EIAR chapter references guidelines published in CIEEM, (2018)[1] and EPA, (2022)[2]. Definitions for the level of significance outlined in EPA, (2022)[2] are presented below in **Table 7.4**. A matrix is then provided in **Table 7.5** to outline how those criteria correspond to the equivalent level of significance defined by CIEEM, (2018)[1].

**Table 7.4. EPA guidelines for determining significance of effects as relates to ecology**

| Significance following EPA guidelines | Definition |
|---|---|
| Profound effect | Significant effect on Internationally designated sites.<br>An effect which obliterates sensitive characteristics.<br>Total/near total loss of feature populations due to mortality or displacement. Total/near total loss of productivity of a feature population due to disturbance.<br>Guide: >80% of population lost through additive mortality. |
| Very significant | Significant effect on nationally designated sites.<br>An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the environment.<br>Major reduction in the status or productivity of a feature population due to mortality, displacement, or disturbance.<br>Guide: 21-80% of population lost through additive mortality. |
| Moderate effect | An effect that alters the character of the environment that is consistent with existing and emerging trends.<br>Partial reduction in the status or productivity of a feature population due to mortality, displacement, or disturbance.<br>Guide: 6-20% of population lost through additive mortality. |
| Slight effect | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.<br>Small but discernible reduction in the status or productivity of a feature population due to mortality, displacement, or disturbance.<br>Guide: 1-5% of population lost through additive mortality. |
| Not significant | An effect which causes noticeable changes in the character of the environment but without significant consequences.<br>Very slight reduction in the status or productivity of a feature population due to mortality, displacement, or disturbance. Reduction barely discernible, approximating to the “no change” situation.<br>Guide: <1% population lost through additive mortality. |

**Table 7.5: Significance matrix**

| Significance following CIEEM, 2018[1] Criteria | Equivalent significance using the EPA, 2022[2] Criteria |
|---|---|
| Significant effect on a feature of International importance | Profound effect |

| Significance following CIEEM, 2018[1] Criteria | Equivalent significance using the EPA, 2022[2] Criteria |
|---|---|
| Significant effect on a feature of National importance | Very significant |
| Significant effect on a feature of County importance | Moderate effect |
| Significant effect on a feature of Local (Higher) importance | Slight effect |
| Effect on a feature of Local (Lower) importance | Not significant |

As outlined above, a significant effect at the international level under the CIEEM guidelines would equate to a profound effect using the EPA guidelines. As a deviation from the standard EIA methodology, minor effects identified within this chapter have been classified as negligible to ensure that (as per the CIEEM guidelines) a clear statement is made as to whether the effect is "significant" or "not significant".

### *7.6.4.5 Mitigation hierarchy*

In accordance with CIEEM's guidelines, (2018)[1], a sequential process has been adopted to avoid, mitigate, and compensate negative ecological impacts and effects, otherwise known as the 'mitigation hierarchy'. As part of this project, avoidance, mitigation, offsetting, and enhancement measures have been identified as part of the impact assessment process. These principles underpin any EcIA and are adapted from CIEEM as follows:

- **Avoidance**: seek options that avoid harm to ecological features (for example, by locating on an alternative site).
- **Mitigation**: negative effects should be avoided or minimised through mitigation measures, either through the design of the Project or subsequent measures that can be guaranteed – for example, through a condition or planning obligation.
- **Offsetting**: where there are significant residual negative ecological effects despite the mitigation proposed, these should be offset by appropriate compensatory measures.
- **Enhancement**: seek to provide benefits for biodiversity over and above requirements for avoidance, mitigation, or offsetting.

Wherever possible, strategies of avoidance have been implemented to minimise any effects to ecological features. If avoidance is not possible, mitigation and offsetting measures will be required, as described in section 7.10 of this chapter.

### *7.6.4.6 Constraints and limitations*

Designated and protected sites are described and reviewed from existing information. This information, although accurate at the time of publishing, is often several years old and may not reflect the current status or condition of sites.

The Phase 1 habitat survey and assessment was completed in July and August 2022 and January 2023, and while it is considered optimal for this type of survey, given the seasonality of biodiversity, some components may have been under-represented (e.g., certain flora / early or late flying solitary bees); however, the data gathered is considered sufficient for identifying the important ecological features that are relevant to the Project.

Whilst desk study data are useful in providing supplementary ecological information for a site, it should be acknowledged that these data are dependent on the submission of records to the relevant organisation. As such, a lack of records for a particular species does not necessarily mean that the species is absent from the wind farm site and/or wider search area. Similarly, records of a particular species do not necessarily mean that the species is still present within the wind farm site and/or wider search area.

It should be noted that ecological features are transient, and the distributions of habitats and species may be subject to change. Guidance published by the Chartered Institute of Ecology and Environmental Management (CIEEM, 2019)[32] states that baseline survey data is likely to remain valid for a period of up to 18 months from the point in which it was collected, after which a professional ecologist will need to undertake a site visit to assess its and need for updated surveys. Since the habitat surveys and surveys for terrestrial mammals and amphibians were last updated in 2023, and those surveys found that the habitats on the wind farm site and their management had not changed significantly since the time in which the baseline surveys first commenced (2022), it is considered that the baseline data presented herein is sufficiently robust and valid for informing this assessment and that further updated surveys to inform the planning application are not necessary.

Further limitations associated with the collection of bat and aquatic ecology baseline data are discussed within EIAR **Volume III, Appendix 7.1** and **Appendix 7.2** respectively.

The information provided in this EIAR chapter accurately and comprehensively describes the baseline ecological information and provides a prediction of the likely ecological effects of the Project, along with prescriptions for mitigation as necessary. The specialist studies, analysis, reporting, and assessment methodologies have all been undertaken in accordance with appropriate guidelines. No significant limitations in relation to the scope, scale, or context of the impact assessment have been identified.

## 7.7 Ecological baseline

### 7.7.1 Desk study

#### *7.7.1.1 European designated sites*

The desk study identified two internationally designated sites within 15km of the Project that are of relevance to this chapter. The sites included two Special Areas of Conservation (SACs), as described in **Table 7.6** below.

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[32] Chartered Institute for Ecology and Environmental Management (CIEEM) 2019.Advice Note on the Lifespan of Ecological Reports and Surveys. Available at www.cieem.net

**Table 7.6. Internationally designated sites within 15km of the wind farm site boundary**

| Site name | Distance from the wind farm site (km) | Direction from the Project | Connectivity |
|---|---|---|---|
| Blackwater River (Cork / Waterford) SAC | 5.1 | W / S & NE | Stream, Dreenagh East (IE_SW_18A050700), is within 800m of turbine T1 and drainage ditches occur on the wind farm site. |
| Ballyhoura Mountains SAC | 10.2 | NE | No |

SPAs are protected for ornithological features and are therefore discussed in EIAR **Chapter 8 Ornithology** of this EIAR.

The SACs identified in the desk study are of international importance for nature conservation. **Table 7.7** below provides a summary of the Qualifying Interests (QIs) and Special Conservation Interests (SCIs) of the SACs; the locations of which are shown on **Figure 7.1**.

**Table 7.7. Qualifying interests of SACs within 15km of the Project.**

| Site name | Qualifying Interest(s) / Special Conservation Interest |
|---|---|
| Blackwater River (Cork / Waterford) SAC (002170) | Estuaries [1130]<br>Mudflats and sandflats not covered by seawater at low tide [1140]<br>Perennial vegetation of stony banks [1220]<br>Salicornia and other annuals colonising mud and sand [1310]<br>Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]<br>Mediterranean salt meadows (*Juncetalia maritimi*) [1410]<br>Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]<br>Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]<br>Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]<br>Freshwater Pearl Mussel (*Margaritifera margaritifera*) [1029]<br>White-clawed Crayfish (*Austropotamobius pallipes*) [1092]<br>Sea Lamprey (*Petromyzon marinus*) [1095]<br>Brook Lamprey (*Lampetra planeri*) [1096]<br>River Lamprey (*Lampetra fluviatilis*) [1099]<br>Twaite Shad (*Alosa fallax fallax*) [1103]<br>Salmon (*Salmo salar*) [1106]<br>Otter (*Lutra lutra*) [1355]<br>Killarney Fern (*Trichomanes speciosum*) [1421] |
| Ballyhoura Mountains SAC (002036) | Northern Atlantic wet heaths with *Erica tetralix* [4010]<br>European dry heaths [4030]<br>Blanket bogs [7130] |

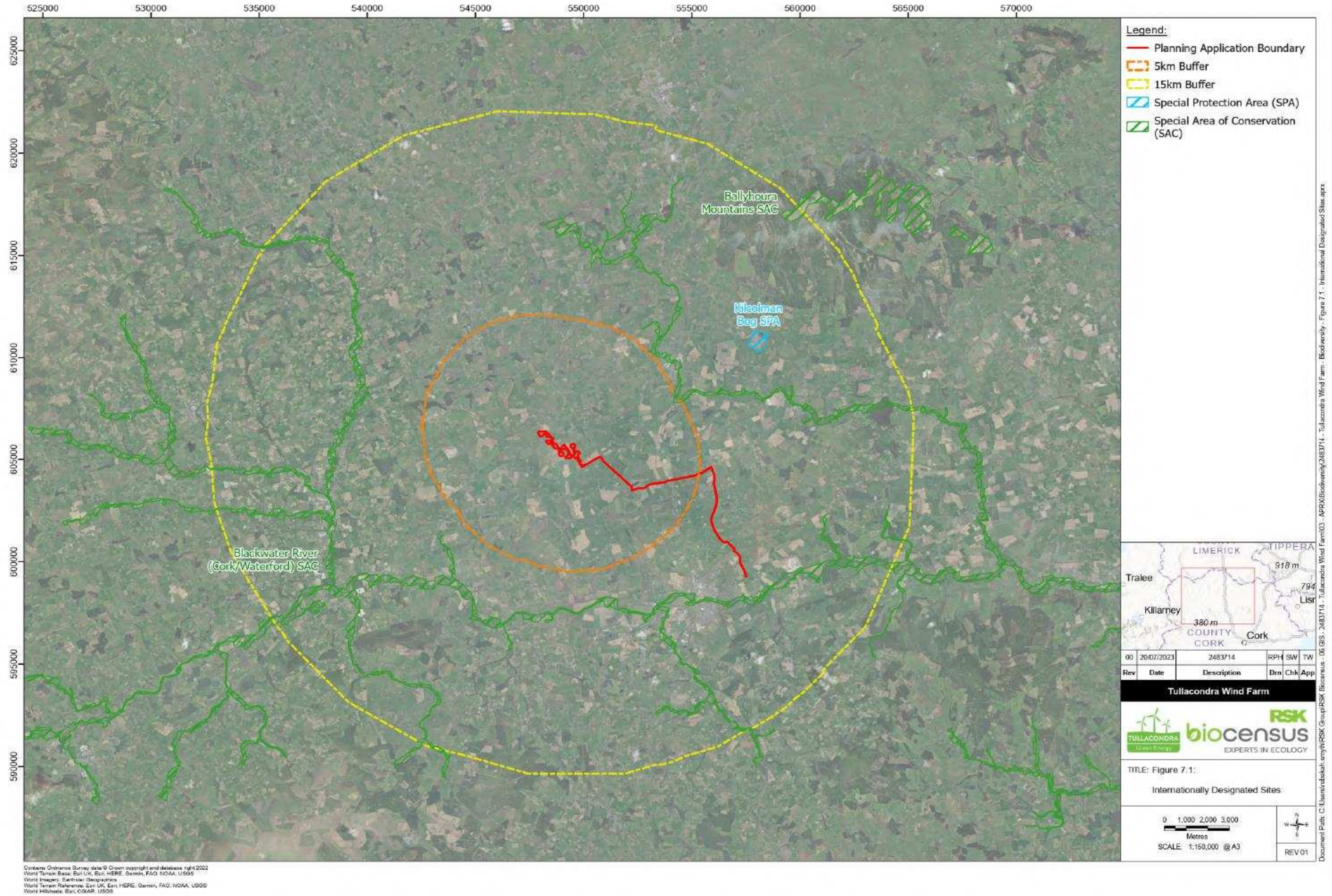



**Figure 7.1: Internationally designated sites**

### 7.7.1.2 *Nationally designated sites*

Natural Heritage Areas (NHAs) are sites of national importance for nature conservation designated under the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation. Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. A review of the National Parks and Wildlife Service (NPWS) website indicates that there are seven pNHA's located within 15km of the wind farm site with the closest (as described in **Table 7.8** below and shown on **Figure 7.2**) being Eagle Lough pNHA, located 7.3km from the wind farm site. Hydrological connectivity occurs with one site, Awbeg Valley (Above Doneraile) pNHA, which has accordingly been scoped in for assessment of effects. While Ballyhoura Mountains pNHA is known to host hen harrier (*Circus cyaneus*) this species is considered further in EIAR **Chapter 8 Ornithology**. On the basis of this and given the distance and absence of effect pathways from the Project to other pNHAs, it is considered that the remaining pNHAs can be scoped out for further assessment of effects for the Project.

**Table 7.8. Nationally designated sites within 15km of the wind farm site.**

| Site name | Distance from the wind farm site (km) | Features of conservation importance |
|---|---|---|
| Eagle Lough pNHA | 7.3 | Turlough type lough, Orange foxtail (*Alopecurus aequalis*) and other associated notable flora |
| Awbeg Valley (Above Doneraile) pNHA | 9.0 | Limestone valley with notable woodland and marsh |
| Kilcolman Bog pNHA | 9.2 | Lake and fen with large numbers of wintering wildfowl and uncommon plants |
| Ballinvonear Pond pNHA | 9.7 | Golden dock (*Rumex maritimus*) |
| Ballyhoura Mountains pNHA | 10.3 | Mosaic of wet and dry heath with some active blanket bog and hen harrier. |
| Banteer Ponds pNHA | 12.5 | Semi-permanent ponds and marshes rich in wetland birds, invertebrates and with some botanical interest |
| Priory Wood pNHA | 13.0 | Oak – birch – holly semi-natural woodland |

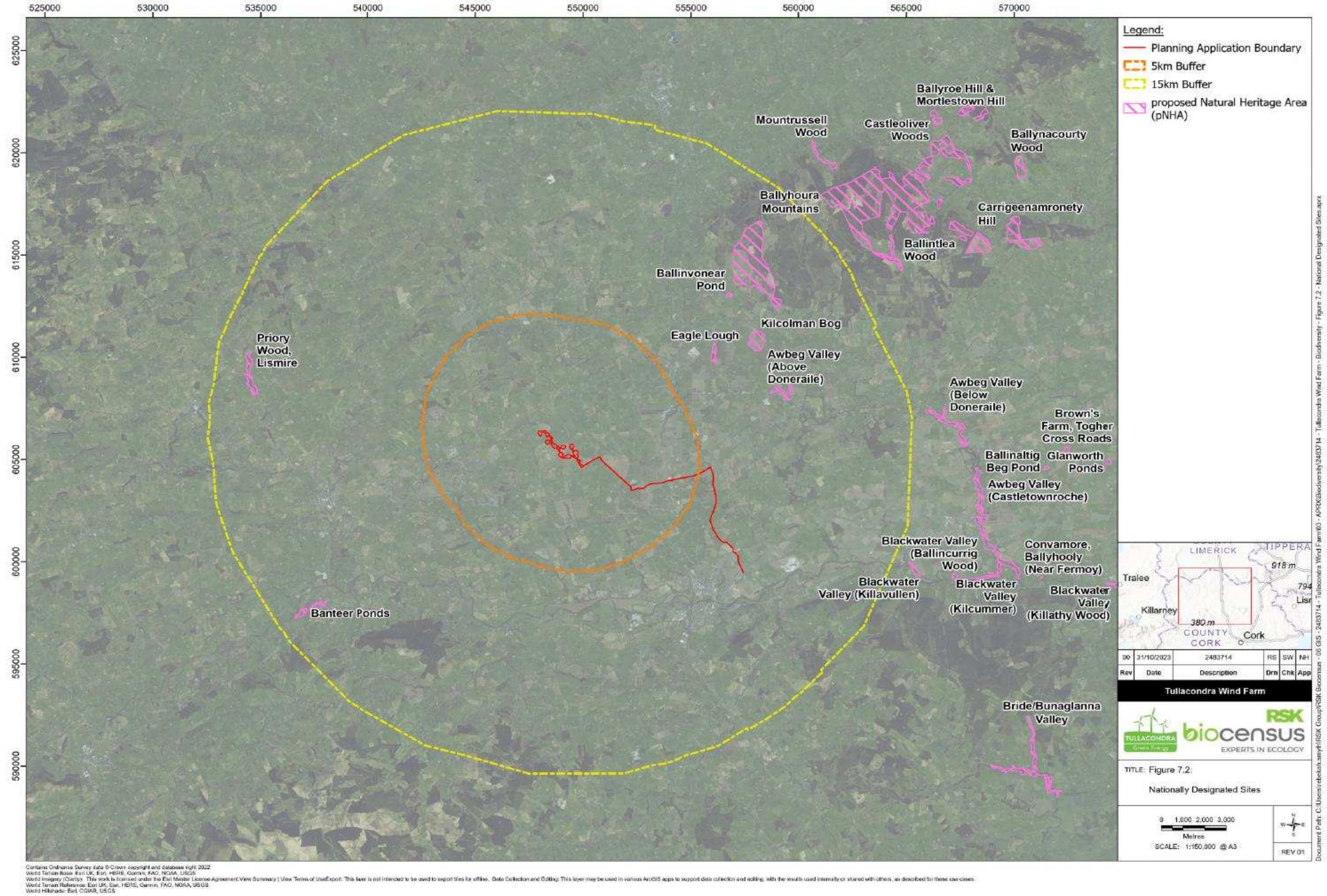



**Figure 7.2: Nationally designated sites**

*7.7.1.3 Priority habitats*

One Annex 1 priority habitat was identified during the desk study within 5km of the wind farm site boundaries, namely residual alluvial woodland occurring approximately 4.8km to the southwest of the wind farm site (see **Figure 7.3**).

*7.7.1.4 Protected and notable species records*

Records for seven protected species were identified within 10km of the wind farm site boundaries. Two additional records of otherwise notable species were identified within 2km of the wind farm site boundaries. A list of these species' records is provided in **Table 7.9** below. Those which are of relevance to the wind farm site and the impact assessment are discussed further within the remainder of this chapter.

**Table 7.9. Notable species records**

| Species | Species group | Conservation status | Record count | Date of last record |
|---|---|---|---|---|
| Common pipistrelle (*Pipistrellus pipistrellus*) | Mammal | Wildlife Acts<br>Annex IV of EU Habitats Directive<br>Least Concern on Irish Red List | 2 | 19/09/2006 |
| Soprano pipistrelle (*Pipstrellus pygmaeus*) | Mammal | Wildlife Acts<br>Annex IV of EU Habitats Directive<br>Least Concern on Irish Red List | 4 | 18/09/2006 |
| Eurasian pygmy shrew (*Sorex minutus*) | Mammal | Wildlife Acts<br>Least concern on Irish Red list | 3 | 02/09/2012 |
| Eurasian badger (*Meles meles*) | Mammal | Wildlife Acts<br>Least concern on Irish Red list | 29 | 31/12/2013 |
| European red squirrel (*Sciurus vulgaris*) | Mammal | Wildlife Acts<br>Least concern on Irish Red list | 3 | 04/10/2016 |
| European otter (*Lutra lutra*) | Mammal | Wildlife Acts<br>Annex II and IV of EU Habitats Directive<br>Least concern on Irish Red list. | 10 | 25/02/2016 |
| West European hedgehog (*Erinaceus europaeus*) | Mammal | Wildlife Acts<br>Least concern on Irish Red list | 5 | 28/08/2020 |
| Common extinguisher moss (*Encalypta vulgaris*) | Moss | Threatened species: near threatened | 2 | 18/02/2012 |
| Sausage beard-moss (*Didymodon tomaculosus*) | Moss | Threatened species; vulnerable | 2 | 18/02/2012 |

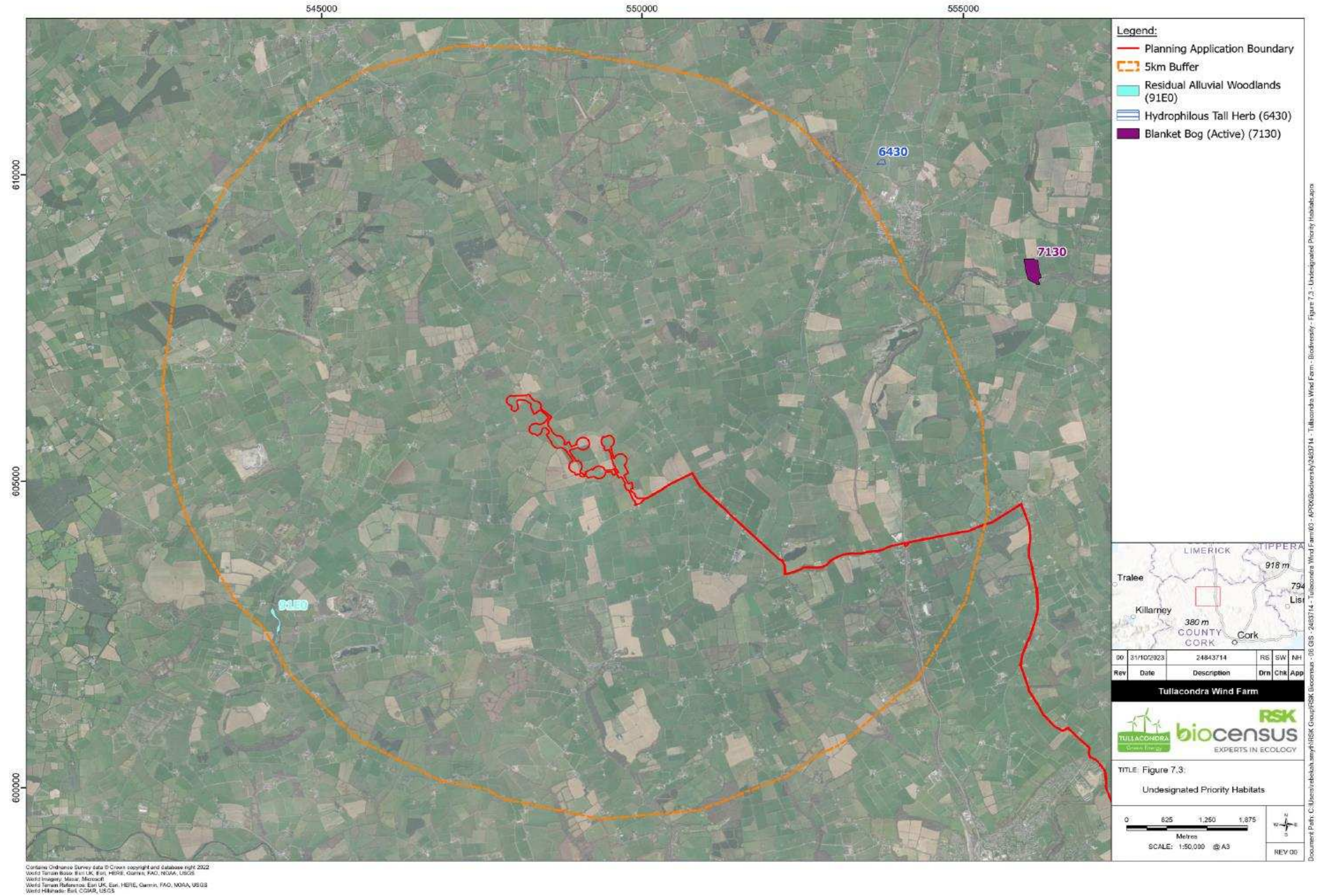



**Figure 7.3: Undesignated priority habitats**

### 7.7.2 Habitats on the wind farm site

The wind farm site is comprised predominantly of modified habitat types associated with intensive farming systems and includes improved agricultural grassland, tilled earth, and arable land, although semi-natural habitat such as hedgerows and treelines, emerging scrub and wet grassland occur to a lesser extent throughout the wider landholding. The habitats recorded within the wind farm site and wider landholding, as indicated by the 'blueline boundary' in **Figure 7.4** are listed in **Table 7.10**, as described in Fossitt (2000)[9], with additional ecological context with regard to dominant species present provided in section 7.7.2.1.

**Table 7.10 Habitat types on the wind farm site and within wider landholding and their ecological valuation**

| Habitat code | Habitat type | Extent (Ha) | Ecological valuation |
|---|---|---|---|
| BC1 | Arable Land | 29.07 | Negligible |
| BC3 | Tilled Land | 20.41 | Negligible |
| BL3 | Buildings and Artificial Surfaces | 0.45 | Negligible |
| ED2 | Disturbed Ground – informal farm lanes<br>Disturbed Ground – cattle rubs | 0.97 | Local importance (higher value) |
| FL5 | Eutrophic Lakes | 0.09 | Local importance (higher value) |
| FL8 | Artificial Lakes and Ponds | 0.01 | Local importance (higher value) |
| FW4 | Drainage Ditches | 0.01 | Local importance (higher value) |
| GA1 | Improved Agricultural Grassland | 135.90 | Local importance (lower value) |
| GS4 | Wet Grassland | 0.23 | Local importance (higher value) |
| HD1 | Dense Bracken | 0.13 | Local importance (lower value) |
| WL1 | Hedgerow | 14.4 (km) | Local importance (higher value) |
| WL2 | Treelines | 598 (m) | Local importance (higher value) |
| WS1 | Scrub | 1.52 | Local importance (higher value) |
| WD1 | Mixed Broadleaved Woodland | 6.02 | Local importance (higher value) |

*7.7.2.1 Habitat descriptions*

*7.7.2.1.1 Arable Land (BC1)*

Arable land occurs to the north and to the southwest of the wind farm site, being predominantly parcellated by hedgerow and scrub habitat. It consists mostly of crops, predominantly cereals, and these heavily disturbed areas suffer a low diversity and biomass of native flora. As such, this habitat is considered to be of **Negligible importance.**

*7.7.2.1.2 Tilled Land (BC3)*

Tilled land occurs to the southwest of the wind farm site and is related to the arable land use that occurs in other sections of the wind farm site. This habitat is parcellated predominantly by hedgerow habitat and included areas of bare soil with a low diversity and biomass of flora. As such, this habitat is considered to be **Negligible importance**.

*7.7.2.1.3 Buildings and Artificial Surfaces (BL3)*

There are two small areas that contain farm buildings within the wind farm site boundary, with further farm and residential buildings that border the wind farm site. This habitat is highly modified and disturbed and is unlikely to provide any ecological value. However, bats are known to roost within farm and residential buildings, and this is further assessed separately in section 7.7.4.4. Taking into account the highly modified and disturbed nature of the buildings, along with their ubiquity in the surrounding landscape, this habitat is considered to be of **Negligible importance**.

*7.7.2.2 Disturbed Ground (ED2)*

Disturbed ground predominantly occurs as informal farm lanes providing vehicular access to fields or as ‘rubs’ where dairy cattle have removed vegetative cover from high sided road verges and created sporadic sandy banks to the south of the wind farm site. Field surveys identified solitary bees utilising these banks, including the buff mining bee (*Andrena nigroaenea*), which is an IUCN red listed species of conservation concern. This habitat has low floral diversity but offers some conservation value for priority nesting mining bee species. Subsequently, the spoil and bare ground habitat associated with the farm lanes and cattle rubs is considered to be of **Local (Higher value) importance.**

*7.7.2.3 Eutrophic Lakes (FL5)*

A lake was recorded to the north of the wind farm site within an area of improved agricultural grassland. A second body of water was also found to be present within a hollow within an improved agricultural grassland field located to the south of an area of woodland within the landholding. A large abundance of damselflies (*Zygoptera sp.*) was recorded within the vicinity of the waterbodies, albeit with a low diversity of species. Lakes have the potential to support a wide range of species and as a result of this, and a lack of similar habitat types in the area, this habitat is deemed to be of **Local (Higher value) importance.**

### 7.7.2.4 *Artificial Lakes and Ponds (FL8)*

A karst feature / historic quarry is present within the wind farm site to the east of the proposed location of turbine T5 (see EIAR **Chapter 1 Introduction, Figure 1.4**), comprising an artificial hollow where water had accumulated at the time of the survey in 2022. This habitat has had farm rubbish and rubble deposited into it but is a habitat type that offers some suitability for species to breed such as dragonflies, damselflies, hoverflies, and amphibians. This habitat was subsequently found to be dry during amphibian surveys conducted in May 2023.

A second instance of this habitat occurred in the south of the wind farm site adjacent to scrub, farm buildings, and an area of wet grassland. This pond was dominated by soft rush (*Juncus effusus*), Yorkshire fog (*Holcus lanatus*), creeping buttercup (*Ranunculus repens*) and other tree species such as silver birch (*Betula pendula*), willow (*Salix sp.*), ash (*Fraxinus excelsior*), and sycamore (*Acer pseudoplatanus*). This habitat additionally provides suitability for common frog, and smooth newt and other aquatic and semi-aquatic invertebrate species. No evidence of these species breeding in either pond was identified but given a lack of freshwater habitat in the area and the potential for ponds to support important levels of biodiversity (despite their degraded nature), it has been deemed to be of **Local (Higher value) importance.**

### 7.7.2.5 *Drainage Ditches (FW4)*

Drainage ditches are common on the wind farm site, being present within many of the field boundaries, performing drainage functions in the surrounding agricultural landscape. Most of the ditches present were in sub-optimal condition, primarily lacking bankside vegetation with very low levels of water and evidence of pollution and nutrient enrichment. There was no presence of aquatic wildlife, such as wetland plants and invertebrates, that indicate a healthy ditch ecosystem. In their current state, the ditch network is unlikely to be able to provide valuable habitat for invertebrate, plant, and bird species. However, within an arable landscape such as this, ditches can act as wildlife corridors for many species and thus are considered to be of **Local (Higher value) importance.**

### 7.7.2.6 *Improved Agricultural Grassland (GA1)*

This habitat type occurs extensively throughout all areas of the wind farm site and is associated with operational intensive dairy farming. Field parcels of this habitat are frequently separated by hedgerow and occasionally by spoil and bare ground habitat in the form of informal field lanes and drainage ditches that were dry during the field survey. This habitat is considered of **Local (Lower value) importance** due to a lack of species diversity and mixture of common and widespread flora, whilst also being ubiquitous in the surrounding landscape.

### 7.7.2.7 *Wet Grassland (GS4)*

Two small fragments of wet grassland occur to the south of the wind farm site adjacent to scrub. This habitat is under grazed and has botanical interest, being dominated by indicative species such as glaucous sedge (*Carex flacca*), devil's-bit scabious (*Succisa pratensis*), silverweed (*Potentilla anserina*) and meadowsweet (*Filipendula ulmaria*). Wet grassland habitats are of high ecological value, being beneficial for a number of species and potentially important areas for lepidoptera other invertebrates, amphibians, and reptiles. Therefore, this habitat is considered to be of **Local (Higher value) importance.**

*7.7.2.8 Dense Bracken (HD1)*

Dense bracken (*Pteridium aquilinum*) is isolated to inside a rath to the southwest of the wind farm site and is surrounded by scrub habitat. Low floral diversity occurs throughout the wind farm site although there is evidence, including a den, that the area is being used for resting and/or breeding red fox (*Vulpes vulpes*). Whilst bracken does serve some value as a different habitat, strands of the species commonly outcompete other, more desirable, plant species reducing botanical diversity. This habitat has therefore been deemed to be of **Local (Lower value) importance.**

*7.7.2.9 Hedgerow (WL1)*

Hedgerows occur as field boundaries throughout the majority of the wind farm site. Where the habitat occurs between field parcels within a landownership it tends to be over managed and, in some areas, gappy. Where it occurs between landownerships it tends to be much taller and thicker as a consequence of being relatively unmanaged and of greater biodiversity value, transitioning in places to treeline habitat. This habitat type is considered to be **Local (Higher value) importance** due to its importance to species in terms of the breeding, foraging, and commuting opportunities they provide for insects, birds, bats, and non-volant mammals such as hedgehogs.

*7.7.2.10 Treelines (WL2)*

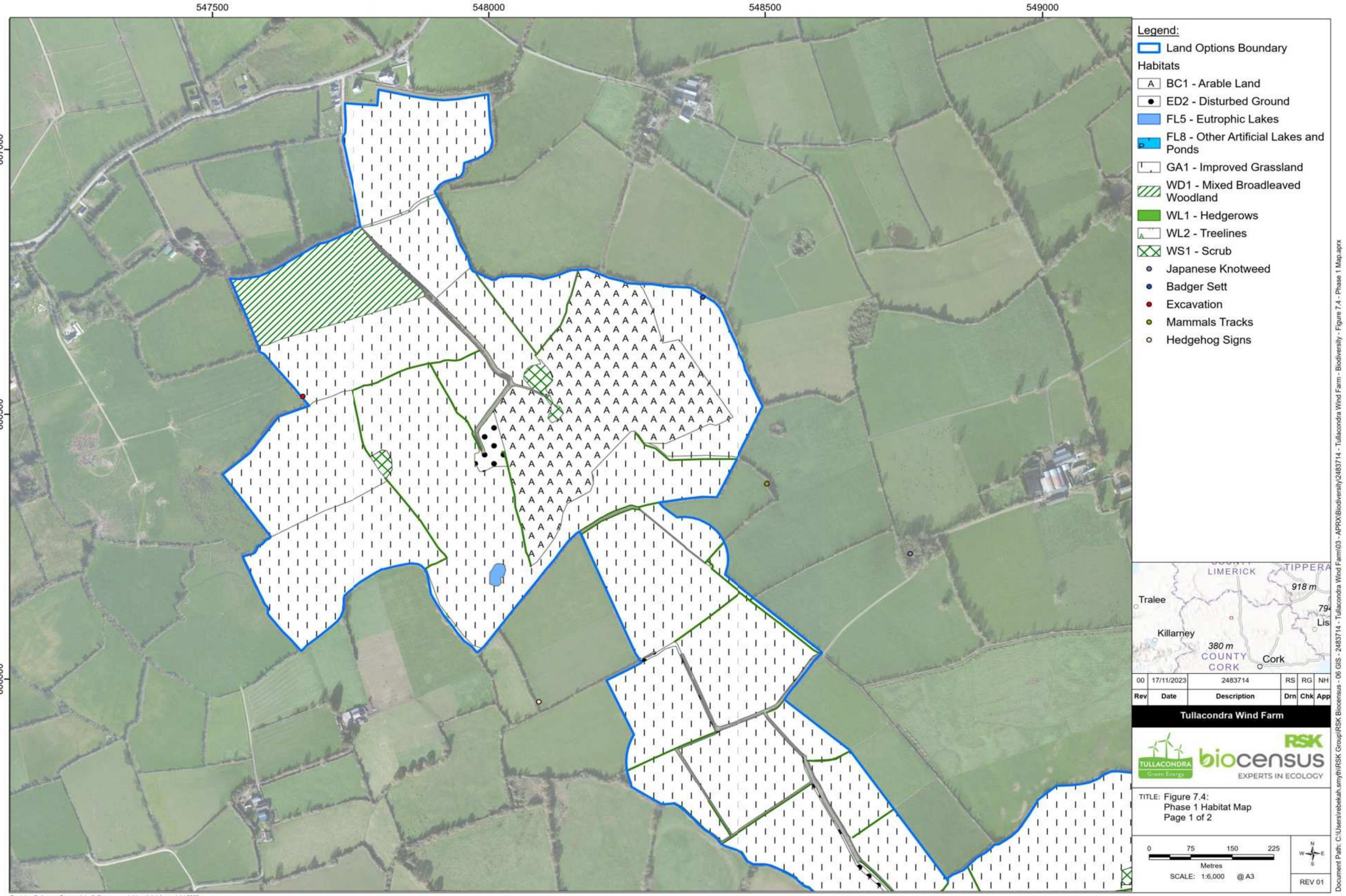
Treelines occur to the west of the wind farm site as a boundary between landowners and in the southeast where it is perpendicular to a large area of scrub habitat adjacent to a farmyard. This habitat primarily consists of species including ash, oak (*Quercus sp.),* and silver birch. Though some of the hedgerows on the wind farm site also include trees, they are not dominated by them and have been classified as hedgerows according to Fossitt, 2000[9]. This habitat is considered of **Local (Higher value) importance** due to its relatively limited extent across the wind farm site and its value to ecological features such as bats and birds as a linear habitat.

*7.7.2.11 Scrub (WS1)*

There are several pockets of scrub throughout the wind farm site consisting primarily of willow (*Salix sp.)*, European gorse (*Ulex europaeus*), hawthorn (*Crataegus monogyna*), and blackthorn (*Prunus spinosa).* Three parcels occur to the north of the wind farm site and a further five parcels occur to the south. This habitat is predominantly associated with wetter areas that are unfarmed and historic features on the wind farm site such as raths. Despite scrub being of particular ecological importance to some fauna species (i.e., birds), the extent of scrub is limited and thus is only of **Local (Higher value) importance.**

*7.7.2.12 Mixed Broadleaved Woodland (WD1)*

There were two pockets of mixed broadleaved woodland present within the study area. One area was recorded in the southern section of the wind farm site, east of a farm building and another larger area was recorded to the north of the wind farm site. Both pockets of woodland are isolated within the agricultural landscape and are highly modified stands with some non-native species present. The southern area of woodland contained the presence of Japanese knotweed on its eastern border. Woodland habitats are, however, of ecological value to a number of species of birds, bats, invertebrates, and other mammals, and given its infrequency within the surrounding landscape, it is deemed to be of **Local (Higher value) importance.**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Land Options Boundary
Habitats
BC1 - Arable Land
ED2 - Disturbed Ground
FL5 - Eutrophic Lakes
FL8 - Other Artificial Lakes and Ponds
GA1 - Improved Grassland
WD1 - Mixed Broadleaved Woodland
WL1 - Hedgerows
WL2 - Treelines
WS1 - Scrub
Japanese Knotweed
Badger Sett
Excavation
Mammals Tracks
Hedgehog Signs
LIMERICK
TIPPERA
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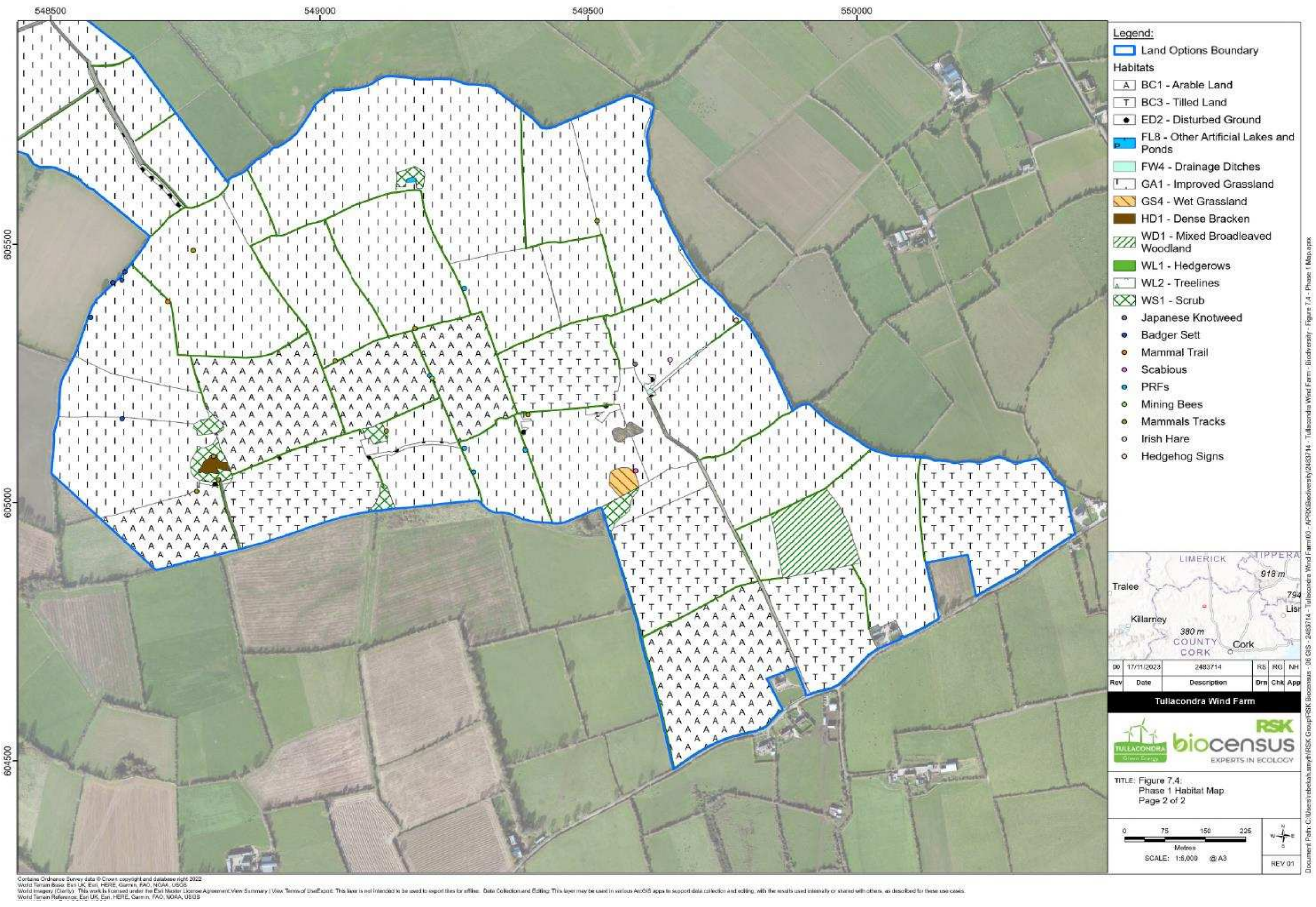


**Figure 7.4: Phase 1 habitat map**

### 7.7.3 Protected or priority flora

While there were no protected or priority plants recorded on the wind farm site, two bryophytes of conservation concern were identified within 10km of the Project. Common extinguisher-moss (*Encalypta vulgaris*), a near threatened species, and sausage beard-moss (*Didymodon tomaculosus*), a vulnerable species, were recorded in February 2012. The habitat on the wind farm site is not considered to be suitable for either species. Common extinguisher-moss chiefly relies on chalk or limestone soils, neither of which are present on the wind farm site. Whilst sausage beard-moss is often found on arable lands the following conditions are generally considered indicative, (Blockeel, 2002)[33]:

- a heavy clay substrate.
- the presence of moisture loving bryophytes (*Pseudephemerum nitidum, Pohlia melanodon*).
- arable fields with evidence of a rich, diverse ruderal flora.

These conditions were not observed on the wind farm site. Furthermore, given the intensiveness of the arable farming and preparatory tilling that takes place, the wind farm site is not considered suitable for sausage beard-moss.

#### *7.7.3.1 Invasive non-native species*

Japanese knotweed was identified in two locations on the wind farm site (see **Figure 7.4**). The first location occurs throughout an entire field boundary northeast of farm sheds to the west of turbine T9 (see EIAR **Chapter 1 Introduction, Figure 1.4**), and the second stand was identified in a field adjacent to an area of woodland within the southern part of the wind farm site near to the proposed substation location. It was also recorded at Boherash Cross on TDR Option 1 and the near to the turn off after Mallow Hospital on TDR Option 2. A further five non-native plants were recorded from the desk study within 10km of the wind farm site: black currant (*Ribes nigrum*), cherry laurel (*Prunus laurocerasus*), Indian balsalm (*Impatiens glandulifera*), sycamore and rhododendron (*Rhodendron ponticum*). These species were not, however, noted as being present on the wind farm site.

### 7.7.4 Fauna

#### *7.7.4.1 Terrestrial invertebrates*

Whilst the desk study identified no records of protected and/or notable invertebrates within 10km of the wind farm site, two red-listed species were recorded on wind farm site. The red-tailed bumblebee (*Bombus lapidaries)* and buff mining bee are listed as near threatened and vulnerable respectively on the Irish Red list and were both recorded utilising the wind farm site, with the former recorded foraging along hedgerows throughout the wind farm site, and the latter recorded on cattle rubs to the northeast of the wind farm site. Habitats on wind farm site are largely suitable for these two species with the presence of farmland, hedgerows, and dry soil with open areas of bare ground. Whilst

[33] Blockeel, T. 2002. *A profile of Didymodon tomasculosus* (Sausage beard moss): Notes for field workers. Plantlife.

limited, there are some areas of suitable habitat for other potentially notable invertebrate species on the wind farm site with the presence of ponds, lakes, hedgerows, woodland edges, scrub, and wet grassland. The food plant of the marsh fritillary butterfly (*Euphydryas aurinia*), Devils-bit scabious (*Succisa pratensis*), was found to be present within areas of wet grassland, although no evidence of marsh fritillary butterfly being present was found during the field surveys.

Due to the presence of suitable habitat within the wind farm site and the recording of two notable invertebrate species, the invertebrate assemblage on the wind farm site is considered to be of **Local (Higher value) importance.**

#### *7.7.4.2 Amphibians*

The desk study returned no records of amphibians within 10km of the wind farm site boundaries. However, eDNA surveys undertaken on the waterbodies within the landholding in May 2023, returned a positive result for smooth newt and common frog, confirming the presence of these species within two waterbodies containing water within the northern part of the landholding. DNA from amphibians degrades in water over a period of approximately seven to 21 days.

Suitable habitat on the wind farm site for common frog and smooth newt is largely restricted to the waterbodies, field boundaries, and wet grassland, habitats which are lacking in extent and connectivity and unlikely to be able to support notable populations of amphibians. The waterbodies where amphibian presence was confirmed are not within or adjacent to the proposed construction footprint, being located in excess of 50m from the nearest proposed works.

Natterjack toad (*Epidalea calamita)* is predominantly found on sandy and heathland areas, of which the wind farm site has none. This species is, therefore considered unlikely to be present.

Despite the presence of smooth newt and common frog being confirmed within the landholding, the amphibian assemblage within the ZoI is considered to be of **Local (Lower value) importance**, given the lack of extensive and well-connected habitats within the construction footprint that could support a notable population.

#### *7.7.4.3 Reptiles*

The only native reptile species to Ireland is the common lizard (*Zootoca* vivipara), with slow worms (*Anguis fragilis*) being an introduced species. The desk study returned records of these species within 10km of the wind farm site boundaries. Additionally, no evidence was recorded during the surveys to confirm their presence with the ZoI. The wind farm site is mainly comprised of sub-optimal habitat for reptiles with more suitable habitat restricted to scrub and hedgerows. The wind farm site is therefore unlikely to be able to support a notable population of reptiles. Therefore, the reptile assemblage is considered to be of **Local (Lower value) importance.**

#### *7.7.4.4 Bats*

A summary of the bat survey results is presented below. Further details of the individual surveys and their findings are provided in EIAR **Volume III, Appendix 7.1**.

### Desk study

The background data search returned records of five different bat species within 10km of the wind farm site:

- Common pipistrelle (*Pipistrellus pipistrellus)*
- Soprano pipistrelle (*Pipistrellus pygmaeus*)
- Brown long-eared bat (*Plecotus aubent*)
- Daubenton's bat (*Myotis aubentoniid*)
- Leisler's bat (*Nyctalus leisleri*)

It is worth noting that due to the rural nature of the wind farm site, the absence of records is likely to be due to a lack of study in this location rather than reflecting a low population of bats. This is made relevant by the age of some of the records, dating from 1986 to 2007.

### Habitat suitability

The Bat Conservation Ireland (BCI) landscape model identifies areas of habitat suitability for bats across Ireland. Suitability varies for different bat species, depending on their habitat requirements. However, the areas where the proposed wind turbines will be located are identified by the BCI landscape model as low suitability for bats in general. The area of the wind farm site to the southeast of turbine T8 where the proposed substation as well as the access into the wind farm site will be located (see EIAR **Chapter 1 Introduction, Figure 1.4**) is identified as being of moderate suitability. **Table 7.11** shows the wind farm site divided into two sections, with the 'north' area including the proposed turbine locations and the 'south' area including the land to the southeast of turbine T8 where the proposed substation and access into the wind farm site will be located. Section 2 to the south represents 13% of the wind farm site and has the highest levels of bat suitability. While the difference in suitability between the two sections is minor, it is worth noting that the proposed turbine locations are all within the lower-risk northern section.

**Table 7.11 Landscape model assessing bat habitat suitability.**

| **Section** | | **1** | **2** |
|---|---|---|---|
| Location | | North | South |
| Area (Ha) | | 172 | 22.6 |
| Overall risk level BCI | | 19.33 | 21.44 |
| **Risk by species*** | | | |
| *Nyctalus leisleri* | Leisler's bat | 26 | 28 |
| *Pipistrellus pipistrellus* | Common Pipistrelle | 30 | 32 |
| *Pipistrellus pygmaeus* | Soprano Pipistrelle | 29 | 31 |
| *Pipistrellus nathusii* | Nathusius Pipistrelle | 5 | 7 |

| Section | | 1 | 2 |
|---|---|---|---|
| *Plecotus auritus* | Brown Long-eared bat | 29 | 32 |
| *Rhinolophus hipposideros* | Lesser horseshoe bat | 0 | 0 |
| *Myotis mystacinus* | Whiskered bat | 15 | 20 |
| *Myotis daubentonii* | Daubenton's bat | 16 | 17 |
| *Myotis nattereri* | Natterer's bat | 24 | 26 |

** Green shading and low numbers indicate low suitability, amber shading indicates moderate suitability and red shading, and high numbers indicate high suitability.*

### Roost assessment

A total of 49 trees and seven built structures were identified to have potential for roosting bats and were later subject to emergence/re-entry surveys. Due to the results of the preliminary assessment of buildings, it was possible for the majority of the structures around the wind farm site to be scoped out of further surveys. One building within the 200m buffer of turbines was found to contain a brown long-eared bat transition roost. This was located 160m south-west of turbine T9. High levels of common pipistrelle activity were recorded around farmyard buildings 600m from turbine T2, as such it is likely that a bat roost is located in the close proximity to this location. The emergence and re-entry surveys did not identify any roosts in trees, though a single soprano pipistrelle was found to be roosting in a crevice in the Ballybeg Prior ruins, 5km east of the turbine T6 location.

### Activity assessment

During walked surveys, a total of five species of bats were recorded: common pipistrelle, soprano pipistrelle, Leisler's bat, brown long-eared bat, and a myotis species. Where the call could not be identified to species, the identification was determined to the highest possible level. The most commonly recorded species were common and soprano pipistrelle, followed by Leisler's, with lower levels from other species.

Over the course of four rounds of static detector deployment, 77,414 recordings were made from at least seven different species: common pipistrelle, soprano pipistrelle, Leisler's bat, Nathusius's pipistrelle, brown long-eared bat, Natterer's bat, and Daubenton's bat. The majority of these recordings were from common pipistrelles, soprano pipistrelles, and Leisler's bats.

### Ecological valuation

All bats recorded are classified as 'Least Concern' on the Irish Red List (2019)[34] but are afforded protection under the Wildlife Acts and further additional protection due to their inclusion as Annex IV species under the EU Habitats Directive. Due to the wind farm site's suitability for bat species, the numbers of bats recorded during the surveys and

[34] Marnell, F., Looney, D. & Lawton, C. 2019. Ireland Red List No. 12: Terrestrial Mammals. National Parks and Wildlife Service, Department of the Culture, Heritage and the Gaeltacht, Dublin, Ireland.

their inclusion as Annex IV species, the bat assemblage is considered to be of **Local (Higher value) importance.**

*7.7.4.5 Badgers*

The desk study returned records of badger within 10km of the wind farm site boundaries and habitats such as improved grassland and hedgerows were noted as being suitable for sett building and foraging badgers. The National Sett Database, Biodiversity Ireland, (2022)[35] was reviewed to establish if badger setts have been recorded within and around the wind farm site, where it was confirmed that badger setts had historically been recorded around the periphery areas. During ecological surveys on the wind farm site, five active badger setts were recorded on the wind farm site boundaries in the south-west and additionally one active sett was recorded on the wind farm site boundaries in the north-east. Furthermore, a small number of field signs were recorded around these areas including mammal paths. Suitable badger habitat exists in abundance throughout the immediate vicinity of the wind farm site and with their presence on site being confirmed, badgers are considered as being of **Local (Higher value) importance.**

*7.7.4.6 Otters*

The desk study returned ten records of otter within 10km of the wind farm site boundaries, though no evidence of otter was recorded during the site visits. Habitat on site was additionally deemed not suitable to support otters as access to waterways is too distant or unsubstantial given the only watercourses within 1km of the wind farm site are order one streams, which are generally unsuitable for foraging otters. It is therefore considered that otters are likely absent from the wind farm site and the immediate surroundings and thus are deemed of **Local (Lower value) importance.**

*7.7.4.7 Other mammals*

The desk study returned five records of hedgehog within 10km of the wind farm site boundaries, with the latest record being from August 2020. The field survey additionally identified droppings from hedgehog towards the southwest of the wind farm site adjacent to suitable hedgerow habitat. Other suitable habitat present consists of treelines, scrub, and improved grassland. Taking this and their conservation status into consideration, hedgehog populations on site are deemed to be of **Local (Higher value) importance.**

The desk study returned a number of records of other terrestrial mammals protected under the Wildlife Acts as amended within the wind farm site and surrounding area. These included the pygmy shrew and the red squirrel.

Although no records exist for Irish hare in the vicinity of the wind farm site the species was sighted on four occasions throughout the field survey with maximum numbers seen at one time totalling three individuals.

No signs of pygmy shrew or red squirrel were recorded on site though habitat is deemed suitable for pygmy shrew through the presence of arable land, hedgerows, and treelines. Habitat is not deemed sufficient for red squirrel except as sub-optimal, fragmented

[35] Biodiversity Ireland. 2022. The National Badger Sett Database. Available at https://maps.biodiversityireland.ie/Dataset/30.

commuting corridors. Due to evidence of presence from desk studies or field surveys and their conservation interest, along with the presence of suitable habitat on site, pygmy shrews are deemed to be of **Local (Higher value) importance.**

However, as there is a lack of suitable habitat on site to support a notable population of red squirrel, they have been considered to be of **Local (Lower value) importance.**

### 7.7.5 Aquatic ecology

A summary of the aquatic ecology results is provided below. Further details of the individual surveys and their findings are provided in EIAR **Volume III, Appendix 7.2**.

#### *7.7.5.1 Physical characteristics*

The wind farm site is located within the Munster Blackwater catchment and is drained by three main watercourses within that catchment: the Awbeg (Kanturk), the Finnow (also known as the Ballyclogh stream) and the Awbeg (Buttevant). The wind farm site is situated atop a limestone and sandstone plateau which is a significant driver in terms of the characteristics of watercourses in the area. On both the OSI mapping, and on the EPA web portal, there are no streams indicated in the vicinity of the wind farm site, and when viewed on mapping, the whole area is devoid of watercourses.

Drainage on this plateau is good, and in dry conditions water leaves the wind farm site via underground limestone aquifers. During wet weather, small intermittent[36] and ephemeral[37] flows are present in drains on the plateau, draining what water the aquifers do not take. Two broad zones of influence were identified when identifying the characteristics of the aquatic ecology of the wind farm site and its surroundings. Such zones include:

- The inner zone, which consists of the small drains on the plateau.
- The middle zone, which consists of the Awbeg (Kanturk), the Finnow (Ballyclough stream) and the upper Awbeg (Buttevant).

The majority of the wind farm site and its infrastructural elements are drained by the Awbeg (Kanturk). Many of the drains within this drainage network are partially dry, the majority of the time, being especially dry during the surveys. During times of higher precipitation, this drain flows south-west until it turns into a 'losing watercourse'[38] between the townlands of Scart and Cecilstown, and eventually completely disappears to the ground water aquifers. As such there is no direct overground link to the Lisduggan stream and the Awbeg (Kanturk). This is significant in terms of aquatic ecology, as it represents a complete barrier to fish passage, and when a drain dries out, this eventually renders the drain unsuitable to fish and other target aquatic species such as crayfish and mussels.

Two small drains head east from the wind farm site and are within the Awbeg (Buttevant) catchment; again, these were dry during the surveys, and they only drain a small proportion of the wind farm site, with one turbine and a small section of access track in each. They were revisited in autumn/winter 2022 following heavy rain and were found to

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[36] A watercourse that occurs only in a certain time of the year when it receives ample water.

[37] A watercourse that only flows in direct reaction to rainfall, and whose cannel is always above the water table.

[38] A stream or reach of a stream which shows a net loss of water to groundwater or evaporation.

contain a small flow of water. The northern of the two drains was found to go to ground into a pothole/sinkhole at the Mallow-Lisgriffin Road in the townland of Dreenagh East, and it was not found to re-emerge anywhere nearby. The southern of the two drains crosses the Mallow-Lisgriffin Road in the townland of Kilmaclenine soon after which it enters a wetland, vegetated with mat-grass and rushes. Full connectivity to a downstream watercourse was not established during the assessment; however, applying the precautionary principle, it is assumed to connect to a first order watercourse in the Botharascrub area which drains in the Awbeg immediately downstream of Buttevant village. Both drains were generally heavily vegetated and of low gradient, which would have a reductive effect on suspended solids resulting from the Project.

Finally, there is a small section of the southern part of the wind farm site within the Finnow stream catchment, also known as the Ballyclough stream catchment. There are no proposed turbines within this catchment and only a short section of existing access track is present within this part of the wind farm site. This was included at scoping stage to allow for design flexibility, and to ensure a good radial baseline understanding given the potential for karst geology at the wind farm site. There is no direct surface water connectivity between the wind farm site and the Ballyclough stream.

The aquatic network off-wind farm site, within the wider ZoI, including the Turbine Delivery Routes (TDR) and Grid Connection Routes (GCR) is made up of the middle zone and the main channel of the Blackwater which eventually leads to the Blackwater River SAC. The majority of the turbine hardstands, and associated infrastructure are situated within the Lisduggan North sub-catchment of the Awbeg (Kanturk). The Lisduggan North sub-catchment is made up of one main first order stream and one small first order stream which converge at Ardine Bridge, then flow 1.5km southwest before they flow into the Awbeg (Kanturk) 2km upstream of the confluence with the Blackwater. The southern tip of the wind farm site is within the Finnow, or Ballyclogh, catchment. This watercourse consists of two main legs which converge at Ballyclogh village: one from the east, and one from the west. The leg from the east rises in New Twopothouse and flows for 6.5km to Ballyclogh village. Within all of these watercourses, suitable and varied habitat exists with the potential to be able to support populations of FPM, crayfish, and other fish such as salmonids.

#### *7.7.5.2 Biological water quality analysis*

A total of seven biological water quality sample sites were selected for the Project to augment existing information from the EPAs water quality monitoring programme (refer to EIAR **Volume III, Appendix 7.2**). The sample sites achieved ratings of Q2 - 4, with further details provided in EIAR **Volume III, Appendix 7.2**.

#### *7.7.5.3 Crayfish*

The watercourses within and close to the wind farm site which are not shown on OSI map or on the EPA web portal were all found to be dry during the surveys and are likely to only contain a small flow of water following spells of heavy rain, as was observed in autumn/winter 2022; as a result, they were assessed to be unsuitable for crayfish. Therefore, crayfish within the wind farm site are deemed likely to be absent.

Suitable habitat for crayfish was only found at a distance from the wind farm site. A total of eight sites were surveyed for crayfish; these sites ranged from 2.5km to 10km from the wind farm site. Two sites were within the Awbeg Buttevant catchment, one was within the Ballyclough catchment, and the remaining five were within the Awbeg Kanturk catchment (refer to EIAR **Volume III, Appendix 7.2** for the locations of crayfish surveys). Three sites recorded the presence of crayfish, either as individual or within otter spraint remains. Such sites are detailed within EIAR **Volume III, Appendix 7.2** and include Gortnagross in the Ballyclough catchment and reach 1 and 2 in the Blackwater main channel catchment.

#### *7.7.5.4 Freshwater Pearl Mussel (FPM)*

The watercourses with and close to the wind farm site were found to be all but dry during the surveys and are likely to only contain a small flow of water following spells of heavy rain, as was observed in autumn/winter 2022; as a result, they were assessed to be unsuitable for FPM; a species which requires a constant source of water. Additionally, the streams close to the wind farm site that were not dry were considered too small and too base rich in terms of water chemistry to support a population of FPM, and thus no survey transects were conducted within them. Furthermore, snorkel surveys that targeted crayfish and fish surveys within the wider catchment revealed no presence of FPM.

Two 'reaches' of the Blackwater main channel were surveyed for FPM. Reach 1 was selected 150m downstream of the Awbeg (Kanturk) confluence, within suitable FPM habitat. Reach 2 was situated within suitable habitat immediately downstream of the Finnow confluence. One live mussel and six dead mussel shells were found in a small patch of what would be considered optimal habitat in Reach 2, in a run downstream on Longfields Bridge. No FPM were observed during the surveys of Reach 1. The National Biodiversity Data Centre have records of FPM throughout the Blackwater catchment. No records were present within Reach 1, but a record from 2006 was present within Reach 2.

#### *7.7.5.5 Fish*

The plateau upon which the wind farm site sits has no flowing streams and the drainage network dries out during the dry spells. When this drainage network is re-wetted following precipitation, there are fish passage issues because the drainage network drains to the groundwater aquifers and there is no direct connectivity to a watercourse through which fish can pass. As such, it is unlikely the wind farm site supports any significant fish populations, and no fish were observed to be present during the on-site surveys.

Within the wider area, juvenile and adult salmon (*Salmo salar)* and trout (*Salmo trutta)* were seen in the main channel of the Blackwater, with one particularly big trout seen in a run at the lower end of Reach 2, and adult salmon resting in the pool gouged out by the drop off of the apron of Longfields Bridge. A number of European eel (*Anguilla Anguilla*) were also seen. River/brook lamprey (Lampetra sp.) were plentiful in pockets of suitable habitat (caught with dip net). Three-spined stickleback (*Gasterosteus aculeatus*) and minnow (*Phoxinus phoxinus)* were also present. Shoals of dace (*Leuciscus leucisus*) were seen in large numbers in the shallows; the Blackwater is thought to be the first river in the country to receive this non-native invasive fish.

The Ballyclough river contained a strong population of trout, with some rather large individuals given the size of this watercourse. Eel were also present as well as lamprey. The Awbeg (Kanturk) contained salmon and trout. A visit in winter 2022 revealed the presence of a good number of spawning salmon in the vicinity of the Awbeg-Lisduggan confluence as evidenced by the remains of individuals having been eaten by otter as well as remains in large heaps of otter spraints; this, combined with spawning and holding habitat indicated that the middle section of this river is an important area for salmonid spawning. Eel, lamprey (sp) and three-spined stickleback were also present in this system. Only trout were seen in the unnamed stream passing through Lisgriffin beyond the wind farm site boundaries, and the Awbeg (Buttevant), again beyond the wind farm site boundaries, was not snorkelled/surveyed with bathyscope.

**Twaite shad and lamprey**

The three native lamprey species[39] as well as the twaite shad (*Fallax fallax*) all occur in the Blackwater catchment. They are addressed here as they are designated species of the Blackwater River (Cork/Waterford) SAC 002170, although there is no potential for them to be present within the wind farm site. There are two weirs within the Blackwater catchment that are preventing the upstream migration of twaite shad and river lamprey completely and stopping a large percentage of the sea lamprey population from gaining passage. This essentially relegates twaite shad and river lamprey to the lower reaches of the Blackwater. It also brings the sea lamprey population far below its potential for the river. Brook lampreys are essentially ubiquitous in the Blackwater, existing, as long as suitable spawning and nursery habitat is present, in all but the steep headwater streams, stretches of small streams above barriers to passage and ephemeral streams within the catchment. However, as outlined above, habitat that is potentially suitable for brook lamprey and other fish species is not present within the wind farm site.

#### *7.7.5.6 Watercourse crossings along the cable route*

The GCR Option 1 crosses one water feature along it's ~13.5km length (see EIAR **Volume III, Appendix 7.2**) where Horizontal Directional Drilling (HDD) will be used. This is a third order stream (Blackwater (Munster_140) – also locally known as Caherduggan South) and varies between 1.4m and 2.6m in width. It is subject to spate floods, owing to a fan of four steep headwater tributaries. The bed is silted, and the water, during both visits, had a murky silty look to it; this may be due to its proximity to the N72 or to the large percentage of its catchment given over to tillage, or a combination of the two. There are trout in this stream. Salmon are almost certainly absent due to the fact that it is forced under mallow town for at least 500m. The banks are stable and well vegetated.

#### *7.7.5.7 Ecological valuation*

Taking into consideration the physical characteristics summarised above and detailed within EIAR **Volume III, Appendix 7.2**, the drain network across the wind farm site and within its immediate surroundings is deemed to be of **Local (Higher value) importance** given the susceptibility for the drains to dry out and their relative abundance in the wider landscape.

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[39] Sea lamprey (*Petromyzon marinus*), brook lamprey (*Lampetra planeri*) and river lamprey (*Lampetra fluviatilis*)

The watercourse network off-site, within the wider 15km ZoI, all drains towards the Blackwater channels which leads to the Blackwater River (Cork/Waterford) SAC. A number of watercourses within this network have suitable habitat for and contain the presence of a number of protected and/or priority species, as discussed above, some which are designated species of the Blackwater River (Cork/Waterford) SAC (see **Table 7.7**). Therefore, taking this into consideration combined with the potential effect from the construction of the GCR where a watercourse crossing is proposed, the aquatic ecology off-site has been deemed as up to **International importance**.

### 7.7.6 Future baseline ('Without Scheme' scenario)

The future baseline describes the ecological features as they would be in the opening year/year of operation, in the absence of the Project. They are influenced by future developments and factors that have a high degree of uncertainty, such as future land management and climate change. Where information exists on planned future developments, this has been taken into consideration during the assessment.

Long-term climatic predictions suggest that warmer, wetter, winters and drier summers will become more frequent, with more extreme weather events likely. Combined with changes in land management, increased urbanisation and increased biotic pressures, climate change may lead to an increase in the population and distribution of some species in Ireland, but a decrease in other species, such as barn owl. However, such changes are unlikely to be material during the intervening period between the time when the field surveys were undertaken to inform this assessment and the opening year of operation of the Project.

There are no committed or forecasted changes in land management proposals within the wind farm site that will likely materially alter the baseline conditions in the absence of the Project. It is therefore assumed that the future baseline will, in general, be similar to the current baseline, and the value of the ecological features that are relevant to the Project would be consistent with that of the existing baseline conditions described above.

### 7.7.7 Evaluation of ecological features

**Table 7.12** below outlines the importance of each of the ecological features identified within the ZoI of the Project. Features of Local (Lower value) or of Negligible importance, and those to which effects can be categorically ruled out, are scoped out for further assessment, and are therefore not considered further. It should be noted that a precautionary approach has been taken in determining which features are taken forward for further assessment as described in section 7.6.4.2, based upon their conservation status, population trends and likely importance to designated sites.

**Table 7.12. Assessment of ecological importance.**

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| **European Designated Sites** | | | | |
| Blackwater River (Cork/Waterford) SAC | Designated as a Special Area for Conservation (SAC) under the EU Habitats Directive | There is no direct connectivity from the site to Dreenagh East stream (IE_SW_18A050700) which is connected to the Blackwater River SAC. However, drainage ditches on site may offer indirect connectivity to the stream. This stream is within 800m of the proposed turbine T1 location. Any hydrological pollution may potentially negatively affect conservation interests of the SAC, especially given that the majority are aquatic based. Assessment of effects upon these effect pathways is therefore required. | **International Importance** | **In** |
| Ballyhoura Mountains SAC | Designated as a Special Area for Conservation (SAC) under the EU Habitats Directive | There is no clear pathway between the wind farm site and any of the qualifying interests of the SAC. | International Importance | Out |
| **Nationally Designated Sites** | | | | |
| Eagle Lough pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts. | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |
| Awbeg Valley (Above Doneraile) pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | The wind farm site is hydrologically connected to the pNHA. Assessment of effects upon these effect pathways is therefore required. | **National Importance** | **In** |
| Kilcolman Bog pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| Ballinvonear Pond pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |
| Ballyhoura Mountains pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |
| Banteer Ponds pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |
| Priory Wood pNHA | Designated as a proposed Natural Heritage Area under the Wildlife Acts | There is no clear pathway between the wind farm site and any of the qualifying interests of the pNHA. | National Importance | Out |
| **Habitats** | | | | |
| Arable Land (BC1) | N/A | Widespread habitat with little native vegetation, poor species diversity as well as being ubiquitous in the surrounding landscape. Intensively managed and of limited biodiversity value, with only a small amount of permanent land take (0.06 ha) involved as part of the development proposals. 1.39 ha of temporary habitat loss is proposed but the reinstatement of this habitat would be straightforward, immediate, and unlikely to cause significant effects to local fauna. Therefore, an assessment of effects is not required. | Negligible Importance | Out |
| Tilled Land (BC3) | N/A | Widespread disturbed habitat that is absent of vegetation, and ubiquitous in the surrounding agricultural landscape. Being intensively managed, it has limited biodiversity value. Only a | Negligible Importance | Out |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | small amount of permanent land take (0.04 ha) is proposed as part of the proposals, with temporary loss amounting to no more than 0.23 ha. Reinstatement of this habitat would be straightforward, immediate, and unlikely to cause significant effects to local fauna. Therefore, an assessment of effects is not required. | | |
| Buildings and Artificial Surfaces (BL3) | N/A | Widespread, highly modified, disturbed habitat that provides little value to biodiversity. No buildings within the wind farm site are being proposed for demolishment and so an assessment of effects is not required. | Negligible Importance | Out |
| Disturbed Ground (ED2) | N/A | Farm lanes consisting of spoil and bare ground provide continuity across portions of the wind farm site, providing access to field parcels, some species indicative of disturbed ground but not considered of conservation concern. Cattle rubs along some of the farm lanes have created suitable nesting habitat for buff mining bee, a species listed as vulnerable on the Irish Red List. There will be some permanent and temporary loss to this habitat and so an assessment of effects is required. | **Local (Higher value) Importance** | **In** |
| Eutrophic Lakes (FL5) | N/A | This habitat occurs in the northeast of the wind farm site within an area of improved agricultural grassland. It represents a source of freshwater and therefore improves the habitat heterogeneity of the area. Damselfly abundance was noted to be substantial in the vicinity indicating value as an important breeding and foraging site for | **Local (Higher value) Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | invertebrates, which form the base of the food chain. Whilst this habitat is to be retained as part of the development, it will be sensitive to pollution from the construction and decommissioning phases. Therefore, an assessment of effects is required. | | |
| Artificial Lakes and Ponds (FL8) | N/A | This habitat occurs in the northeast of the wind farm site within an area of scrub and consists of a hollow with standing water, rubble and waste. This habitat additionally occurs in the southern part of the wind farm site adjacent to the wet grassland. Providing habitat heterogeneity, this habitat is of ecological value and supports a wide range of species. This habitat is to be retained as part of the Project; however, it will be sensitive to pollution from the construction and decommissioning phases and so an assessment of effects is required. | **Local (Higher value) Importance** | **In** |
| Drainage Ditches (FW4) | N/A | This habitat is widespread within the wind farm site, running along many of the field boundaries, acting as drainage within an intensively farmed landscape. Even though only a small amount of temporary loss is being proposed, it will be sensitive to pollution from the construction and decommissioning phases and so an assessment of effects is required. | **Local (Higher Value) Importance** | **In** |
| Improved Agricultural Grassland (GA1) | N/A | Widespread and common habitat with poor species diversity as well as being ubiquitous in the surrounding landscape. Intensively managed and of limited biodiversity value, with only a relatively | Local (Lower value) Importance | Out |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | small amount of permanent land take (1.53 ha) involved as part of the development proposals in proportion to its presence within the wind farm site and surrounding landscape. Approximately 8.36 ha of temporary habitat loss is proposed but the reinstatement of this habitat would be straightforward, immediate, and unlikely to cause significant effects to local fauna. Therefore, an assessment of effects is not required. | | |
| Wet Grassland (GS4) | N/A | Small proportions of this habitat exist to the south of the wind farm site with a wide diversity of plant species. Despite there being no temporary or permanent land take proposed, this habitat is of ecological value and sensitive to pollution from development. Therefore, an assessment of effects upon this habitat is required. | **Local (Higher value) Importance** | **In** |
| Dense Bracken (HD1) | N/A | This habitat occurred within scrub around a historic feature. Little species diversity was recorded, though mammal trails, an excavation and droppings indicate use of the habitat by red fox. Nevertheless, this is a widespread and common habitat that provides little biodiversity value. Additionally, no land take of this habitat is proposed as part of the Project and so an assessment of effects is not deemed necessary. | Local (lower value) Importance | Out |
| Treelines (WL2) | N/A | Limited in its extent but where it does occur, this habitat has a variety of native species. Treelines are of ecological value to some notable species, due to their importance as linear habitats and areas of nesting and/or roosting habitat. The | **Local (Higher value) Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | Project proposals do include some permanent (89 m) and temporary (11 m) of treeline loss and thus an assessment of effects upon this habitat is deemed necessary. | | |
| Hedgerow (WL1) | N/A | Relatively continuous and widespread habitat across the wind farm site which is of ecological value. There is some variation in the condition of this habitat with some hedgerows gappy and over managed and others more mature with less intensive management. Project plans propose some permanent (221m) and temporary (220m) removal of this habitat to facilitate the construction and transportation of wind turbines as well as species specific mitigation plans (i.e., for bats) that involve the loss of hedgerows. An assessment of effects upon this habitat is therefore required. | **Local (Higher value) Importance** | **In** |
| Scrub (WS1) | N/A | Present on the wind farm site predominantly in the south-east and to the north. Despite the proposals not involving any scrub removal to construct the wind farm and associated infrastructure, scrub removal is proposed at pinch points along the TDR to facilitate the transportation of the turbines. Taking this into consideration, an assessment of effects upon this habitat is required. | **Local (Higher value) Importance** | **In** |
| Mixed Broadleaved Woodland (WD1) | N/A | Two areas of highly modified pockets of woodland are present within the wind farm site boundaries. Despite no land take of this habitat being proposed as part of the development, the southern pocket of woodland is directly adjacent to the proposed location of the new substation, which | **Local (Higher value) Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | may result in pollution of this habitat during construction/decommissioning. Furthermore, due to the presence of Japanese Knotweed within the vicinity of the woodland, it is possible that construction activities may spread this further within the woodland, in the absence of mitigation. Therefore, an assessment of effects upon this habitat is required. | | |
| **Fauna** | | | | |
| Invertebrates | Red-tailed bumble bee (near threatened on the Irish Red list), and buff mining bee (Vulnerable on the Irish Red list) | The red-tailed bumble was recorded utilising habitat throughout the wind farm site, predominantly hedgerows. Due to the planned loss of hedgerows as part of the Project plans and the conservation status of this species, an assessment of affects upon this species is required.<br>The buff mining bee was recorded on cattle rubs in the northeast of the wind farm site with southerly aspects. There is some small loss associated with disturbed ground, a habitat which this species utilises. Habitat loss and disturbance/displacement effects therefore cannot be ruled out at this stage, making an assessment of effects necessary.<br>An assessment of effects will also be conducted on invertebrate assemblages on site as a whole due to possible construction related disturbance effects and habitat loss associated with hedgerows and treelines. | **Local (Higher value) Importance** | **In** |

| **Ecological feature** | **Conservation status** | **Evaluation rationale** | **Importance** | **Scoped in/out of assessment** |
|---|---|---|---|---|
| Amphibians | Protected under the Wildlife Acts and EU Habitats Directive [92/43/EEC] Annex V.<br>Common frog and smooth newt (least concern on Irish Red list)<br>Natterjack toad (endangered on Irish Red list) | Habitat suitable for amphibians is restricted to ponds and small areas of wet grassland, and field margins. The wind farm site is unlikely to support a notable population of amphibians and so effects from the Project are not likely to be significant. Additionally, the limited amount of suitable habitat that is present is being retained as part of the Project and so habitat loss would not result in a significant effect. An assessment of effects is therefore not deemed necessary. | Local (Lower value) Importance | Out |
| Reptiles | Protected under the Wildlife Acts.<br>Common lizard (least concern on Irish red list) | Habitats on site for reptiles are largely sub-optimal with suitable habitat being restricted to field margins and hedgerows. This habitat is not extensive enough to be able to support a notable population of reptiles and the construction of the Project will largely avoid these areas of suitable habitat. There would therefore be no significant effects on reptiles as a result of the Project and so further assessment of effects is not deemed necessary. | Local (Lower value) Importance | Out |
| Bats | Protected under the Wildlife Acts and listed as an Annex IV species under the EU Habitats Directive.<br>All bat species are of least concern on the Irish Red List. | Results from detailed bat assessments show a considerable number of bats using habitats on site for commuting and foraging. While no roosts were recorded within the wind farm site itself, one was recorded within the 200m buffer of a turbine. As part of the Project proposals, some hedgerows (a commuting and foraging resource for bats) in the vicinity of the turbines will be removed causing potentially significant habitat losses. Additionally, there is a possibility of bat mortality through collision with wind turbines as well as the potential | **Local (Higher value) Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | for disturbance and displacement from construction, operational, and decommissioning related activities. Therefore, an assessment of effects is required. | | |
| Badgers | Protected under the Wildlife Acts.<br>Least concern on the Irish Red list. | Due to the presence of badger setts and field signs on site, as well as suitable habitat, disturbance/displacement effects cannot be ruled out. Additionally, land take as part of the development will result in a temporarily small loss of foraging habitat. Therefore, an assessment of effect is deemed necessary. | **Local (Higher value) Importance** | **In** |
| Otters | Protected under the Wildlife Acts and listed as an Annex II and IV species under the EU Habitats Directive.<br>Least concern on the Irish Red list. | Habitats on site were deemed not suitable to support otters as access to waterways is too distant or unsubstantial given the only water courses within 1km of the wind farm site are order one streams, which are generally unsuitable for foraging otters. Therefore, effects from habitat loss and disturbance/displacement can be ruled out and so an assessment of effects is unnecessary. | Local (Lower value) Importance | Out |
| Hedgehog | Protected under the Wildlife Acts.<br>Least concern on the Irish Red list. | Evidence of hedgehogs were recorded on site and as part of the desk study, along with suitable habitat in and around the wind farm site. Effects from habitats loss and disturbance/displacement can therefore not be ruled out and an assessment of effects is required. | **Local (Higher value) Importance** | **In** |
| Pygmy shrew | Protected under the Wildlife Acts.<br>Least concern on the Irish Red list. | Suitable habitat for pygmy shrew occurs in arable land, hedgerow, and treeline habitat throughout the wind farm site. Effects from habitats loss and disturbance/displacement can therefore not be | **Local (Higher value) Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | ruled out and so an assessment of effects is required. | | |
| Red squirrel | Protected under the Wildlife Acts.<br>Least concern on the Irish Red list. | Recorded in the study area as part of the desk study but there is unsuitable habitat for foraging or breeding red squirrel on site, meaning a notable population would not be able to exist on site. Significant effects from habitat loss and disturbance/displacement can therefore be ruled out. | Local (Lower value) Importance | Out |
| **Aquatic ecology** | | | | |
| Aquatic ecology (within the wind farm site boundaries) | Covered under the Water Framework Directive and the Wildlife Acts. | The watercourses within and close to the wind farm site were found to be all but dry during the surveys; as a result, they were assessed to be unsuitable for most aquatic species. Regular drying out of ditches acts as a barrier for most aquatic species and reduces the potential for pollution to be carried off-site. However, during times of higher precipitation, limited hydrological connectivity has the potential to impose construction and decommissioning related effects through the introduction of pollution to the watercourse. As such, an impact assessment is required for aquatic ecology within the wind farm site. | **Local (Higher value) Importance** | **In** |
| Aquatic ecology (off-site, within the Zone of Influence) | Covered under the Water Framework Directive and the Wildlife Acts. Some species listed as Annex II species under the EU Habitats and Species Directive. | There is potential for works along the grid connection route to affect the watercourse network off-site, within the wider ZoI. As many of the water features connect, have high water quality, and support FPM, crayfish, and other fish species like salmonids, an assessment of effects is required. | **Up to International Importance** | **In** |

| Ecological feature | Conservation status | Evaluation rationale | Importance | Scoped in/out of assessment |
|---|---|---|---|---|
| | | This is especially significant as those species recorded are listed as designated features of the Blackwater River (Cork/Waterford) SAC. | | |
| **Invasive non-native species** | | | | |
| Japanese knotweed | High-risk invasive non-native species: Biodiversity Ireland (Article 49 and 50 species under the Wildlife Acts), the Third Schedule list of the European Communities (Birds and Natural Habitats) Regulations 2011 – 2-15; and the Invasive Alien Species of Union concern listed under the EU IAS Regulation [Regulation No. 1143/2014] | Japanese knotweed was identified in two different locations on site. The first location occurs throughout an entire field boundary northeast of farm sheds within the southern part of the wind farm site, and the second stand was identified in a field east of the southern farmyard adjacent to an area of woodland. Japanese knotweed was also identified at Boherash Cross on TDR Option 1 and the near to the turn off after Mallow Hospital on TDR Option 2. An assessment of whether Project activities would likely spread Japanese knotweed is therefore required, which is presented in section 7.9.3 of this chapter. | **High-risk** | **In** |

## 7.8 Embedded mitigation

From the early stages of the Project design development, an iterative process of a constraints led design was employed, whereby ecological information was utilised to avoid effects on potentially important ecological features where possible.

Likely effects on ecological features were a contributing factor to the wind farm site selection, with the selected wind farm site generally comprising relatively low suitability for protected habitats and species populations. Areas of greater importance to ecological features are to be retained within the design of the Project (e.g., waterbodies and woodland habitats). Furthermore, the Project has been designed to minimise the extent of habitat loss. As such, new hardstanding areas will cover the minimum required area possible. Furthermore, the grid connection and turbine delivery routes would utilise-built infrastructure for the majority of their lengths, with cables being laid underground within the existing road network where possible, which will minimise disturbance to semi-natural habitats.

The Project design has followed the basic principles outlined below to eliminate the potential for significant effects on ecological features.

### 7.8.1 Construction methods

Best practice construction measures will be adopted to minimise potential construction and decommissioning effects on ecological features. These are detailed within the Construction Environmental Management Plan (CEMP) (see EIAR **Volume III, Appendix 5.1**) and include measures to minimise working areas to avoid unnecessary habitat removal/alteration and disturbance, and measures to avoid/minimise the generation of additional noise, dust, light spill, and vibration. Avoiding nocturnal lighting of suitable habitat will limit disturbance effects on bats and other crepuscular species. In particular, removal of trees and dense vegetation such as hedgerows and scrub will be limited wherever possible. The CEMP also includes measures to avoid pollution of terrestrial habitats and waterbodies within and adjacent to the wind farm site.

Additional measures to be implemented within the construction and decommissioning phases of the development described within the CEMP include:

- No removal of habitats or movement of construction machinery will occur outside of the development works area during the construction phase, clearly marking out the works footprint for site staff.
- There is potential for retained trees and hedgerows to become damaged by construction activity whereby damage to roots would occur if they remained unprotected during construction activities. Measures to protect trees include the installation of tree protection barriers around the root protection zones of retained trees and hedgerows. Where essential works are required within the root protection zones, ground protection (such as cellweb membrane) will be installed following consultation with a qualified arboriculturist, to minimise risks of damage to roots (Refer to EIAR **Volume III, Appendix 7.4**).

- Existing hedgerows and trees being retained within and in the vicinity of the wind farm site will be protected in line with current guidance and on the advice of an appointed arboriculturist, (NRA, 2006).
- Management of invasive species prior to the commencement of construction. This will include measures to eradicate and control Japanese knotweed, which is present on site and along the TDR options and will ensure that all relevant staff are briefed and aware of the issues, the management plan, and their responsibilities. Management will include eradication through long term treatment with herbicides, excavation and disposal at a licensed landfill site and control through marking out contaminated areas (with a 7m radius from any stands), ensuring vehicles do not work within contaminated areas, and treating contaminated soils carefully.
- Construction materials will be stored and stockpiled so as to avoid deleterious effects according to strategies set out within the CEMP.
- Excavations will be covered at night to prevent mammals getting trapped. If this is not possible then a method of egress will be provided.
- All plant and machinery will comply with specific noise legislation (European Communities (Noise Emission by Equipment for Use Outdoors) Regulations 2001) and will be turned off when not in use.

### 7.8.2 Operational methods

Best practice measures described in relation to construction methods will also be adopted during operational maintenance, as described within the CEMP. Specifically, operational maintenance will minimise the level of removal of suitable habitat (e.g., grassland, hedgerows, scrub) and use existing access routes where possible. Best practice methods will be adopted to minimise the potential for disturbance (e.g., to minimise generation of additional noise, light and vibration), with a particular focus on avoiding activity within nocturnal periods, when particularly notable species are active.

Operational maintenance will additionally act to prevent any pollution from fuels, turbine fluids, and silty water through the appropriate use of silt fences, cut-off drains, and silt traps. Any pollution incidents will be reported immediately to the operational site manager and other external agencies as necessary. Any environmental incidents will be followed by appropriate remedial measures in consultation with those external agencies.

The finalised drainage design aims to result in attaining net beneficial effects through Nature Based Solutions (see **EIAR Chapter 9 Hydrology and Hydrogeology**, section 9.6.1.3). Nature Based Solutions include Sustainable Drainage Systems (SuDS), which will be employed to attenuate runoff and reduce the hydrological response to rainfall at the wind farm site. Extending or maximising this approach sufficiently has the potential to attain net beneficial effects (i.e., a net reduction in runoff rates at the wind farm site, beneficial effects to water quality and reducing flood risk to downstream flood risk areas). Coupling SuDS with ecology and biodiversity mitigation provides opportunities to attain net biodiversity gain.

### 7.8.3 Ecological Clerk of Works

An Ecological Clerk of Works (ECoW) will be appointed to address issues relating to ecological features during the construction and decommissioning phases, as described within the CEMP. Their responsibilities will include:

- Undertaking pre-construction surveys to ensure that significant effects to ecological features will be avoided.
- Inform and educate site personnel of sensitive ecological features within the wind farm site and how effects on these features could occur.
- Oversee management of ecological issues during the construction and decommissioning period and advise on ecological issues as they arise.
- Provide guidance to contractors to ensure legal compliance with respect to protected habitats and species on site.
- Liaise with officers from consenting authorities and other relevant bodies and contractors with regular updates in relation to construction and/or decommissioning progress.

### 7.8.4 Embedded bat mitigation

In order to reduce the risk of collision mortality of bats with turbine blades and overall effects on bats, the following embedded mitigation has been applied within the design phase of the Project:

#### *7.8.4.1 Buffer zones*

Bats typically use woodland edge habitats for commuting and feeding purposes. In situations where turbines are built within conifer plantations a typical mitigation measure is to keyhole the turbine by felling trees in order to discourage bat species from flying close to turbines. Various publications provide guidelines on buffer zones surrounding turbines to reduce the favourability of the wind farm site for bat activity. Eurobats 'Guidelines for consideration of bats in wind farm projects', (Rodrigues, *et al*., 2015)[40] recommend buffer zones of 200m from turbine base to high potential features, whilst Natural England, 2014[41] recommend 50m buffers from blade tip to tree. NIEA, Natural Environment Division, 2021[15] recommends a minimum buffer of 100m between the turbines at the edge of commercial forestry where wind farms are proposed to be key-holed.

The Project is situated within habitats dominated by improved grassland with accompanying treelines and hedgerows. The proposed wind turbines; Vestas V-150 4.5MW, will have a hub height of 100m and a blade length of 73.66m. Should the typical 50m buffer be put in place it would require a buffer of 98m from the turbine base where treelines are affected and 89m buffer when hedgerows are affected as described within **Table 7.13**.

[40] Rodrigues, Luisa., Bach, Lothar, Dubourg-Savage, Marie-Jo., & Karapandza, Branko. 2014. Guidelines for consideration of bats in wind farm projects. Eurobats.

[41] Natural England. 2014. Bats and onshore wind turbines: interim guidance. TIN051. Third Edition.

**Table 7.13. Buffer zone calculations.**

| | |
|---|---|
| **Buffer for treelines** | √((50+73.66)^2-(100 – 25)^2) |
| | 98m buffer zone |
| **Buffer for hedgerows** | √((50+73.66)^2-(100 – 15)^2) |
| | 89m buffer zone |

Based on a review of aerial photographs, the habitat map (see **Figure 7.4**), and information collected during surveys, turbines T1, T2, and T7 would require a buffer zone of 89m from the turbine bases while turbines T3, T4, T5, T6, T8, and T9 would require a buffer zone of 98m (see EIAR **Chapter 1 Introduction, Figure 1.4** for turbine locations). To follow this guidance would have resulted in the loss of 2.13km of hedgerow and treelines; habitats that have a considerable wider biodiversity value in a local context, providing shelter and foraging resources for assemblages of birds, invertebrates and other mammals (refer to section 7.7.2.9). As such, alternative mitigation measures have been proposed in order to mitigate bat fatalities, while retaining many of these features where their loss would otherwise be avoidable.

Where sections of treeline and hedgerow that fall within the bat buffers that are to be removed by necessity to facilitate construction of the Project, then those features will not be reinstated in-situ post-construction. Instead, their losses will be offset by planting elsewhere within the blue line boundary (see EIAR **Volume III, Appendix 7.3**). **Table 7.14** details the loss and retention of hedgerow and treeline habitats within the identified bat buffers.

**Table 7.14. Portions of hedgerow/treelines to be removed and retained within the bat buffer zones.**

| Turbine no. | Buffer zone | Length of hedgerow within buffer (retained) (m) | Length of hedgerows within buffer to be removed (m) | Distance of closest retained hedgerow to turbine (m) |
|---|---|---|---|---|
| T1 | 89 | 90 | 5 | 70 |
| T2 | 89 | 110 | 0 | 39 |
| T3 | 98 | 114 | 0 | 25 |
| T4 | 98 | 151 | 90 | 13 |
| T5 | 98 | 190 | 0 | 33 |
| T6 | 98 | 270 | 0 | 22 |
| T7 | 89 | 302 | 5 | 40 |
| T8 | 98 | 300 | 110 | 38 |
| T9 | 98 | 285 | 0 | 50 |
| **Total length** | | **1,812** | **200** | |

Given the necessity of keeping these portions of habitats within the buffer zones, additional mitigation strategies (curtailment and feathering strategies) are likely to be required as a result of the impact assessment. This is further discussed in sections 7.9 and 7.10 of this chapter.

*7.8.4.2 Retention of trees*

Any trees and treelines along approach roads and planned site access tracks will be retained unless felling is unavoidable. As described within the CEMP and within section 7.8.1 retained trees will be protected from root damage by an exclusion zone of at least 4x the girth of the tree(s) to be retained, as defined and advised by a suitably qualified and experienced arborist. Such protected trees will be fenced off by adequate temporary fencing prior to other works commencing.

*7.8.4.3 Lighting restrictions*

In general, artificial light creates a barrier to bats so lighting will be avoided wherever possible. As described within the CEMP and section 7.8.1, construction activities within the wind farm site will take place during daylight hours where possible to minimise disturbances to crepuscular species. Working hours for construction will generally be from 07:00 to 19:00 on weekdays, with reduced working hours from 08:00 to 14:00 on a Saturday. It should be noted that it may be necessary to commence turbine base concrete pours earlier due to time constraints incurred by the concrete curing process. Similarly, earlier working hours may be required in the case of turbine assembly to allow works within suitable weather conditions and turbine deliveries will generally be early morning working hours. However, the Project ECoW will limit night-time works to sections of the route/site that avoid sensitive features (i.e., mature treelines and hedgerows). Where lighting is required, directional lighting (i.e., lighting which only illuminates work areas and not nearby habitat features) will be used to prevent overspill. This can be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvers, and shields to direct the light to an intended area only.

There is some evidence to suggest that the lighting on top of wind turbines may affect the likelihood of bats colliding with turbines. Research indicates that intermittent lighting is less likely to cause species to collide with turbines (Powesland, 2009)[42]. All structures over 150m in height are required to have lighting to warn aviation traffic (see EIAR **Chapter 11 Material Assets**). Where this is the case, an aeronautical obstacle warning light scheme will be implemented, utilising flashing red aviation obstruction lights, subject to agreement with the Irish Aviation Authority, which will not adversely affect bats, (Bennett and Hale, 2014)[43].

*7.8.4.4 Pre-construction surveys*

**Ecological walkover**

Prior to the commencement of construction works, a pre-construction walkover survey of the wind farm site will be undertaken by a suitably experienced ecologist to confirm the robustness and validity of the ecological baseline and check for the presence of any new ecological constraints, such as badger setts, for example, which could have been created

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[42] Powlesland, R., 2009. Impacts of wind farms on birds: A review.

[43] Bennett, V.J. and Hale, A.M. 2014. Red aviation lights on wind turbines do not increase bat-turbine collisions. *Animal Conservation*, 17(4), 354-358.

during the intervening period since the baseline surveys were undertaken to inform this assessment. Should any additional constraints be identified then further mitigation will be designed and agreed with the relevant authorities as necessary.

**Bat activity surveys**

If three or more years lapse from between the baseline surveys from 2022 and installation of the wind turbines, one season of bat activity surveys during the activity period (EUROBATS, 2014)[44], will be repeated to establish a robust and reliable baseline for future monitoring. Future survey work will be completed according to best practice guidelines available (Hundt, 2012[45]; Collins, 2016[14]; SNH, 2019[13]; 2021[5]) and include static detector, activity, and roost inspection surveys.

**Pre-felling survey of trees**

A preliminary survey of trees within a 200m zone of each turbine was undertaken, identifying 49 category 1 and 2 trees and shrubs. All of these trees will require at-height surveys to be conducted by a suitably qualified (with roost disturbance and inspection camera licenses) ecologist if felling is required. Surveyors will carry out a detailed internal inspection using a torch, mirror, and endoscope. Data such as internal dimensions, particularly length of cavity, will be gathered, which is vital information to inform the removal of any bat roosts, should such be unavoidable. A derogation license will be sought from NPWS should a roost be identified within any feature requiring removal; seeking permission for the roost to be translocated (if possible).

Evidence of bat usage during the surveys will include:

- Bat droppings (these will accumulate under an established roost or under access points).
- Live bats or bat corpses.
- Insect remains (under feeding perches).
- Oil (from fur) and urine stains.
- Scratch marks.

#### *7.8.4.5 Monitoring*

The vegetation around the buffer zones around the identified turbines will be managed and maintained during the operation of the wind farm. These will be kept clear by mechanical means only and maintained on an annual basis in the same condition as during the first clearance. The immediate surroundings of individual turbines will be managed and maintained so that they do not lead to bat collision or attract bats through the increase of prey or vegetation.

### 7.8.5 Embedded aquatic ecology mitigation

To mitigate against the spread of crayfish plague, all earthworks related machinery (excavators, dumpers etc) which will be used in the creation of the site drainage system

[44] EUROBATS. 2014. Guidelines for consideration of bats in wind farm projects Revision 2014.

[45] Hundt L. 2012. Bat Surveys: Good Practice Guidelines, 2nd edition, Bat Conservation Trust.

will be washed when they are brought to the wind farm site; this will either happen in the contractor's yard, at a washing facility, or in the site compound.

The major embedded mitigation to prevent the likely effects to the ecology of watercourses, is the design and implementation of a highly functional site drainage system, with integrated silt management and flow attenuation management. For this project, a bespoke drainage system considering parameters such as rainfall rates, gradient, area, etc., was designed. A detailed breakdown of the site drainage system and associated mitigations are presented in EIAR **Chapter 9 Hydrology and Hydrogeology** and in EIAR **Volume III, Appendix 5.1**. Measures integrated into the drainage system will include a 50m buffer from watercourses except at water crossings, drainage installed in parallel with road construction, use of check dams and settlement-attenuation ponds for road drainage, and use of silt fencing during water crossings and around stockpiles. Crucially, the site drainage system will not outflow to the existing drainage network directly, but will discharge, via stilling ponds. The large number of these outfalls across the wind farm site are intended to keep volumes at each outfall low, thus ensuring high filtration efficiency and low erosion rates.

The input of silt will be managed using a range of techniques integrated into the design of the CEMP including stilling ponds, check dams, silt fences and silt screens.

The input of cement to watercourses will be mitigated onsite. Where concrete is delivered to the wind farm site, only the chute will be cleaned onsite. Chute cleaning water is to be isolated in temporary wash-out pits. No discharge of cement-contaminated water to the construction phase drainage system or directly to any artificial drain or watercourse will take place.

The input of hydrocarbons and other chemicals to watercourses will be mitigated against onsite, as detailed within the CEMP. All plant will be inspected and certified to ensure they are leak free and in good working order prior to use on the wind farm site. On-site re-fuelling of machinery will be carried out at a designated and controlled refuelling area will be established at the wind farm site Any chemical storage areas will be bunded appropriately for the fuel storage volume, as described in the CEMP. An emergency plan for the construction phase to deal with accidental spillages will be contained within the CEMP. Spill kits will be available to deal with accidental spillages.

Groundwater will not be significantly affected by the development (see EIAR **Chapter 9 Hydrology and Hydrogeology**). The principal residual risk to groundwater posed by the development is the use, storage and transfer of hydrocarbons (fuel) on site for plant equipment. In the unlikely event a spill occurs, the contaminant will be contained, managed and removed in good time.

Hydro-morphological changes to watercourses, brought about by changes within the catchment, will be mitigated to a large extent by the use of stilling ponds and check dams to attenuate water. Additionally, the vast majority of precipitation falling on the wind farm site ends up in the groundwater aquifers which has a modulating effect on hydrology and hydro-morphology. As such, hydro-morphological changes within watercourses are not expected as a result of the Project (see EIAR **Chapter 9 Hydrology and Hydrogeology** for further details).

The CEMP includes the provision of drainage monitoring and water quality monitoring during the construction and decommissioning phases of the Project. This will include an inspection and maintenance plan for the site drainage system and will be prepared in advance of commencement of any works (within the CEMP). 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.

Any excess build-up of silt levels at dams, the stilling ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed; however, this will be given careful consideration by the ECoW. During the construction of the GCR watercourse crossing, field testing, sampling and analysis of a range of parameters with relevant regulatory limits and Environmental Quality Standards (EQS) will be undertaken (i.e., weekly, monthly and event-based) as described in detail within the CEMP. Monitoring will be carried out following heavy rainfall events and during 95th percentile low flow rates (the flow which is surpassed 95% of the time) as this is the stage when pressures and threats are highest on aquatic biota.

All small drains to be crossed within the wind farm site will be piped. The design and installation of these crossings will follow the guidelines set out in "National Roads Authority National Roads Authority, (2005)[24]. Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes", further details of which are provided in EIAR **Chapter 9 Hydrology and Hydrogeology**. Drains or watercourses requiring culverting do not have significant ecological value.

The GCR crossing will be carried out using the directional drilling methodology (Horizontal Directional Drilling). The general concept of this is in itself a mitigation to protect watercourses in that it is carried out in a manner that avoids the direct contact with the watercourse, unlike the more traditional excavated cross-channel approach.

In terms of directional drilling, the key mitigations (as described within the CEMP) with respect to aquatic ecology include a geotechnical assessment prior to directional drilling, in particular where drilling is carried out through fissured or fractured rock or other geological formations where there is a risk of bentonite blow-out occurring. The works, including launch and receiver pits, will be carried out outside 20m from each watercourse. This is the buffer zone width recommended by Inland Fisheries Ireland (IFI). The drilling process shall be constantly monitored to detect any possible breakout or leaking of bentonite into the surrounding geology; this is gauged by observation and by monitoring pumping rates and pressures. Monitoring by an ecologist/environmental engineer will be required during directional drilling works. IFI and NPWS will be notified of the works in advance.

In terms of crossing within the bridge deck, critical elements with respect to aquatic ecology include for the placement of a sealed silt fence at both sides of the bridge crossing point and to a minimum of 10m upstream and downstream of each crossing on both sides of the road to divert water and runoff from the road into silt traps at each corner of the road. The size and design of these silt traps will vary and be suited to local conditions. The silt traps and sealed silt fence will be installed prior to any construction works commencing at the bridge crossing. An ecologist/environmental engineer will again be monitoring for the duration of the works.

# 7.9 Assessment of effects

## 7.9.1 Scope of assessment

Likely effects on ecological features from the Project during its construction, operation, and decommissioning phases are described in this section. The potential for impacts to adversely affect the identified Key Ecological Features is assessed in accordance with the process described in section 7.6.4.4. This assessment takes into consideration embedded mitigation within the Project design. Where embedded mitigation measures are insufficient to avoid potentially significant effects on features, further mitigation measures will be required (as described in section 7.10).

This assessment of effects is structured as follows:

- Assessment of effects in relation to sites designated for nature conservation.
- Assessment of effects in relation to key ecological features.
- Summary of likely effects associated with other proposed development projects (cumulative assessment).

## 7.9.2 Assessment of effects on designated sites

### *7.9.2.1 European designated sites*

**Natura Impact Statement**

In accordance with best practice guidance, a screening assessment and Natura Impact Statement (NIS) were prepared to provide the Planning Authority with the information necessary to complete an Appropriate Assessment for the Project in compliance with Article 6(3) of the Habitats Directive.

As per EPA guidance, 'a biodiversity section of an EIAR should not repeat the detailed assessment of likely 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 regarding relevant European sites with ecological interests within the ZoI.

**Blackwater River (Cork/Waterford) SAC**

The desk study and subsequent evaluation of ecological features identified one internationally designated site as requiring a detailed assessment of potential impacts, namely, Blackwater River (Cork/Waterford) SAC. This designated site is located approximately 6.2km from the Project and is designated for its internationally important riparian habitats and species.

There is no direct connectivity from the wind farm site to Dreenagh East stream (IE_SW_18A050700), which is connected to the Blackwater River SAC; however, drainage ditches on site may offer indirect connectivity to the stream. This stream is approximately 800m from turbine T1. Several qualifying interests of the Blackwater River SAC are vulnerable to sedimentation, for instance freshwater pearl mussel (*Margaritifera margaritifera*) and white-clawed crayfish (*Austropotamobius pallipes*). Drainage ditches on site were dry when checked in July and August 2022 and vegetation types suggest any water within the ditches is likely to be ephemeral, resulting in water evaporating from the ditch or infiltrating into the soil below. Accordingly, it is anticipated that the wind farm site offers negligible connectivity to the Dreenagh East stream. It should also be noted that this stream is approximately 7.3km from the Blackwater River (Cork/Waterford) SAC, which negates the risk of sedimentation reaching the SAC and having a likely significant effect on the conservation objectives of the qualifying interests of the SAC. Furthermore, standard good practice pollution prevention and control measures will be implemented during construction, as outlined in the CEMP (see EIAR **Volume III, Appendix 5.1**), which will further ensure that there will be no likely significant adverse effect on the SAC There is not considered to be any other viable pathways between the SAC and the wind farm site and therefore there would **not be a Likely Significant Effect** on this site as a result of the Project.

#### *7.9.2.2 Nationally designated sites*

**Awbeg Valley (Above Doneraile) pNHA**

The desk study and subsequent evaluation of ecological features identified one nationally designated site as requiring a detailed assessment of likely effects, namely, Awbeg Valley (Above Doneraile) pNHA. This designated site exists along the Blackwater River and is situated approximately 15km downstream of the wind farm site.

The assessment of effects upon Blackwater River SAC on hydrological connectivity and other viable pathways applies to this site also. In addition, while no significant impact pathways are noted, as discussed above under section 7.9.2.1, given the distance between the designated site and the Project, there is no likelihood of a significant effect occurring as a result of sedimentation or other aerial factors such as dust deposition and air quality deterioration as a result of the Project. As such, there would **not be a Likely Significant Effect** on this site as a result of the Project.

### 7.9.3 Assessment of effects on key ecological features

#### *7.9.3.1 Construction effects*

The assessment of effects upon key ecological features during the construction of the Project is described in this section. A summary of the assessment detailing the categorisation of the effects is found within **Table 7.16**. Likely effects identified through the construction phase are as follows:

- Direct habitat loss and fragmentation: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present on site;
- Disturbance and displacement: disturbance of protected and/or priority species from additional noise, dust, light, vibration, and human activity, with the possibility of causing displacement;
- Direct mortality of individuals; and
- Pollution of habitats through construction related activities such as pollutant sedimentation and the use, assembly and storage of machines and materials (risk of chemical and fuel spills).

Direct habitat loss or change is inevitable in the development of any wind farm, especially when the development of access tracks, turbines, substation buildings and other associated construction and decommissioning activity is considered. This can result in reduced habitat heterogeneity and connectivity as well as reduced feeding, nesting, roosting, and commuting opportunities for protected and priority species.

Direct habitat loss due to the development of wind farms tends to be relatively small (Drewitt & Langston, 2006)[46]. The permanent land take will be largely limited to the area of the turbine bases, new access tracks, electrical substation, and a met mast. Temporary land take during construction and decommissioning will additionally include temporary access tracks for site vehicles and machinery, crane hard standing areas and lay down areas for each turbine, a site compound with associated car parking, and borrow pits. Temporary land take will also occur at 'pinch points' along the TDR where vegetation will need to be pruned in order to enable the transportation of the turbine infrastructure. In some locations there may be a requirement to punch temporary gaps of less than 6m width within hedgerow habitat also, although in such situations any associated habitat loss would be temporary and any gaps created would be replanted with using species in keeping with the character of those hedgerows affected, following the delivery of the infrastructure to the wind farm site.

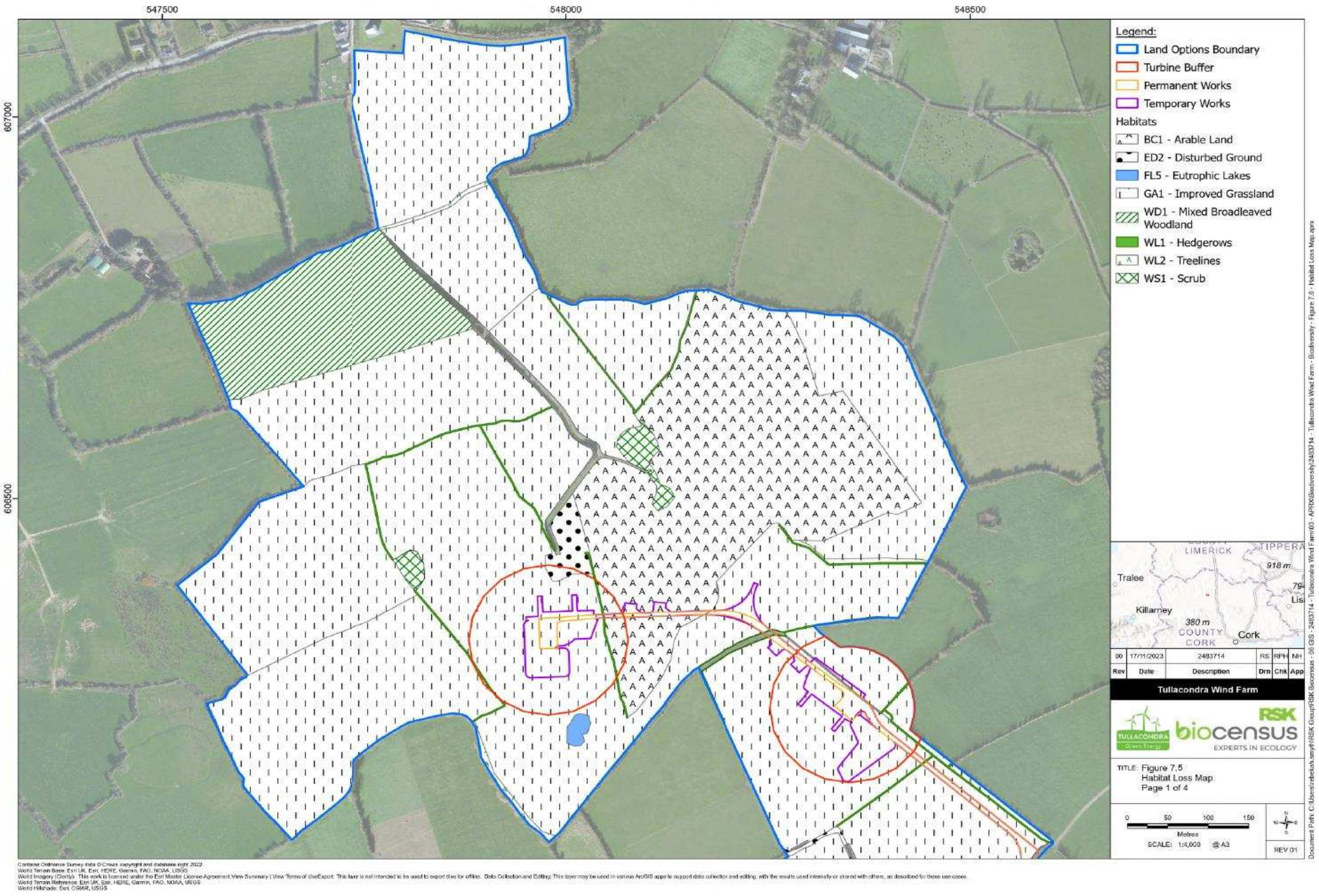
As described in section 7.1.1, habitats on site are largely dominated by agricultural land, the areas in which the turbines will be constructed. The proposed site substation, met mast, and construction compounds will additionally sit within these areas. These habitats are highly modified and are of low ecological value, thus limiting effects on biodiversity features. In overview, not including temporary vegetative loss along the TDR, the Project will result in the loss of 2.686 ha of habitats as a result of permanent infrastructure and a loss of 11.11 ha of habitats as a result of temporary works areas, as detailed in **Table 7.15** below and shown on **Figure 7.5**.

**Table 7.15 Habitat losses for the Project (before mitigation/offsetting).**

| Habitat type | Total area (ha) |
|---|---|
| **Temporary works** | |
| BC1 – arable land | 1.11 |
| BC3 – tilled land | 0.73 |
| ED2 – disturbed ground | 0.18 |
| FW4 – drainage ditches | 0.01 |
| GA1 – improved grassland | 9.08 |
| **Linear features** | **Total length (m)** |
| WL1 – hedgerows | 220 |
| WL2 – treelines | 0 |
| **Permanent works** | |
| BC1 – arable land | 0.37 |

[46] Drewitt, A. & Langston, R. 2006. Assessing the impacts of wind farms on birds. In: Wind, Fire and Water. *Renewable Energy and Birds*, 148, 29-42.

| Habitat type | Total area (ha) |
|---|---|
| BC3 – tilled land | 0.12 |
| ED2 – disturbed ground | 0.17 |
| FW4 – drainage ditches | 0.006 |
| GA1 – improved grassland | 2.02 |
| **Linear features** | **Total length (m)** |
| WL1 – hedgerows | 211 |
| WL2 – treelines | 0 |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Permanent Works
Temporary Works
Habitats
BC1 - Arable Land
ED2 - Disturbed Ground
FL5 - Eutrophic Lakes
GA1 - Improved Grassland
WD1 - Mixed Broadleaved Woodland
WL1 - Hedgerows
WL2 - Treelines
WS1 - Scrub
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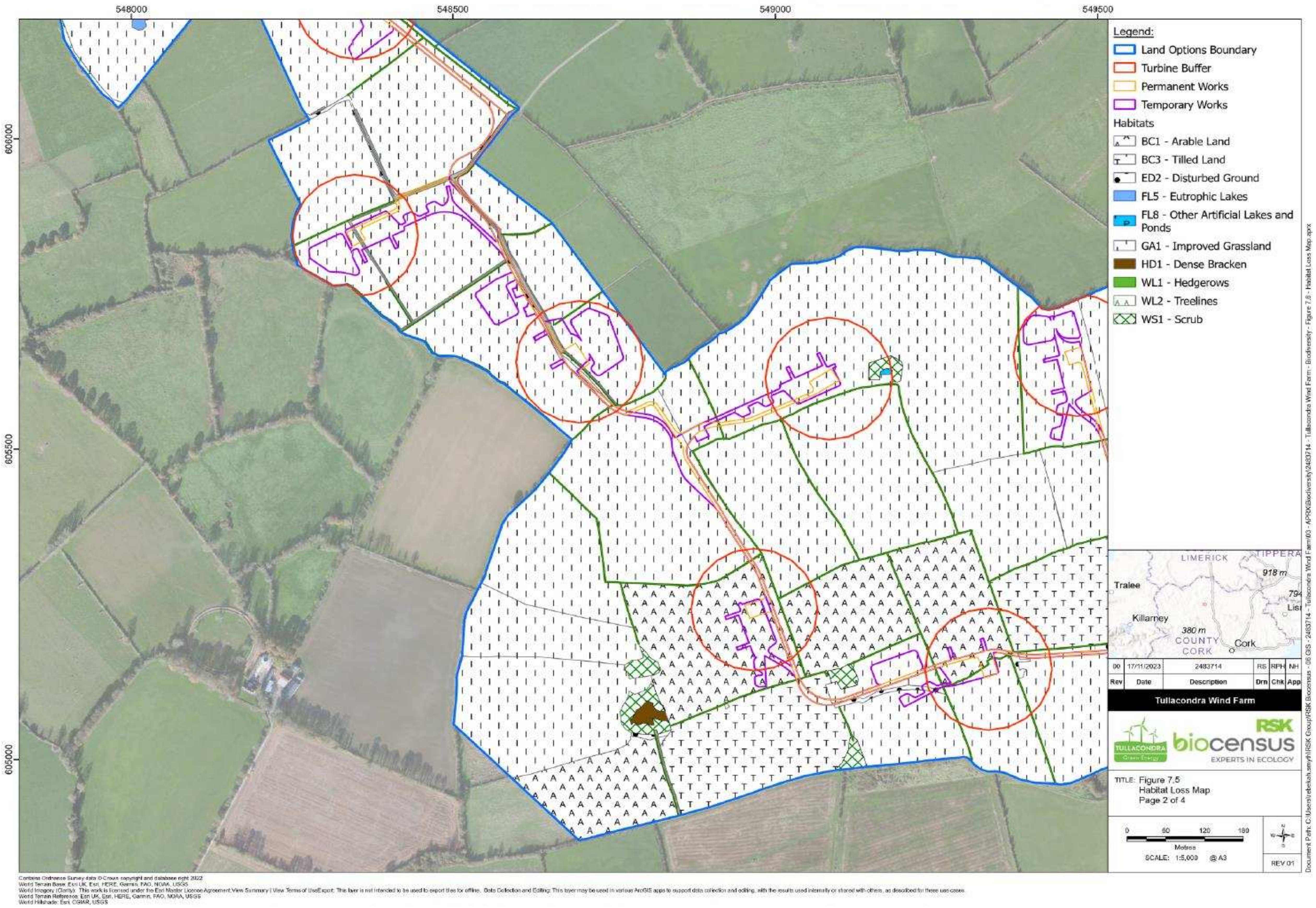
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Turbine Buffer
Permanent Works
Temporary Works
Habitats
BC1 - Arable Land
BC3 - Tilled Land
ED2 - Disturbed Ground
FL5 - Eutrophic Lakes
FL8 - Other Artificial Lakes and Ponds
GA1 - Improved Grassland
HD1 - Dense Bracken
WL1 - Hedgerows
WL2 - Treelines
WS1 - Scrub
LIMERICK
Tralee
Killarney
COUNTY CORK
Cork
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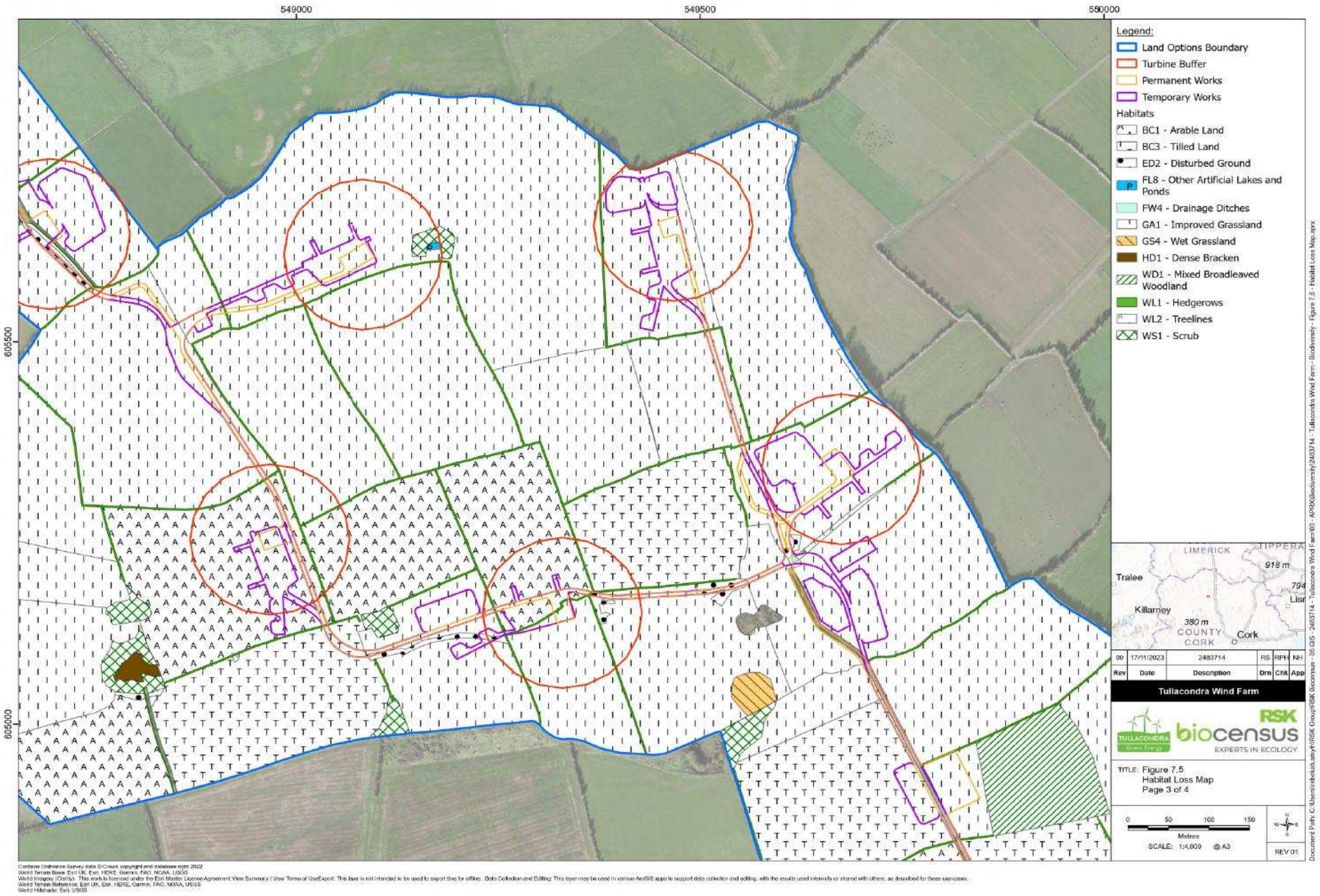
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Habitats
BC1 - Arable Land
BC3 - Tilled Land
ED2 - Disturbed Ground
FL8 - Other Artificial Lakes and Ponds
FW4 - Drainage Ditches
GA1 - Improved Grassland
GS4 - Wet Grassland
HD1 - Dense Bracken
WD1 - Mixed Broadleaved Woodland
WL1 - Hedgerows
WL2 - Treelines
WS1 - Scrub
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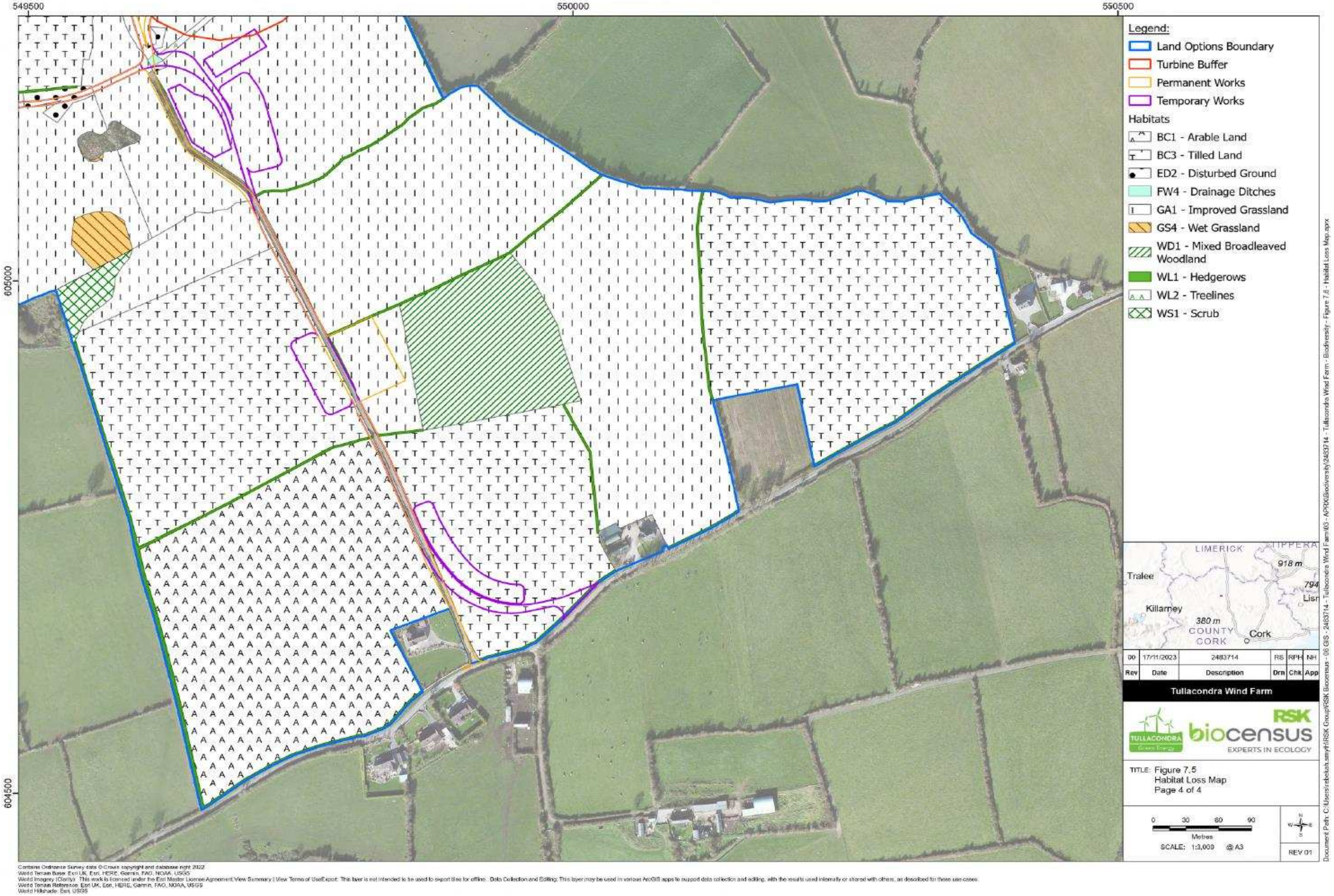


**Figure 7.5: Phase 1 habitat loss**

**Habitats and flora**

No rare or protected flora were recorded within the study area, with no documented records of vascular plants identified as part of the desk study. While two priority bryophytes were recorded during the desk study, the habitats within the wind farm site are unlikely to support these species, as described in section 7.1.1. Habitats associated with the wind farm site are considered common and widespread within the local area (and beyond) and are considered of low ecological importance, due to their generally poor botanical diversity. There will be a slight long-term increase in modified habitat from the construction and installation of turbines and associated infrastructure and the construction of new access tracks, which will lead to a **slight adverse effect** on semi-natural habitats and flora species within the wind farm site and its footprint, as described below. However, overall, permanent land-take as proposed by the Project is very limited, as detailed in **Table 7.15**. Furthermore, wherever temporary loss of habitat will occur, reinstatement of these areas will take place post-construction, unless permitted otherwise.

*Disturbed ground (ED2)*

The Project will result in the temporary and permanent loss of a small extent of disturbed ground to facilitate the construction of the wind turbines and associated infrastructure, including access tracks, lay-down areas, crane pads, and hard-standing areas in relation to the base of the turbines. As a result, there will be 0.18 ha of temporary and 0.17 ha of permanent habitat loss. The temporary habitat losses will easily be reinstated post-construction. Whilst there is a small amount of permanent reduction of existing disturbed ground, disturbed ground in this format is ubiquitous in the surrounding area, which is predominantly made up of agricultural land. Cattle rubs along some of the farm tracks have created suitable nesting habitat for buff mining bee, a species listed as vulnerable on the Irish Red List. The limited removal of such habitat is not extensive enough however to significantly affect the conservation status of this species, especially considering the extent of which this habitat occurs in the surrounding area. The removal of spoil and bare ground is not extensive enough to generate a significant effect on this habitat at a local level or above. Consequently, likely effects from habitat loss and fragmentation are considered **not significant**.

*Eutrophic lakes (FL5)*

A lake was recorded to the north of the wind farm site within an area of improved agricultural grassland. The Project will not involve any land take within this area with the aim of retaining this habitat. Effects from habitat loss and fragmentation are therefore considered **not significant**.

It is possible that pollutants associated with construction related activities have the potential to introduce silt, hydrocarbons and other chemicals into the waterbody and cause sedimentation, affecting the viability of this habitat. This may particularly affect the aquatic and semi-aquatic invertebrate populations that inhabit this lake, specifically the damselfly population that was recorded here. However, the design of the wind farm has ensured that turbines and related infrastructure will not be built within close proximity to this habitat and following the provision of best practice construction guidelines described within the CEMP (see EIAR **Volume III, Appendix 5.1**), pollution of this waterbody would be avoided. Consequently, likely effects from pollution to this habitat are considered **not significant**.

*Artificial lakes and ponds (FL8)*

An instance of an artificial lake/pond occurs to the east of the turbine T5 in an artificial hollow where water has accumulated to create a seasonal pond. A second instance occurs in the south of the wind farm site adjacent to scrub, farm buildings, and wet grassland. The Project will not involve any land take within these areas with the aim of retaining these habitats. Effects from habitat loss and fragmentation are therefore considered **not significant**.

It is possible that pollutants associated with construction related activities could build up and cause sedimentation, affecting the viability of this habitat and possibly causing eutrophication. However, the design of the wind farm has ensured that turbines and related infrastructure will not be built in close proximity of waterbodies and following the provision of best practice construction guidelines described within the CEMP (see EIAR **Volume III, Appendix 5.1**), pollution of ponds would be avoided. Consequently, likely effects from pollution to ponds is considered **not significant**.

*Drainage ditches (FW4)*

Drainage ditches are common on site, being present within many of the field boundaries, performing drainage functions in the surrounding agricultural landscape. The Project will result in 0.01 ha of temporary loss and 0.006 ha of permanent loss of ditch habitat across the wind farm site. This very small extent of habitat loss is highly unlikely to cause a profound reduction in ditches, especially given its ubiquity in the surrounding agricultural landscape. Therefore, effects from habitat loss and fragmentation would be **not significant**.

It is possible that pollutants associated with construction related activities could build up and cause sedimentation, affecting the viability of this habitat. However, the nature of the Project is unlikely to cause an abundance of pollutants and following the provision of best practice construction methods described within the CEMP (see EIAR **Volume III, Appendix 5.1**), any construction related pollution would be controlled and/or prevented. Consequently, likely effects from pollution to ditch habitats is considered **not significant**.

*Wet grassland (GS4)*

Two small areas of wet grassland were recorded towards the south of the wind farm site adjacent to scrub. The Project will not involve any land take within these areas and so effects from habitat loss and fragmentation are considered **not significant**.

It is possible that pollutants associated with construction related activities could build up and cause sedimentation, affecting the viability of this habitat. However, the nature of the Project is unlikely to cause an abundance of pollutants and following the provision of best practice construction methods described within the CEMP (see EIAR **Volume III, Appendix 5.1**), whereby the entry of pollutants or silt to waters will be prevented any construction related pollution would be controlled and/or prevented. Consequently, likely effects from pollution to wet grassland habitats is considered **not significant**.

*Hedgerows (WL1)*

As part of the embedded design mitigation for the Project, opportunities to make use of existing gaps in hedgerows from farm accesses have been taken wherever possible and infrastructure has been sited away from hedgerows where possible in order to protect their root protection zones. The Project will nonetheless result in the unavoidable loss of hedgerow habitat to facilitate the construction of the wind turbines and associated infrastructure, including from temporary and permanent access tracks, temporary lay down areas, crane pads, and hard-standing areas in relation to the bases of the turbines. The total amount of unavoidable hedgerow loss as a result of the Project equates to 431m. The majority of these losses would occur as a result of constructing and maintaining access into the wind farm site from the L5302 public road at Croughta, as well as in the vicinity of turbines T4 and T8.

Approximately 140m of hedgerow habitat would need to be removed between the permanent and temporary site entrances in order to maintain safe sightlines for vehicles exiting the wind farm site to the L5302 public road at Croughta. This habitat includes eight ash trees, seven of which have been recommended for felling (in the absence of the Project) due to their poor condition as a result of ash dieback disease (*Hymenoscyphus fraxineus*). The eighth tree is considered likely to contract ash dieback in the short-term future and is recommended for monitoring.

Approximately 90m of hedgerow habitat would need to be removed in the vicinity of turbine T4 in order to accommodate the laydown and temporary construction areas for this turbine. This hedgerow is species-poor and dominated by bracken, gorse and elder, which forms a linear feature demarcating a field boundary, as shown in **Plate 7.1** below.

**Plate 7.1 Section of Hedgerow at turbine T4 to be removed**

The hedgerow loss in the vicinity of turbine T8 equates to approximately 110m of species-poor habitat that is dominated by hawthorn, bramble, gorse and bracken, as shown in

**Plate 7.2** below. Again, this loss is required in order to accommodate the temporary construction working areas.

**Plate 7.2 Section of Hedgerow at turbine T8 to be removed**

As part of the embedded mitigation for the Project, wherever hedgerows are present within specifically calculated bat buffer zones around the base of each turbine and need to be temporarily removed to facilitate ground clearance for construction activities and/or delivery of components, then this habitat will not be reinstated in-situ in this instance, as a way of reducing collision risk to bats with turbines (see section 7.8.4.1). These extents are, therefore, for the purpose of this assessment, considered as permanent losses and equate to 200m of hedgerow habitat, as outlined above for turbines T4 and T8.

The remaining 91m of unavoidable hedgerow loss would occur as a result of the proposed permanent and temporary access tracks within the wind farm site, where new gaps in hedgerows need to be created and existing gaps widened. However, such losses would generally require between 1m and 5m of hedgerow habitat to be removed at each location and would not result in the fragmentation of those habitats.

Overall, the total loss of 431m of hedgerow habitat would represent a significant reduction of this habitat within the wind farm site, with the potential to significantly affect species that utilise this habitat (i.e., birds, bats, hedgehogs, badgers etc.) for nesting, commuting, foraging, and roosting. Additionally, further hedgerow loss is likely in order to facilitate the delivery of abnormal loads as part of the TDR. The delivery of turbine components will be a specialist transport operation that will include accommodation works, although it is envisaged that any required vegetation removal for this would be limited to small-scale pruning and punching small (i.e. less and 6m width) temporary gaps in hedgerows rather than large-scale habitat removal. This would nonetheless result in a further impact on hedgerows within the Project's ZoI.

Hedgerows are considered to be of high ecological value on site, especially given that they represent one of the few semi-natural habitats present within an intensively modified landscape. Therefore, in the absence of mitigation, a **significant negative effect** of habitat loss and fragmentation to hedgerow habitat would be likely at a **Local level (slight effect)** during the construction phase.

*Treelines (WL2)*

The Project will not require the removal of any treeline habitat to facilitate the construction of the wind turbines and associated infrastructure. As stated above, eight ash trees will require removal to accommodate site access off the L5302 public road at Croughta. However, all of these, with the current exception of one tree, have been recommended for removal on the grounds of public health and safety due to ash dieback disease. This limited loss would not cause a significant reduction in tree habitat within the Project's ZoI and would not be likely to significantly affect species of bats, birds and other fauna that rely of trees for foraging and shelter. Consequently, likely effects from habitat loss and fragmentation of treelines are considered **not significant**.

*Scrub (WS1)*

The Project will not result in the temporary or permanent loss of any scrub habitat to facilitate the construction of the wind turbines and associated infrastructure. A small extent of temporary scrub loss is proposed to facilitate the delivery of abnormal loads as part of the TDR including accommodation works that will involve scrub cutting. Whilst this does represent a slight reduction in scrub habitat that is of biodiversity value to a number of ecological features (i.e., birds, hedgehogs, badgers, pygmy shrew, etc.), scrub is a common habitat that is widespread in the surrounding area. The predicted losses of scrub habitat is not sufficiently extensive to cause a significant reduction of this habitat in the context of the wider landscape and will not result in fragmentation of habitats on site. Consequently, likely effects from habitat loss and fragmentation are considered **not significant**.

*Mixed Broadleaved Woodland (WD1)*

The Project proposals will not result in any loss of woodland habitat on site and so effects from habitat loss and fragmentation are considered to be **not significant**.

It is possible that construction related activities could lead to the introduction and build-up of silt, dust, and other pollutants. The northern pocket of woodland is at a considerable distance from the construction areas (i.e., in excess of 380m), which means that such effects are unlikely to occur. The construction of the substation would, however, take place directly adjacent to the southern pocket of woodland, which could possibly lead to this habitat experiencing higher amounts of disturbance and degradation in the form pollution. Furthermore, with the presence of Japanese knotweed within this area, it is possible that construction activities could lead to the further spread of this invasive species within the woodland. However, the nature of the Project is unlikely to cause an abundance of pollutants and following the provision of best practice construction methods described within the CEMP (see EIAR **Volume III, Appendix 5.1**), any construction related pollution would be controlled and/or prevented. Additionally, the CEMP will also detail a Japanese knotweed management plan to ensure construction activities do not lead to the spread of this species. Therefore, in the presence of embedded mitigation, effects from disturbance, degradation, and pollution to mixed broadleaved woodland would be **not significant**.

*Invasive non-native species*

The high-risk invasive species, Japanese knotweed, was recorded within the wind farm site in two different locations. One stand of this invasive species will be adjacent to the construction footprint of the proposed substation and a second stand is located in the vicinity of the proposed access track to turbine T6. It was also recorded at Boherash Cross on TDR Option 1 and the near to the turn off after Mallow Hospital on TDR Option 2. Construction works could therefore potentially disturb stands of invasive plants and/or soils contaminated with invasive plant material and cause them to spread onsite. Construction plant can also potentially carry seeds or viable plant material from other works sites if not adequately cleaned. In addition to lands within the proposed works areas, there is an identified risk of invasive plant species being spread onto neighbouring lands and onto public roads, and other locations. Construction works could therefore result in the spread of invasive plant species both in-situ and ex-situ. The most common ways that these species can be spread are:

- Site and vegetation clearance, mowing, hedge-cutting or other landscaping activities
- Spread of seeds or plant fragments during the movement or transport of soil
- Spread of seeds or plant fragments through the local surface water and drainage network
- Contamination of vehicles or equipment with seeds or plant fragments which are then transported to other areas
- Importation of soil from off-site sources contaminated with invasive species plant material

A watercourse can act as a potential effect-receptor pathway allowing the transit of invasive species resulting in the indirect habitat loss/damage to downstream habitats in the wider areas including designated nature conservation sites that are present. In this case there are potential hydrological pathways that link the Project, along the TDR and grid connection route, to the Blackwater River SAC and the Awbeg Valley (above Doneraile) pNHA. Run-off from traffic, deposition of spoil from the wheels of vehicles or accidental spillage of soil from trailers may result in the inadvertent spread of invasive plant species to nearby aquatic habitats downstream. As described in section 7.9.2 however, hydrological connection is limited to these sites as the ditches/streams on site are largely dry, containing ephemeral vegetation, with contaminated water unlikely to be able to reach the designated sites. Nevertheless, these water features are still likely to be able to spread invasive species off site into the immediate surroundings. Machinery, equipment, and material (including soil) which may be transported onto the wind farm site for construction could lead to the introduction of further invasive species to the wind farm site with potential to displace local natural biodiversity.

Given the location of the wind farm site with, albeit limited hydrological connection to adjacent areas, the potential effect from the spread of non-native invasive plant species in the absence of mitigation during the construction phase of the Project would be considered a significant negative effect at the Local level (slight effect) and could affect habitats on site and adjacent habitats. However, as part of the embedded mitigation described in section 7.8, the provision of a CEMP will include the management of invasive species that will ensure invasive species are dealt with appropriately to prevent further spread and to remove them where appropriate. In the presence of embedded mitigation effects from non-native invasive plant species during the construction phase would be **not significant**.

**Fauna**

*Invertebrates*

Two red-listed species were recorded on site during the extended Phase 1 habitat survey. The red-tailed bumblebee was recorded foraging along hedgerows throughout the wind farm site, and the buff mining bee was recorded on cattle rubs in the northeast of the wind farm site. The limited reduction in cattle rub habitat (disturbed ground) is not extensive enough to significantly affect the population of this species, especially considering the extent to which this habitat occurs in the surrounding area. Whilst there will be some reduction in hedgerow habitat, there is an abundance of such habitat within the immediate surroundings of the wind farm site that will be retained and the red-tailed bumblebee will also extensively make use of other habitats including grassland, arable land, field margins, scrub and woodland where flowering plants are present. Habitat loss will therefore not result in significant effects on the buff mining bee or red-tailed bumblebee.

In regard to other invertebrate species, no further protected and/or priority species were recorded during the desk study or noted during the field surveys on site, with no significant invertebrate assemblages recorded during the field surveys either. Furthermore, key invertebrate habitats, such as ponds and lakes, are being retained as part of the Project proposals, and with the presence of more suitable habitat in the vicinity of the wind farm site, disturbance and displacement effects are unlikely to be significant.

Considering the low abundance of invertebrate species in the study area, the widespread availability of similar habitat in the wider area and the comparatively small scale of the construction works areas, potential construction phase habitat loss, disturbance/displacement, and mortality effects are considered to be **not significant.**

*Bats*

The construction of wind energy developments present three potential risks to bats (SNH, 2019):

- Loss or damage to commuting and foraging habitat.
- Loss of, or damage to roosts.
- Displacement of individuals or populations.

For each of these risks, the detailed knowledge of bat distribution and activity within the study area gained during the baseline assessment is used to predict the likely effects of the Project on bats. Several bat species were noted in the vicinity of the wind farm site, all of which are legally protected under the Wildlife Acts and listed under the EU Habitats Directive.

One building within the 200m buffer of one of the turbine locations was found to contain a brown long-eared bat transition roost, with another set of farmyard buildings, 600m from turbine T2, predicted to contain a common pipistrelle roost. These buildings are to be retained as part of the Project proposals and so roosts will not be affected during construction. A soprano pipistrelle roost was located 5km east of the proposed turbine T6 location. However, the Project lies outside of the core sustenance zone of this species, Davidson-Watts & Jones, 2006[46]; Bartonicka *et* al. 2008[47]; Nicholls & Racey, 2006[48]; Bat Conservation Trust, 2016[49], and so effects upon this roost and its inhabitants can be ruled out. While no other bat roosts were located in the study area, there are many structures in the wider area with potential for roosting bats. It is possible that individual bats or small groups of bats may roost in trees or existing structures within the study area, at least occasionally.

The Project will result in the loss of a proportion of hedgerow habitat to facilitate the construction of the wind turbines and associated infrastructure. Much of this removal will include small areas around the turbines to enable construction, such as lay-down areas and the areas for crane pads. It has been incorporated within the Project design that not all hedgerow removal associated with the construction of the turbines will be reinstated. Reinstatement will only occur out with specifically calculated bat ‘buffer zones’ around the turbines, which have been calculated according to SNH guidance (2019[13]) (see section 7.8.4.1). The provided recommended buffer zones equate to 89m for hedgerows. As such, where hedgerow removal is required within these buffer zones then reinstatement in situ will be avoided as part of the Project design, as reiterated as embedded mitigation, to minimise the risk of operational phase effects on bats, including collision, barotrauma, and other related injuries associated with wind turbines throughout the lifetime of the Project.

This has the potential to significantly reduce the commuting and foraging areas for bat species and fragment habitats on site from the surrounding areas. Therefore, in the absence of additional mitigation, a **significant adverse effect** of habitat loss and fragmentation to bat species is deemed likely at a **Local level (slight effect)** during the construction phase, persisting for the long-term throughout the lifetime of the Project.

Due to the high levels of bat activity recorded, disturbance from construction related activities, such as increased noise and lighting, is likely to cause some temporary displacement of bat species in the absence of mitigation. Construction phase lighting has the potential to attract certain bat species and displace others and floodlighting can be a significant source of disturbance. However, this effect will be temporary in nature and as part of the embedded mitigation described in section 7.8, the provision of a CEMP will include temporal considerations to any construction related activities. This would include guidance on avoiding any construction related activities during nocturnal periods when

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[47] Bartonicka, T., Bielik, A., Rehak, Z. 2008. Roost switching and activity patterns in the soprano pipistrelle, *Pipistrellus pygmaeus*, during lactation. Annales Zoologici Fennici, 45, 503-512.

[48] Nicholls, B. & Racey, P. 2006. Contrasting home-range size and spatial partitioning in cryptic and sympatric pipistrelle bats. *Behaviour Ecology and Sociobiology*, 61, 131-142.

[49] BCT. 2016. Core Sustenance Zones: Determining zone size. The Bat Conservation Trust, London.

bats are most active. Night-time lighting will be limited in extent (both static lighting, and vehicle headlights) as standard construction works will be carried out mostly during daylight hours. In the presence of embedded mitigation, effects from construction related disturbance and displacement is considered **not significant**.

*Badgers and other mammals*

Potential construction phase effects on non-volant mammal species include habitat loss, disturbance/displacement, and direct mortality of individuals. The terrestrial biodiversity on site was found to have relatively low mammal abundance reflecting the dominance of highly modified habitats (i.e., arable land).

Habitats present on site that are suitable for badgers, hedgehog, and pygmy shrew include improved grassland, hedgerows, treelines, and scrub. Direct habitat loss due to the construction of the Project will be small, in the context of the wider site and surrounding local area. The permanent land take is largely limited to the area of the turbine bases, crane hard standing areas, new access tracks, borrow pits, electrical sub-station, and met mast. As described in section 7.1.1, the Project footprint is dominated by improved agricultural grassland and arable land. These habitats are highly modified and are not of ecological value to most mammal species. The improved agricultural grassland may provide foraging opportunities to some mammal species (i.e., badgers); however, this habitat is widespread within and around the study area and the predicted losses of this modified habitat are not expected to have any adverse effect on badgers and other local mammal species.

The Project proposals would result in a reduction in hedgerows. However, much of this reduction is temporary in nature and is not considered sufficiently extensive to cause a significant reduction in available habitat for badgers and other mammal species (other than bats). Furthermore, additional hedgerows, treelines, woodland, scrub and other suitable habitats would be retained on site and the predicted habitat losses would be unlikely to cause fragmentation to other areas of more suitable habitat in the surrounding landscape. Therefore, effects from habitat loss and fragmentation to badgers and other mammals are deemed **not significant**.

During the construction of the Project, there is likely to be a certain amount of disturbance to mammals occurring on/near the wind farm site and along the TDR and GCR. However, this will be temporary in duration, with much of the construction activity taking place along roadways and within agricultural land, areas of which have low ecological value. Given the habitats present in the wider environment, affected mammals will be able to move to other locations in the wider areas and return when disturbance has lessened. Additionally, due to the relatively small footprint of the development, any displacement or disturbance that may occur is likely to be highly localised, both temporally and spatially. The badger setts recorded during the site visits were located on the periphery areas, a considerable distance away from any construction activities, and so would not be disturbed by the Project. Additionally, no breeding sites of pygmy shrew and hedgehog (as well as any other mammal) were recorded within 50m of the proposed turbine locations or other infrastructure, and although it remains possible that such could be present, the disturbance, displacement and mortality of breeding or sheltering individuals is not likely to occur during the construction of the Project (where a pre-construction survey will be carried out immediately prior to construction to confirm the absence of such).

It is possible that the increase in site traffic might lead to an increased risk of road casualties of badgers, hedgehogs and other mammals occurring in the area. However, given the bulk of construction traffic and movement of machinery and personnel will occur during daylight hours and the relatively low site speed limits that will be imposed, the risk of any significant increase in fatalities of such species is insignificant.

Considering the low abundance of mammal species in the study area, the widespread availability of similar habitat in the wider area and the small scale of the proposed construction works, potential construction phase disturbance/displacement and mortality effects are considered to be **not significant**. Furthermore, the provision of a CEMP will include best practice construction guidance requiring the avoidance of such effects. This would include pre-construction checks by an ECoW, covering excavations to prevent trapping species (or providing egress routes), and temporal considerations to work; avoiding nocturnal periods when these species are most active.

**Aquatic ecology**

The Project will result in 0.01ha of temporary loss and 0.006ha of permanent loss of ditch habitat across the wind farm site. This very small extent of habitat loss is highly unlikely to cause a profound reduction in ditches, or available habitat for protected aquatic species as they are unlikely to be present on-site. Additionally, given the ubiquity of watercourse habitats in the surrounding agricultural landscape, effects from habitat loss and fragmentation of aquatic ecology on-site are considered **not significant**.

The GCR Option 1 as shown in EIAR **Chapter 1 Introduction, Figure 1.1**) crosses one water feature along its ~13.5km length. This is a third order stream (Blackwater (Munster_140) – also locally known as Caherduggan South) and varies between 1.4m and 2.6m in width. HDD is proposed for crossing under the watercourse at this location. A launch pit will be constructed within the L5320 public road approximately 18m before the junction with the N72. The reception pit will be located approximately 6m from the N72 in the carriageway of a road in private ownership. While a small amount of temporary habitat loss will be involved during the construction of the GCR, this will only be temporary, and that small section of habitat will be reinstated post-construction. Therefore, effects from habitat loss and fragmentation of aquatic ecology off-site, within the ZoI, are considered to be **not significant**. There is the potential for on-site construction works to adversely affect the aquatic ecology within the wind farm site and within the wider ZoI, through disturbance and pollution, as described within section 7.6.4.1.1. The sources of effects described within section 7.6.4.1.1 during the construction phase include:

- Earthworks including the excavation, storage, and movement of soil and sub-soil carried in relation to the construction of the wind turbines has the potential to introduce silt, hydrocarbons, and other chemicals into watercourses, as well as inducing hydro-morphological changes. This has been highlighted as on 12 existing pressures in the Blackwater Catchment Assessment, EPA, 2022[50].

[50] Environmental Protection Agency. 2022. 3rd Cycle Draft Blackwater (Munster) Catchment Report (HA 18) Catchment Science & Management Unit Environmental Protection Agency February 2022 Version no. 1

- Runoff from access tracks – passage of machinery on current and new access tracks can cause the release of sediment and hydrocarbons to watercourses.
- Dewatering and pouring of foundations – onsite deep excavations may need to be watered as they are usually laden with suspended solids and the suction associated with the pumping usually increases the level of suspended solids further.
- Chemical spillage – the operation and maintenance of the machinery onsite involves the use of hydrocarbon derivatives such as diesel, hydraulic fluid, and various lubricants. Common causes for spillage include burst hose pipers, leaking tanks, spillage during refill/maintenance at the holding tanks.
- Introduction of crayfish plague – machinery that has been working close to another watercourse on a different Project has the potential to introduce crayfish plague to the ZoI.

Despite all of the potential sources of effects identified above, most of the watercourses within the wind farm site were dry and did not contain any suitable habitat for protected and/or priority aquatic species such as freshwater pearl mussel, crayfish, salmonids, twaite, and lampreys. All records of such species recorded during the surveys were identified a large distance away from the wind farm site, and with limited hydrological connectivity to the wider landscape, effects from the Project are likely to be very limited.

In terms of the Awbeg (Kanturk) and its Lisduggan sub-catchment, the direct connectivity is severed by the drainage network going to ground in the upper Lisduggan North catchment as well as the settling effect of the reservoir at Sheepmount (again in the Lisduggan sub-catchment of Awbeg (Kanturk)). There is no direct surface water connectivity between the wind farm site and the Ballyclough river. There is some weak surface water connectivity during heavy rainfall between the wind farm site and the Awbeg (Buttevant); however, the Awbeg (Buttevant) does not contain significant populations of any of the target protected and/or priority aquatic species and its assimilative capacity is such that silt levels would not be measurable at the Blackwater confluence.

There is a chance that during heavy rainfall, hydrological connectivity to the wider landscape would increase and pose a risk to aquatic species recorded off-site within the wider ZoI, with the potential of increasing silt, hydrocarbons, suspended solids and other pollutants into the watercourses. However, the implementation of best practice construction guidelines as described within embedded mitigation, would likely prevent these effects from occurring. As such, effects from construction works on aquatic ecology within the wind farm site are considered to be **not significant**.

The installation of a grid connection cable has the potential to introduce silt, chemicals or cement to the watercourse or even impart hydro-morphological changes. The magnitude of the effect can vary from slight to significant, depending on a variety of parameters such as flow rate, dilution rate, amount of material, which was incident on the watercourse, chemical characteristics of the material incident on the watercourse. The GCR crosses one water feature along its ~13.5km length, namely an unnamed third order stream. Effects to this watercourse would be limited as Horizontal Direct Drilling of the cable route will prevent pollution from construction activities. The duration of the effect is usually short as the effect would only occur during the construction phase and a small or medium size watercourse crossing (such as this) usually commences and finishes within one or two days. Additionally, best practice construction guidelines as described within the CEMP and within the embedded mitigation section will act to decrease the likelihood of pollution and disturbance effects and prevent and avoid pollutants from entering the watercourse and having an effect on protected and/or priority aquatic species. As such, effects along the GCR are considered **not significant**.

**Summary**

**Table 7.16. Construction effect characterisation for key ecological features.**

| Ecological feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| **Habitats and flora** | | | |
| Disturbed ground | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Eutrophic lakes | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Artificial lakes and ponds | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Drainage ditches | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Wet grassland | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Hedgerows | Habitat loss and fragmentation | Medium | **Direct, Long-term Slight Adverse Effect (significant at the Local level)** |
| Treelines | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Scrub | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Mixed broadleaved woodland | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| **Fauna** | | | |
| Invertebrates | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Negligible | Not significant |
| Bats | Habitat loss and fragmentation | Medium | **Direct, Long-term, Slight Adverse Effect** |

| Ecological feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| | | | **(significant at the Local level)** |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Badgers | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Hedgehog | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Pygmy shrew | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Aquatic ecology | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement/mortality | Low | Not significant |
| | Pollution | Low | Not significant |
| **Non-native invasive plant species** | | | |
| Japanese knotweed | Habitat loss and damage | Low | Not significant |

### 7.9.3.2 *Operational effects*

The assessment of effects upon ecological features during the operational phase of the Project is described in this section. It is understood that the wind farm has an anticipated lifespan of 35 years. A summary of the assessment detailing the categorisation of the effects is found within **Table 7.19**. Likely effects identified through the operational phase are as follows:

- Habitat loss and fragmentation: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present on site;
- Disturbance and displacement: disturbance of protected and/or priority species from additional noise, light, vibration, and human activity, with the possibility of causing displacement; and
- Bat fatalities and/or injuries through collisions with new turbines or barotrauma whilst flying over/within the wind farm site.

**Habitats and flora**

There will be no additional removal of habitat during the operational phase of the Project. As a result, there is no potential for direct adverse effects to habitats arising from the operational phase of the Project. Effects from habitat loss and fragmentation are therefore **not significant**.

Operational phase maintenance work has the potential to introduce silt, hydrocarbons, and other chemicals into waterbodies, and other ecologically sensitive habitats. Where maintenance of site infrastructure, or the drainage network (e.g., drain clearance, turbine repairs, etc) over the operational lifetime is required, measures included within the CEMP will be implemented as part of embedded mitigation (section 7.8). Such measures will be used to prevent pollution (e.g., fuels, turbine fluids, and silty water) though the appropriate and temporary use of silt fences, spill kits, cut-off drains, silt traps, check dams, and drainage to vegetated areas where appropriate. As a result, effects from damage/disturbance and pollution are deemed **not significant**.

*Invasive non-native species*

Operational phase maintenance work is highly unlikely to disturb or displace any stands of Japanese knotweed. Additionally, the CEMP implemented during the construction phase of the development will also be utilised during any operational maintenance works. This will ensure that all relevant staff are briefed and aware of relevant constraints, the presence of invasive species, and their responsibilities. In the presence of embedded mitigation effects from non-native invasive species during the operation phase are considered **not significant**.

**Fauna**

*Invertebrates*

As the Project proposals do not involve any loss of habitat as part of the operational phase, effects from habitat loss and fragmentation on invertebrates are **not significant**. The increase in noise, vibration, and human activity as part of the operational phase is unlikely to significantly affect the viability of the invertebrate assemblage on site, especially considering the extent of suitable habitat in the immediate surrounding area and the small numbers of invertebrates recorded during the field surveys. Therefore, disturbance and displacement effects form the operational phase are considered **not significant**.

*Bats*

Effects from habitat loss experienced during the construction phase will continue to persist throughout the operational phase resulting in a **significant negative effect** at the **Local level (slight effect**). Commuting and foraging areas may change as a result of the development due to the small loss of some linear habitat features.

The operation of the wind farm is unlikely to cause disturbance to roosting bat species due to the distances of the wind turbines from the known roost sites.

The operation of the wind farm does have the potential to result in disturbance to commuting and foraging bats. Bat activity at the wind farm site was high for much of the field surveys with bats using the hedgerows, and treelines on site to commute and forage. With the exception of aviation warning lights, required by the Irish Aviation Authority, the wind farm will not be lit at night (apart from emergency maintenance works) and switchable lighting around the substation building is unlikely to affect bat species. It is possible that noise and vibration of moving turbines will cause disturbance to bats. However, vegetation removal (as part of the embedded mitigation) around the bases of the turbines would provide a sufficient buffer zone so that bat species do not get close enough to turbines to be affected. Therefore, in the presence of embedded mitigation, disturbance/displacement effects from the operational phase of the development are considered **not significant**.

Both direct collision with turbine blades and barotrauma resulting from close contact with blades have been reported as an issue for bats at wind farms Cryan & Barclay, 2009[51]. The susceptibility of bat species likely to be at risk of effects from wind turbines is partly associated with the likelihood of different species flying at rotor blade height. A general assessment of vulnerability of bat populations to collision with wind turbines, based on best available scientific information, is provided in **Table 7.17** below. SNH, 2019[13] provides a generic assessment of bat collision risk for UK species, based on species behaviour and flight categorisation as well as evidence of casualty rates in the UK and Europe. This bat species collision risk assessment is considered to represent best available information for use in an Irish context.

This species collision risk categorisation is used in combination with relative abundance to indicate the potential vulnerability of bat populations. Relative abundance for Irish species was determined in accordance with a scheme for rarity of bat species provided in Wray *et al*. 2010[52] in combination with best available population data. It should be noted that Leisler's bats, whilst fairly rare in Great Britain and Europe, are one of the commonest species found in Ireland. The Irish population is therefore considered a global stronghold, with an estimated population of 73,000 – 130,000 (2007-2012) (Roche, 2014[53]), and should be considered as such within impact assessments.

**Table 7.17. Scheme for estimation of Irish bat species' population vulnerability to wind energy development.**

| Relative abundance | Collision Risk (of all UK and Irish species) | | |
|---|---|---|---|
| | Low | Medium | High |
| Common (100,000 plus) | Brown long-eared bat | | Common pipistrelle<br>Soprano pipistrelle |
| Rare (10,000 – 100,000) | Daubenton's bat<br>Natterer's bat<br>Whiskered bat<br>Brandt's bat<br>Lesser horseshoe | Serotine bat | Nathusius' pipistrelle<br>Noctule bat<br>Leisler's bat |

[51] Cryan, R.M. & Barclay, R.M.R. 2009. Cause of bat fatalities at wind turbines: hypotheses and predictions. *Journal of Mammalogy*, 90, 1330-1340.

[52] Wray, S., Wells, D., Long, E. & Mitchell-ones, T. 2010. Valuing Bats in Ecological Impact Assessment, In Practice, 23-26.

[53] Roche, N.A. 2014. Irish bats in the 21st Century. Bat Conservation Ireland.

| Relative abundance | Collision Risk (of all UK and Irish species) | | |
|---|---|---|---|
| | Low | Medium | High |
| Rarest (under 10,000) | Alcathoe bat<br>Bechstein's bat<br>Great horseshoe<br>Grey long-eared bat | Barbastelle bat | |

*Population vulnerability: yellow = low, orange = medium, red = high.*

In determining the Project specific potential risk to bats, SNH (2019[13]) recommends a two-stage process as follows:

- Stage 1: indicatively assess the potential site risk based on consideration of habitat present and development related features (i.e., number of turbines, size of turbines, and proximity to other wind farms); and
- Stage 2: overall assessment of risk for high collision-risk species, considering bat activity site survey results and the relative vulnerability of species.

An initial risk assessment is based on an assessment of habitats and the size of the development. Habitat suitability is ranked either low, moderate, and high while project size is ranked from small, medium, and large. Habitats surrounding the subject turbines are ranked as Moderate given connectivity to the wider landscape with the presence of hedgerows and occasional treelines. The wind farm site is not located within or surrounding extensive sections of native lowland woodland or near a river which could act as an ecological corridor. The Project size is ranked as large given proposed turbines are over 100m in height. The proposed Project thus derives an Initial Site Risk Assessment Value of 4: high site risk.

The next stage of the process is applicable to 'high-collision risk' species only and utilises information on the activity level recorded on site in each monitoring period. This assessment is intended to identify projects that are of greatest concern in terms of bat collision risk. The following high-collision-risk species have been recorded at the wind farm site:

- Leisler's bat
- Common pipistrelle
- Soprano pipistrelle
- Nathusius' pipistrelle

The output from the initial site risk assessment is used in the matrix presented in **Table 7.18** to derive an overall risk assessment based on the activity level of high collision risk species that were recorded during field surveys on site. In the absence of mitigation, the collision risk of bat species with turbines has been categorised as high for all turbines apart from turbine T1. Vegetation removal around the base of the turbines will create buffer zones that will reduce the likelihood that bat species will collide with turbine blades.

However, there is still a present risk of collision and based on these risk assessments, collision related effects on bat species are considered to be a **significant, adverse effect** at the **Local level (slight effect)** in the absence of mitigation.

### Table 7.18. Overall risk assessment based on relevant bat survey data.

| Turbine No | Static Detector ID used for assessment | Leisler's bat | | Common pipistrelle | | Soprano pipistrelle | | Nathusius's pipistrelle | | Is location of static at proposed turbine location? | Suitable Bat Habitat within 200m of turbine | If no mitigation is applied, what is the potential effect level? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | | | |
| 1 | D1 | 20 | 16 | 20 | 20 | 20 | 16 | 16 | 4 | 1a was set at turbine location. | Yes | Medium |
| | D1a | 16 | 12 | 20 | 8 | 16 | 12 | 8 | 4 | | | |
| | Combined[54] | 17 | 13 | 20 | 12 | 17 | 13 | 11 | 4 | | | |
| 2 | D2 | 20 | 16 | 20 | 12 | 20 | 12 | 12 | 4 | Within 25m set within similar habitats | Yes | High |
| 3 | D3 | 20 | 16 | 20 | 20 | 20 | 20 | 20 | 4 | Yes | Yes | High |
| 4 | D4 | 20 | 16 | 20 | 16 | 20 | 12 | 16 | 4 | Yes | Yes | High |
| 5 | D5 | 20 | 16 | 20 | 20 | 20 | 20 | 20 | 8 | Yes | Yes | High |
| 6 | D6 | 20 | 16 | 20 | 16 | 20 | 16 | 20 | 4 | No. Detector set 60m south but similar habitat composition | Yes | High |
| 7 | D7 | 20 | 12 | 20 | 20 | 20 | 12 | 16 | 4 | No. Detector D7set 130m SE. Turbine is proposed in centre of field. T1a gives an idea of bats in open habitats | Yes | High |
| | D1a | 16 | 12 | 20 | 8 | 16 | 12 | 8 | 4 | | | High |
| | Combined | 18 | 12 | 20 | 14 | 18 | 12 | 12 | 4 | | | High |
| 8 | D8 | 20 | 12 | 20 | 20 | 20 | 16 | 12 | 4 | No. D8 set 83m W | Yes | High |

[54] D1a is weighted twice as much as D1 given its position at a proposed turbine location. For turbine T7 and T9 statics are weighted equally given the distances to the turbine.

| Turbine No | Static Detector ID used for assessment | Leisler's bat | | Common pipistrelle | | Soprano pipistrelle | | Nathusius's pipistrelle | | Is location of static at proposed turbine location? | Suitable Bat Habitat within 200m of turbine | If no mitigation is applied, what is the potential effect level? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | Maximum Percentile | Median Percentile | | | |
| 9 | D9 | 20 | 16 | 20 | 20 | 20 | 16 | 20 | 8 | No. D9 set 65m S by treeline. Turbine set within centre of field thus activity likely lower | Yes | High |
| | D1a | 16 | 12 | 20 | 8 | 16 | 12 | 8 | 4 | | | |
| | Combined | 18 | 14 | 20 | 14 | 18 | 14 | 14 | 6 | | | |

*Badgers and other mammals*

As no further habitat loss is proposed during the operational phase of the Project, effects from habitat loss and fragmentation are considered to be **not significant** for non-volant mammal species.

There is very limited potential for disturbance/displacement effects from the operational phase on, badgers, hedgehogs, and pygmy shrews. Maintenance requirements of wind farms is relatively low and there is unlikely to be a permanent staff presence or increase in human and traffic activity over and above the background conditions. It should also be noted that the majority of mammals that occur at the wind farm site, including hedgehogs and badgers, are nocturnal or crepuscular and as such will be active at times when human activity at the wind farm site will be absent or very low. No breeding sites are known to occur within the study area and the loss of such would be unlikely.

With the exception of aviation warning lights, required by the Irish Aviation Authority, the wind farm will not be lit at night (apart from emergency maintenance works) and switchable lighting around the substation building. As such, effects on nocturnal mammal species as a result of light pollution from the operational wind farm would not occur.

The potential disturbance/displacement effects on badgers, pygmy shrew, hedgehogs, and other mammal species as a result of the operational phase of the Project are considered to be **not significant**. There are no anticipated operational phase works associated with the transport delivery route or grid connection route that would be likely to result in adverse impacts on mammals and thus these project elements do not have any potential significant effects on mammal species in the operational phase.

**Aquatic ecology**

As no further habitat loss is proposed during the operational phase of the Project, effects from habitat loss and fragmentation are considered to be **not significant** for aquatic ecology.

The operational phase of the Project has the potential to increase surface water run-off into watercourses. Surface run-off from access tracks and turbine bases has the potential to introduce silt, hydrocarbons, and other chemicals into watercourses, as well as possibly inducing hydro-morphological changes. However, as the watercourses within the wind farm site are known to be dry the majority of the time, effects associated with this would be limited, especially considering the low numbers of operational vehicles that would be accessing the wind farm site. Furthermore, the implementation of embedded mitigation as described within section 7.8.4, would prevent and avoid pollution effects. As such, operational effects on aquatic ecology are considered to be **not significant.**

**Summary**

**Table 7.19. Operational phase effect characterisation on ecological features.**

| Ecological feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| **Habitats and flora** | | | |
| All habitats on the wind farm site | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage (from increased human activity) | Negligible | Not significant |
| | Pollution | Negligible | Not significant |
| **Fauna** | | | |
| Invertebrates | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Mortality | Negligible | Not significant |
| Bats | Habitat loss and fragmentation | Medium | **Direct, Long-term, Slight Negative Effect (significant at the Local level)** |
| | Disturbance and displacement | Low | Not significant |
| | Collision risk mortality | Medium | **Direct, Long-term, Slight, Negative Effect (significant at the Local level)** |
| Badgers | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance and displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Hedgehog | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance and displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Pygmy shrew | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance and displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Aquatic ecology | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement/mortality | Low | Not significant |
| | Pollution | Low | Not significant |
| **Non-native invasive species** | | | |
| Japanese knotweed | Habitat loss and damage | Low | Not significant |

#### 7.9.3.3 Decommissioning effects

The assessment of effects on ecological features during the decommissioning phase of the Project is described below and summarised in **Table 7.20**. Likely effects identified are as follows:

- Direct habitat loss: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present.
- Disturbance and displacement: disturbance of nesting, sheltering, foraging and commuting species (e.g., from additional noise, dust, light, vibration, and human activity), potentially causing displacement.

No other likely effects other than those already discussed above for the construction and operational phases are likely to occur during decommissioning. Turbine design renders the decommissioning phase as a straightforward process. Within this phase, cranes disassemble each turbine section which is then removed from the wind farm site. The upper sections of the foundations projecting above ground will be removed, and the remainder of the foundations and hardstanding areas covered over with topsoil. Underground cables will be cut back at the turbine termination, and either be recycled or left buried in-situ. Site materials will be disposed of in accordance with current waste legislation and best practice construction guidelines.

Decommissioning activities are assumed to be similar to construction activities, having similar type risks and sensitive features associated with them. However, they are temporary in nature and considerably less intrusive and would result in less land take of available habitat. Available habitat will increase post-decommissioning as infrastructure associated with the wind farm is demolished, likely increasing the viability of habitats and associated species.

The wind farm site is dominated by intensive agricultural land, with relatively low availability of higher quality habitat for ecological features. This will likely continue to be the case throughout the operational phase of the Project to the time of decommissioning. Removal of habitat during the decommissioning of the Project will be limited in extent, likely involving only small areas of relatively low-quality habitat, similar to those temporary losses reported above for the construction phase, where habitats temporarily removed during construction are to be reinstated. Following decommissioning, habitats would be reinstated to their pre-construction baseline and effects would be short-term and temporary. As such, likely effects on ecological features from habitat loss and fragmentation during the decommissioning of the Project are deemed **not significant**.

Decommissioning works would likely result in short-term disturbance as a result of increased noise and human presence. However, such effects would be experienced on a temporary basis only and would not be expected to affect the conservation status of any key ecological features within the ZoI. Effects during decommissioning would be less extensive and of a shorter duration than those experienced during construction and disturbance during decommissioning is unlikely to significantly disturb key ecological features, especially given the short-term temporary nature of the proposed works and extensive areas of suitable habitat that will exist and remain on site and in the wider area during the decommissioning phase of the Project. Disturbance effects on ecological features from decommissioning are therefore considered **not significant**.

**Summary**

**Table 7.20. Decommissioning phase effect characterisation on ecological features.**

| Ecological feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| **Habitats and flora** | | | |
| Disturbed ground | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Eutrophic lakes | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Artificial lakes and ponds | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Drainage ditches | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Wet grassland | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Hedgerows | Habitat loss and fragmentation | Medium | Not significant |
| Treelines | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Scrub | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| Mixed broadleaved woodland | Habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance/damage/pollution | Low | Not significant |
| **Fauna** | | | |
| Invertebrates | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Negligible | Not significant |
| Bats | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Badgers | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Hedgehog | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |

| Ecological feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| Pygmy shrew | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement | Low | Not significant |
| | Mortality | Low | Not significant |
| Aquatic ecology | Habitat loss and fragmentation | Low | Not significant |
| | Disturbance/displacement/mortality | Low | Not significant |
| | Pollution | Low | Not significant |
| **Non-native invasive plant species** | | | |
| Japanese knotweed | Habitat loss and damage | Low | Not significant |

#### *7.9.3.4 Cumulative effects*

As described in EIAR **Chapter 2 EIA Methodology, Table 2.2**, a planning search was carried out to identify permitted and constructed projects in the wider receiving environment. Projects in the wider hinterland were identified using various online resources, including:

- Cork County Council planning viewer (https://www.corkcoco.ie/en/resident/planning-and-development)
- An Bord Pleanála (Strategic infrastructure development (SID) applications, Strategic Housing Development (SHD) applications and major project applications including wind farms) (https://www.pleanala.ie/en-ie/home)
- Irish Wind Energy Association (IWEA) (https://windenergyireland.com/)
- Department of Housing, Local Government and Heritage's EIA Portal (https://www.gov.ie/en/publication/9f9e7-eia-portal/)

The majority of consented applications pertain to one-off residential dwellings or farm buildings/structures along the regional roads. The scale of these applications are unlikely to have cumulative effects upon the ecological features identified within this chapter. Therefore, within this section, only developments of a particular size and nature have been considered further for the cumulative assessment. The list of projects and plans was reviewed and the potential for cumulative effects on terrestrial biodiversity was considered.

As per SNH guidance on *Assessing the Cumulative Impacts of onshore Wind Energy Developments* (2018[55]), cumulative effects arising from two or more developments may be:

- **Additive** (i.e., multiple independent additive model).
- **Antagonistic** (i.e., the sum of impacts are less than in a multiple independent additive model).

[55] Scottish Natural Heritage. 2018. Assessing the Cumulative Impacts of onshore Wind Energy Developments.

- **Synergistic** (i.e., the cumulative impact is greater than the sum of the multiple individual effects).

*7.9.3.1 Projects with potential to cause cumulative effects*

**N/M20 Upgrade Works**

A project with potential for in-combination effects upon biodiversity has been identified within this assessment, namely the N/M20 Upgrade Works. The proposed development will improve connectivity between Cork and Limerick and provide for safer and more efficient journey times. The route extends 80km from Blarney, Co. Cork to Patrickswell, Co. Limerick.

While it could be several years before a consent application is made, it is possible that within the 10-year lifetime of consent requested for the Project, this proposed development has a reasonable prospect of either being submitted for planning consent or commencing construction by this time. Also, both of the TDR routes examined in the EIAR will cross the proposed N/M20 corridor in certain areas.

**N72/N73 Dublin to Cork Railway Line**

The proposed development is located at seven numbered level crossings along a 24km section of the Dublin to Cork Railway Line. Railway works and all works necessary to eliminate and, where necessary, upgrade the seven numbered level crossings is due to be undertaken. An Environmental Impact Assessment has been conducted with associated baseline ecological surveys. Such surveys recorded the presence of a small number of protected species with the outcome of the EIAR showing that the proposed development will have no significant residual effects upon ecological features after mitigation.

**Limestone Quarry extension**

An extension to an existing limestone quarry, including all associated site development and landscaping works is proposed approximately 2.7km southwest of the proposed wind farm site at Scart, Ballyclough and Kilgilky South, Cecilstown, Mallow, Co. Cork. The proposed extension area is 5ha to the east of the existing quarry and will be accessed via existing via existing access to the north onto the L1201-57 via the L5302-0-12 local road. This application was subject of Stage 2 Appropriate Assessment and was granted planning consent on appeal by Board Order, concluding no significant residual effects upon important ecological features after mitigation.

**Foynes to Limerick Road upgrade (including Adare bypass)**

The proposals include a new road from the N69 at Shannon-Foynes port to the existing N21/M20 at Patrickswell to the east of Adare via the towns of Askeaton and Rathkeale. It is 35km in length and would be located along the Option 1 (Foynes Port) TDR, but approximately 42km north of the proposed wind farm site.

**Ballyroe Solar Farm and related 110kV substation**

A 10-year planning permission has been granted for the development of a 102.76 ha solar PV farm and associated underground electricity grid connection located approximately 1.2km west of TDR Option 1 (Foynes Port) TDR and approximately 10.8km north of the proposed wind farm site. The proposed solar farm will consist of the installation of 40 year operation and subsequent decommissioning of a series of ground mounted solar photovoltaic (PV) panels, mounted on steel support structures, together with one single storey ESB control room, 12 electrical transformation enclosures, underground cabling, inverters, CCTV poles and cameras, deer type security fencing, landscaping and biodiversity measures.

**Fiddane Solar Farm and related grid connection**

The Fiddane Solar Farm comprises the development of a 67.8ha site approximately 4.4km west of TDR Option 1 (Foynes Port) and approximately 10.8km north of the proposed wind farm site. It will comprise a series of ground mounted solar PV panels, mounted on steel support structures 2.1m in height, together with one single storey ESB control room, 14 electrical transformation enclosures, underground cabling, CCTV poles and cameras, deer type security fencing, site entrance, hardstanding area, landscaping along part of the northern site boundary and other associated development works.

**Soleire Renewable SPV Limited Solar Farm**

A 10-year planning permission has been granted for the development of a 42.6ha solar PV farm and associated underground electricity grid connection located approximately 11km north of the proposed wind farm site and 2km west of TDR Option 1. The proposed solar farm will consist of the installation of 40-year operation and subsequent decommissioning of a series of ground mounted solar photovoltaic (PV) panels, mounted on steel support structures, together with one single storey ESB control room, 12 electrical transformation enclosures, underground cabling, inverters, CCTV poles and cameras, deer type security fencing, landscaping and biodiversity measures.

**Restoration works in a discontinued quarry**

The development will consist of the restoration and infilling of the existing and future void over an area of approximately 17.2ha of existing permitted quarry located approximately 4.5km south of the proposed wind farm site and 4.8km west of TDR Option 2.

**Ballinrea Solar Farm (modification) & 110kV substation and grid connection**

The previously consented Ballinrea Solar Farm is currently subject of an application for permission for modifications that are entirely within the boundary of the permitted development, which is located within 200m of TDR Option. It will, amongst other proposals, increase the solar photovoltaic footprint of the permitted development from approximately 17.86ha of ground mounted solar panels to approximately 18.8ha of ground mounted solar panels.

**Hazelbrook Housing Development**

The Hazelbrook Housing Development is a permitted development that will be located approximately 8.2km southeast of the proposed windfarm site, 2km east from TDR Option 2, within 200m of GCR Option 1. It comprises the construction of a strategic housing development including 148 residential units, a creche, the provision of landscaping and amenity area to include 3 local play areas and 3 neighbourhood play areas.

**Clonmore Housing Development**

The Clonmore Housing Development will be located approximately 8.2km southeast of the proposed windfarm site, 2km east from TDR Option 2, within 200m of GCR Option 1. The permitted development will comprise the construction of 108 residential houses, a creche, car parking and associated ancillary development.

**Student Housing Development**

An application that is subject to an appeal is and which is yet to be determined has been submitted for the construction of 24 student housing units comprising 192 study bedrooms and ancillary communal amenities.

**Wind farms with potential to cause cumulative effects**

Wind farms, and proposed wind farms, in the vicinity of the wind farm site were also considered for the potential to give rise to cumulative effects. The proximity of the wind farms and whether they are operational, permitted, or pending (proposed) has been considered within this assessment. Wind farm projects with the potential to give rise to cumulative effects include the following projects outlined in **Table 7.21**:

**Table 7.21: Wind farms within 20km of the proposed wind farm site**

| Development | Status | Distance/ Direction[1] | Number of Turbines | Tip Height |
|---|---|---|---|---|
| Kilberehert wind farm | Operational | 9km, NW | 3 | 125m |
| Boolard wind farm | Operational | 12.8km, N | 2 | 150.5m |
| Knocknatallig wind farm | Operational | 13.8km, NE | 6 | 135m |
| Esk wind farm | Operational | 13.8km, SW | 14 | 136.5m |
| Rathnacally wind farm | Operational | 14.2km, N | 2 | 150.5m |
| Castlepook wind farm | Operational | 15km, NE | 14 | 126m |
| Carrigcannon wind farm | Operational | 17.1km, SW | 10 | 100m |
| Boggeragh 1 and 2 | Operational | 17.4km, SW | 43 | 136.5m |
| Coom wind park | Consented | 19.1km, SE | 22 | 172m |

| Development | Status | Distance/ Direction[1] | Number of Turbines | Tip Height |
|---|---|---|---|---|
| Ballinagree wind farm | In planning | 20.6km, SW | 20 | 185m |
| Annagh wind farm | In planning (appeal) | 10.9km, N | 6 | 175m |

[1] From nearest turbine of the proposed development.

#### 7.9.3.2 *Cumulative effects on designated sites*

The potential cumulative and in-combination effects on internationally designated sites (Natura 2000 sites) arising from the Project is discussed in detail in the NIS which accompanies this planning application. This includes the Blackwater River SAC which was identified for further assessment within this chapter.

No projects were identified which are considered likely to act cumulatively upon the local terrestrial ecology (habitats and species) of the identified designated sites during the construction, operational, and decommissioning phases of the Project. The only possible effect pathway identified between the Project and the two identified designated sites was hydrological. This pathway was, however, not considered likely to cause significant effects upon the designated sites and effects in combination with other developments is considered highly unlikely.

The regional projects and wind farms identified within proximity to the wind farm site have all been subject to their own relevant detailed biodiversity impact assessments and mitigation measures. The proper planning and implementation of environmental controls, monitoring and mitigation at such large-scale projects greatly minimises the risk of significant residual effects upon species and habitats of elevated conservation importance. Consequently, the risk of cumulative and in-combination effects on terrestrial biodiversity is also unlikely to be significant for the terrestrial habitats and species of interest, especially considering the distance at which the designated sites lie from the Project and other developments assessed for cumulative effects.

#### 7.9.3.3 *Cumulative effects on habitats and flora*

Due to the constraints led design approach and the avoidance of direct impacts on high-value habitats, it is not likely that there will be cumulative effects on habitats and flora of relevance to this Project. Any habitat loss on site is mostly restricted to such habitats which are common and widespread in the surrounding landscape, and of which are intrinsically low value for biodiversity. Furthermore, where significant effects from other proposed developments are predicted, mitigation and offsetting measures are included to ensure that any loss of valued habitats are reinstated and/or sufficiently replaced to avoid significant residual effects.

#### 7.9.3.4 *Cumulative effects on fauna*

The constraints led design approach has minimised the risk of disturbance, displacement and loss of habitats of importance for species. There is potential for bat species to be affected by other developments due to their transitory nature as a volant mammal. However, they are unlikely to be significantly affected by the N/M20 Cork to Limerick improvement scheme or other projects and developments outlined above due to their temporary construction nature and their limited amount of land take of suitable commuting, foraging, and roosting habitat. Furthermore, those developments considered as part of the cumulative assessment, including the other cumulative wind farms are outside of the core sustenance zones of all resident bat species in Ireland that are known to be roosting and active within, and in the vicinity of, the Project. Therefore, disturbances and habitat loss from construction and operation of these developments are unlikely to result in significant cumulative effects on bats associated with the Project.

No permitted or operational developments in the wider receiving environment were identified which were likely to act cumulatively or in combination with the proposed wind farm to effect upon other mammals and taxa present in the study area. No likelihood of cumulative effects have been identified in relation to the construction, operation, or decommissioning phases of the Project.

## 7.10 Mitigation and enhancement

### 7.10.1 Scope

This section describes the measures that are in place to mitigate adverse effects of the Project on ecological features. These measures are recommended in addition to the embedded mitigation described in section 7.8 which was taken into consideration during the assessment of effects.

Effects on features have been addressed in two ways:

- Design of the Project in terms of embedded mitigation (see section 7.8).
- Management and enhancement of development phases (described in this section).

The mitigation measures described below are designed to address and minimise the risk of effects arising from each phase of the Project. A Habitat Management Plan (HMP) (see EIAR **Volume III, Appendix 7.3**) has been prepared to ensure that the wind farm site is managed in the interests of biodiversity and that ongoing management is successful in achieving a biodiversity net gain as described within Section 0. Habitat creation and enhancement proposals included within the HMP are presented on **Figure 7.6**.

### 7.10.2 Mitigation of significant effects

Assessment of effects undertaken in section 7.9.3.1 identified the following potentially significant effects on ecological features during construction of the Project:

- Direct habitat loss and fragmentation of hedgerows.
- Direct loss and fragmentation of habitat used by commuting and foraging bat species.

Furthermore, the assessment of effects also identified the following potentially significant effects on ecological features during operation of the Project:

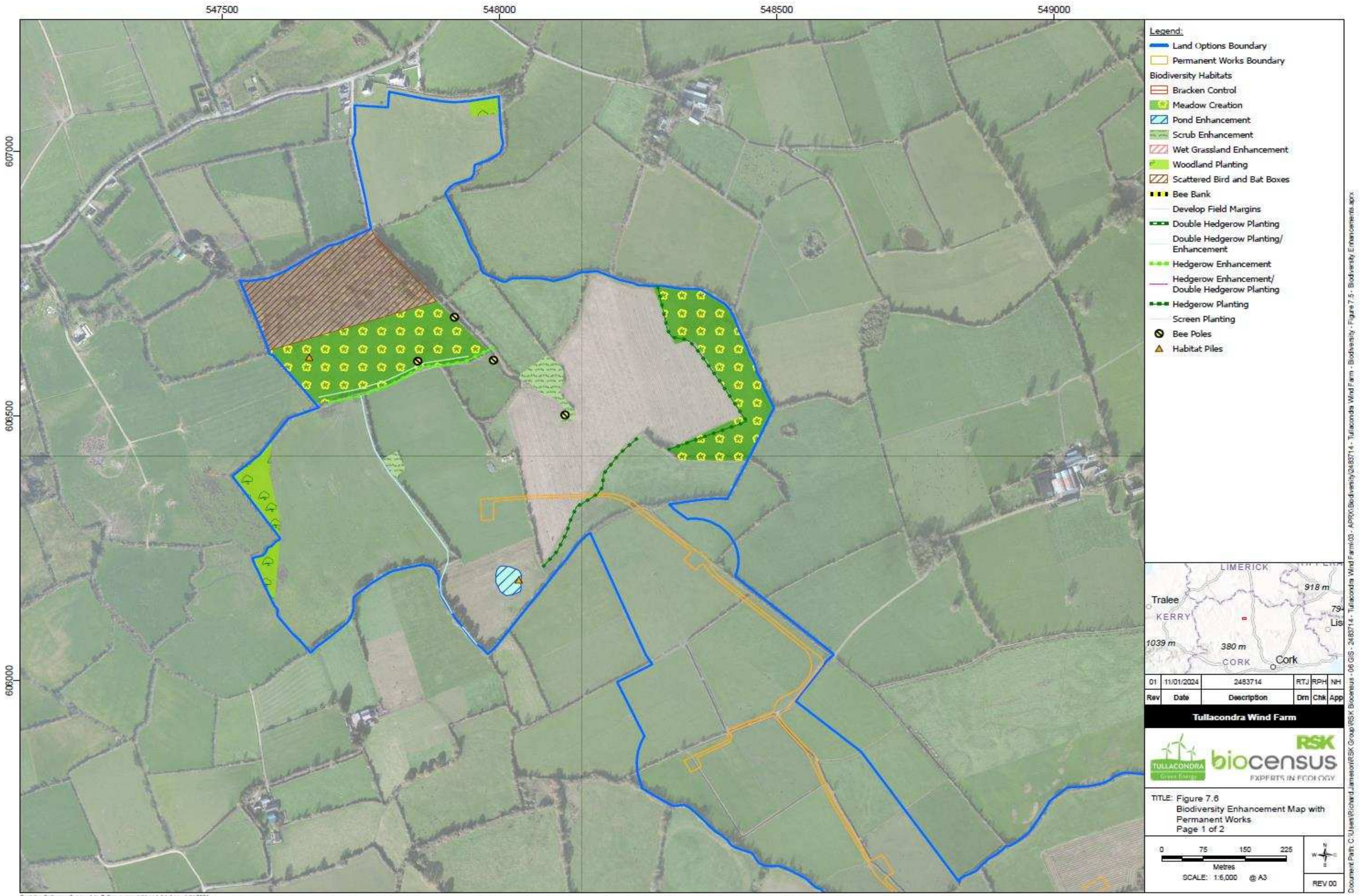
- Direct loss and fragmentation of habitat used by commuting and foraging bat species.

- Mortality of bats species from collision risk and barotrauma.

No potentially significant effects were identified for the decommissioning phase of the Project.

As stated within section 7.8, the development design includes the following measures which will serve to minimise these effects:

- Retention of areas of more important habitat within the landscape design.
- Minimisation of the extent of habitat loss during construction as much as is possible within the development design.
- Selection of a delivery route with the least amount of land take required wherever possible, and selection of an underground cable route which uses existing built infrastructure wherever possible.
- A Construction Environmental Management Plan to ensure best practice construction methodologies are used to limit, control, and avoid environmental effects.
- Presence of an Ecological Clerk of Works on site to oversee any ecological issues.
- Provision of embedded bat mitigation to reduce the potential for collision related mortality and barotrauma.

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World Terrain Base: Esri UK, Esri, TomTom, Garmin, FAO, NOAA, USGS
World Hillshade: Esri, USGS


**Figure 7.6: Biodiversity enhancement map with permanent works**

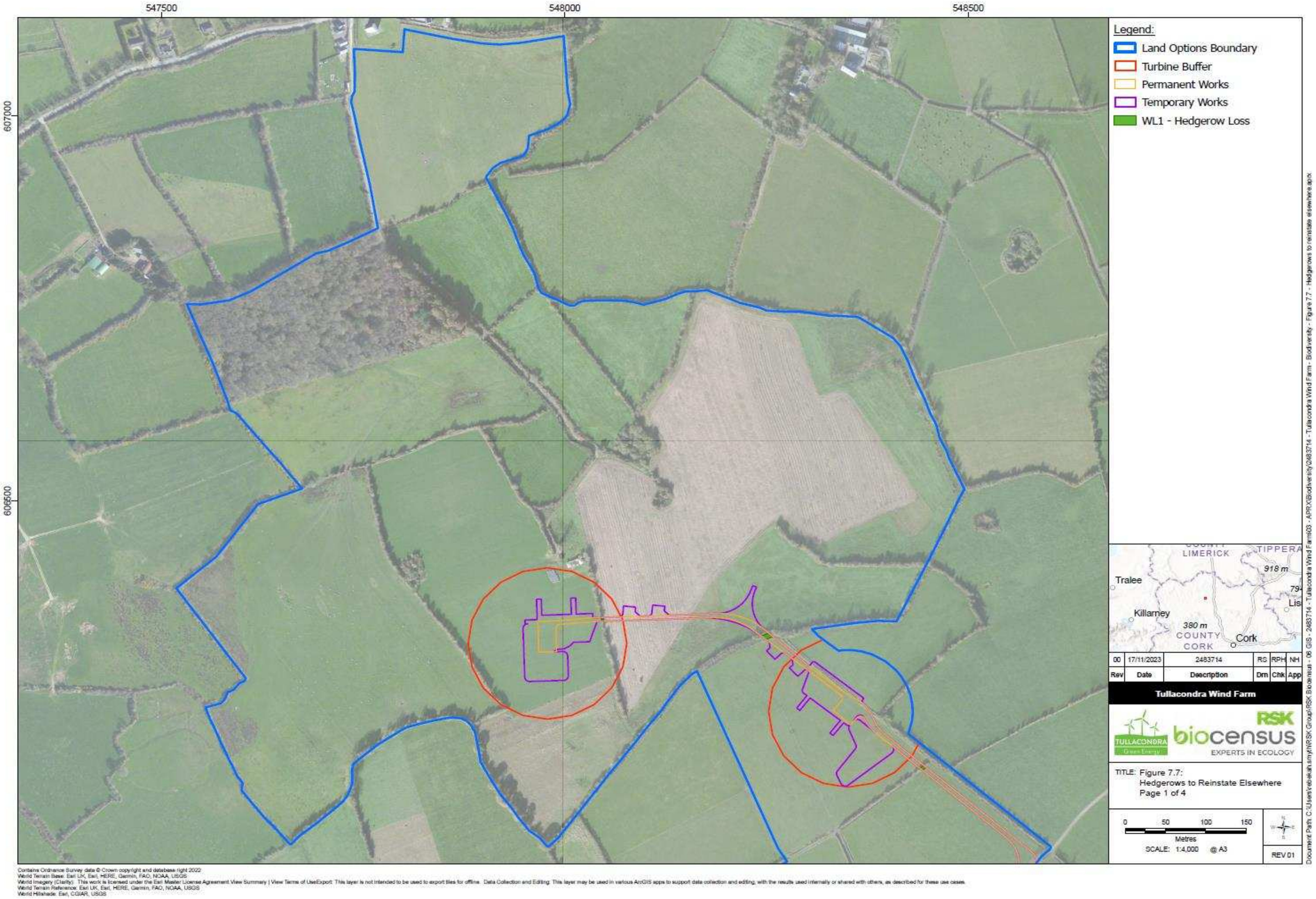
### 7.10.3 Hedgerow loss mitigation

Replacement hedgerow habitat will be created in proportion with the type and extent of habitat loss during construction. Hedgerows that will be temporarily lost in order to facilitate construction works will be reinstated on a like-for-like basis in the same location, where they fall outside of the proposed bat buffers. In total, this amounts to the reinstatement of 20m of hedgerows where temporary losses would occur. Where new gaps in hedgerows need to be created in order to facilitate permanent site access, then existing gaps within those hedgerows which are present to facilitate farm access will be planted in order to minimise potential fragmentation effects. This equates to approximately 15m of replacement hedgerow planting.

In areas where hedgerows cannot be reinstated in- situ (i.e., due to permanent works or around bat buffer zones), they will be created elsewhere within the wind farm site. To accommodate the Project, 411m of hedgerows will be permanently lost, primarily due to avoiding reinstating in-situ those hedgerows that need to be removed to accommodate temporary works, where they fall within bat buffer areas, and where in the interest of road safety sight lines need to be maintained at the site entrance (see **Figure 7.7**). To offset these losses an additional 2,911m of new hedgerow will be planted across the wind farm site as detailed in **Figure 7.6**, which represents a significant increase in hedgerow habitat, over and above the extent of which will be affected (431m), and an overall net gain for biodiversity. Whilst it is recognised that newly created hedgerow habitat will take time (up to ten years) to establish before it becomes functional and of value to biodiversity, the extensive amount of additional habitat that will be provided over and above what is to be lost will nonetheless represent a long-term benefit to biodiversity.

Only pruning or punching new holes in vegetation will be required along the TDR and GCR, with habitat losses here avoided. As such, additional replacement habitat is not required to mitigate such effects.

Planting is proposed to be distributed across the wind farm site in areas where potential enhancement will provide significant benefits to the heterogeneity of the area, and improve connectivity to bat foraging, commuting, and roosting areas along other hedgerows and woodlands off-site. Planting will ensure that collision risk to bats does not increase by strategically placing these newly created habitats away from turbines. Hedgerow planting will be arranged following single row and double row planting methodologies, utilising old field boundaries wherever possible and incorporating hedgerow trees to offset the small losses of some tree habitat. The proposals and management of this is detailed within the HMP which additionally describes the monitoring techniques to ensure this habitat remains viable (see EIAR **Volume III, Appendix 7.3**)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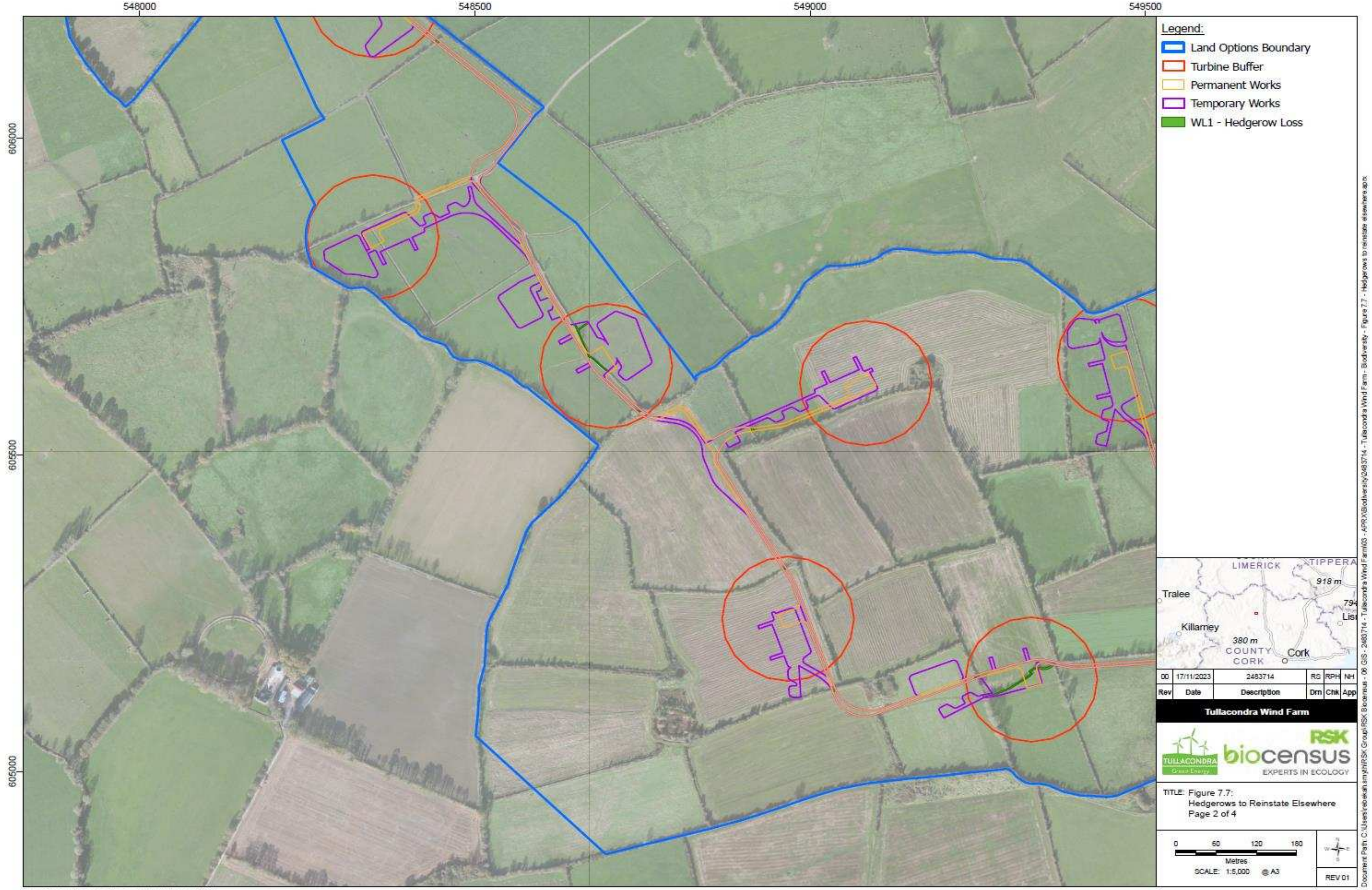

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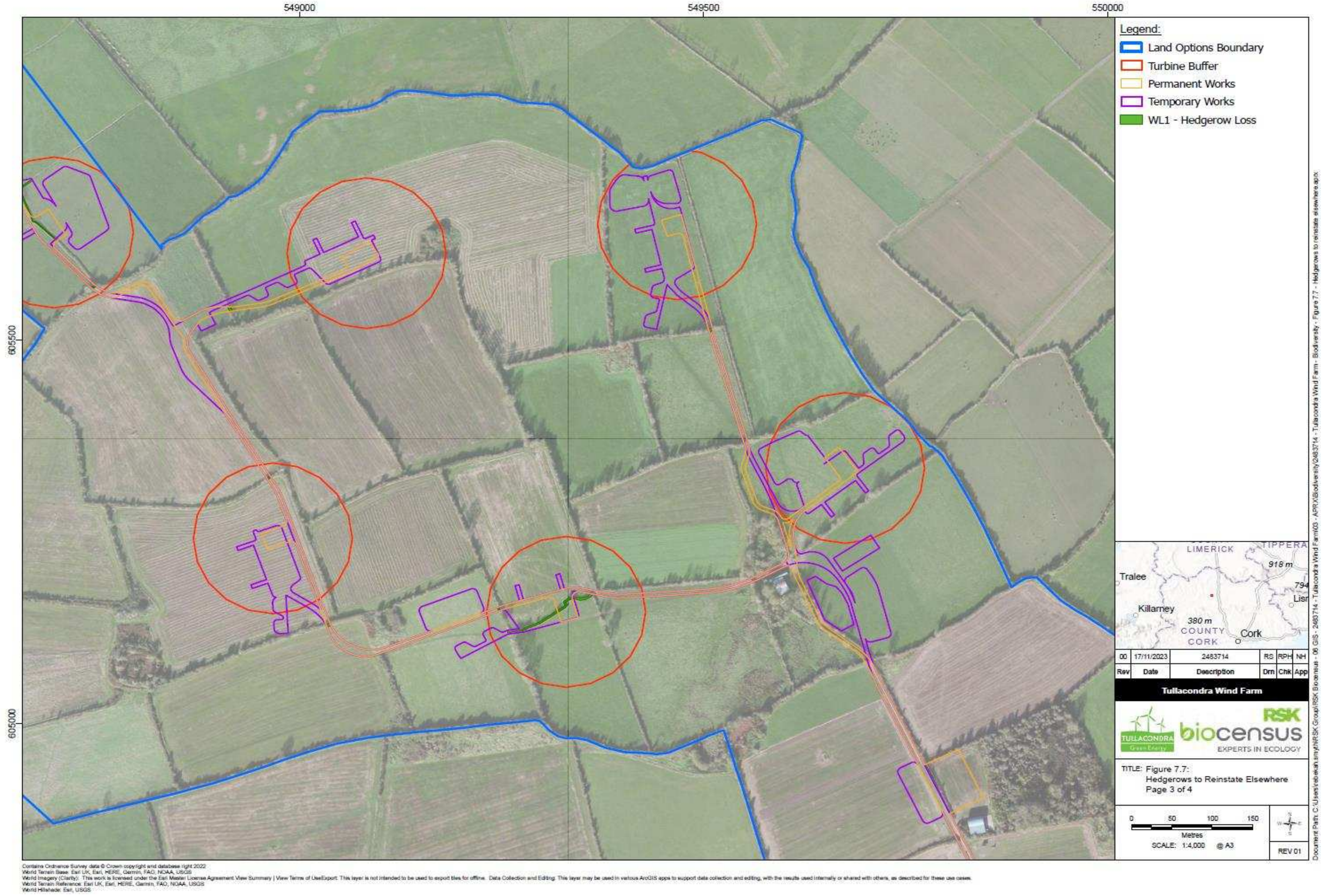

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Tullacondra Wind Farm
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**Figure 7.7: Hedgerows to be removed and reinstated elsewhere within the wind farm site**

### 7.10.4 Bat mitigation

*7.10.4.1 Habitat replacement*

Linear features such as hedgerows and treelines serve as commuting corridors for bats (and other wildlife). The loss of a proportion of these features on site as a result of the construction of the Project has resulted in a likely significant effect for commuting and foraging bat species. As described in section 7.1.1 above, hedgerows will be reinstated and replaced on a like-for-like basis. Additional hedgerows will be created to offset the unavoidable loss of these habitats, along with the creation of pockets of woodland to overall increase the commuting, foraging, and roosting habitats on site for bat species, achieving a net gain for biodiversity (as described in section 7.10.6.1). The planting aims to provide substantially improved bat foraging and commuting habitats to both the south and north of the wind farm site, influencing bats to utilise these areas rather than fly towards the turbines. Additionally, the installation of bat boxes in strategic locations will provide further roosting opportunities for bat species, as detailed within section 7.10.6.1.

*7.10.4.2 Feathering of blades and curtailment*

The turbines in the Project will operate in a manner which restricts the rotation of the blades as far as is practicably possible below the manufacturer's specified cut-in speed. This is usually achieved by feathering the blades during low wind speeds; the angle of the blades is rotated to present the slimmest profile possible towards the wind, ensuring that rotation of the blades is restricted to a minimum when not generating power.

Turbine blades spinning in low wind can kill bats; however, bats cannot be killed by feathered blades which are not spinning (Horn *et al*., 2008)[56]. As such, the feathering of blades during low wind speeds will be applied during the operation phase of the Project to restrict rotation of the blades to a minimum.

Modern remotely operated wind turbines as proposed here allow cut-in speeds to be controlled centrally/automatically, facilitating an operation regime designed to minimise harmful effects to bats. Increasing the cut-in speed above that set by the manufacturer can reduce the potential for bat/turbine collisions. A study by Arnett *et al*., (2011)[57] showed a 50% decrease in bat fatality can be achieved by increasing the cut-in speed by 1.5 m/s.

The feathering of turbine blades combined with increased cut-in speeds have been shown to reduce bat fatalities from 30% to 90% (Adams *et al*., 2021[58], Arnett *et al*., 2008[59],

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[56] Horn, J.W., Arnett, E.B. & Kunz, T.H. 2008. Behavioural Responses of Bats to Operating Wind Turbines. Journal of Wildlife Management, 72, 123-132.

[57] Arnett, E.B, Huso, M.M.P., Schirmacher, M.R. & Hayes. J.P. 2011. Altering turbine speed reduces bat mortality at wind-energy facilities. *Frontiers in Ecology and the Environment*, 9(4), 209-214.

[58] Adams, E.M., Gulka, J. & Williams, K.A. 2021. A review of the effectiveness of operational curtailment for reducing bat fatalities at terrestrial wind farms in North America. *PLoS ONE*, 16(11), 1-21.

[59] Arnett, E,B., Brown, W.K., Erickson, W.P., Fiedler, J.K., Hamilton, B.L., Henry, T.H., Jain, A., Johnson, G.D., Kerns, J., Koford, R.R., Nicholson, C.P., O'Connell, T.J., Piorkowski, M.D. & Tankersley Jr, R.D. 2008. Patterns of bat fatalities at wind-energy facilities in North America. *Journal of Wildlife Management*, 72, 61-78.

2011[57], 2013; Baerwald *et al*., 2009[60]). The most recent of studies showed a 63% decrease in fatalities (Adams *et al*., 2021)[58].

Species with elevated risk of collision (Leisler's bat, soprano, and common pipistrelle) in particular would benefit from increasing the cut-in speed of turbines, as dictated on a case-by case basis depending on the activity levels recorded at each turbine.

### *7.10.4.3 Curtailment methodology*

A dynamic curtailment strategy is proposed as part of the Project to mitigate the potential effects of collision related mortality and barotrauma of bats. The strategy will be adapted during the initial three years of operation of the Project in order to respond to up-to-date monitoring data. Curtailment during the opening two years of operation will be based on a 'blanket' approach, being more precautionary and informed by data derived from pre-construction surveys. Monitoring will take place during these initial years of operation to provide sufficient data to detect any significant changes in bat activity relative to pre-construction surveys, as detailed within section 7.10.4.4 below. This will aim to assess changes in bat activity patterns and the efficacy of the mitigation, to then inform any changes to curtailment. From year three of operation, a more advanced and focused curtailment approach will then be implemented, making use of the latest advances in bat detector technology and once the efficacy of the mitigation has been demonstrated. The curtailment strategy proposed is further outlined below:

**Year 1 curtailment**

Year 1 curtailment will be based on data derived from the pre-construction surveys in combination with weather data previously obtained. Cut-in speeds of turbines will be increased during the bat activity season (April-October) from 30 minutes prior to sunset and to 30 minutes after sunrise.

Cut-in speed restrictions will be operated according to specific weather conditions:

For turbines T2, T4, T5, T7 and T8:

1. When the air temperature is above 10.5°C (at nacelle height).
2. Wind speeds below 5.0m/s (at nacelle height).

For turbines T3, T6 and T9:

1. When the air temperature is above a 10.0°C (at nacelle height).
2. Wind speeds below 5.0m/s (at nacelle height).

Curtailment at turbine T1 has been deemed unnecessary.

A monitoring report will be submitted after the first year of operation to Cork County Council and NPWS (see section 7.10.4.4 below).

**Year 2 curtailment**

After the first year of operation, bat data from each of the turbines will be analysed alongside 10-minute interval (or less) weather data, in order to establish baseline

[60] Baerwald, E.F., D'Amours, G.H., Klug, J.B. & Barclay, R.M.R. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines. *Current Biology*, 18, 695-696.

parameters for the curtailment strategy for the second year of operation. The aim will be to curtail turbines for 80% at turbines T3, T6 and T9 and 78% for turbines T2, T4, T5, T7 and 8. Should collision monitoring establish fatalities occurring at a particular turbine location, these parameters can be adjusted. If a bat fatality occurs at turbine T1 it will be included in the curtailment regime. A monitoring report will then be submitted after the second year of operation to Cork County Council and NPWS (see section 7.10.4.4 below).

**Year 3 onwards curtailment**

In addition to the curtailment strategy outlined above, smart bat detectors such as those developed by Wildlife Acoustics (Wildlife Acoustics, 2023)[61] will be installed at each of the proposed turbines. These detectors have two components; a controller (Linux based computer which uses real time kaleidoscope software to identify bat calls) situated within the turbine, and a microphone to be placed at nacelle height. These detectors will record bats from 30 minutes before sunset to 30 minutes after sunrise year-round. Each detector unit has two microphones and a calibrator.

Given the proximity to retained hedgerows, turbines T4, T5, T6 and T8 will have an additional microphone installed (at 20m height facing the landscape feature). It is unlikely the detectors mounted at nacelle (100m) would record low flying bats such as brown long-eared (which may still fly high enough to be hit when turbine blades are moving at their lowest extent – 26.34m). Due to the proximity of a brown long eared bat roost, turbine T9 will also have a second detector placed at 20m height.

To prevent considerable unnecessary downtime resulting from the proposed “blanket curtailment” regime outlined as above for Year 1 and Year 2 and due to the advances in smart curtailment, a focused curtailment regime is further proposed from year three of operation onwards. This will help to maximise the electricity generated from the Project whilst safeguarding bats and thus avoid the need for onerous curtailment. Smart detectors such as those developed by Wildlife Acoustics can be programmed to interact with the SCADA (Supervisory Control and Data Acquisitions) operating system (or equivalent) to only pause the blades based on real time bat sound analysis. The program will implement curtailment at a value of; four bat passes per minute (bp/min) or higher and turn back on when bat passes reduce to two bp/min or below. Should collision monitoring establish fatalities occurring at a particular turbine location, these parameters will be adjusted in consultation with Cork County Council.

#### *7.10.4.4 Monitoring*

Monitoring will take place to provide sufficient data to detect any significant changes in bat activity relative to pre-construction surveys, as detailed within **Table 7.22**. This will aim to assess changes in bat activity patterns and the efficacy of mitigation to inform any changes to curtailment. A monitoring strategy has been developed as part of the HMP (see EIAR **Volume III, Appendix 7.3**). Monitoring will be led by a suitably qualified ecologist, overseeing the collision monitoring and the review of activity data.

[61] Wildlife Acoustics. 2023. SMART Song Meter with Analysis and Remote Transfer User Guide. Available at https://www.wildlifeacoustics.com/uploads/user-guides/SMART-User-Guide-03022023.pdf

Bat activity will be measured within monitoring years continuously between April and October at each turbine location, in combination with carcass surveys. In addition, wind speed and temperature data will be recorded at the nacelle height of each turbine. Following two consecutive years of monitoring, a review of the curtailment regime will be undertaken and refined to a “smart curtailment” strategy informed by the continuous monitoring of weather and bat activity data determined from the post-construction monitoring survey data and using software parameters programmed into the SCADA system. This approach will be agreed in consultation with Cork County Council.

**Monitoring curtailment**

If, following the initial three years of post-construction surveys, bat activity increases above the baseline and/or remains consistently high and carcass searches indicate fatalities are occurring (refer below), increased cut-in speeds will continue and be adjusted to reduce effects. This will subsequently be monitored in years 5, 7, 10, 15, 20, 25 and 30 with further review after each monitoring period (should smart curtailment be implemented, bat monitoring will be implemented for the lifespan of the wind farm).

Alternatively, if it is found that the results of bat activity surveys and fatality searches confirm that the level of bat activity at turbine locations is low then consent will be sought from Cork County Council (in consultation with NPWS) for the reduction and / or cessation in the requirement for these cut-in speeds / curtailment measures, or a reduction on the timing restrictions for these measures.

An assessment of static data gathered during operational surveillance will be completed using the online analysis tool Ecobat as recommended by SNH (2021)[5] as a minimum, or other equivalent guidance as dictated by up-to date standards and practices.

**Bat fatality monitoring**

Although curtailment is a mitigation strategy proven to lower bat fatalities, a fatality monitoring programme will be implemented within the operational wind farm. This will aim to confirm the accuracy of the collision risk assessment for bats and inform the curtailment strategy as described above. Monitoring will involve monthly searches of carcasses within monitoring years (March-October), ensuring that bat carcasses are discovered during periods of time when bats are active. Monitoring will take place within the first three years of operation and subsequently in years 5,7,10,15,20,25, and 30 as part of the curtailment monitoring schedule. All carcasses will be photographed and logged in an annual fatality search report, which will be submitted to relevant stakeholders and the Planning Authority for consultation to inform any remedial actions that may be necessary. It is possible a change in the curtailment strategy will be required if it is reported that bat mortality is deemed at an unacceptable level due to the wind farm development or if the curtailment strategy proves to be overly precautionary. A comprehensive onsite fatality monitoring programme will follow best practice guidance (SNH, 2021)[5] and include:

a) Carcass removal trials to establish levels of predator removal of possible fatalities. This should be done following recommended best practice and with due cognisance of published effects such as predator swamping, whereby excessive placement of carcasses increases predator presence and consequently skews results. At the time of publication predation trials set using trail cameras following guidance set out in Smallwood, 2010 provides the most accurate results.

b) Turbine searches for fatalities should be undertaken with the use of conservation dogs following best practice in terms of search area (minimum radius hub height) and at intervals selected to effectively sample fatality rates as determined by carcass removal trials in (a) above. At the time of publication, the typical search area surrounding the turbine bases follow (Edkins, 2014)[62] *Impacts Of Wind Energy Developments On Birds And Bats: Looking Into The Problem*, who recommends the "search width should be equal to the maximum rotor tip height'', e.g., proposed turbines for the Project have a max tip height of 175m thus the spread of the searched area, as a rectangle, square or circle, should be 87.5m in either direction form the turbine base."

c) Search intervals would follow (SNH, 2021)[5].

d) Recorded fatalities should be calibrated against known predator removal rates to provide an estimate of overall fatality rates. The analysis tool Evidence of Absence V2 is recommended as a minimum, or other equivalent guidance as dictated by up-to date standards and practices.

e) Monitoring report to be submitted annually to Cork County Council and NPWS.

**Table 7.22. Monitoring schedule for bat mitigation measures.**

| Mitigation measure | Monitoring required | Description | Duration |
|---|---|---|---|
| Bat boxes and tubes | Monitor bat use | Bat boxes, rocket boxes and tubes to be placed at locations outside the construction and operational footprint of the wind farm as determined by the Project ecologist/ECoW at least 1 season before construction start. These shall be examined by a licensed bat specialist according to NPWS recommendations. Records should be submitted to Bat Conservation Ireland for inclusion in its bat distribution database.<br>If the boxes / tubes are not used within the first three years of deployment re-site if necessary. Annual cleaning required if well used by bats or if used by birds. Replacement if damaged/lost. | From installation to years 1, 2, 3, 5, 10, 20, 30, 34. |
| Roost monitoring | Emergence surveys | Conduct emergence surveys of Brown Long-eared bat roost throughout the bat active season of first three years of operational phase. Observe if mitigation measures are working and bats are travelling south. Use of thermal cameras for surveys to avoid disturbance. | From initial operation and during years 1,2, and 3. |

[62] Edkins, M.T. (2014) *Impacts of wind energy development on birds and bats: Looking into the problem*.

| Mitigation measure | Monitoring required | Description | Duration |
|---|---|---|---|
| Bat activity | Static monitoring | Review of static data produced by bat detectors within turbines. | From initial operation conducted during years 1, 2, 3, 5, 7, 10, 15, 20 25 and 30 post construction. |
| Fatality study | Fatality monitoring | Corpse searches beneath turbines to assess the effect of operation on bats. | From initial operation conducted during years 1, 2, 3, 5, 7, 10, 15, 20,25, and 30 post construction. |

### 7.10.5 General mitigation measures

The following supplementary and/or additional measures are recommended to avoid significant effects on any ecological features identified within this chapter during the construction phase.

Similarly, to the replacement of hedgerow habitat described in section 7.1.1, habitats will be created in proportion with the type and extent of habitat lost during construction and decommissioning. All temporary habitat loss will be reinstated on a like-for-like basis, including along the turbine delivery and grid connection route, with exception to those hedgerow habitats that fall within the specified bat buffers (see section 7.8.4.1).

Replacement habitat will be delivered on site or as near to the wind farm site as possible. However, given the risk of effects from collisions with wind turbines, consideration has been given to the location of created and enhanced habitat suitable for use by target species (e.g., bats); specifically, creating features which may attract such species into the collision risk zone of new wind turbines will be avoided. Suitable features of created replacement habitat are consistent with those for the habitat enhancements described in section 0 and within the HMP.

Assessment of effects undertaken in section 7.9.3.3 identified no potentially significant effect on ecological features during the decommissioning phase of the Project. Therefore, mitigation will be limited to those already prescribed for the construction phase of the Project as decommissioning activities are assumed to be similar, having similar types of risks and sensitive features associated with them. Following reinstatement, the wind farm site will be monitored on a regular basis to determine the progress of re-vegetation and if necessary to look at introducing supplementary planting with native species. A reassessment of the wind farm site will be carried out at the end of the first-year post-decommissioning to assess the site’s progression over the previous year in relation to vegetation status, drainage management, and general site appearance to ensure the wind farm site remains favourable to biodiversity.

### 7.10.6 Enhancement measures

In accordance with ecological best practice and the requirement to achieve a net gain for biodiversity, enhancements will be delivered to ensure the Project has an overall positive effect on ecological features. This is further detailed within the HMP (EIAR **Volume III, Appendix 7.3**), which outlines the objectives and targets of the enhancement plan along with prescriptions for management and monitoring to achieve such aims. The plan is accompanied by **Figure 7.6** which applies an indicative location plan for the management measures prescribed.

The management plan will incorporate enhancement of retained habitat as well as the creation of new habitat of ecological value. Consideration has been given to the location of enhancements with regard to potential collision effects; for example, features targeting species susceptible to collisions with turbines (e.g., bats) will be located away from turbines and in locations which will not encourage commuting routes through the wind farm area.

#### *7.10.6.1 Habitat creation and enhancements*

Enhancements will target the ecological features assessed for effects, as identified in this chapter, as well as species of conservation concern in Ireland. The following measures have been proposed to offset any habitat loss or alteration resulting from the Project, and to further enhance the wind farm site and/or adjacent land for ecological features. The provision of the management plan will ensure that they establish successfully and deliver long-term benefits.

- **Hedgerow planting and enhancement** to provide additional nesting, foraging, and commuting habitats for a range of species, namely pygmy shrew, hedgehogs, bats, birds, and badgers. Proposals will position hedgerows in a way that will create commuting corridors for bats that will decrease the risk of collisions with turbines. Planting will use native plant species of known value to wildlife, whilst rotational management regimes will be adopted to newly planted and existing hedgerows to create varying age structures which will be favoured by different species and at different times of the year.
- **Woodland planting and enhancement** to further provide additional nesting, foraging, and commuting habitats. Planting will take place in three areas along the peripheries of the wind farm site and will incorporate a varying mosaic of different species and age structures, using native species of known value to the local ecology. Management will include rotational coppicing as well as the creation of glades and rides to benefit butterfly and other invertebrate species.
- **Wildflower meadow creation** to improve the botanical diversity of the wind farm site as well as increasing available habitat for invertebrate species. Two areas are proposed with one being in the area of improved grassland just south of the woodland in the north and the other in the vicinity of the proposed substation toward the south of the wind farm site.
- **Scrub enhancement** will aim to improve current condition of the scrub to be more beneficial for wildlife by varying the age structure and developing the ground flora.

This will be done through the provision of coppicing, natural regeneration, grazing management, and bracken control.

- **Wet grassland management** to improve botanical diversity and provide further foraging and breeding habitat for species such as butterflies and other invertebrates. It is proposed that the two areas of wet grassland will be expanded into one larger area that will be fenced off to reduce grazing pressure.
- **Enhancement of existing ponds**. Enhancement of two existing waterbodies on wind farm site will include eutrophication management, botanical planting, invasive species management, and the creation of a bund to prevent nutrient enrichment from the surrounding agricultural landscape. Open canopy farmland ponds dominated by aquatic macrophytes are known to be positively associated with many species, such as invertebrates, birds, and mammal species.
- **Field margin development** adjacent to boundary features such as hedgerows and ditches to provide nesting, foraging, and sheltering habitat and to improve habitat connectivity. Flower-rich margins typically support a more diverse invertebrate assemblage, providing food for a range of species.
- **Bee bank creation** (i.e., sand banks) in two locations to provide additional habitat for the buff mining bee, which was recorded to be present on site.
- **Bee pole provision** to provide additional habitat for the buff mining bee and other solitary insects. Bee poles will be erected in a number of locations within the wind farm site adjacent to suitable habitat for invertebrates such as bee banks, wildflower meadows, and ponds.
- **Bat box provision** throughout both pockets of existing woodland to increase roosting habitat for bat species. Bat boxes will be positioned sensitively so as to avoid increasing the risk of collisions with turbines.
- **Habitat piles** (collection of logs and dead wood) will be incorporated into quiet and varied habitats in the wind farm site to offer refuge for hedgehogs, hibernating reptiles, and amphibians, as well as deadwood specialist insects. Wherever possible, they will be created using any logs generated from vegetation clearance to reduce waste.
- **Tree planting** will involve planting a line of native trees around the peripheries of the proposed new substation.
- **Invasive Non-Native Species (INNS) management** will involve the control of Japanese knotweed in the southern section of the. A further site visit in advance of the pre-construction phase will be undertaken to map Japanese knotweed and any other invasive species that may have spread into new areas since the baseline surveys were conducted, which will inform an appropriate management strategy. On most occasions, a herbicide (Glyphosate) will be used as it is relatively low cost and does not involve the removal of hazardous waste from the wind farm site.

As a result of the enhancement measures proposed above and further detailed within the HMP, effective management will lead to the provision of a net gain for biodiversity. More habitat will be created and enhanced than those that will be affected. Creating further diversity and quality of habitats within the site will increase heterogeneity leading to increased suitability for a greater number of species. **Table 7.23** details the quantities for habitat creation and enhancement on site.

**Table 7.23. Habitat creation and enhancement figures**

| Habitat type/feature | Area (ha) |
|---|---|
| Bracken control | 0.15 |
| Meadow creation | 7.21 |
| Pond enhancement | 0.38 |
| Scrub enhancement | 0.97 |
| Wet grassland enhancement | 0.74 |
| Woodland planting | 1.04 |
| **Total** | **10.49** |
| **Habitat type/feature** | **Length (m)** |
| Bee bank | 89 |
| Field margin development | 282 |
| Hedgerow planting | 2,911 |
| Hedgerow enhancement | 1,046 |
| Treeline planting | 135 |
| **Total** | **4,463** |

*7.10.6.2 Monitoring*

As detailed within the HMP, a monitoring strategy will be developed in order to maintain the viability of the ongoing management of habitat creation and enhancement. Commencing in the first year of operation of the wind farm, the status of habitats created, enhanced, and controlled will be checked following a monitoring regime. For most management prescriptions monitoring will take place within the first three years of operation and then subsequently in years 5, 7, 10, 15, 20, 25, 30 and 34. This will follow implementation of the plan to confirm whether habitats have successfully established and to ascertain if any remedial measures need to take place as identified within a feedback loop. A concise report will be produced following these visits, to ensure documentation of the ongoing success of the HMP, and to identify any actions. A HMP monitoring report will then be submitted to Cork County Council at the end of each monitoring year. A final assessment of the condition of the management prescriptions will be undertaken in the year prior to decommissioning.

## 7.11 Residual effects

The following features were identified as sensitive and were subject to detailed assessment of effects:

- Habitats and flora (including hedgerows, scrub, disturbed ground, treelines, wet grassland, artificial lakes and ponds, eutrophic lakes, drainage ditches and mixed broadleaved woodland)
- Japanese knotweed (as an invasive non-native species)
- Invertebrates
- Bats
- Badgers
- Hedgehogs
- Pygmy shrew

As described in the assessment of effects presented in section 7.9, taking into consideration embedded mitigation within the Project design, effects on hedgerows and bats were assessed as being potentially significant. Effects on all other ecological features were assessed as being not significant.

Additional mitigation measures to avoid significant effects on these features are specified in section 7.10. Considering the scope for effects from the Project, and the importance and sensitivities of the ecological features, it is deemed that these measures will be sufficient to avoid significant effects with **no significant adverse residual effects** anticipated.

The planting of significantly more hedgerow habitat (2,480m more than will be removed) to that which will be permanently lost as a result of the Project will not only sufficiently offset those predicted losses but will also provide a long-term biodiversity benefit within the local area. Additionally, further enhancements laid out within the Habitat Management Plan (EIAR **Volume III, Appendix 7.3**) will ensure that the Project has an overall beneficial effect on those sensitive ecological features identified within this assessment as well as biodiversity as a whole. This will represent a **significant positive effect in the long-term**.

# EIAR Volume II

# Main Report

# Chapter 8: Ornithology

# CONTENTS

## TABLES



## FIGURES



## APPENDICES

# 8 ORNITHOLOGY

## 8.1 Introduction

### 8.1.1 Purpose of this report

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents an assessment of the potential impacts on ornithological features (sites, habitats, and species). This chapter is supported by the following technical appendices and their accompanying figures:

- **Appendix 8.1 – Ornithology Baseline Report** identifies the bird populations present within and in close proximity to the Project (i.e., the Project's 'ornithological baseline'), in reference to relevant statutory designated sites of ornithological interest, based on desk-based review and field surveys undertaken between 2020 and 2023 inclusive.
- **Appendix 8.2 – Ornithology Collision Risk Modelling Report** presents a study of potential effects on Key Ornithological Features (KOF) through collisions with new wind turbines, based on field data presented in the Ornithology Baseline Report.

The key objectives of the assessment presented in this EIAR chapter are to:

- Assess the current ornithological baseline characteristics of the Project, including determination of the importance of ornithological features (i.e., sites, habitats and species populations).
- Evaluate the likely significance of effects from the Project on ornithological features, including from potential impacts during the construction, operational and decommissioning phases, and potential impacts in isolation (i.e., from the Project alone) and in combination with other relevant Projects.
- Identify mitigation and enhancement measures to minimise the potential for significant effects from the Project on ornithological features and deliver ornithological enhancements where possible.

### 8.1.2 Site overview

The wind farm site is located in the townlands of Tullacondra, Croughta, Poulnareagha and Ardskeagh (approximately 2km) south of Lisgriffin Cross, Co. Cork). The wind farm site is primarily mixed farmland habitat with hedgerows and occasional areas of scrub, ponds and lakes and man-made drains and ditches. The area in which the turbines will be located, within the red line boundary, ranges in elevation from 133m AOD in the south to 120m AOD in the north.

## 8.2 The Project

As summarised in EIAR **Chapter 5 Project Description**, the Project includes the construction, operation and decommissioning of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and underground grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements..

The site layout plan of the proposed wind farm is shown in **Figure 8.1**. Of the two Grid Connection Route (GCR) options examined in the EIAR (as shown in **Figure 8.2**), only one route (Option 1) is included in the application for planning permission.

The EIAR also presents an assessment of potential effects from the proposed temporary accommodating works that will be implemented along two option routes from ports of origin in Foynes and Cork for delivery of large components to the wind farm site (as shown in **Figure 8.3**). These temporary accommodating works do not form part of the development for which planning permission is sought[1]. The GCR and turbine delivery routes (TDR) are shown in **Figure 8.2** and **Figure 8.3** respectively**.** Further details of the Project, the construction programme and sequencing of works which is used as a basis for assessments in this EIAR is provided in EIAR **Chapter 5 Project Description**.

[1] As the nature of the works are such that they do not require such permission. This will include temporary removal of street furniture, cutting through roundabouts, creation of temporary surfaces in road verges and clearance / trimming back of vegetation.

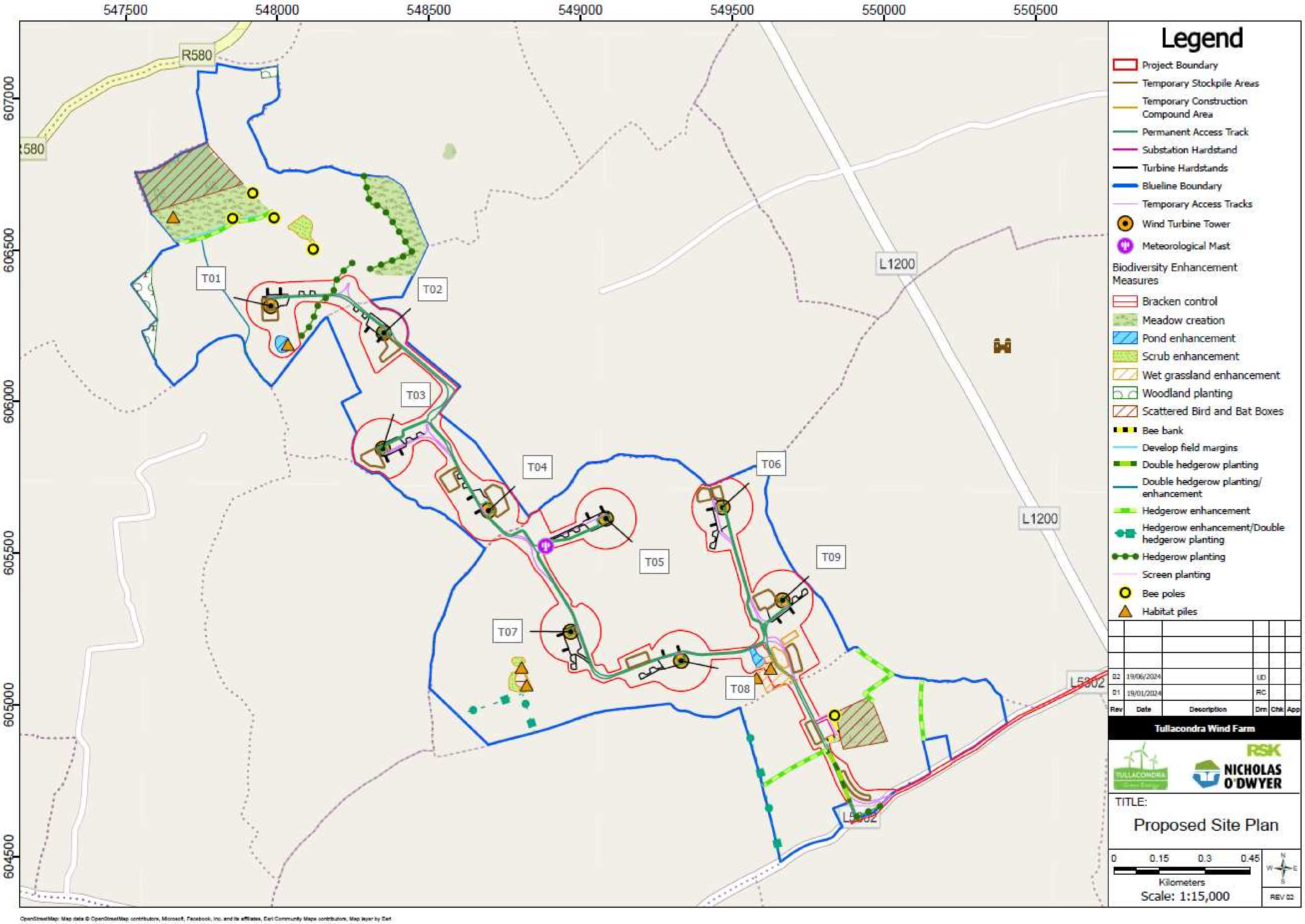
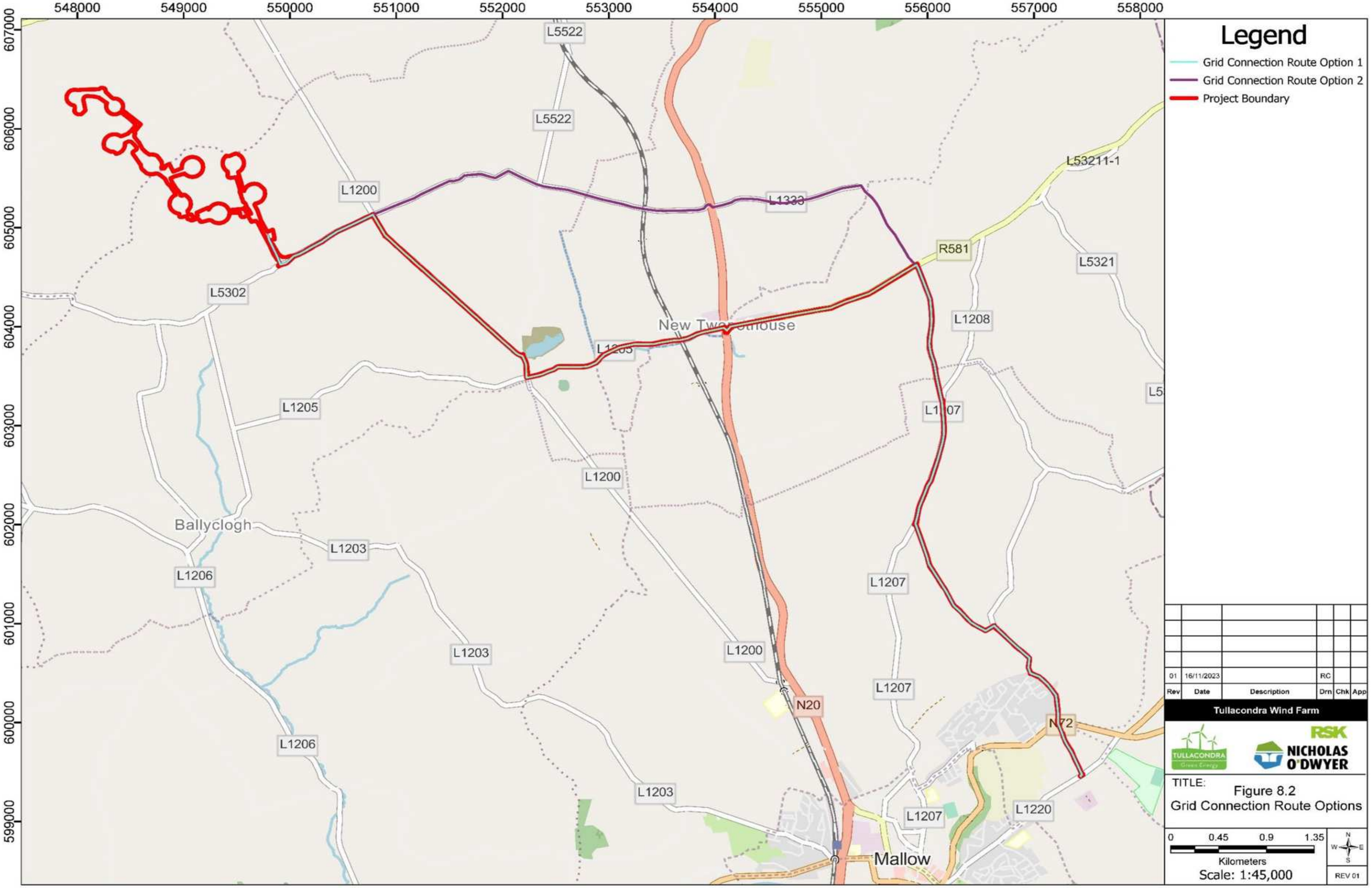



**Figure 8.1: Proposed site plan**




OpenStreetMap: Map data © OpenStreetMap contributors, Microsoft, Facebook, Inc. and its affiliates. Esri Community Maps contributors, Map layer by Esri

**Figure 8.2: GCR options**

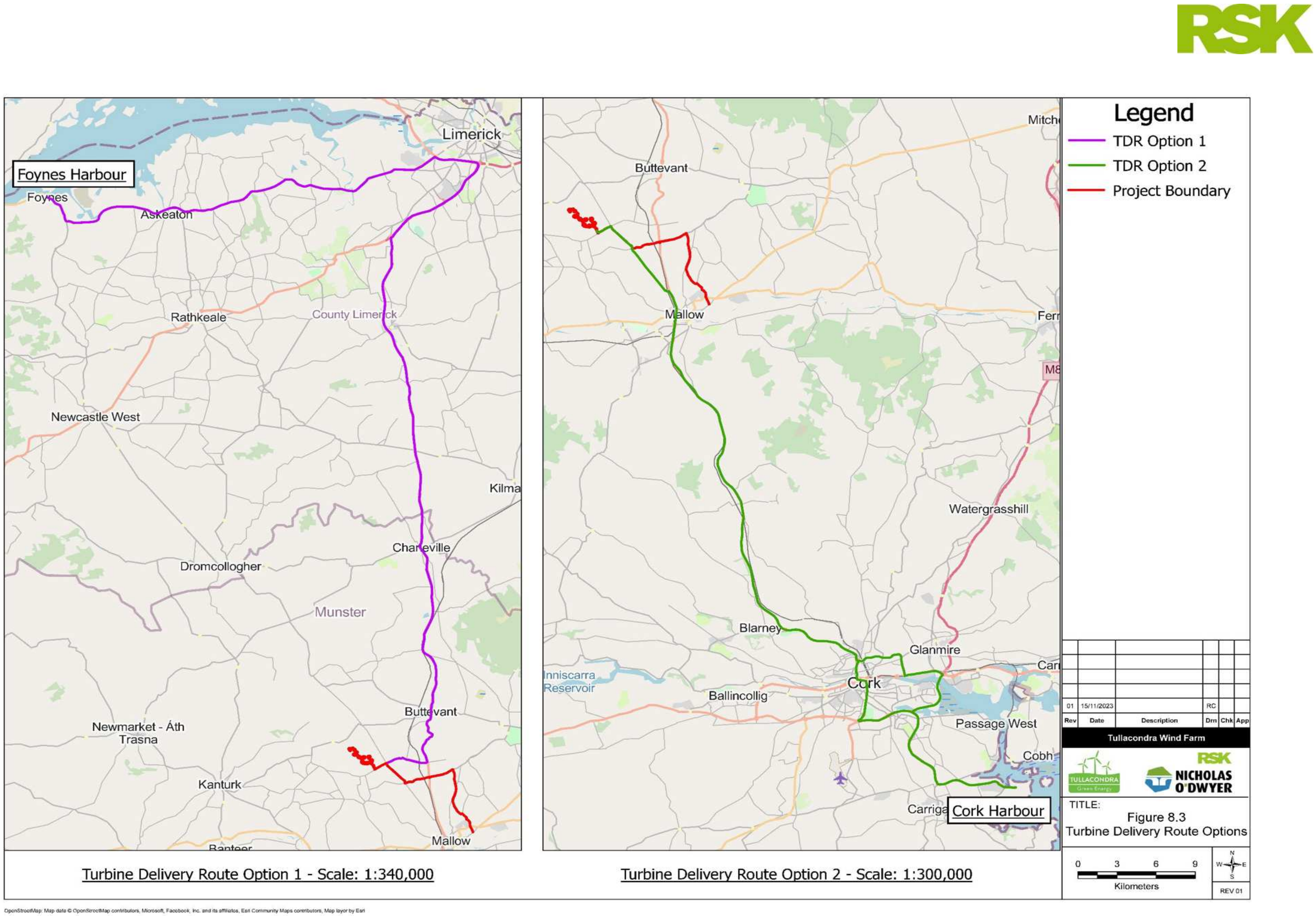



**Figure 8.3: TDR options**

## 8.3 Legislation, policy, and guidance

### 8.3.1 Legislative context

This EIAR chapter has been prepared in reference to the following legislation:

- The Birds Directive 2009/147/EC (as amended).
- The Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1971: the Ramsar Convention.
- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.
- The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1979.
- The EIA Directive 2011/92/EU and Directive 2014/52/EU.
- The European Communities (Birds and Natural Habitats) Regulations 2011 -23 (transposing the EU Birds Directive 2009/147/EC and EU Habitats Directive 2009/147/EC, 92/43/EC).
- Planning and Development Acts 2000-23.
- The Wildlife Act 1976-2023.

### 8.3.2 Policy framework

National and local planning policy relevant to this assessment include the following statutory policies:

- Project Ireland 2040: National Planning Framework.
- National Parks and Wildlife Service, Climate Change Sectoral Adaptation Plan (September 2019).
- County Cork Biodiversity Action Plan 2009 – 2014.
- Cork County Council, Biodiversity and the Planning Process, Guidance on the management of biodiversity issues during the planning process, Version 2, April 2022.
- Ireland's 4th National Biodiversity Action Plan 2023 – 2030.
- All-Ireland Pollinator Plan 2021-2025.

### 8.3.3 Guidance and resources

This EIAR chapter has been prepared in reference to current key industry standard guidance including the following:

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater Coastal and Marine version 1.1 (CIEEM, 2018)[2].

[2] CIEEM. 2018. Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Version 1.1 – Updated September 2019. [Available at: Guidelines for Ecological Impact Assessment (EcIA) | CIEEM – accessed 27/10/2022].

- Guidelines on the information to be contained in Environmental Impact Assessment Reports (EPA, 2022)[3].
- Best Practice Guidelines for the Irish Wind Energy Industry, (Irish Wind Energy Association, 2012)[4].
- Wind energy development and Natura 2000, (European Commission, 2011)[5].
- Recommended bird survey methods to inform impact assessment of onshore wind farms, (Scottish Natural Heritage, 2017)[6].
- The Birds of Conservation Concern in Ireland (BoCCI) Red and Amber Lists (Gilbert *et al*., 2021)[7].

## 8.4 Statement of authority

This EIAR chapter and accompanying appendices have been prepared by suitably qualified RSK ornithologists experienced in ornithological impact assessments. Preparation of the EIAR chapter was led by Nick Henson CEnv MCIEEM, assisted by RSK Biocensus ornithologist George Wilkinson. The baseline ornithology surveys described in this report were conducted by experienced ornithologists from MWP Consultants. Short profiles for each contributor are provided below and further details regarding the contributors to this EIAR are provided in EIAR **Chapter 1 Introduction**.

**Nick Henson**

Nick has more than 18 years' experience of ecological work, including extensive experience with assessing potential ecological effects of wind farm projects in the UK and Ireland. He has a Master's Degree in Environmental Sciences, is a Full Member of the Chartered Institute of Ecology and Environmental Management and a Chartered Environmentalist.

Role: Project Director, client liaison, technical and quality review of reports.

**George Wilkinson**

George Wilkinson is a Senior Ecologist who has over 5 years' experience in working with protected habitats and species, identifying and addressing ecological constraints. He has an MSc in Species Identification and Survey Skills from the University of Reading, and a BSc in Biology from the University of Bristol. He is also an Associate member of CIEEM.

Role: Lead author and assessor of ornithological effects.

**Monica Kane**

Monica Kane, during her time at Malachy Walsh and Partners (MWP), managed the Environmental Section of MWP. She is an Environmental and Ecological Consultant with

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[3] Environmental Protection Agency. 2022. Guidelines on the information to be contained in Environmental Impact Assessment Reports.

[4] Irish Wind Energy Association. 2012. Best Practice Guidelines for the Irish Wind Energy Industry.

[5] European Commission. 2011. Wind energy development and Natura 2000.

[6] Scottish Natural Heritage. 2017. Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage, Perth.

[7] Gilbert, G., Stanbury, A. & Lewis, L. 2021. Birds of Conservation Concern in Ireland 2020 – 2026. Irish Birds, 43, 1- 22.

over 15 years consultancy experience. She has been responsible for EIA and planning application project management, Appropriate Assessments, Ecological Impact Assessments, auditing, and constraints studies. She undertook and managed the environmental inputs into the Cluddaun Wind Farm, a Strategic Infrastructure Development, as well as the Boggeragh Wind Park, Knockranny Wind Farm and Clydaghroe Wind Farm EIS.

Role: Project Manager, liaising with client, review of all reports.

**Ciara Barry-Hannon**

Ciara Barry-Hannon is an Ecologist who worked for MWP until January 2023. She qualified with an Honours Degree in Wildlife Biology from Munster Technological University (MTU), formerly I.T. Tralee, in 2020. During her time at MWP Ciara contributed and helped complete numerous reports for bird survey work.

Role: Managing and co-ordinating surveys.

**Fiona McKenna**

Fiona McKenna is an Ecologist who has been working with MWP since 2019. She qualified with a degree in Wildlife Biology from Tralee IT in 2019. Over the last three years she has contributed and helped complete numerous reports for bird survey work and is experienced in the collation of data and in field ecology survey techniques.

Role: Field surveyor.

**Davey Farrar**

Davey Farrar is a Senior Ornithologist with MWP. Davey has more than 30 years of bird survey experience. He has worked on projects for Hen Harriers for UCC and Estuary Bird Monitoring for BirdWatch Ireland. Davey has worked on many projects in Ireland and the UK and is proficient in VP Surveys, Transect Surveys, Point Count Surveys, red grouse Surveys and Hinterland Surveys.

Role: Senior Ornithologist and Field surveyor

**John Murphy**

John Murphy is a Senior Consultant Ornithologist. He is very experienced having worked in the field of ornithology and ecology since 1982 and has extensive knowledge of the Irish landscape with regard to bird populations. He collaborates regularly with NPWS on different projects throughout the country. John is one of the country's foremost ornithologists and is a licensed bird ringer. He was the Biodiversity Officer with Clare County Council and has worked as part of the MWP Ecology team on a variety of projects nationwide since 2010.

Role: Senior Ornithologist & Field surveyor, liaising with client and technical reviewer.

**Marie Kearns**

Marie Kearns is a field ecologist with a background in terrestrial and marine ecology, with professional experience in bird, mammal and habitat surveys. She qualified with an MSc in Marine Mammal Science from St Andrews University (2015) and a BSc in Zoology from University College Cork (2013).

Role: Field surveyor.

**Deidre O'Brien**

Deirdre O'Brien has been working with MWP since 2018. During that time, she has carried out field work which included invasive species survey's, bird surveys, freshwater macroinvertebrate sampling and identification, (sensu Q' value assessment) and collection of water samples. She has also gained experience in standard field survey methodologies including mammal surveying and habitat mapping.

Role: Field surveyor.

**Paidi Cullinan**

Paidi has more than 20 years of bird watching experience in Ireland and abroad and is the Vice Chairperson of the Clare branch of Birdwatch Ireland and the eBird county recorder for Clare. Paidi has worked on a variety of projects in many locations around Ireland. He is proficient in iWebs, common bird census, Vantage Point surveys, Transect surveys, hen harrier roost watches, Point count surveys, hinterland surveys, merlin, golden plover and red grouse survey.

Role: Field surveyor.

**Austin Cooney**

Austin has more than 35 years of bird surveying experience both in Ireland and abroad and is an active member of the Clare branch of Birdwatch Ireland. Austin has worked on a variety of projects in many locations around Ireland. He is proficient in Vantage Point surveys, Transect Surveys, Point Count surveys, Hinterland surveys, merlin surveys and red grouse surveys. Austin has over 10 years iWeBS survey experience and is co-author of the book "Shannon Airport Lagoon – A Unique Irish Habitat".

Role: Ornithologist & Field surveyor.

**Luíse Ní Dhonnabháin**

Luíse is a passionate field ecologist with extensive experience of bird surveys, fieldwork planning and lone working. She is meticulous in data collection and entry and management. Luíse is a trainee ringer with over 3000 birds ringed, including c. 1500 seabirds.

Role: Field surveyor.

**Stan Nugent**

Stan founded Waxwing Wildlife Productions Ltd in 2006 to provide ecological services to companies such as Roche Ireland Ltd, Inland Fisheries Ireland and National Parks and Wildlife Service etc. Stan is a life-long naturalist with a specific interest in ornithology and freshwater habitats.

Role: Field surveyor.

**Michael O'Clery**

Michael has been birding for over 40 years and, since 2005, has been involved in many professional bird surveys, projects and bird counts in Kerry and throughout Ireland, for

BirdWatch Ireland, NPWS and several Environmental Consultancies and NGOs. Michael now works as a full-time Bird Surveyor for Goldcrest Environmental Services Ltd., with contracts with several Environmental Consultancies and NGOs. Foremost among them is the long-term, on-going study of barn owls in the county. This pioneering work has resulted in new and detailed information on the breeding and distribution of the species, as well as helping to conserve and protect nest sites, and to create new nesting opportunities for the species by careful siting, positioning and monitoring of nest boxes. He is compiler and editor of The Dingle Peninsula Bird Reports, currently in its twelfth year.

Role: Field surveyor & barn owl ecologist.

**Aidan Duggan**

Aidan Duggan has more than 30 years of bird surveying experience in Ireland and abroad and is an active member of the Cork branch of Birdwatch Ireland. Aidan has worked on a variety of projects throughout Ireland and is proficient in Vantage Point surveys, Transect Surveys, Hinterland surveys, merlin surveys and red grouse surveys.

Role: Field surveyor.

**John Hehir**

John has 10 years of experience working on a number of conservation projects in Ireland. John took up his position with MKO in November 2016. Prior to joining MKO John worked as an intern ecologist for Westmeath County Council. John also has over four years of experience working as a conservation support worker for Birdwatch Ireland. John's key strengths include bird identification, various field surveying methodologies, data management and report writing. In his time with MKO, John has performed bird surveys for nine different windfarm applications.

Role: Field surveyor.

**Tom Ryan**

Tom is a freelance Ecologist / Ornithologist with extensive field experience. Familiar with a broad range of environments, having carried out ecological surveys in many different habitat types. He is experienced in carrying out all SNH bird survey methodologies and very competent at locating and understanding the ecology of all red listed and annex 1 bird species found in Ireland, including some rarities. His most notable experience to date has been with breeding common crane, breeding and roosting hen harrier at numerous locations, experienced in breeding wader surveys, red grouse tape lure surveys and breeding barn owl surveys. He is proficient in the use of mapping software, QGIS and MapInfo.

Role: Field surveyor & GIS Analyst and flight path/activity mapping.

**Ashling Fenton**

Ashling has worked in both Data and GIS Analysis. Her experience spans a variety of project types including wind and solar site origination and development, due diligence within the utilities and agriculture sector. She is also experienced in data cleansing & analysis, report writing, and the provision of PRAI compliant maps.

Role: GIS Analyst responsible for GIS Analytics and flight path/activity mapping.

## 8.5 Consultation

A scoping consultation for the Project was made to the Department of Agriculture, Food and the Marine in October 2022. This did not raise any specific comments regarding ornithology.

Further to the submission of a formal scoping request, a pre-planning meeting was held with Cork County Council on 17th November 2022, where the Project proposals were presented to Council officials, including a high-level overview of the ecological characteristics of the Project site. With regards to terrestrial ecology, it was noted during the pre-planning meeting with Cork County Council that the Project would likely result in unavoidable effects to local features such as hedgerows, particularly at the construction phase. In addition, the principle of biodiversity gain is to be addressed within the application. This is further discussed in EIAR **Chapter 7 Biodiversity**, as well as EIAR **Volume III, Appendix 7.3.** No specific comments were made with regards to ornithology.

A second pre-planning meeting was held on 2nd August 2023. In attendance from the applicant were members of the consultant team including town planners, the project ecologist and engineer, and members of the Project team. In attendance from Cork County Council were planning officers, and the County ecologist, and engineer. A third and final pre-application meeting (in person) was held with the Planning Authority on the 11 September 2023.

At both of these pre-planning meetings, an update on the preparation of the EIAR, project design and planning application was presented. In the second pre-application meeting particular focus was on plans for access to the proposed wind farm site, biodiversity net gain, and validation queries.

## 8.6 Assessment Approach and Methodology

The methods adopted to inform and undertake the assessment presented in this EIAR chapter are described in this section, specifically the methods for determining the 'ornithological baseline' of the wind farm site (i.e., the bird populations present within and in close proximity to the site prior to development) and the methods for identifying and assessing likely significant effects from the Project (including potential impacts from collisions with new wind turbines). These methods were informed by the best practice guidance described in section 8.3.3.

Full details of methods for the desk study and field surveys to inform determination of the ornithological baseline of the site are provided in **Volume III, Appendix 8.1.** Full details of methods for ornithology collision risk modelling are provided in **Volume III, Appendix 8.2**.

### 8.6.1 Scope of the assessment

The scope of this assessment has been established through an ongoing scoping process. This section defines the scope of the assessment and re-iterates the evidence base for scoping in elements following further iterative assessment.

The assessment approach prescribed by the Chartered Institute for Ecology and Environmental Management's (CIEEM) Ecological Impact Assessment (EcIA) guidelines CIEEM, (2018)[2] is summarised below, including an explanation of key terminology. In summary, the guidelines advocate the following approach which were followed for the purposes of this EIAR:

- Prediction of the activities associated with a proposed scheme that are likely to generate biophysical changes which may lead to significant effects (either positive of negative) upon ornithological features and resources of importance.
- Identification of the likely Zone of Influence of the Project.
- Scoping to select the ornithological features and resources (ecological features) that are likely to fall within the potential Zone of Influence of the Project to be considered within the assessment.
- Evaluation of ornithological features likely to be affected.
- Assessment of the significance of effects on ornithological features (including assessment of cumulative and residual effects).
- Refinement of the proposed scheme to incorporate mitigation to avoid significant adverse effects on ornithological features, and to incorporate enhancements where possible.

### 8.6.2 Determining the Zone of Influence

The Zone of Influence (ZoI) is defined as 'the area over which features may be affected by biophysical changes as a result of the Project and associated activities' CIEEM, (2018)[2]. The ZoI therefore potentially extends beyond the wind farm site boundary due to ecological and hydrological links between the wind farm site and areas that fall outside its boundaries. Additionally, the ZoI is likely to differ between different ornithological features depending on their characteristics and likely sensitivities. For individual ornithological features, the ZoI was assessed following available best practice guidance (SNH 2017[8]; McGuinness *et al*., 2015[9]).

In the absence of specific European or Irish guidance in relation to Special Protection Areas (SPA), Scottish Natural Heritage (SNH) Guidance[10] was consulted. This provides guidance in relation to the identification of ecological connectivity between project sites and SPA. The guidance is relevant in Ireland for species that are present in Ireland. The distances for core and maximum dispersal and foraging ranges are drawn from literature reviews that examined ranging behaviour across a variety of locations in the UK and Ireland. The guidance takes into consideration the distances species may travel beyond the boundary of SPA and provides information on dispersal and foraging ranges of birds that are encountered when considering plans and projects. Where SPAs are at greater distances for their listed Species of Conservation Interest (SCI), there is no likely ecological connectivity to the development and so the SPA are outside the likely ZoI.

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[8] Scottish Natural Heritage. 2017. Recommended bird survey methods to inform impact assessment of onshore wind farms. Scottish Natural Heritage, Perth.

[9] McGuinness, S., 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. BirdWatch Ireland, Kilcoole, Wicklow.

[10] Scottish Natural Heritage. 2016. Assessing Connectivity with Special Protection Areas (SPA). Guidance Version 3 – June 2016. Scottish Natural Heritage, Inverness.

According to the NatureScot guidance, the core foraging distances of wintering grey geese (greylag goose (*Anser anser*) and pink-footed goose (*Anser brachyrhynchus*)) from SPAs is 15-20km. This represents the largest foraging range of all the species listed in this guidance document. It is acknowledged that information on core foraging ranges is not available for all SCI species. In such cases, the 15-20km core foraging range for grey geese has been adopted as a precautionary approach.

Therefore, taking this into consideration and with reference to baseline surveys carried out for this Project, the ZoI is broadly considered to extend across the wind farm site and up to 20km from it. This is well beyond the likely regular dispersal or foraging distance for any SCI species (as stated above, the largest core foraging range for any terrestrial bird species is 15-20km). Significant effects beyond this distance are deemed highly unlikely, due to the likely dilution of waterborne and airborne impacts and since the core sustenance zones and published foraging ranges (SNH, 2016; NatureScot, 2023) of mobile species that are relevant to the site is unlikely to extend beyond 20km.

The ZoI of individual ornithological features is further outlined in the sections below.

### 8.6.3 Determination of the ornithological baseline

#### *8.6.3.1 Desk study*

To facilitate a broad review of potential ornithological constraints and the identification of target bird species for subsequent assessment, a desk study was undertaken to identify relevant designated sites with features of ornithological interest and records of specially protected and notable bird species.

A search was made via the National Parks and Wildlife Service (NPWS) website for any statutory designated sites for nature conservation value (e.g., SPA and Ramsar sites) with features of ornithological interest, and any other relevant protected and priority habitats. A search was also made on the NPWS website for non-statutory designated sites with features of ornithological interest. Based on the potential ZoI of the Project, sites with a statutory designation were initially identified within a 20km radius of the wind farm site, whilst those with a non-statutory designation were initially identified within a 2km radius of the wind farm site. Where appropriate (e.g., due to the presence of potential impact pathways), statutory and non-statutory designated sites located outside of these areas were also assessed. This has been determined based on the combined professional experience, judgement and discretion of contributors to the field surveys and report authors.

To provide context on the presence of specially protected and notable species in the wider area, records were obtained from The National Biodiversity Data Centre (NBDC) for a polygon spanning 10km beyond the wind farm site boundary, in September 2022. Records were obtained for:

- Species afforded protection under wildlife legislation (i.e., the Wildlife Acts).
- Species considered to be of conservation concern (e.g., Red or Amber Listed Bird species of Conservation Concern in Ireland (BoCCI; Gilbert *et al*., 2021[7])).
- Invasive Non-native Species (INNS).

Any relevant Irish Wetland Bird Surveys (I-WeBS) data for sites within 10km of the wind farm site were also reviewed[11] and general ornithological information was reviewed from BirdWatch Ireland[12].

#### *8.6.3.2 Field surveys*

Detailed ornithological field surveys of the wind farm site were undertaken between 2020 and 2023 inclusive to identify the bird populations using the wind farm site and the immediately adjacent land, and to gather supporting data to enable detailed impact assessment (e.g., through collision risk modelling). Field surveys undertaken to inform this EIAR chapter were as follows:

- Vantage Point (VP) surveys during the breeding season (i.e., April to September inclusive) in 2021 and 2022, and during the non-breeding season (i.e., October to March inclusive) in 2020/21, 2021/22 and 2022/23.
- Walked transect surveys in 2021, 2022 and 2023.
- Targeted surveys of buildings for nesting barn owl (*Tyto alba*) and kestrel (*Falco tinnunculus*) in July 2022 and May 2023.

The survey approach adopted was based on best practice guidance and professional judgement, in reference to known bird-habitat associations and best practice survey methods for target species. The geographical scope of the field surveys was determined in reference to Scottish Natural Heritage (SNH) and CIEEM guidance, SNH, (2017)[6]; CIEEM, (2018)[2].

Certain bird species were identified as 'target species' for consideration in relation to the Project. The process for selecting target species is described in the Ornithology Baseline Report (see **Volume III, Appendix 8.1**). Surveys were designed to aid recording of these target species. Selection of target species took into consideration:

- Their known or likely presence within or in close proximity to the wind farm site.
- Their likely sensitivity to the Project (particularly their potential collision risk and/or susceptibility to disturbance from new wind turbines), (Nairn & Partridge, 2013)[13].
- Their level of legislative protection and conservation concern.
- Their relevance to any nearby designated sites of conservation importance (e.g., SPA).

In summary, the following species were identified as target species for this assessment, with particular emphasis on specifically protected and notable species including any species relevant to nearby designated sites:

- All species of waterfowl
- All species of raptor
- All species of owl
- All species of grouse

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[11] Available at: [Irish Wetland Bird Survey (I-WeBS) - BirdWatch Ireland]() (accessed 05/07/2023).

[12] Available at: [Home Page - BirdWatch Ireland]() (accessed 05/07/2023).

[13] Nairn, R. & Partridge, K. 2013. Assessing wind energy impacts on birds - towards best practice. CIEEM 2013 Irish Section Conference: Presentations.

- All species of wader
- All species of gull and skua

**Vantage point surveys**

Vantage Point (VP) surveys were undertaken in accordance with best practice guidance SNH, (2017)[6] to record bird activity throughout the wind farm site during the breeding and non-breeding seasons, including flight activity by target species. In accordance with the aforementioned best practice guidance, VP surveys were undertaken over two consecutive years in order to establish a more detailed ornithological baseline for the wind farm site, to facilitate thorough assessment of impacts within this EIAR chapter.

To enable detailed coverage of the wind farm site, an initial four VP locations (VPs 1-4) were identified for the surveys. In response to Project design changes two additional VPs, VP5 and VP6, were surveyed during the 2022 breeding season and the 2022/23 non-breeding season to ensure sufficient coverage of the wind farm site (**Figure 8.4**). VP locations were selected to maximise coverage of the wind farm site (particularly the proposed turbine locations) and aid observation of potential flight lines and habitat assessed as being suitable for aggregations of target species.

Where possible, two surveys from each VP were undertaken monthly during the breeding season in 2021 and 2022, and during the non-breeding season in 2020/21, 2021/22 and 2022/23. As such, VP survey data were collected for two complete breeding seasons and three complete non-breeding seasons. Monthly coverage year-round enabled the recording of species using the site at all times of year, including breeding species, wintering species and spring and autumn passage species. VP survey effort is summarised in **Table 8.1**.

**Table 8.1: Summary of vantage point survey effort**

| VP | Hours of observation | | | | | |
|---|---|---|---|---|---|---|
| | Breeding season 2021 | Breeding season 2022 | Non-breeding season 2020/21 | Non-breeding season 2021/22 | Non-breeding season 2022/23 | Total |
| VP1 | 36 | 36 | 36 | 36 | 36 | 180 |
| VP2 | 36 | 36 | 36 | 36 | 36 | 180 |
| VP3 | 36 | 36 | 36 | 36 | 36 | 180 |
| VP4 | 36 | 36 | 35 | 36 | 36 | 179 |
| VP5 | 0 | 36 | 0 | 0 | 36 | 72 |
| VP6 | 0 | 6 | 0 | 0 | 36 | 42 |

The VP surveys followed a standard approach in accordance with best practice guidance, with surveyors scanning the pre-determined viewshed from the VP location for a period of three hours per survey. All flight activity and aggregations of target species were recorded onto standardised recording forms and maps, with the following flight parameters recorded to facilitate collision risk modelling:

- Start time of flight observation
- Duration of flight observation
- Species and number of individuals
- Approximate height of flight in metres, with the time spent in each flight height category (non-flight, 0-20m, 20-50m, 50-100m, 100-180m and >180m) recorded
- The likely purpose of the flight (e.g., foraging, displaying, commuting, etc.)

**Transect surveys**

In accordance with best practice guidance, VP surveys were accompanied by transect surveys to record supplementary information on bird use of the wind farm site. As for VP surveys, transect surveys were undertaken during two years. Transect surveys initially focused on activity during the breeding season and autumn passage periods, with additional transect surveys undertaken in winter 2022/23 to supplement VP survey data.

Based on the size of the wind farm site and available access, two transect routes were initially surveyed (as indicated in **Figure 8.4**). These transect routes were designed to maximise coverage of the wind farm site where access permitted, whilst enabling detailed observation of habitats assessed as likely to be of value to bird populations, particularly for target species. During the non-breeding season of 2022/23, an additional two transect routes were surveyed (Transect C and Transect D) based on additional permitted access (see **Figure 8.4**).

Transect surveys were undertaken between June and October 2021 inclusive, and between April 2022 and March 2023 inclusive. These visits were timed to aid recording of breeding, wintering and passage birds which might be difficult to record from VP locations (e.g., songbirds and small wader species).

During each transect survey, the ornithologist walked the predetermined transect route, recording target species onto standardised maps using recommended British Trust for Ornithology (BTO) species codes and behaviour notation, (Marchant, 1983)[14]. Counts for non-target species were also recorded. Transect routes were interspersed with stops, during which the ornithologist scanned for birds using optical equipment. Transect surveys were undertaken at different times of day, ensuring that different areas of the wind farm site were surveyed at a range of times and therefore aiding the recording of species that are active at varying times of day.

[14] Marchant, J.H. 1983. BTO Common Birds Census instructions. BTO, Tring.

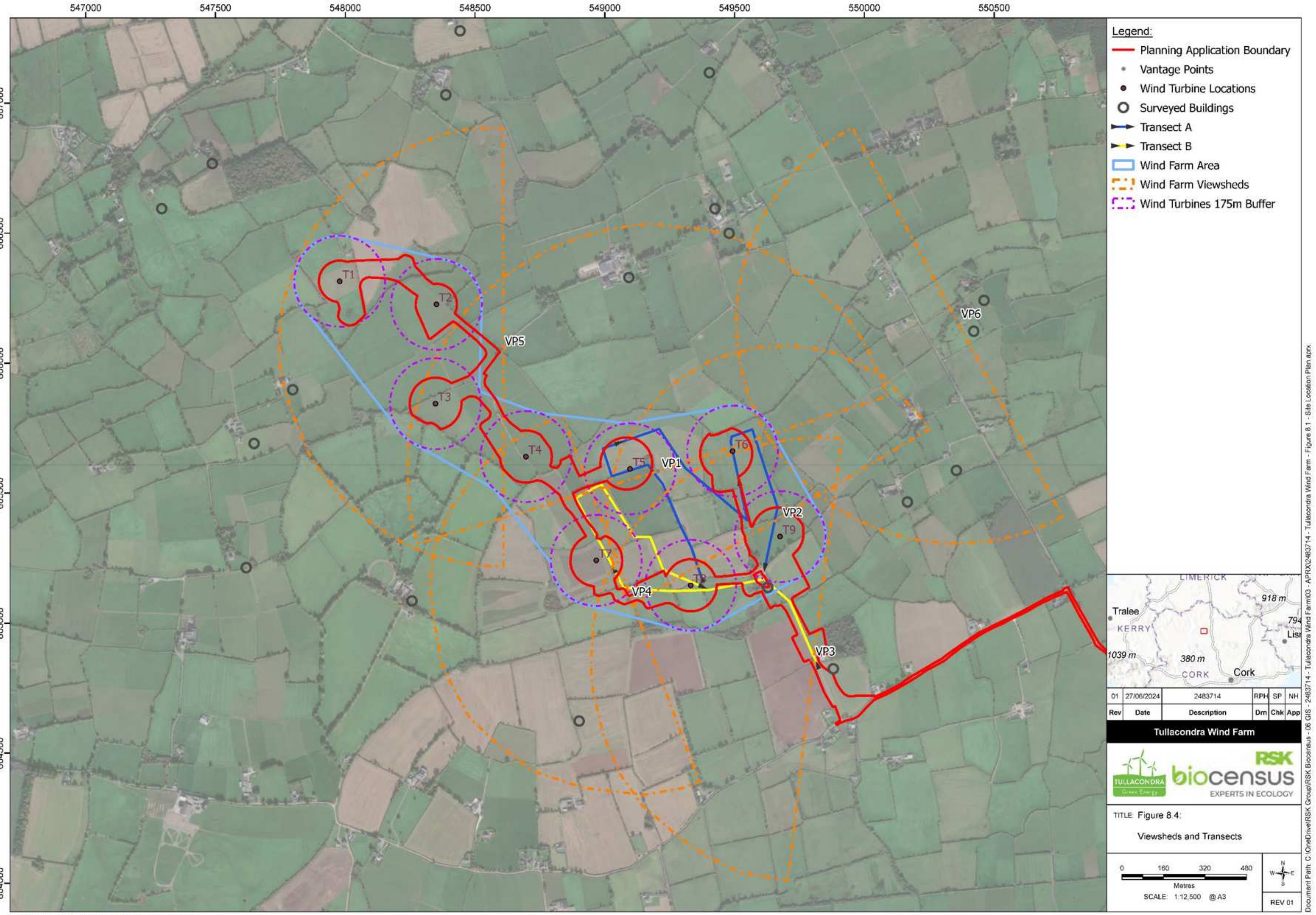




**Figure 8.4: Viewsheds and transects**

**Nesting barn owl and kestrel surveys**

Selection of target species identified barn owl and kestrel as being of potential relevance in the context of the Project, with buildings within and in close proximity to the wind farm site potentially providing suitable nesting habitat. As such, a detailed search was undertaken for any evidence of nesting by these species, in reference to species-specific information and methodologies, (BirdWatch Ireland, 2014/2021[15]; Gilbert *et al*., 1998[16]).

All safely accessible buildings within the wind farm site and within 1km of the wind farm site boundary with potential for use by barn owl or kestrel were subject to a detailed search for evidence of barn owl and kestrel use on 24th July 2022 and 2nd May 2023 by experienced barn owl ecologist Michael O'Clery. Other suitable buildings encountered opportunistically outside of this 1km buffer were also surveyed on a precautionary basis.

Any barn owl or kestrel sightings during this survey or any other surveys of the wind farm site (i.e., VP surveys and transect surveys) were recorded and mapped to supplement understanding of use of the wind farm site by these species and assist in locating any active nest sites.

### 8.6.4 Assessment methodology

*8.6.4.1 Likely effects associated with wind farm development*

As per SNH guidance, wind farms present the following potential risks to ornithological features (Drewitt & Langston, 2006[17]; Band *et al*., 2007[18]):

- Direct habitat loss and alteration: through construction and (generally to a lesser extent) operational maintenance and decommissioning of wind farm infrastructure.
- Disturbance and displacement: the construction, operational and decommissioning phases of the wind farm have the potential to cause disturbance of birds using habitats within/near to the wind farm. This may lead to birds avoiding the wind farm and its surrounding area (displacement). Displacement may also include barrier effects, in which birds are deterred from using normal routes to/from feeding or roosting grounds.
- Death/injury: through collision or interaction with turbine blades and other infrastructure.

For each of these risks, detailed knowledge of bird distribution and flight activity within and adjacent to the wind farm site gained from the field surveys has been used to predict the effects of the Project on birds. Effects are assessed with regard to the construction

[15] BirdWatch Ireland. 2021. Survey and Mitigation Standards for Barn Owls to inform the Planning, Construction and Operation of National Road Projects. Transport Infrastructure Ireland, Dublin.

[16] Gilbert, G., Gibbons, D.W. & Evans J. 1998. Bird monitoring methods. A manual of techniques for key UK species. RSPB, Sandy, Bedfordshire.

[17] Drewitt, A. & Langston, R. 2006. Assessing the impacts of wind farms on birds. In: *Wind, Fire and Water: Renewable Energy and Birds*, 148, 29–42.

[18] Band, W., Madders, M., & Whitfield, D. 2007. Developing field and analytical methods to assess avian collision risk at wind farms. In: de Lucas, M., Janss, G.F.E. & Ferrer, M. (eds.) Birds and Wind Farms: Risk Assessment and Mitigation. Pp. 259- 275. Quercus, Madrid.

phase, the operational phase, the decommissioning phase and cumulatively in consideration with other plans and projects.

*8.6.4.2 Collision risk modelling*

Detailed collision risk modelling has been undertaken in order to identify the potential effects of the Project on target bird species (i.e., Key Ornithological Features) through collisions with new wind turbines. Full details of methods for collision risk modelling are described in EIAR **Volume III, Appendix 8.2.**

Collision risk modelling was undertaken using field data collected during the surveys described in section 8.6.3.2, and in accordance with the following best practice guidance:

- Recommended bird survey methods to inform impact assessment of onshore wind farms, (SNH, 2017)[6].
- Wind farms and birds: Calculating a theoretical collision risk assuming no avoiding action, (SNH, 2000)[19].
- Developing field and analytical methods to assess avian collision risk at wind farms, (Band *et al*., 2007)[16].
- Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model, (SNH, 2018)[20].
- Calculation of collision risk for birds passing through rotor area (Band, 2011).

Based on the process for selection of Key Ornithological Features described in EIAR **Volume III, Appendix 8.2**, the following species were identified for inclusion within collision risk modelling to inform impact assessment within this EIAR chapter:

- Buzzard (*Buteo buteo*)
- Golden plover (*Pluvialis apricaria*)
- Kestrel (*Falco tinnunculus*)
- Peregrine (*Falco peregrinus*)
- Pomarine skua (*Stercorarius pomarinus*)
- Whooper swan (*Cygnus cygnus*)

*8.6.4.3 Assessment of the importance of ornithological features*

The importance of the ornithological features relevant to this assessment was evaluated based on the methodology set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes', NRA, (2009)[21]. These guidelines and the CIEEM, (2018)[2] guidelines set out the context for the determination of value on a geographic basis. They provide a basis for determining whether any particular site is of importance at the following scales:

- International importance

[19] Scottish Natural Heritage. 2000. Wind farms and birds: Calculating a theoretical collision risk assuming no avoiding action. Scottish Natural Heritage, Inverness.

[20] Scottish Natural Heritage. 2018. Avoidance Rates for the onshore SNH Wind Farm Collision Risk Model. September 2018 v2. Scottish Natural Heritage, Inverness.

[21] National Road Authority. 2009. Guidelines for Assessment of Ecological Impacts of National Road Schemes. NRA.

- National importance (i.e., important in an Irish context)
- County/district importance (i.e., important in the context of County Cork)
- Local importance (Higher or Lower) (i.e., locally important populations/assemblages of bird species and/or protected and/or priority species/habitats)

The evaluation criteria for these scales of importance are provided in **Table 8.2**:

**Table 8.2: Evaluation criteria for assessing the importance of ornithological features**

| Level of Importance | Evaluation Criteria |
|---|---|
| International importance | Special Protection Area (SPA) or proposed Special Protection Area (pSPA).<br>Land that is functionally linked to a Natura 2000 site of ornithological importance to the extent that it is essential to maintaining the coherence of the Natura 2000 Network.<br>Ramsar site supporting populations of birds that form qualifying features of reason for the designation of the site.<br>Resident or regularly occurring populations (assessed to be important at the international level) of bird species listed in Annex I and/or referred to in Article 4(2) of the Birds Directive. |
| National importance | Natural Heritage Area (NHA) or Statutory Nature Reserve designated for its ornithological interests.<br>Resident or regularly occurring populations of birds assessed to be important at the national level, including species listed in Annex I and/or referred to in Article 4(2) of the Birds Directive, species protected under the Wildlife Acts and/or species included in the red list of Birds of Conservation Concern in Ireland (BoCCI) (Gilbert *et al.*, 2021[7]). |
| County/district importance | Resident or regularly occurring populations of birds assessed to be important at the county level, including species of bird listed in Annex I and/or referred to in Article 4(2) of the Birds Directive, species protected under the Wildlife Acts and/or species included in the red or amber list of BoCCI (Gilbert *et al.*, 2021[7]). |
| Local importance (Higher value) | Resident or regularly occurring populations of birds assessed to be important at the local level, including species listed in Annex I and/or referred to in Article 4(2) of the Birds Directive, species protected under the Wildlife Acts and/or species included in the red or amber list of BoCCI (Gilbert *et al.*, 2021[7]), or populations of species that are assessed as uncommon in the local area. |
| Local importance (Lower value) | Populations of species that are common in the local area including those listed in the green list of BoCCI (Gilbert *et al.*, 2021[7]); |

Features assessed as being of less than Local importance were considered to be of 'Negligible' importance and were scoped out of the detailed assessment of effects, since these would not be a material consideration for planning and any effects on these features would not be significant in the context of the local (or higher level) population statuses of these species or species assemblages.

The importance of an ornithological feature (using the geographical scale of importance defined above) can be assessed based on the following factors:

**Conservation status**

The assessment of the importance of the bird populations took into consideration the conservation statuses of the species recorded. Species afforded special statutory protection or included on lists of species of conservation interest were evaluated. These included:

- EC Birds Directive (2009/147/EC) Annex 1 species
- BoCCI Red and Amber listed species

**Species abundance**

The assessment of the importance of bird populations took into consideration their sizes relative to international, national, and regional population estimates for the species in question. International population estimates used for this analysis were as presented by the International Union for the Conservation of Nature (IUCN) and Wetlands International[22]. Importance at a national level was assessed against available national population estimates such as those published by Crowe *et al*. 2014[23]. Assessment of county or local importance was based on professional judgement and using county population estimates where available (as presented in the appropriate county bird report).

**Species diversity**

The assessment of the importance of the populations took into consideration the sizes of ornithological species assemblages (i.e., the number of species) recorded during the breeding and non-breeding seasons.

**Relevant designated sites for features of ornithological interest**

The importance of the bird populations was assessed in the context of relevant designated sites for features of ornithological interest. Specifically, where species recorded during field surveys were deemed to potentially belong to populations of nearby SPA (in reference to SNH (2016) guidance[24]), if the populations of those species recorded within/in close proximity to the wind farm site exceeded 1% of the cited population estimates for those species for the relevant SPA, the populations recorded were assessed as being significant in the context of the SPA. As such, any adverse effects on those populations recorded within/in close proximity to the wind farm site could potentially result in effects on ornithological features of international importance, and therefore cause adverse effects on the integrity of Natura 2000 sites.

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[22] As detailed by Wetlands International. Available at Waterbird Population Estimates (wetlands.org) (accessed 27/10/22).

[23] Crowe, O., Musgrove, A. J., & O'Halloran, J. 2014. Generating population estimates for common and widespread breeding birds in Ireland. *Bird Study*, 61(1), 82-90.

[24] Scottish Natural Heritage. 2016. Assessing Connectivity with Special Protection Areas (SPA). Guidance Version 3 – June 2016. Scottish Natural Heritage, Inverness.

8.6.4.4 *Identification of Key Ornithological Features*

The methodology for assessment followed a precautionary screening approach with regard to the identification of Key Ornithological Features (KOF). Within this chapter, a KOF is defined as a species occurring within the ZoI of the development upon which likely significant effects are anticipated and assessed. In accordance with NRA (2009) guidelines CIEEM (2018) guidelines[2], a KOF is an important feature which is "both of sufficient value to be material in decision making and likely to be affected significantly". For this assessment KOF have been identified as receptors with a value of local importance (higher value) or greater, which may be subject to significant effects from the Project, either directly or indirectly. It includes those species subject to detailed collision risk modelling, as presented in EIAR **Volume III, Appendix 8.2**.

8.6.4.5 *Methodology for assessing effects*

The assessment of potential effects from the Project on ornithological features has taken consideration of the following factors:

- The quality of the effect: assessing the effect as either positive (a change which improves the quality of the environment), neutral (no effects or effects that are imperceptible), or negative (a change which reduces the quality of the environment).
- The duration of the effect: assessed as either 'short-term' (up to one year), 'medium-term' (one to ten years) or 'long-term' (more than ten years).
- The sensitivity of the feature: (i.e., the likelihood of the ornithological feature being significantly affected by a potential effect source) considered on a scale of negligible, low, medium or high.
- The magnitude of change: (i.e., the extent of change in the baseline conditions of the ornithological feature as a result of the Project) in terms of size, amount, intensity and volume. Expressed in absolute terms where possible and considered on a scale of negligible, low, medium or large.
- Frequency and timing: (i.e., the number of times an activity may occur to influence the resulting effect).
- Extent: (i.e., the spatial or geographical area over which the impact/effect may occur under a suitably representative range of conditions).
- Reversibility: an irreversible effect is one from which recovery is not possible within a reasonable timescale or there is no reasonable chance of action being taken to reverse it. A reversible effect is one from which spontaneous recovery is possible or which may be counteracted by mitigation.

Following the classification of an effect based on the factors described above, a clear statement is made as to whether the effect is "significant" or "not significant". In accordance with CIEEM, (2018)[2] guidelines, the significance of an effect on an ornithological feature has been determined based on analysis of the factors that characterise the effect.

A significant effect is defined as "an effect that either supports or undermines biodiversity conservation objectives for the ecological feature or for biodiversity in general". The assessment considers whether an effect has the potential to affect the conservation status of a species or species assemblage.

The conservation status of a species or species assemblage is defined as "the sum of the influences acting on it which may affect its long-term distribution and abundance, within the geographical area of interest". Conservation status is considered to be favourable under the following circumstances:

- Population dynamics indicate that the species is maintaining itself on a long-term basis as a viable component of its habitats.
- The natural range of the species is not being reduced, nor is it likely to be reduced for the foreseeable future.
- There is (and probably will continue to be) a sufficiently large habitat to maintain its population on a long-term basis.

Terminology regarding the significance of effects described in this EIAR chapter references guidelines published in CIEEM, (2018)[2] and EPA, (2022)[3]. Definitions for the level of significance outlined in EPA, (2022)[3] are presented in **Table 8.3**. **Table 8.4** presents a matrix outlining how those criteria correspond to the equivalent level of significance defined by CIEEM, (2018)[2].

**Table 8.3: CIEEM and EPA guidelines for determining significance of ecological effects**

| Significance following EPA guidelines | Definition |
|---|---|
| Profound effect | An effect which obliterates sensitive characteristics.<br>Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of productivity in a bird population due to disturbance.<br>Guide: >80% of population lost through additive mortality. |
| Very significant | An effect which, by its character, magnitude, duration, or intensity significantly alters most of a sensitive aspect of the environment.<br>Major reduction in the status or productivity of a bird population due to mortality, displacement, or disturbance.<br>Guide: 21-80% of population lost through additive mortality. |
| Moderate effect | An effect that alters the character of the environment that is consistent with existing and emerging trends.<br>Partial reduction in the status or productivity of a bird population due to mortality, displacement, or disturbance.<br>Guide: 6-20% of population lost through additive mortality. |
| Slight effect | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.<br>Small but discernible reduction in the status or productivity of a bird population due to mortality, displacement, or disturbance.<br>Guide: 1-5% of population lost through additive mortality. |
| Not significant | An effect which causes noticeable changes in the character of the environment but without significant consequences.<br>Very slight reduction in the status or productivity of a bird population due to mortality, displacement, or disturbance. |

| Significance following EPA guidelines | Definition |
|---|---|
| | Reduction barely discernible, approximating to the "no change" situation.<br>Guide: <1% population lost through additive mortality. |

**Table 8.4: Significance matrix**

| Significance following CIEEM (2018) Criteria | Equivalent significance using the EPA (2022)[3] Criteria |
|---|---|
| Significant effect on a feature of International importance | Profound effect |
| Significant effect on a feature of National importance | Very significant |
| Significant effect on a feature of County importance | Moderate effect |
| Significant effect on a feature of Local (Higher) importance | Slight effect |
| Significant effect on a feature of Local (Lower) importance | Not significant |

As outlined above, a significant effect at the international level under the CIEEM guidelines would equate to a profound effect using the EPA guidelines. As a deviation from the standard EIA methodology, minor effects identified within this chapter have been classified as negligible to ensure that (as per the CIEEM guidelines) a clear statement is made as to whether the effect is "significant" or "not significant".

#### 8.6.4.6 *Mitigation hierarchy*

In accordance with CIEEM's guidelines, (2018)[2], a sequential process has been adopted to avoid, mitigate, and offset negative ornithological impacts and effects, otherwise known as the 'mitigation hierarchy'. As part of this Project, avoidance, mitigation, offsetting, and enhancement measures have been identified as part of the impact assessment process. These principles underpin any EcIA and are adapted from CIEEM, 2018[2] as follows:

- **Avoidance**: seek options that avoid harm to ornithological features (for example, by locating on an alternative site).
- **Mitigation**: negative effects should be avoided or minimised through mitigation measures, either through the design of the Project or subsequent measures that can be guaranteed – for example, through a condition or planning obligation.
- **Offsetting**: where there are significant negative effects despite the mitigation proposed, these should be offset by appropriate compensatory measures.
- **Enhancement**: seek to provide benefits for biodiversity over and above requirements for avoidance, mitigation, or offsetting.

Wherever possible, strategies of avoidance have been implemented to minimise any impacts to ornithological features. If avoidance is not possible, mitigation and offsetting measures will be required, as described in section 8.10 of this chapter.

### 8.6.5 Constraints and limitations

Limitations associated with ornithological baseline data are discussed within the Ornithology Baseline Report (see EIAR **Volume III, Appendix 8.1**); notably limitations relating to VP survey effort, VP positioning and the use of overlapping viewsheds. Limitations associated with collision risk modelling are discussed within EIAR **Volume III, Appendix 8.2.**

In accordance with best practice guidance for wind farm developments SNH, 2017[8], the wind farm site was surveyed year-round. To facilitate analysis of wind farm site usage by bird species at different times of year, surveys undertaken in October to March inclusive have been broadly categorised as 'non-breeding' surveys, whilst surveys undertaken in April to September inclusive have been broadly categorised as 'breeding' surveys. However, it is recognised that species are likely to differ in their patterns of seasonal use of the wind farm site, with some species likely to exhibit breeding behaviour outside of April to September inclusive, whilst species present during April to September were not necessarily breeding on the wind farm site. This has been taken into consideration within this report.

Whilst desk study data are useful in providing supplementary ecological information for a site, it should be acknowledged that these data are dependent on the submission of records to the relevant organisation. As such, a lack of records for a particular species does not necessarily mean that the species is absent from the wind farm site and/or wider search area. Similarly, records of a particular species do not necessarily mean that the species is still present within the wind farm site and/or wider search area.

It should be noted that ecological features are transient, and that the distributions of habitats and species may be subject to change. As such, in line with CIEEM guidance, the ecological survey data presented in this report are considered valid for at least two years, CIEEM, (2019)[25] and are therefore considered sufficiently representative and relevant to inform this assessment. Furthermore, as presented in EIAR **Chapter 7 Biodiversity**, updated surveys for habitats and terrestrial mammals and surveys for amphibians were undertaken in 2023, which found that the habitats on the wind farm site and their management had not changed significantly since the time in which the baseline surveys first commenced (2020). Therefore, species populations are also unlikely to have changed significantly as a result.

The information provided in this EIAR chapter accurately and comprehensively describes the baseline ornithological information and provides a prediction of the likely ornithological effects of the Project, along with prescriptions for mitigation as necessary. The specialist studies, analysis, reporting, and assessment methodologies have all been undertaken in accordance with the appropriate guidelines. No significant limitations in relation to the scope, scale or context of the impact assessment have been identified.

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[25] CIEEM. 2019. Advice Note on the lifespan of ecological surveys and reports. [Available at: Advice-Note.pdf (cieem.net) – accessed 26/09/2022].

## 8.7 Ornithological Baseline

### 8.7.1 Designated sites

The desk study identified two international statutory sites designated for features of ornithological interest within 20km of the wind farm site boundary, namely Kilcolman Bog SPA, which is located approximately 9.4km north-east of the wind farm site boundary, and Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA, which is located approximately 19.7km to the north-west of the wind farm site boundary.

Kilcolman Bog SPA is designated for its internationally important wintering populations of the following species (SPA citation populations are provided in brackets):

- Shoveler (*Spatula clypeata*) (150)
- Teal (*Anas crecca*) (690)
- Whooper swan (95)

The Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA is designated for its breeding population of hen harrier (*Circus cyaneus*), supporting the largest breeding concentration of the species in the country.

Conservation objectives for the SPA are to maintain or restore the favourable conservation condition of those bird species listed above as Special Conservation Interests for the SPA. The Kilcolman Bog SPA is also designated for its waterbird assemblage. Thus, a second conservation objective of the Kilcolman Bog SPA is to maintain or restore the favourable conservation condition of the wetland habitat within the SPA as a resource for the regularly occurring migratory waterbirds that utilise it.

A third European site, Blackwater River (Cork/Waterford) Special Area of Conservation (SAC), is located approximately 5.1km north-east of the wind farm site boundary at its nearest point. This extensive site includes the Blackwater Callows and Blackwater Estuary SPA, which are designated for their internationally important waterbird populations. However, these SPA are far outside of the 20km buffer adopted in this assessment. The wider areas of river and marginal habitats within the SAC (including those within 20km of the wind farm site) are recognised on the SAC citation as being of value to several species including cormorant (*Phalacrocorax carbo*), dipper (*Cinclus cinclus*), grey heron (*Ardea cinerea)* and long-eared owl (*Asio otus*), although these species are not identified as being present in internationally important numbers and are not qualifying features of this European site.

No other relevant designated sites (e.g., relevant Natural Heritage Areas or proposed Natural Heritage Areas) were identified within 20km of the wind farm site boundary.

### 8.7.2 Protected and notable bird species

**Table 8.5** details the specially protected and notable bird species records identified from The National Biodiversity Data Centre (NBDC) within 2km of the wind farm site boundary. In summary, no records of any specially protected species were returned. Records were returned for 12 species of conservation concern including two Red Listed species (Gilbert *et al.,* 2021), namely kestrel and yellowhammer (*Emberiza citrinella*).

**Table 8.5: Protected and notable bird species recorded within 2km of the wind farm site**

| Common name | Scientific name | Conservation status | Number of records | Most recent record |
|---|---|---|---|---|
| Goshawk | *Accipiter gentilis* | Amber Listed | 1 | 31/12/2011 |
| House martin | *Delichon urbicum* | Amber Listed | 3 | 31/12/2011 |
| House sparrow | *Passer domesticus* | Amber Listed | 7 | 31/12/2011 |
| Kestrel | *Falco tinnunculus* | Red Listed | 3 | 21/02/2013 |
| Linnet | *Linaria cannabina* | Amber Listed | 3 | 31/12/2011 |
| Little grebe | *Tachybaptus ruficollis* | Amber Listed | 2 | 31/12/2011 |
| Mute swan | *Cygnus olor* | Amber Listed | 2 | 31/12/2011 |
| Sand martin | *Riparia riparia* | Amber Listed | 3 | 31/12/2011 |
| Skylark | *Alauda arvensis* | Amber Listed | 3 | 31/12/2011 |
| Starling | *Sturnus vulgaris* | Amber Listed | 7 | 31/12/2011 |
| Stock dove | *Columba oenas* | Amber Listed | 3 | 31/12/2011 |
| Yellowhammer | *Emberiza citrinella* | Red Listed | 5 | 31/12/2011 |

***Source: The National Biodiversity Information Data Centre***

A review of I-WeBS data identified two sites within 10km of the wind farm site: Blackwater Valley (c.7.1km south of the wind farm site), and Kilcolman Marsh (c.9.1km north-east of the wind farm site). Whilst peak counts since 2011 were not published for Blackwater Valley, published peak counts for 24 waterbird species recorded at Kilcolman Marsh between 2011 and 2019 included shoveler (155), teal (1,000), whooper swan (78) and wigeon (*Mareca penelope*) (259).

### *8.7.2.1 Breeding bird populations*

**Vantage point and transect surveys**

Full details of the bird populations recorded from VP and transect surveys during the breeding season are provided in EIAR **Volume III, Appendix 8.1.** A total of 58 species was recorded during the breeding season.

Target species recorded during these surveys are specified below, along with their peak counts from the field surveys undertaken in 2021 / 2022 (Birds Directive Annex 1 species are indicated in **bold** text; BoCCI Red and Amber Listed species are indicated with (red) and (amber) following the species name.

- Black-headed gull (*Chroicocephalus ridibundus*) (amber) – 0 / 9
- Buzzard – 4 / 6
- Great black-backed gull (*Larus marinus*) 5 / 0
- Grey heron – 3 / 1

- Herring gull (*Larus argentatus*) (amber) – 0 / 1
- Kestrel (red) – 3 / 2
- Lapwing (*Vanellus vanellus*) (red) – 2 / 0
- Lesser black-backed gull (*Larus fuscus*) (amber) – 2 / 30
- Mallard (*Anas platyrhynchos*) (amber) – 2 / 3
- **Peregrine** – 1 / 1
- Snipe (*Gallinago gallinago*) (red) – 1 / 2
- Sparrowhawk (*Accipiter nisus*) – 0 / 1

Peak counts for specially protected and notable non-target species recorded during the breeding season in 2021 / 2022 are provided below:

- Goldcrest (*Regulus regulus*) (amber) – 2 / 1
- Grasshopper warbler (*Locustella naevia*) (amber) – 1 / 0
- Grey wagtail (*Motacilla cinerea*) (red) – 0 / 1
- House martin (amber) – 14 / 10
- House sparrow (amber) – 17 / 3
- Linnet (amber) – 100 / 90
- Meadow pipit (*Anthus pratensis*) (red) – 10 / 20
- Mistle thrush (*Turdus viscivorus*) (amber) – 2 / 10
- Skylark (amber) – 8 / 22
- Spotted flycatcher (*Muscicapa striata*) (amber) – 0 / 5
- Starling (amber) – 200 / 60
- Stock dove (red) – 12 / 20
- Swallow (*Hirundo rustica*) (amber) – 23 / 50
- Swift (*Apus apus*) (red) – 7 / 0
- Wheatear (*Oenanthe oenanthe*) (amber) – 4 / 0
- Willow warbler (*Phylloscopus trochilus*) (amber) – 2 / 2
- Yellowhammer (red) – 6 / 18

**Nesting barn owl and kestrel surveys**

The initial desk-based reviews and subsequent field surveys undertaken on 24th July 2022 within the site and a minimum 1km buffer identified 19 buildings (or clusters of buildings) as potentially suitable for nesting barn owl and kestrel and thus requiring further surveys; and specifically, ten buildings within 1km of the wind farm site boundary, and nine buildings more than 1km from the wind farm site boundary. No potentially suitable buildings requiring further surveys were identified within the wind farm site boundary. No trees, artificial boxes, or other structures within the wind farm site or within 1km of the wind farm site boundary were identified as being suitable for nesting by barn owl or kestrel.

A large stone farm shed located approximately 160m to the southwest of the proposed location of turbine T9 contained three barn owl pellets and a barn owl feather on the ground below a joist inside the western end of the shed during an inspection undertaken in May 2023. The age of the pellet and lack of any suitable nesting cavities in the shed or nearby would indicate that this site was used infrequently as a winter roost.

Regarding buildings within 1km of the wind farm site boundary, no evidence of barn owl or kestrel nesting was recorded. Only one building, a two-storey derelict farmhouse at Templemary, was found to be suitable for nesting barn owl. No buildings were considered suitable for nesting kestrel within 1km of the wind farm site upon further inspection. Six sites were found to be potentially suitable as temporary roost sites for both species, although no evidence of use by either species was recorded.

Regarding potentially suitable buildings identified more than 1km from the wind farm site boundary, an active barn owl nest site was confirmed approximately 1.8km east of the wind farm site boundary (see EIAR **Volume III, Appendix 8.1**). Two recently fledged barn owl chicks were observed at this site on 24th July 2022. No other evidence of barn owl nesting was recorded in buildings surveyed more than 1km from the wind farm site boundary.

No evidence of kestrel nesting was recorded in buildings surveyed more than 1km from the wind farm site boundary. Four sites were found to be potentially suitable as temporary roost sites for barn owl and kestrel, although no evidence of use by either species was recorded at those locations.

#### *8.7.2.2 Non-breeding bird populations*

**Vantage point and transect surveys**

Full details of the bird populations recorded from VP and transect surveys during the non-breeding season are provided in EIAR **Volume III, Appendix 8.1.** A total of 57 species was recorded during the non-breeding season.

Target species recorded during these surveys are specified below, along with their peak counts from the field surveys undertaken in 2020/21 / 2021/22 / 2022/23:

- Black-headed gull (amber) – 16 / 0 / 18
- Buzzard – 6 / 1 / 4
- **Golden plover** (red) – 14 / 100 / 7
- Great black-backed gull – 1 / 0 / 0
- Grey heron – 0 / 0 / 1
- Kestrel (red) – 1 / 1 / 1
- **Hen harrier (*Circus cyaneus*)** (amber) – 0 / 1 / 0
- Lesser black-backed gull (amber) – 12 / 1 / 34
- Mallard (amber) – 4 / 0 / 3
- **Merlin** (amber) – 1 / 1 / 1
- **Peregrine** – 2 / 2 / 1
- Pomarine skua – 0 / 0 / 1
- Snipe (red) – 4 / 2 / 19
- Sparrowhawk – 1 / 0 / 3
- **Whooper swan** (amber) – 0 / 1 / 4

Peak counts for specially protected and notable non-target species recorded during the non-breeding season in 2020/21 / 2021/22 / 2022/23 are provided below:

- Brambling (*Fringilla montifringilla*) (amber) – 0 / 1 / 0
- Goldcrest (amber) – 8 / 2 / 4
- Grey wagtail (red) – 1 / 0 / 1
- House sparrow (amber) – 16 / 0 / 24
- Linnet (amber) – 72 / 50 / 83
- Meadow pipit (red) – 24 / 17 / 72
- Mistle thrush (amber) – 6 / 3 / 10
- Redwing (red) – 282 / 30 / 450
- Skylark (amber) – 36 / 34 / 78
- Starling (amber) – 283 / 90 / 274
- Stock dove (red) – 23 / 8 / 123
- Swallow (amber) – 0 / 18 / 0
- Yellowhammer (red) – 70 / 14 / 35

#### *8.7.2.3 Flight activity*

Full details of flight activity by target species in 2020-2023 are provided in the Ornithology Baseline Report (EIAR **Volume III, Appendix 8.1**) and the Ornithology Collision Risk Modelling Report (EIAR **Volume III, Appendix 8.2**). In summary, flight activity was recorded by 16 target species as summarised in **Table 8.6**. This flight activity data was incorporated into subsequent collision risk modelling for KOF.

**Table 8.6: Summary of flight activity by target species in 2020-2023**

| Species | Breeding season | | Non-breeding season | | Total | |
|---|---|---|---|---|---|---|
| | No. of observations | Flight time (s) | No. of observations | Flight time (s) | No. of observations | Flight time (s) |
| Black-headed gull | 4 | 325 | 5 | 367 | 9 | 692 |
| Buzzard | 114 | 12,674 | 65 | 12,801 | 179 | 25,475 |
| Golden plover | 0 | 0 | 9 | 565 | 9 | 565 |
| Great black-backed gull | 1 | 60 | 1 | 120 | 2 | 180 |
| Grey heron | 1 | 12 | 3 | 35 | 4 | 47 |
| Hen harrier | 0 | 0 | 1 | 20 | 1 | 20 |
| Herring gull | 1 | 17 | 0 | 0 | 1 | 17 |
| Kestrel | 47 | 6,543 | 34 | 2,435 | 81 | 8,978 |

| Species | Breeding season | | Non-breeding season | | Total | |
|---|---|---|---|---|---|---|
| | No. of observations | Flight time (s) | No. of observations | Flight time (s) | No. of observations | Flight time (s) |
| Lesser black-backed gull | 22 | 2,104 | 16 | 1,167 | 38 | 3,271 |
| Mallard | 3 | 201 | 2 | 79 | 5 | 280 |
| Merlin | 0 | 0 | 6 | 215 | 6 | 215 |
| Peregrine | 8 | 103 | 13 | 1,015 | 21 | 1,118 |
| Snipe | 1 | 5 | 21 | 999 | 22 | 1,004 |
| Sparrowhawk | 5 | 252 | 21 | 1,432 | 26 | 1,684 |
| Whooper swan | 0 | 0 | 1 | 120 | 1 | 120 |

### 8.7.3 Future baseline ('Without Scheme' scenario)

The future baseline describes the ornithological features as they would be in the opening year/year of operation, in the absence of the Project. They are influenced by future developments and factors that have a high degree of uncertainty, such as future land management and climate change. Where information exists on planned future developments, this has been taken into consideration during the assessment.

Long-term climatic predictions suggest that warmer, wetter, winters and drier summers will become more frequent, with more extreme weather events likely. Combined with changes in land management, increased urbanisation and increased biotic pressures, climate change may lead to an increase in the population and distribution of some species in Ireland, such as certain species of migratory birds, for example, but a decrease in other species, such as barn owl. However, such changes are unlikely to be material during the intervening period between the time when the field surveys were undertaken to inform this assessment and the opening year of operation of the Project.

There are no committed or forecasted changes in land management proposals within the Project that will likely materially alter the baseline conditions in the absence of the Project. It is therefore assumed that the future baseline will, in general, be relatively similar to the current baseline, and the value of the ornithological features that are relevant to the Project would be consistent with that of the existing baseline conditions described above.

### 8.7.4 Evaluation of ornithological features

Determination of population importance within the likely ZoI is provided in the sections below, following the criteria described in section 8.6.4.3 and specifies KOF carried forward for detailed assessment of potential effects.

Field surveys undertaken in 2020-2023 recorded five species included on Annex 1 of the Birds Directive, all of which were target species: specifically, golden plover, hen harrier, merlin, peregrine and whooper swan. The surveys also recorded 10 BoCCI Red Listed species and 21 BoCCI Amber Listed species. These included four Red Listed target species and seven Amber Listed target species.

Based on the findings of these field surveys, no species were present in numbers of international importance or in numbers of national importance.

Regarding target species, kestrel and buzzard were both frequently recorded in 2020-2023 during the breeding and non-breeding seasons, with two buzzard territories and at least one kestrel territory overlapping with the wind farm site boundary. Peregrines were recorded on 21 occasions, comprising multiple birds including an adult with a juvenile. Whilst no peregrine nest sites were identified within or in close proximity to the wind farm site, hinterland surveys identified four confirmed or possible peregrine nest sites in the wider area in 2022, the nearest of which was approximately 2.5km north-east of the wind farm site boundary. Golden plovers were recorded on nine occasions, all comprising small groups with the exception of a flock of 100 birds that were recorded approximately 350m east of the wind farm site boundary in March 2022. Solitary merlins were recorded on six occasions during the non-breeding season, with observations comprising commuting, hunting and perching birds. Based on the levels of activity recorded for these species, and their population statuses and trends, the year-round populations of buzzard, kestrel and peregrine, and the non-breeding populations of golden plover and merlin, these species populations within the ZoI are considered to be of **Local (Higher value) importance**.

Regarding non-target species, based on the level and type of activity recorded, breeding populations of linnet, meadow pipit, skylark, starling, stock dove and yellowhammer are considered to be of **Local (Higher value) importance**. Non-breeding populations of linnet, meadow pipit, redwing, skylark, starling, and yellowhammer are also considered to be of **Local (Higher value) importance**.

Other species recorded during the 2020-2023 field surveys were present in low numbers and/or infrequently within or adjacent to the wind farm site boundary. No other species was potentially present in numbers exceeding **local (Lower value) importance**.

#### *8.7.4.1 Importance to nearby Natura 2000 designated sites*

The desk study identified three internationally designated sites for features of ornithological interest relevant to the Project: Kilcolman Bog SPA, Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA and Blackwater River (Cork/Waterford) SAC.

One qualifying species for the designation of Kilcolman Bog SPA was recorded during the field surveys of the wind farm site, namely whooper swan. Field survey records comprised a single bird flying over the south-east section of the wind farm site in November 2021, and four birds flying over the centre of the Project in January 2023. This will be carried forward for assessment to identify whether the Kilcolman Bog SPA is functionally linked to the Project through whooper swans.

Non-qualifying species listed on the citation for Kilcolman Bog SPA include black-headed gull (citation population of 133 wintering birds), golden plover (162), lapwing (74), lesser black-backed gull (131) and mallard (188). Whilst these species were recorded within and/or in close proximity to the wind farm site in 2020-23, considering the numbers recorded in relation to the citation populations, and the distance between Kilcolman Bog SPA and the wind farm site (approximately 9.1km), it can be concluded that the Project is not of significant value to these wintering (non-qualifying) bird populations of the SPA.

No qualifying species of the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA, namely breeding hen harrier, were recorded during the field surveys of the wind farm site. Only one observation of hen harrier was made during the surveys, comprising a solitary individual bird that was observed on a single occasion in December 2021. Significant effects on this designated site are therefore highly unlikely as a result of the Project, especially considering it is located beyond the core sustenance zone of breeding hen harrier that could be associated with the designated site, which is 2km, with a maximum range of 10km during the breeding season. The Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA will therefore not be considered further in this assessment.

Grey heron is listed as a non-qualifying feature of Blackwater River (Cork/Waterford) SAC. Whilst grey heron was recorded on the wind farm site in 2020-23, considering the numbers recorded and the distance between the wind farm site and the SAC (approximately 5.6km), the Project is not considered to be significant value to the grey heron population of the SAC.

#### *8.7.4.2 Identification of KOF*

**Table 8.7** outlines the importance of each of the ornithological features identified within the ZoI of the Project. Features of Local (Lower value) or of Negligible importance, and those to which impacts can be categorically ruled out, are scoped out for further assessment, and are therefore not considered to be KOF. It should be noted that a precautionary approach has been taken in determining which features are described as KOF (and thus which are taken forward for further assessment) as described in section 8.6.4.4, based upon their conservation status, population trends and likely importance to designated sites.

**Table 8.7: Assessment of importance and identification of Key Ornithological Features**

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| **Designated sites** | | | | |
| Kilcolman Bog SPA | Designated as a Special Protection Area (SPA) under the EU Habitats Directive. | Kilcolman Bog SPA is designated for its internationally important populations of whooper swan, teal and shoveler. Whooper swan was recorded during the 2020-23 field surveys of the wind farm site. In order to assess potential effects on this SPA, functional linkage between the wind farm site and this designated site must be determined regarding its whooper swan population. The Kilcolman Bog SPA is therefore identified as a KOF and brought forward for further assessment on a precautionary basis. | International importance | **Yes** |
| Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA | Designated as a Special Protection Area (SPA) under the EU Habitats Directive. | The Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle SPA is designated for its breeding population of hen harrier. No hen harriers were recorded using the wind farm site or its immediate surrounds during the breeding season surveys undertaken at the wind farm site. The wind farm site is located beyond the core sustenance zone of breeding hen harrier that could be associated with the SPA. Therefore, likely significant effects to the SPA in view of its conservation objectives will not arise through hen harrier habitat loss, mortality, displacement and/or disturbance and this Project will, as such, not be considered further in this assessment. | International importance | No |
| Blackwater River (Cork/Waterford) SAC | Designated as a Special Area for Conservation (SAC) under the EU Habitats Directive. | Whilst the Blackwater River SAC falls within the ZoI of the wind farm site, the part of the site that does fall within the ZoI is not designated for its bird interests with none of the non-qualifying bird species referenced on the citation being recorded within the wind farm site in significant numbers. | International importance | No |

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| | | | | |
| **Bird Species** | | | | |
| Barn owl | Annex 1 EU Birds Directive, BoCCI Red List, & Wildlife Act. | Regarded as a species of high conservation concern in Ireland due to its inclusion on the BoCCI Red List and afforded additional legal protection due to its inclusion on Annex 1 of the Birds Directive. Barn owls were not recorded during the VP and transect surveys, although survey timings and methods were sub-optimal for barn owl. Targeted nesting barn owl surveys identified a confirmed nest site approximately 1.8km east of the wind farm site boundary.<br>The wind farm site and the potential ZoI includes suitable habitat for foraging, roosting and nesting barn owls and so **further assessment of potential habitat loss and disturbance/displacement is required.** | Local (Higher value) importance (all seasons) | **Yes** |
| Buzzard | BoCCI Green list & Wildlife Act. | Whilst a common and widespread species in Ireland, reflected by its inclusion on the BoCCI Green list, high levels of flight activity were recorded within the Wind Farm Area (WFA), including year-round activity. The buzzard population is therefore considered to be of **Local (Higher value) importance.**<br>Therefore, the potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded, and so **further assessment of potential effects is required.** | Local (Higher value) importance (all seasons) | **Yes** |
| Golden plover | Annex 1 EU Birds Directive; BoCCI Red List & Wildlife Act. | Regarded as a species of high conservation concern in Ireland due to its inclusion on the BoCCI Red List, and its inclusion on Annex 1 of the Birds Directive. Based on the level of activity recorded, the golden plover population is considered to be of **Local (Higher value) importance**.<br>Therefore, the potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded and so **further assessment of potential effects is required.** | Local (Higher value) importance (non-breeding season) | **Yes** |
| Gull (black headed gull, great black-backed gull, lesser black-backed gull, herring gull) and | Wildlife Act (all species); BoCCI Amber list (black headed gull, lesser black- | Gull species were identified as target species during the ornithology surveys on the wind farm site with four species recorded. Three of these are of conservation concern due to their inclusion on the BoCCI Amber List. However, gulls were only recorded in low numbers and/or were only recorded occasionally during the breeding and non-breeding seasons. The wind farm site therefore has a low value to gull species. Furthermore, | Gulls: Local (Lower value) importance (all seasons)<br>Pomarine skua: Negligible | Gulls: No<br>**Pomarine skua: Yes** (included in collision risk |

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| skua (pomarine skua) | backed gull, & herring gull), and BoCCI Green list (great black-backed gull) | a collision risk assessment was not deemed necessary for gull species as it is highly unlikely, based on the low levels of observed activity on the wind farm site, that they would be significantly impacted. Gull species on the wind farm site has been determined as **Local (Lower value) importance.**<br>One skua species, pomarine skua, was recorded during the field surveys. Considering the suitability of the wind farm site for this species, and the level of activity recorded (one individual observed flying over the wind farm site on a single occasion), this feature is considered to be of Negligible importance. Considering the scarce nature of this species in Ireland, pomarine skua has been brought forward as a KOF for inclusion within collision risk modelling on a precautionary basis. | | modelling on a precautionary basis) |
| Grey heron | BoCCI Green list; Wildlife Act. | Grey heron is a common and widespread species in Ireland, reflected by its inclusion on the BoCCI Green list. The species was recorded infrequently, with four records of individuals flying over the wind farm site and WFA. Due to the low numbers recorded, the population of grey heron is considered to be of **Negligible importance** and is therefore not considered to be a KOF. | Negligible importance (all seasons) | No |
| Hen harrier | Annex 1 EU Birds Directive; BoCCI Amber List, & Wildlife Act. | Hen harrier is an Amber Listed bird species of conservation concern in Ireland and is afforded additional legal protection due to its inclusion on Annex 1 of the Birds Directive. A hen harrier was recorded on a single occasion during the non-breeding VP surveys, comprising an adult female flying over semi-improved grassland in the south-east part of the wind farm site at a height of 3m for 20 seconds in December 2021. Anecdotal information suggests the potential presence of wintering roosts in the wider landscape, although there is no known roost near to the wind farm site. Considering the low level of hen harrier activity recorded, the wind farm site is considered to be of no more than Local (Lower value) importance to this species. No further assessment is therefore required, although general recommendations regarding mitigation and enhancement for birds that would be adopted would also potentially benefit hen harrier (see section 8.10). | Local (Lower value) importance (non-breeding season) | No |

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| Kestrel | BoCCI Red List, & Wildlife Act. | Regarded as a species of high conservation concern in Ireland due to its inclusion on the BoCCI Red List. High levels of flight activity were recorded within the WFA, and the kestrel population is considered to be of **Local (Higher value) importance**. Kestrel activity was recorded throughout the year.<br><br>Therefore, the potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded and so **further assessment of potential effects is required.** | Local (Higher value) importance (all seasons) | **Yes** |
| Merlin | Annex 1 EU Bird Directive; BoCCI Amber List, & Wildlife Act. | Merlin is an Amber Listed species of conservation concern in Ireland and is afforded additional legal protection due to its inclusion on Annex 1 of the Birds Directive. Merlin was recorded a total of six times across the survey periods, concentrated more towards the south of the wind farm site. Considering the levels of activity recorded in the context of their conservation status in Ireland, the merlin population is considered to be of **Local (Higher value) importance**.<br><br>Therefore, the potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded and so **further assessment of potential effects is required.** | Local (Higher value) importance (non-breeding season) | **Yes** |
| Peregrine | Annex 1 EU Birds Directive; BoCCI Green list, & Wildlife Act. | A locally common and increasingly abundant species in Ireland, reflected by its inclusion on the BoCCI Green list. Afforded additional protection due to its inclusion on Annex 1 of the Birds Directive. Peregrine was recorded on multiple occasions during the breeding and non-breeding seasons, including observations of juveniles. Four confirmed or potential nest sites were identified in the wider area in 2022, the nearest of which was approximately 2.5km north-east of the wind farm site boundary. Considering the presence of nearby nesting sites and the level of flight activity within and near the Project site, the peregrine population is considered to be of **Local (Higher value) importance**.<br><br>Therefore, the potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded and so **further assessment of potential effects is required.** | Local (Higher value) importance (all seasons) | **Yes** |

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| Sparrowhawk | BoCCI Green list, & Wildlife Act. | Sparrowhawk is regarded as a widespread species and is not considered to be of particular conservation concern in Ireland. This species was recorded flying over the wind farm site relatively infrequently, with the wind farm site including some suitable habitat for hunting. Taking this into consideration, the species has been assessed as being of **Local (lower value) importance**. Sparrowhawks would not be significantly affected by the Project and so are not identified as a KOF. They will therefore not be taken forward for further assessment. | Local (Lower value) importance (non-breeding season) | No |
| All other wader and waterfowl species (mallard, lapwing, snipe) | BoCCI Red (lapwing, & snipe) and Amber (mallard) lists, Wildlife Act. | Three other wader species of conservation concern were recorded during the ornithological surveys, with two being BoCCI Red Listed species. These species were recorded in low numbers and infrequently. As such, the wind farm site is considered to be of low value to these species. Whilst flight activity was recorded, the majority of observations recorded were not within the potential collision risk zone of the Project. A collision risk assessment is therefore not necessary. The population of these species has therefore been considered as being of **Local (Lower value) importance** and are not taken forward for further assessment. | Local (Lower value) importance (all seasons) | No |
| Whooper swan | Annex 1 EU Birds Directive, BoCCI Amber List, & Wildlife Act. | An Amber Listed species of conservation concern in Ireland, afforded additional legal protection due to its inclusion on Annex 1 of the Birds Directive. Whooper swan is a qualifying species for Kilcolman Bog SPA, with the site citation specifying a wintering population of 95 birds, NPWS, 2014[26]. The observations of one individual recorded flying over the wind farm site in November 2021 and four birds flying over the wind farm site in January 2023 related to more than 1% of the SPA population. The whooper swan population is therefore considered to be of **Local (Higher value) importance**. | Local (Higher value) (non-breeding season) – subject to determination of functional linkage with Kilcolman Bog SPA | **Yes** |

[26] NPWS. 2014. Site Synopsis: Kilcolman Bog SPA (Site Code 004095). National Parks and Wildlife Service. [Available at: https://www.npws.ie/sites/default/files/protected-sites/synopsis/SY004095.pdf – accessed 26/09/2022].

| Ornithological feature | Conservation status | Evaluation rationale | Importance | KOF Yes/No |
|---|---|---|---|---|
| | | The potential for effects through habitat loss, disturbance/displacement and collision-related mortality cannot be excluded and so **further assessment of potential effects is required.** | | |
| Notable non-target species (Red and Amber Listed species) | BoCCI Red and Amber List, & Wildlife Act. | The ornithological surveys recorded various non-target farmland bird species including species of conservation concern as specified on the BoCCI Red and Amber Lists. Considering the numbers of these species recorded, populations of linnet, meadow pipit, redwing, skylark, starling, stock dove and yellowhammer are considered to be of **Local (Higher value) importance**.<br><br>Therefore, the potential for effects through habitat loss and disturbance/displacement cannot be excluded and so **further assessment of potential effects is required.** | Local (Higher value) importance (all seasons) | **Yes** |

## 8.8 Embedded Mitigation

From the early stages of the Project design development, an iterative process of a constraints-led design was employed, whereby ecological information was utilised to avoid impacting potentially important ornithological features where possible.

Likely impacts on ornithological features were a contributing factor to the site selection, with the selected Project generally comprising relatively low suitability habitat for breeding and non-breeding birds, and therefore being unlikely to support particularly notable bird populations. Areas of greater importance to avian features are to be retained within the design of the Project (e.g., waterbodies and woodland habitats). Furthermore, the Project has been designed to minimise the extent of habitat loss. As such, new hardstanding areas will cover the minimum required area possible. Furthermore, the GCR and TDR option routes will utilise-built infrastructure for the majority of their lengths, with cables being laid underground within the existing road network to minimise disturbance to semi-natural habitats.

The Project design has followed the basic principles outlined below to eliminate the potential for significant effects on ornithological features.

### 8.8.1 Construction methods

Best practice construction measures will be adopted to minimise potential construction and decommissioning impacts on bird populations. These are detailed within the Construction Environmental Management Plan (CEMP) (see EIAR **Volume III, Appendix 5.1**) and include measures to minimise working areas to avoid unnecessary habitat removal/alteration and disturbance, and measures to avoid/minimise the generation of additional noise, dust, light spill and vibration. Whilst significant effects on barn owls are not anticipated, works will aim to avoid the use of artificial lighting of suitable habitat (i.e., rough grassland, hedgerows and tree lines). In particular, removal of trees and dense vegetation (i.e., hedgerows and scrub) will be avoided where possible. The CEMP has also included details of measures to avoid pollution of waterbodies within and adjacent to the wind farm site. All plant and machinery will comply with specific noise legislation (for example, Construction Plant and Equipment Permissible Noise Levels Regulations, 1998) and will be turned off when not in use (see EIAR **Chapter 13 Noise and Vibration**).

### 8.8.2 Operational methods

Best practice measures described in relation to construction methods will also be adopted during operational maintenance. Specifically, operational maintenance will minimise the level of removal of suitable habitat (e.g., grassland, hedgerows and scrub) and use existing access routes where possible. Best practice methods will be adopted to minimise the potential for disturbance (e.g., to minimise generation of additional noise, light and vibration). In particular, effects on active bird nests will be avoided by undertaking any required vegetation maintenance in accordance with methods described in section 8.8.3 (i.e., by timing works outside the peak bird breeding season, and undertaking nesting bird checks prior to clearance of any suitable nesting habitat where avoidance is not possible).

Furthermore, the installation of warning lights on turbines can help to increase their visibility, thereby reducing the risk of bird collision. A number of the turbines will be fitted with aviation warning lights in accordance with the requirements of the Irish Aviation Authority in advance of Project operation.

### 8.8.3 Timing of works

To minimise the potential for impacts on nesting birds, removal or alteration of suitable nesting habitat (e.g., grassland, hedgerow, scrub and trees) will, wherever possible, be undertaken outside of the peak breeding season (i.e., outside of the period mid-February to early September inclusive). Similarly, works with the potential to cause significant disturbance to breeding birds (e.g., through the generation of noise, dust, vibration and/or light spill, or through increased human activity) will also be undertaken outside of the peak breeding season where possible. It should be recognised that whilst undertaking works in late-September to February inclusive minimises the likelihood of effects on breeding birds, certain species may still nest during this period.

If suitable nesting habitat needs to be removed or altered during the peak breeding season, works to the habitat will be preceded by a nesting bird check, during which a suitably experienced ornithologist will check the affected habitat for any active nests. This check will be undertaken within 48 hours prior to the commencement of the works. If an active nest is encountered, an exclusion zone will be established within which works will be suspended until the nest is no longer active (to be confirmed by a suitably experienced ornithologist through ongoing monitoring of the nest). The size of the exclusion zone will be dependent on the species affected, the likely level of disturbance caused by the works relative to baseline disturbance levels on site, and the extent to which the nest site is screened from disturbance (e.g., by adjacent dense vegetation). Exclusion zones may range from 5m to several hundred metres.

### 8.8.4 Ecological Clerk of Works

An Ecological Clerk of Works (ECoW) will be appointed to address issues relating to birds and other sensitive habitats and species. Their responsibilities will include, but not be limited to:

- Undertake a pre-construction walkover survey to ensure that significant effects on breeding and non-breeding birds will be avoided.
- Undertake nesting bird checks on any vegetation that needs to be removed within the breeding season.
- Inform and educate site personnel of sensitive ornithological features within the wind farm site and how effects on these features could occur.
- Oversee management of ornithological issues during the construction and decommissioning period and advise on ornithological issues as they arise.
- Provide guidance to contractors to ensure legal compliance with respect to protected bird species on site.
- Liaise with officers from consenting authorities and other relevant bodies and contractors with regular updates in relation to construction and/or decommissioning progress.

## 8.9 Assessment of Effects

### 8.9.1 Scope of assessment

Potential effects on breeding and non-breeding bird populations and other ornithological features (designated sites) from the Project during its construction, operation, and decommissioning phases are described in this section. The potential for these effects to adversely impact the KOF described in section 8.7 is then assessed in accordance with the process described in section 8.6.4.5. This assessment takes into consideration embedded mitigation within the Project design. Where embedded mitigation measures are insufficient to avoid potentially significant effects on bird populations, further mitigation measures will be required (as described in section 8.10).

This assessment of effects is structured as follows:

- Assessment of effects in relation to designated sites of ornithological interest.
- Assessment of effects in relation to bird species.
- Assessment of potential effects associated with other proposed development projects (i.e., cumulative assessment).

### 8.9.2 Assessment of effects on designated sites

#### *8.9.2.1 Natura Impact Statement*

In accordance with best practice guidance, a screening assessment and Natura Impact Statement (NIS) were prepared to provide the Planning Authority with the information necessary to complete an Appropriate Assessment for the Project in compliance with Article 6(3) of the Habitats Directive.

As per EPA guidance, '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 regarding relevant European sites with features of ornithological interest.

In the absence of any specific European or Irish guidance, the SNH guidance document 'Assessing Connectivity with Special Protection Areas (SPA)' 2016[10] was consulted. This document provides guidance in relation to assessment of connectivity between SPAs and suitable habitat for qualifying bird populations within the wider landscape (i.e., potential Functionally Linked Land). The guidance takes into consideration the typical distances specific species may travel beyond SPA boundaries, and outlines information on dispersal and foraging ranges of relevant species.

#### *8.9.2.2 Kilcolman Bog SPA*

The desk study and subsequent evaluation of ornithological features identified one designated site as a KOF and therefore requiring detailed assessment of potential effects, namely, Kilcolman Bog SPA. This designated site is located approximately 9.4km north-east of the wind farm site and is designated for its internationally important wintering populations of shoveler, teal, and whooper swan. Whilst shoveler and teal were not recorded during the field surveys for the Project, whooper swan was recorded flying over the wind farm site on two occasions.

Considering the distance between the wind farm site and the boundary of Kilcolman Bog SPA, there would be no direct effects (i.e., through habitat loss or disturbance) on the SPA as a result of the construction, operation, or decommissioning phases of the Project and therefore no likely significant effects.

In accordance with best practice guidance, it is necessary to examine whether the wind farm site potentially includes Functionally Linked Land to the SPA with regard to whooper swan populations. The SPA citation for Kilcolman Bog SPA specifies a wintering population of 95 whooper swans NPWS, (2014)[26]. Based on the combined total of two observations (peak count of four birds) recorded during three consecutive winter seasons of field surveys, neither the Project nor its airspace is regularly used by over 1% of the SPA population, and therefore is not of significant importance to the whooper swan population of the SPA.

Furthermore, regarding potential use of the Project (including airspace over the Project site) as Functionally Linked Land to the SPA, SNH, (2016)[24] guidance states that whooper swan has a typical foraging range of less than 5km from their night roost during the non-breeding season. Therefore, this further supports the conclusion that the wind farm site is not functionally linked to the SPA regarding wintering whooper swan populations, since Kilcolman Bog SPA is approximately 9.4km from the wind farm site boundary at its nearest point.

Precautionary collision risk modelling for whooper swan was undertaken (see EIAR **Volume III, Appendix 8.2**), which confirmed that the operation of the Project is highly unlikely to have a significant effect on whooper swans through collisions with new turbines (see section 8.9.3.2 for further details).

As such, it is not considered likely that there will be significant effects on designated whooper swan populations of Kilcolman Bog SPA as a result of the Project. There will therefore be no adverse effects on the integrity and conservation objectives of the SPA.

As described in section 8.7.4.1, whilst non-qualifying species listed on the citation for Kilcolman Bog SPA were recorded within the Project (namely, black-headed gull, golden plover, lapwing, lesser black-backed gull and mallard), considering the numbers and level of activity of these species recorded, and the distance from the SPA boundary, the wind farm site is not considered to be of significant value to these wintering non-qualifying bird populations of the SPA. No adverse effects on the SPA's integrity or conservation objectives through impacts on these populations are therefore likely.

In summary, the predicted likely effect of the Project on the Kilcolman Bog SPA would be **not significant**.

### 8.9.3 Assessment of effects on bird species

#### *8.9.3.1 Construction effects*

The assessment of effects on bird species during the construction of the Project is described below and summarised in **Table 8.9**, in accordance with the effect terminology described in section 8.6.4. Potential effects identified during the construction phase of the Project are as follows:

- Direct habitat loss: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present for birds.

- Disturbance and displacement: disturbance of nesting, flying, sheltering and foraging birds (e.g., from additional noise, dust, light, vibration, and human activity), with the potential to cause displacement of birds into land outside of the Project footprint.

Direct habitat loss or change is inevitable in the development of any wind farm, especially when the establishment of access tracks, turbines, substation buildings and other associated construction and decommissioning is considered. This can result in reduced habitat heterogeneity and connectivity as well as reduced feeding, nesting, roosting, and commuting opportunities for protected and priority bird species.

Direct habitat loss due to the development of wind farms tends to be relatively small (Drewitt & Langston, 2006)[17]. The permanent land take will be largely limited to the area of the turbine bases, new access tracks, electrical substation, and a meteorological mast. Temporary land take during construction and decommissioning will additionally include temporary access tracks for site vehicles and machinery, crane hard standing areas and lay down areas for each turbine, a temporary site compound with associated car parking. Temporary land take will also occur at 'pinch points' along the TDR where vegetation will need to be removed to enable the transport of turbine infrastructure as well as along parts of the cable route. It should be noted however that for the purpose of this ornithological assessment, the likely effects on birds from either of the TDR options and GCR options assessed would not differ significantly.

As described within EIAR **Chapter 7 Biodiversity**, habitats on the wind farm site are largely dominated by agricultural land, within which the turbines will be constructed. The proposed site substation, met mast, and construction compounds will additionally sit within agricultural land. These habitats are highly modified and are of low ecological value, thus limiting impacts on ornithological features. In overview, not including temporary vegetative loss along the TDR and GCR option routes, the wind farm development will result in the loss of 2.69ha of habitats as a result of permanent infrastructure and a loss of 11.11ha of habitats as a result of temporary works areas, as detailed in **Table 8.8**

**Table 8.8: Habitat losses for the Project (before mitigation/offsetting)**

| Habitat type | Total area (ha) |
|---|---|
| **Temporary works** | |
| BC1 – arable land | 1.11 |
| BC3 – tilled land | 0.73 |
| ED2 – disturbed ground | 0.18 |
| FW4 – drainage ditches | 0.01 |
| GA1 – improved grassland | 9.08 |
| **Linear features** | **Total length (m)** |
| WL1 – hedgerows | 220 |
| WL2 – treelines | 0 |
| **Permanent works** | |
| BC1 – arable land | 0.37 |

| Habitat type | Total area (ha) |
|---|---|
| BC3 – tilled land | 0.12 |
| ED2 – disturbed ground | 0.17 |
| FW4 – drainage ditches | 0.006 |
| GA1 – improved grassland | 2.02 |
| **Linear features** | **Total length (m)** |
| WL1 – hedgerows | 211 |
| WL2 – treelines | 0 |

#### Barn owl

No barn owl activity was recorded within the wind farm site. However, the site contains suitable foraging habitat for barn owl, and an active nest site was identified approximately 1.8km east of the wind farm site boundaries. The Project is therefore considered, on a precautionary basis, to potentially be of Local (Higher value) importance for barn owl.

Taking into consideration the embedded mitigation within section 8.8 and the predicted habitat losses presented in **Table 8.8**, direct loss of suitable barn owl habitat during construction will be minimal. There will be no removal of suitable roosting or nesting sites, and land take for the proposed turbines and associated infrastructure will not significantly reduce the availability of barn owl foraging habitat within the wind farm site. Likely effects from habitat loss and fragmentation are therefore deemed **not significant**.

As no nests or roosts were recorded within the wind farm site boundary, potential disturbance effects will be limited to foraging and commuting individuals. Barn owls have comparatively large home ranges, with adults in the breeding season commonly ranging between 1km and 1.5km from their breeding sites to forage, (Shawyer, 1990)[27]. As the nearest confirmed nesting location is approximately 1.8km to the east of the wind farm site boundary, the wind farm site is outside of the core foraging range of this pair. Considering this, and the limited extent and quality of suitable barn owl foraging habitat within the wind farm site, likely effects from disturbance and displacement are considered **not significant**.

#### Raptors

The wind farm site is assessed as being of Local (Higher value) importance for raptors including buzzard, kestrel, merlin (winter only) and peregrine. The wind farm site is dominated by intensive agricultural land, with relatively limited availability of higher quality foraging habitat for these species. Taking into consideration the embedded mitigation within section 8.8 and the predicted habitat losses presented in **Table 8.8**, direct loss of suitable foraging habitat for these species will be minimal and highly unlikely to significantly affect prey availability for raptors. Furthermore, there will be no significant loss of suitable nesting habitat for buzzard, kestrel, or peregrine, with only eight trees predicted to be removed, due to maintaining safe sightlines for vehicles exiting the wind farm site on to the L5302 public road at Croughta, all of which are likely to be removed in the short-term in the absence of the Project due to ash dieback disease (see EIAR **Chapter 7 Biodiversity**). As such, effects on populations of these raptor species as a

[27] Shawyer, C.R. 1990. (Revised 1996) The Barn Owl and its Habitat. The Hawk and Owl Trust, London.

result of habitat loss and fragmentation during construction are considered **not significant**.

Construction activities have the potential to cause disturbance and displacement of the raptor species described above. Of the species recorded during field surveys, only buzzard and kestrel exhibited relatively high levels of flight activity within the wind farm site and would therefore be more susceptible to disturbance impacts during construction. However, the area of potentially suitable habitat that would be subject to disturbing activities will be small, particularly in the context of retained areas of suitable foraging and commuting habitat within the wind farm site and the wider landscape. Considering this, and the levels of activity recorded for raptor species within the wind farm site, potential disturbance and displacement effects from construction are considered **not significant**.

**Golden plover**

The wind farm site is assessed of being of Local (Higher value) importance for golden plover and is also subject to low levels of activity by other wader species such as lapwing and snipe. Whilst habitats on site are suitable for these species, this habitat is relatively limited in extent in the context of the wider landscape, and the majority of observations were of individuals in flight rather than birds using habitats on site for foraging or roosting. No evidence of breeding by any wader species was recorded. Taking into consideration the embedded mitigation within section 8.8 and the predicted habitat losses presented in **Table 8.8**, direct loss of suitable habitat for these species will be minimal, particularly in the context of retained habitat within the wind farm site and the wider landscape. Habitat loss and fragmentation effects from construction are therefore considered **not significant**.

Given the lack of roosting golden plover recorded within the wind farm site, the absence of breeding by any wader species (e.g., lapwing, snipe) and relatively low level of roosting activity (by snipe only), there is limited potential for disturbance of these species during construction of the Project. The area of suitable habitat subject to disturbing activities will be relatively small, particularly in the context of retained areas of suitable habitat within the wider landscape. Regarding flight activity by golden plover recorded on the wind farm site, whilst construction activities in winter could cause minor disturbance (i.e., birds deviating in their flight lines to avoid construction areas), considering the potential level of construction disturbance, the levels of golden plover activity on the wind farm site and the abundance of suitable retained habitat, disturbance effects from construction are considered **not significant**.

**Whooper swan**

The population of whooper swan within the ZoI of the Project was assessed, on a precautionary basis, as being of Local (Higher value) importance, since the numbers recorded potentially represent more than 1% of the population associated with Kilcolman Bog SPA. However, the site has been assessed as not comprising Functionally Linked Land to Kilcolman Bog SPA with regard to designated whooper swan populations (see section 8.9.2.2).

Considering the very low level of whooper swan activity recorded (two records with a peak count of four birds flying over the site during the three winter seasons surveyed), there is no potential for significant construction impacts on whooper swan, either through direct habitat loss or disturbance/displacement. Construction effects on whooper swan would therefore be **not significant**.

### Non-target species

The wind farm site is assessed as being of Local (Higher value) importance for the assemblage of notable non-target bird species such as linnet, meadow pipit, redwing, skylark, starling, stock dove and yellowhammer. Habitats within the wind farm site provide opportunities for these species during the breeding and non-breeding seasons, most notably the hedgerows, treelines, grassland, scrub, and arable fields. The temporary and permanent loss of these habitats to facilitate construction, as outlined in **Table 8.8**, will result in a reduction in the availability and connectivity of habitats for the bird assemblage. Whilst the embedded mitigation outlined within section 8.8 will help to reduce such impacts, in the absence of additional mitigation measures, it is likely that the construction of the Project would have a **significant adverse effect** on these farmland bird species at a **Local level** (**slight effect**) through direct habitat loss and fragmentation. This effect would be reversible through the additional mitigation/offsetting that is outlined in section 8.10.

Whilst the area of suitable habitat subject to disturbing activities for these farmland bird species will be relatively small, particularly in the context of retained areas of suitable habitat present within the wider landscape, there is potential for disturbance and displacement of farmland bird species during the construction of the Project. This includes potential disturbance of birds when nesting and may cause birds to vacate territories close to works. Additional impacts may occur during the construction due to required road works along the TDR, the laying of cabling, the placement of underground cabling, and excavation of materials. Considering the potential extent of disturbance, and the importance of the bird populations present, it is possible that the construction of the Project could have a **significant adverse effect** on these farmland bird species at a **local level** (**slight effect**) through disturbance and displacement, in the absence of additional mitigation.

### Summary

**Table 8.9: Construction effect characterisation for Key Ornithological Features**

| Key Ornithological Feature | Effect | Magnitude of effect | Significance of effect |
|---|---|---|---|
| Barn owl | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| Raptor species | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| Golden plover | Direct habitat loss and fragmentation | Negligible | Not significant |

| Key Ornithological Feature | Effect | Magnitude of effect | Significance of effect |
|---|---|---|---|
| | Disturbance and displacement | Negligible | Not significant |
| Whooper swan | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| Non-target species | Direct habitat loss and fragmentation | **Low** | **Long-term, Slight Adverse Effect (significant at a Local level)** |
| | Disturbance and displacement | **Low** | **Short-term, Slight Adverse Effect (significant at a Local level)** |

#### 8.9.3.2 *Operational effects*

The assessment of effects upon ornithological features during the operation of the Project is described in this section and summarised in **Table 8.11**. It is understood that the wind farm has an anticipated lifespan of 35 years. Potential effects identified during the operational phase are as follows:

- Direct habitat loss: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present for birds to facilitate the operational maintenance of the Project;
- Disturbance and displacement: disturbance of nesting, flying, sheltering, and foraging birds (e.g., from additional noise, light, vibration, visual disturbance, and human activity) potentially resulting in displacement of birds; and
- Bird fatalities and/or injuries through collisions with turbines whilst flying over the site.

Assessment of operational effects for KOF is informed by species-specific collision risk modelling where appropriate. Full details of collision risk modelling are provided in EIAR **Volume III, Appendix 8.2.**

**Barn owl**

No barn owl activity was recorded within the wind farm site. However, the wind farm site contains suitable foraging habitat for barn owl, and an active nest site was identified approximately 1.8km east of the Project. The Project is therefore potentially of Local (Higher value) importance for barn owl.

Removal of habitat (e.g., vegetation clearance) to facilitate operational maintenance of the Project will be limited in extent, likely involving only very small areas of low-quality barn owl foraging habitat, and no removal of suitable nesting or roosting habitat will occur. There would therefore be no significant reduction in the suitability of the site for barn owl due to operational maintenance. Considering this, and the low level of barn owl activity recorded on the wind farm site, likely effects from habitat loss and fragmentation during the operation of the Project are deemed **not significant**.

As no nests or roosts were recorded within the wind farm site boundary, operational disturbance effects will be limited to foraging and commuting individuals. As outlined in section 8.9.3.1, barn owls have comparatively large home ranges with adults commonly ranging between 1km and 1.5km from their breeding sites to forage, (Shawyer, 1990)[27]. As the nearest confirmed nesting location is approximately 1.8km east of the wind farm site boundary, the site falls outside of the core foraging range of this pair. Considering this, and the limited extent and quality of suitable barn owl foraging habitat within the wind farm site (particularly when viewed in the context of the wider landscape), likely effects from disturbance and displacement during the operation of the Project are considered **not significant**.

No barn owl flight activity was recorded within the potential collision risk zone of the proposed turbines. As such, collision risk modelling for barn owl was not undertaken to inform this assessment. Furthermore, the wind farm site is beyond the core foraging range of barn owls associated with the nearest nest location to the wind farm site and so significant levels of barn owl flight activity within the wind farm site is unlikely. Furthermore, collision risk for barn owls with turbines is generally deemed to be low, due to a relatively low cursory flight path associated with foraging and commuting, coupled with high flight manoeuvrability. Considering this, and the assessed importance of the site for barn owl (based on the quality/extent of suitable habitat on site and the level of barn owl activity recorded), effects associated with collision risk are deemed **not significant**.

**Raptors**

The wind farm site is assessed of being of Local (Higher value) importance for raptors including buzzard, kestrel, merlin (winter only) and peregrine. The site is dominated by intensive agricultural land, with relatively low availability of higher quality foraging habitat for these species. Removal of habitat (e.g., vegetation clearance) to facilitate operational maintenance of the Project will be limited in extent, likely involving only very small areas of relatively low-quality foraging habitat, and no removal of suitable nesting habitat for raptors is likely. This is therefore highly unlikely to significantly affect prey availability, particularly in the context of the wider landscape. Considering this, likely effects from habitat loss and fragmentation during the operation of the Project on raptors are deemed **not significant**.

Regarding potential operational disturbance of raptors, the proposed wind turbines have the potential to cause disturbance and displacement of raptor populations using the wind farm site. Whilst there is evidence of raptors avoiding the area within 500m of turbines, (Pearce-Higgins *et al*. 2009)[28], considering the level of raptor activity recorded within and adjacent to the wind farm site, the conservation statuses of these species and the relatively low suitability of habitat within the wind farm site in comparison with suitable raptor habitat within the wider landscape (which, based on field survey data, does not contain sufficient raptor numbers such that competition is likely to be a significant issue), this relatively minor disturbance and potential displacement would not have a significant effect on the local conservation statuses of these species. Operational disturbance and displacement effects from construction are therefore considered **not significant**.

[28] Pearce-Higgins, J.W., Stephen, L., Langston, R.H.W., Bainbridge, I.P. & Bullman, R. 2009. The distribution of breeding birds around upland wind farms. *Journal of Applied Ecology*, 46, 1323-1331.

Due to their size and typical flight patterns, raptor species can be particularly susceptible to impacts from collisions with new turbines which may result in injury or fatalities. Collision risk modelling was therefore undertaken for these raptor species based on field survey data collected for the site between 2020 and 2023.

Of the four raptor species for which the wind farm site is of Local (Higher value) importance, three species were recorded flying within the potential collision risk zone and were therefore subject to collision risk modelling, namely buzzard, kestrel, and peregrine. Estimated collision risk fatalities for these species (taking into account published avoidance rates within best practice guidance), both annually and over the proposed 35-year project lifespan, are summarised in **Table 8.10**. Further details of collision risk modelling for raptor species are provided in EIAR **Volume III, Appendix 8.2**. This presents a precautionary scenario of likely bird collision related mortality.

**Table 8.10: Summary of collision risk modelling for raptor species**

| Survey period | Avoidance rate | Mean estimated collision fatalities | |
|---|---|---|---|
| | | Per year | 35 years |
| Buzzard | 98% | 0.521 | 18.228 |
| Kestrel | 95% | 0.259 | 9.068 |
| Peregrine | 98% | 0.020 | 0.715 |

Modelled buzzard and kestrel collision fatalities are estimated as 0.52 and 0.26 birds per year respectively, equating to 18.2 and 9.1 birds, respectively over the operational lifespan of the Project. Recent population estimates are not available for these species for the local area, but the species are considered locally widespread and common and collision fatalities over the operational lifespan of the Project would equate to less than 1% of the county populations. The resultant increases in bird mortality would not be significant when compared against the annual background mortality for these species, which for buzzard and kestrel are stated to be 10% and 31% of adult birds, respectively and 37% and 68% of juvenile birds, respectively (based on the mortality rates taken from the BTO Bird Facts website[29]).

Based on the methods adopted in collision risk modelling, it should be noted that estimated numbers of fatalities are precautionary and are considered likely to be higher than the actual number of collision fatalities. As such, based on the anticipated number of collision fatalities, collision impacts on buzzard and kestrel during the operation of the Project are considered **not significant**.

Modelled peregrine collision fatalities are estimated as 0.02 birds per year, equating to 0.72 birds over the operational lifespan of the Project. Based on the methods adopted in collision risk modelling, it should be noted that estimated numbers of fatalities are precautionary and are considered likely to be higher than the actual number of collision

[29] Further details available at https://www.bto.org/understanding-birds/welcome-birdfacts [accessed 18/07/2023]

fatalities that occur. Considering these estimated collision fatalities in the context of the national and regional status of this species, collision impacts on peregrine during the operation of the Project are considered **not significant**.

No flight activity within the collision risk zone was recorded for hen harrier or merlin during the field surveys undertaken in 2020 to 2023. As such, collision risk modelling was not undertaken for these species and based on the field data there would be no anticipated hen harrier or merlin collision fatalities during the operation of the Project. As such, collision impacts on hen harrier and merlin during the operation of the Project are considered **not significant**.

**Golden plover**

The wind farm site is assessed as being of Local (Higher value) importance for golden plover and is also subject to low levels of activity by other wader species such as lapwing and snipe. Whilst habitats on site are suitable for these species, this habitat is relatively limited in extent in the context of the wider landscape, and the majority of observations were of individuals in flight rather than of birds using habitats on site for foraging or roosting. No evidence of breeding by any wader species was recorded.

Removal of habitat (e.g., vegetation clearance) to facilitate operational maintenance of the Project will be limited in extent, likely involving only very small areas of suitable wader habitat. There would therefore be no significant reduction in the suitability of the wind farm site for golden plover or other wader species due to operational maintenance. Considering this, and the low level of wader activity recorded on the wind farm site, likely effects from habitat loss and fragmentation during the operation of the Project are deemed **not significant**.

Given the lack of golden plover roosting recorded within the wind farm site, the absence of breeding by any wader species (e.g., lapwing, snipe) and relatively low level of roosting activity (by snipe only), there is limited potential for operational disturbance of these species. Research indicates that golden plovers may reduce their use of habitat within 200m of turbine bases, (Pearce-Higgins *et al*., 2009)[28], whilst a further review of 29 other studies suggests golden plovers will approach wind turbines to an average distance of 175m during the non-breeding season, (Hotker *et al*., 2006)[30]. However, post-construction monitoring at 15 upland wind farms has shown no significant decline in populations, (Pearce-Higgins *et al*., 2012)[31], especially when there are extensive areas of suitable retained habitat in the wider area. Considering the area of retained suitable habitat for golden plover and other waders in the context of the area of suitable habitat within 200m of the proposed turbines, and the level of activity recorded during the field surveys undertaken in 2020 to 2023, likely effects from disturbance and displacement during the operation of the Project are considered **not significant**.

As golden plovers were recorded flying within the potential collision risk zone during the non-breeding season in 2020 to 2023, there is potential for impacts from collisions with

[30] Hotker, 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. Michael-Otto-Institut im NABU, Bergenhusen.

[31] Pearce-Higgins, J.W., Stephen, L., Douse, A. & Langston, R.H.W. 2012. Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis. *Journal of Applied Ecology*, 49, 386-394.

the proposed turbines, potentially resulting in injury and/or fatalities. Collision risk modelling was therefore undertaken for golden plover to inform this assessment. Modelled golden plover collision fatalities are estimated as 0.005 birds per year, equating to 1.632 birds over the operational lifespan of the Project (taking into account published avoidance rates within best practice guidance) (see EIAR **Volume III, Appendix 8.2** for full details).

Based on the methods adopted in collision risk modelling, it should be noted that estimated numbers of fatalities are precautionary and are considered likely to be higher than the actual number of collision fatalities that occur. Considering these estimated collision fatalities in the context of the national and regional status of this species, collision impacts on golden plover during the operation of the Project would affect less than 1% of the county population and are therefore considered **not significant**. This is further justified when considered in the context of the annual background rates of mortality for the species, which for adult birds is 27% (based on the mortality rates taken from the BTO Bird Facts website[29]).

**Whooper swan**

The wind farm site is assessed as not comprising Functionally Linked Land to Kilcolman Bog SPA with regard to designated whooper swan populations. Considering the very low level of whooper swan activity recorded, there is **no potential for significant operational effects** on whooper swan, either through direct habitat loss or disturbance/displacement.

Considering the importance of this species in the context of relevant designated sites (namely Kilcolman Bog SPA), and its high susceptibility to collisions with turbines due to its size and typical flight patterns, collision risk modelling was undertaken for whooper swan on a precautionary basis. Based on observed flight activity within the collision risk zone during the VP surveys, modelled whooper swan collision fatalities are estimated as 0.001 birds per year, equating to 0.05 birds over the operational lifespan of the Project (taking into account published avoidance rates within best practice guidance) (see EIAR **Volume III, Appendix 8.2** for full details). This equates to 0.001% of the whooper swan population associated with the Kilcolman Bog SPA.

A group of four whooper swans were recorded flying through the wind farm site at risk height during a transect survey undertaken in January 2023. This was omitted from collision risk modelling as this data was not collected during VP surveys. Had this observation been recorded during the VP surveys it would result in modelled whooper swan collision risk fatalities of 0.268 birds over the lifespan of the Project (based on an average of the data collected between 2020 and 2023). This would equate to 0.003% of the whooper swan population associated with the Kilcolman Bog SPA.

Based on the methods adopted in collision risk modelling, it should be noted that estimated numbers of fatalities are precautionary and are considered likely to be higher than the actual number of collision fatalities that occur. Considering these estimated collision fatalities in the context of the national and regional status of this species, collision impacts on whooper swan during the operation of the Project are considered **not significant** and have no potential for likely significant effects on the integrity of any designated sites.

**Pomarine skua**

The wind farm site is unsuitable for use by pomarine skua, with the single individual observed during the field surveys considered to comprise a migrating bird flying over the wind farm site. The wind farm site is assessed as being of Negligible importance for pomarine skua. Due to the scarcity of this species in Ireland and its potential sensitivity to collision impacts, collision risk modelling was undertaken for pomarine skua on a precautionary basis. Modelled pomarine skua collision fatalities are estimated as 0.002 birds per year, equating to 0.05 birds over the operational lifespan of the Project (taking into account published avoidance rates within best practice guidance) (see EIAR **Volume III, Appendix 8.2** for full details).

Based on the methods adopted in collision risk modelling, it should be noted that estimated numbers of fatalities are precautionary and are considered likely to be higher than the actual number of collision fatalities that occur. Considering these estimated collision fatalities, collision impacts on pomarine skua during the operation of the Project are considered **not significant**.

**Non-target species**

The wind farm site is assessed as being of Local (Higher value) importance for notable bird species such as linnet, meadow pipit, redwing, skylark, starling, stock dove and yellowhammer. Habitats within the wind farm site provide opportunities for these species during the breeding and non-breeding seasons. As such, the removal of vegetation to facilitate operational maintenance of the Project could cause a reduction in the availability and connectivity of habitats, to the potential detriment of local populations of these species. However, the extent of any such vegetation removal will be small-scale and only likely to have a negligible effect on birds, especially when considered in the context of retained habitat within the site and the wider landscape. As such, likely effects from habitat loss and fragmentation during the operation of the Project are deemed **not significant.**

Regarding effects from operational disturbance due to additional noise, vibration, light, and human activity associated with the Project, farmland bird species for which the wind farm site is of Local (Higher value) importance are considered to be relatively tolerant to such disturbance and are likely to quickly habituate to the new levels of 'background' disturbance within the wind farm site. In addition, any areas subject to higher levels of disturbance will be small-scale in the context of undisturbed suitable habitat within the site and the wider landscape. As such, operational disturbance and displacement effects on these farmland bird species are deemed **not significant**.

Due to their size and typical flight patterns, non-target farmland bird species such as those identified as being of Local (Higher value) importance are not considered to be susceptible to collisions with new wind turbines. As such, collision risk modelling was not undertaken for these species. Collision impacts on non-target farmland bird species during the operation of the Project are considered **not significant**.

**Summary**

**Table 8.11: Operational effect characterisation for ornithological features**

| Key Ornithological Feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| Barn owl | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Collision risk | Negligible | Not significant |
| Raptor species | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Collision risk | Minor | Not significant |
| Golden plover | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Collision risk | Negligible | Not significant |
| Whooper swan | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Collision risk | Negligible | Not significant |
| Pomarine skua | Collision risk | Negligible | Not significant |
| Non-target species | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| | Collision risk | Negligible | Not significant |

### 8.9.3.3 *Decommissioning effects*

The assessment of effects on ornithological features during the decommissioning phase of the Project is described below and summarised in **Table 8.12**. Potential effects identified through the decommissioning phase are as follows:

- Direct habitat loss: permanent and temporary reductions to the extent, quality, and connectivity of the habitats present for birds; and
- Disturbance and displacement: disturbance of nesting, flying, sheltering and foraging birds (e.g., from additional noise, dust, light, vibration, and human activity), potentially causing displacement.

The Project is dominated by intensive agricultural land, with relatively low availability of higher quality nesting and foraging habitat for birds. This will likely continue to be the case throughout the operational phase of the Project to the time of decommissioning.

Removal of habitat during the decommissioning of the Project will be limited in extent, likely involving only small areas of relatively low-quality habitat, similar to those temporary losses reported above for the construction phase, where habitats temporarily removed during construction are to be reinstated. Removal of potentially suitable nesting habitat for raptors and barn owls would be unlikely and the extent of the habitat affected during decommissioning will be small in the context of retained habitat within the wind farm site and the wider landscape. Following decommissioning, where infrastructure has been removed and temporary disturbance of habitats occurred, then habitats will be reinstated to their pre-construction baseline and impacts would be short-term and temporary. As such, likely effects on birds from habitat loss and fragmentation during the decommissioning of the Project are deemed **not significant**.

Decommissioning works would likely result in short-term disturbance as a result of increased noise and human presence, which could lead to energetic stress and a reduction in breeding success of certain bird species. However, such impacts would be experienced on a temporary basis only and would not be expected to affect the population status of any bird populations within the ZoI. Impacts during decommissioning would be less extensive and of a shorter duration than those experienced during construction and disturbance during decommissioning is unlikely to significantly discourage flight activity, foraging or breeding attempts by birds in the vicinity of the Project, especially given the short-term temporary nature of the proposed works. Significant disturbance impacts on birds are not anticipated, given that extensive areas of suitable foraging and breeding habitat exist and will remain on site and in the wider area during the decommissioning phase of the Project. Disturbance effects on birds from decommissioning are therefore considered **not significant**.

### Summary

**Table 8.12: Decommissioning effect characterisation for ornithological features**

| Key Ornithological Feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| Barn owl | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible ` | Not significant |
| Raptor species | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| Golden plover | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |

| Key Ornithological Feature | Effects | Magnitude of effect | Significance of effect |
|---|---|---|---|
| Whooper swan | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |
| Non-target species | Direct habitat loss and fragmentation | Negligible | Not significant |
| | Disturbance and displacement | Negligible | Not significant |

### 8.9.4 Cumulative effects

As described in EIAR **Chapter 2, Table 2.2**, a planning search was carried out to identify permitted and constructed projects in the wider receiving environment. As per SNH guidance on *Assessing the Cumulative Impacts of Onshore Wind Energy Developments*, 2018[32], cumulative effects arising from two or more developments may be:

- **Additive** (i.e., multiple independent additive model).
- **Antagonistic** (i.e., the sum of impacts is less than in a multiple independent additive model).
- **Synergistic** (i.e., the cumulative impact is greater than the sum of the multiple individual effects).

#### *8.9.4.1 Projects with potential to cause cumulative effects*

**N/M20 Upgrade Works**

The proposed N/M20 Cork to Limerick Improvement scheme will improve connectivity between Cork and Limerick and provide for safer and more efficient journey times. The route extends 80km from Blarney, Co. Cork to Patrickswell, Co. Limerick.

While it could be several years before a consent application is made, it is possible that within the 10-year lifetime of consent requested for the Project, this proposed development has a reasonable prospect of either being submitted for planning consent or commencing construction by this time. Also, both of the TDR routes examined in this chapter will cross the proposed N/M20 corridor in certain areas.

**N72/N73 Dublin to Cork Railway Line**

The proposed development is located at seven numbered level crossings along a 24km section of the Dublin to Cork Railway Line. Railway works and all works necessary to eliminate and, where necessary, upgrade the seven numbered level crossings is due to be undertaken. An Environmental Impact Assessment has been conducted with associated baseline ecological surveys. Such surveys recorded the presence of a small number of protected species with the outcome of the EIAR showing that the proposed

[32] Scottish Natural Heritage. 2018. Assessing the cumulative impacts of onshore wind farms on birds. Scottish Natural Heritage, Inverness.

development will have no significant residual effects upon ecological features after mitigation.

### Wind farms with potential to cause cumulative effects

Wind farms, and proposed wind farms, in the vicinity of the wind farm site were also considered for the potential to give rise to cumulative effects. The proximity of the wind farms and whether they are operational, permitted, or pending (proposed) has been considered within this assessment. Wind farm projects with the potential to give rise to cumulative effects are presented in **Table 8.13**:

**Table 8.13: Wind farms within 20km of the proposed wind farm site**

| Development | Status | Distance/ Direction[[1]] | Number of Turbines | Tip Height |
|---|---|---|---|---|
| Kilberehert wind farm | Operational | 9km, NW | 3 | 125m |
| Boolard wind farm | Operational | 12.8km, N | 2 | 150.5m |
| Knocknatallig wind farm | Operational | 13.8km, NE | 6 | 135m |
| Esk wind farm | Operational | 13.8km, SW | 14 | 136.5m |
| Rathnacally wind farm | Operational | 14.2km, N | 2 | 150.5m |
| Castlepook wind farm | Operational | 15km, NE | 14 | 126m |
| Carrigcannon wind farm | Operational | 17.1km, SW | 10 | 100m |
| Boggeragh 1 and 2 | Operational | 17.4km, SW | 43 | 136.5m |
| Coom wind park | Consented | 19.1km, SE | 22 | 172m |
| Ballinagree wind farm | In planning | 20.6km, SW | 20 | 185m |
| Annagh wind farm | In planning (appeal) | 10.9km, N | 6 | 175m |

### Other projects

Other projects identified in EIAR **Chapter 2 EIA Methodology**, **Table 2.2** were considered for their potential to cause likely significant cumulative effects on the KOF considered within this assessment, including an extension to a quarry located approximately 2.7km southwest of the proposed wind farm site, the Ballyroe Solar Farm and related 110kV substation located approximately 10.8km north of the proposed wind farm site, Fiddane Solar Farm and related grid connection located approximately 10.8km north of the proposed wind farm site, various other solar farm proposals as well as the Hazelbrook and Clonmore Housing Developments located approximately 8.2km from the proposed wind farm site. These developments either lie beyond the core ranges of the KOF associated with the wind farm site and/or are not of a sufficient scale whereby significant cumulative effects with the Project would be likely.

Cumulative effects on the KOF for the project are further considered in sections 8.9.4.2 to 8.9.4.4.

*8.9.4.2 Cumulative effects on designated sites*

The potential cumulative and in-combination effects on internationally designated sites (European sites) arising from the Project is discussed in detail in the NIS which accompanies this planning application. This includes the Kilcolman Bog SPA, which has been included as a KOF within this assessment.

No projects were identified which are considered likely to act cumulatively upon the local terrestrial ecology (habitats and species) of the identified designated sites during the construction, operation, and decommissioning phases of the Project. Furthermore, the wind farm site was identified as not being functionally linked to the Kilcolman Bog SPA as described within section 8.9.2.2. Significant effects in combination with other developments are therefore considered highly unlikely.

The regional projects and wind farms identified within proximity to the wind farm site have all been subject to their own relevant detailed biodiversity impact assessments and mitigation measures. The proper planning and implementation of environmental controls, monitoring and mitigation at such large-scale projects greatly minimises the risk of significant residual impacts upon bird species of conservation importance. Consequently, the risk of cumulative and in-combination effects on the Kilcolman Bog and its ornithological interest features is unlikely to be significant, especially considering the distance at which the designated site lies from the wind farm site and other proposed developments assessed for cumulative effects.

*8.9.4.3 Cumulative effects on bird species*

Existing or proposed projects in the hinterland of this Project have the potential to cumulatively impact on the local ecology, particularly through increased fragmentation of the landscape, increased habitat disturbance, barrier effects, intensification of collision or displacement impacts on sensitive bird species.

Each additional turbine erected in the landscape can potentially increase the cumulative risk of collision for birds foraging and commuting through a landscape. For most species, their ecology and in particular their pattern of movement means that they will not experience an incremental increase in collision risk for each turbine erected (e.g., passerine species). For species with large home ranges, or those commuting long distances, there is a potential for individuals to experience a cumulative collision risk. Information from recovery of ringed and tagged birds indicates that losses associated with collision with road traffic and buildings, along with hunting and predation fatalities, are the most significant source of bird mortality (Wernham *et al*., 2002). Observations of flightlines of key target species made during the breeding and wintering VP surveys indicate that the wind farm site is not situated along any regular commuting routes for these species. Therefore, significant cumulative displacement/barrier and collision risk effects are not anticipated.

*8.9.4.4 Summary of assessment of cumulative effects*

Following consideration of the impact assessment, it is noted that the Project on its own, will not result in any significant effects upon any of the identified KOF that would be sensitive to impacts from developments in other areas. Non-target farmland bird species have been the only identified KOF with the potential for significant effects and they are unlikely to be significantly impacted by other wind farm developments (due to their low cursory flight paths) and the N/M20 Cork to Limerick improvement scheme, due its temporary construction nature and its limited amount of land take. No potentially significant cumulative disturbance and habitat loss effects are likely.

No additive, antagonistic, or synergistic effects have been identified with regard to habitat loss, displacement, and collision mortality.

## 8.10 Mitigation and enhancement measures

### 8.10.1 Scope

This section describes recommended mitigation measures for the avoidance of the potentially significant effects on KOF described in section 8.9. These measures will be implemented in addition to the embedded mitigation described in section 8.8, which was taken into consideration during the assessment of effects.

Effects on features have been addressed in two ways:

- Design of the Project in terms of embedded mitigation (see section 8.8).
- Management and enhancement of development phases (described in this section).

The mitigation measures described below are designed to address and minimise the risk of impacts arising from each phase of the Project. A Habitat Management Plan (HMP) has been produced for the Project (see EIAR **Volume III, Appendix 7.3**) to ensure that the wind farm site is managed in the interests of biodiversity and that ongoing management is successful in achieving a biodiversity net gain as described below within section 8.10.5. These measures have been specifically aimed at benefitting birds, as well as other key ecological features.

### 8.10.2 Mitigation of likely significant effects during construction

Assessment of effects undertaken in section 8.9.3.1 identified the following potentially significant effects on ornithological features during the construction of the Project:

- Direct loss and fragmentation of habitat used by non-target farmland bird species such as linnet, meadow pipit, redwing, skylark, starling, stock dove and yellowhammer.
- Disturbance and displacement of these non-target farmland bird species.

As stated in section 8.8, the development design includes the following measures which will serve to minimise these effects:

- Retention of areas of more important habitat within the landscape design (e.g., waterbodies and woodland).

- Minimisation of the extent of habitat loss during construction as much as possible within the development design.
- Selection of delivery routes which use existing built infrastructure wherever possible, with laying of cables underground.
- Presence of an ECoW on site to oversee any ornithological issues during construction.

The following supplementary and/or additional measures are recommended to avoid significant effects on the identified bird populations. In addition to avoiding significant impacts on non-target farmland birds, these measures would further reduce the potential for impacts on other KOF during construction.

#### *8.10.2.1 Habitat reinstatement and creation*

Habitats will be created in proportion with the type and extent of habitat loss during construction. All temporary habitat loss will be reinstated on a like-to-like basis, including along the TDR and GCR. Ideally, vegetation will be allowed to regenerate naturally, but if this is not possible then planting will take place. As hedgerow loss is the main cause of significant effects for passerine species, the replacement of this habitat will be the main focus. In areas where hedgerows cannot be reinstated (i.e., due to permanent works or around bat buffer zones (see EIAR **Chapter 7 Biodiversity)** then they will be created elsewhere within the wind farm site. To accommodate the proposed development, 431m of hedgerow habitat will be removed, primarily due to accommodating the temporary working areas in the vicinity of turbine T4 and turbine T8 (see **Figure 8.1**) and in the interest of road safety, to maintain safe sight lines for vehicles exiting the wind farm site on to the L5302 public road at Croughta (as detailed in EIAR **Chapter 7 Biodiversity**). To offset for these losses, 2,911m of hedgerow habitat will be planted across the wind farm site as detailed in EIAR **Chapter 7 Biodiversity**. This represents a significant increase in hedgerow habitat, over and above the extent of which is impacted, and an overall gain for biodiversity.

Planting is proposed to be distributed across the wind farm site in areas where potential enhancement will provide significant benefits to the heterogeneity of the area and improve connectivity to other areas of more suitable habitat. However, given the risk of effects from collisions with wind turbines, consideration has been given to the location of created and enhanced habitat suitable for use by target species (e.g., raptors, whooper swan and waders); specifically, creating features which may attract such species into the collision risk zone of the proposed wind turbines will be avoided. Suitable features of created replacement habitat are consistent with those for the habitat enhancements.

### 8.10.3 Mitigation of likely significant effects during operation

The assessment of effects undertaken in section 8.9.3.2 identified no potentially significant effects on KOF during the operational phase of the Project and, as such, targeted mitigation during this period is not required.

#### *8.10.3.1 Monitoring*

During the operational phase, an avian fatality monitoring programme will be implemented within the operational wind farm, as detailed within the HMP (see EIAR **Volume III, Appendix 7.3**). This will aim to confirm the accuracy of the collision risk modelling predictions that were made within this assessment. Carcasses of birds likely to be associated with collision with turbines will be searched for using specially trained cadaver dogs and their handlers. Monitoring will involve monthly (January-December) searches of carcasses within the first three years of operation and subsequently in years 5, 7, 10, 15, 20, 25, and 30, to ensure non-breeding and breeding species of birds are accounted for. All feather spots and bird carcasses will be photographed and logged in an annual fatality search report, which will be submitted to relevant stakeholders and the Planning Authority for consultation.

The results obtained from monitoring will be analysed to determine whether EIAR predictions were accurate and whether any additional mitigation measures may be required.

### 8.10.4 Mitigation of likely significant effects during decommissioning

The assessment of effects undertaken in section 8.9.3.3 did not identify potential significant effects on KOF during the decommissioning phase of the Project and, as such, targeted mitigation during this period, over and above the embedded mitigation outlined in section 8.8, will not be required.

Any habitat temporarily cleared during the decommissioning phase to accommodate the planned works will be reinstated on a like-for-like basis. Furthermore, where infrastructure is removed, then those areas will be restored to their pre-construction baseline conditions and returned for agricultural use.

Following reinstatement, the wind farm site will be monitored on a regular basis to determine the progress of re-vegetation and if necessary to look at introducing supplementary planting with native species. A reassessment of the wind farm site will be carried out at the end of the first-year post-decommissioning to assess the site’s progression over the previous year in relation to vegetation status, drainage management, and general site appearance, to ensure the site remains favourable to ornithology and wider biodiversity.

### 8.10.5 Enhancement measures

In accordance with ecological best practice and the requirement to achieve net gains for biodiversity, enhancements will be delivered to ensure the Project has an overall positive effect on ornithological features. This is detailed within the HMP (see EIAR **Volume III, Appendix 7.3**), which presents the objectives and targets of the enhancement plan along with prescriptions for management and monitoring to achieve such aims. The plan is accompanied with an enhancement figure which applies an indicative location plan for the management measures prescribed.

The management plan will incorporate enhancement of retained habitat as well as the creation of new habitats of value to biodiversity, including birds. Consideration has been given to the location of enhancements with regard to potential collision impacts; for example, features targeting species susceptible to collisions with turbines will be located away from turbines and in areas that will not encourage commuting routes through the wind farm site.

Enhancements will target the KOF identified in this report, as well as species of conservation concern in Ireland (i.e., BoCCI Red and Amber Listed species). Specifically, enhancements will be considered for farmland species such as passerines (e.g., linnet, skylark, yellowhammer), barn owl and waders such as snipe and woodcock (*Scolopax rusticola*). Guidance on specific habitat creation and enhancement measures for these species is provided on the RSPB website and will be followed[33]. The provision of the management plan will ensure that enhancements establish successfully and deliver long-term benefits. The following measures have been proposed to offset any habitat loss or alteration resulting from the Project, and to enhance the wind farm site and/or adjacent land for ornithological features:

- **Hedgerow planting and enhancement** to provide additional nesting, foraging, and commuting habitats for a range of species, primarily scrub dwelling passerine species such as yellowhammer. Planting will use native plant species of local provenance and of known value to wildlife, whilst rotational management regimes will be adopted to newly planted and existing hedgerows to create varying age structures which will be favoured by different species and at different times of the year.
- **Woodland planting and enhancement** to further provide additional nesting, foraging, and commuting habitats. Planting will take place in three areas along the peripheries of the wind farm site and will incorporate a varying mosaic of different species and age structures, using native species of known value to the local ecology. Management will include rotational coppicing as well as the creation of glades and rides to benefit butterfly and other invertebrate species.
- **Wildflower meadow creation** to improve the botanical diversity of the wind farm site as well as increasing available habitat for invertebrate species, a common prey source for bird species. Two areas are proposed with one being in the area of improved grassland just south of the woodland to the north of the wind farm site and the other behind the proposed substation toward the south of the wind farm site.
- **Scrub enhancement** will aim to improve current condition of the scrub to be more beneficial for bird species by varying the age structure and developing the ground flora. This will be done through the provision of coppicing, natural regeneration, grazing management, and bracken control.
- **Wet grassland management** to improve botanical diversity and provide further foraging and breeding habitat for species such as waders, butterflies, and other invertebrates. It is proposed that the two areas of wet grassland will be expanded into one larger area that will be fenced off to reduce grazing pressure.
- **Enhancement of existing ponds**. Enhancement of two existing waterbodies on site will include eutrophication management, botanical planting, invasive species management, and the creation of a bund to prevent nutrient enrichment from the surrounding agricultural landscape. Open canopy farmland ponds dominated by aquatic macrophytes are known to be positively associated with many species, such as invertebrates, birds, and mammal species.
- **Field margin development** adjacent to boundary features such as hedgerows and ditches to provide nesting, foraging and sheltering habitat and to improve habitat connectivity. Flower-rich margins typically support a more diverse

[33] Further information is available at: https://www.rspb.org.uk/our-work/conservation/conservation-and-sustainability/farming/advice/helping-species/ [accessed 11/07/2022].

invertebrate assemblage, providing food for a range of breeding bird species. Use of wild bird seed planting mixtures can be adopted to provide a food source, particularly during winter for species such as yellowhammer.

- **Bird box provision** throughout pockets of existing woodland to increase nesting opportunities for bird species. Bird boxes will be positioned sensitively so as to avoid increasing the risk of collisions.

## 8.11 Residual effects

The following features were identified as KOF and were therefore subject to detailed assessment of effects:

- Kilcolman Bog SPA
- Barn owl
- Raptor species (specifically buzzard, kestrel, merlin and peregrine)
- Golden plover
- Whooper swan
- Pomarine skua
- Non-target farmland bird species (e.g., linnet, meadow pipit, redwing, skylark, starling, stock dove and yellowhammer)

As described in the assessment of effects presented in section 8.9, taking into consideration embedded mitigation within the Project design, only effects on non-target farmland bird species were assessed as being potentially significant. Effects on all other KOF were assessed as being **not significant**.

Additional mitigation measures to avoid significant effects on bird populations are specified in section 8.10. Considering the scope for effects from the Project, and the importance and sensitivities of the KOF, it is considered that these measures will be sufficient to avoid significant effects on these bird populations. **No significant residual effects** are anticipated. Additionally, further enhancements laid out within the Habitat Management Plan (EIAR **Volume III, Appendix 7.3**) would ensure that the Project has an overall **positive effect** on those sensitive ornithological features identified within this assessment as well as biodiversity as a whole.

# EIAR Volume II

# Main Report

# Chapter 9: Hydrology and Hydrogeology

# CONTENTS

**TABLES**



**FIGURES**

**APPENDICES (EIAR Volume III)**

# 9 HYDROLOGY AND HYDROGEOLOGY

## 9.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) for the proposed Tullacondra Green Energy Project ('the Project') presents an assessment of the likely significant effects of the Project on the hydrology and hydrogeology features or receptors in the receiving environment. The Project refers to all elements as detailed in EIAR **Chapter 5 Project Description**. This chapter also includes an assessment of the likely significant effects from both Grid Connection Route (GCR) Options and both Turbine Delivery Routes (TDR) Options. The assessment considers the potential effects during the following phases of the development:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Where significant effects are predicted, this chapter identifies appropriate mitigation strategies and describes the residual effects post mitigation. Findings are presented and reported in a clear and logical format that complies with EIAR reporting requirements.

A Construction and Environmental Management Plan (CEMP) is provided in EIAR **Volume III, Appendix 5.1**. This is a live document that will change and will be a key construction contract document, which will ensure that the mitigation measures, which are considered necessary to protect the environment are implemented. If planning permission is granted for the development, any condition(s) relating to the permission will be incorporated into an updated version of the CEMP and will be implemented in accordance with the requirements of the condition(s).

### 9.1.1 Assessment structure

In line with the EIA Directive as amended and current EPA guidelines (as outlined in EIAR, **Volume III, Appendix 9.1**9.2.2) the structure of this Hydrology and Hydrogeology chapter is as follows:

- Assessment Methodology and significance criteria.
- Description of baseline conditions at the wind farm site.
- Identification and assessment of effects to hydrology and hydrogeology associated with the Project, during the construction, operation and decommissioning phases of the Project.
- Mitigation measures to avoid or reduce the effects identified.
- Identification and assessment of the significance of residual effects of the Project considering mitigation measures.
- Identification and assessment of cumulative effects if and where applicable.

### 9.1.2 Project description

The Project includes the construction, operation and decommissioning phases of a wind energy development consisting of nine wind turbines with foundations and crane pad hardstanding areas; a permanent meteorological mast; an on-site 38kV substation, underground cabling connecting the turbines to the on-site substation; and associated grid connection to the boundary of the Mallow 110kV substation; along with all associated site works including site clearance, temporary compounds and storage areas; a new temporary entrance and upgrade of an existing entrance; upgrade of existing site tracks and construction of new site tracks; site drainage; and ancillary developments including security gates and fencing, lighting and signage; and biodiversity mitigations and enhancements.

#### *9.1.2.1 Wind Farm Site*

The site layout plan of the wind farm is shown in **Figure 9.1a**. Further details of the proposed Project, the construction programme and sequencing of works which are used as the basis for assessments in this EIAR is provided in EIAR **Chapter 5 Project Description**.

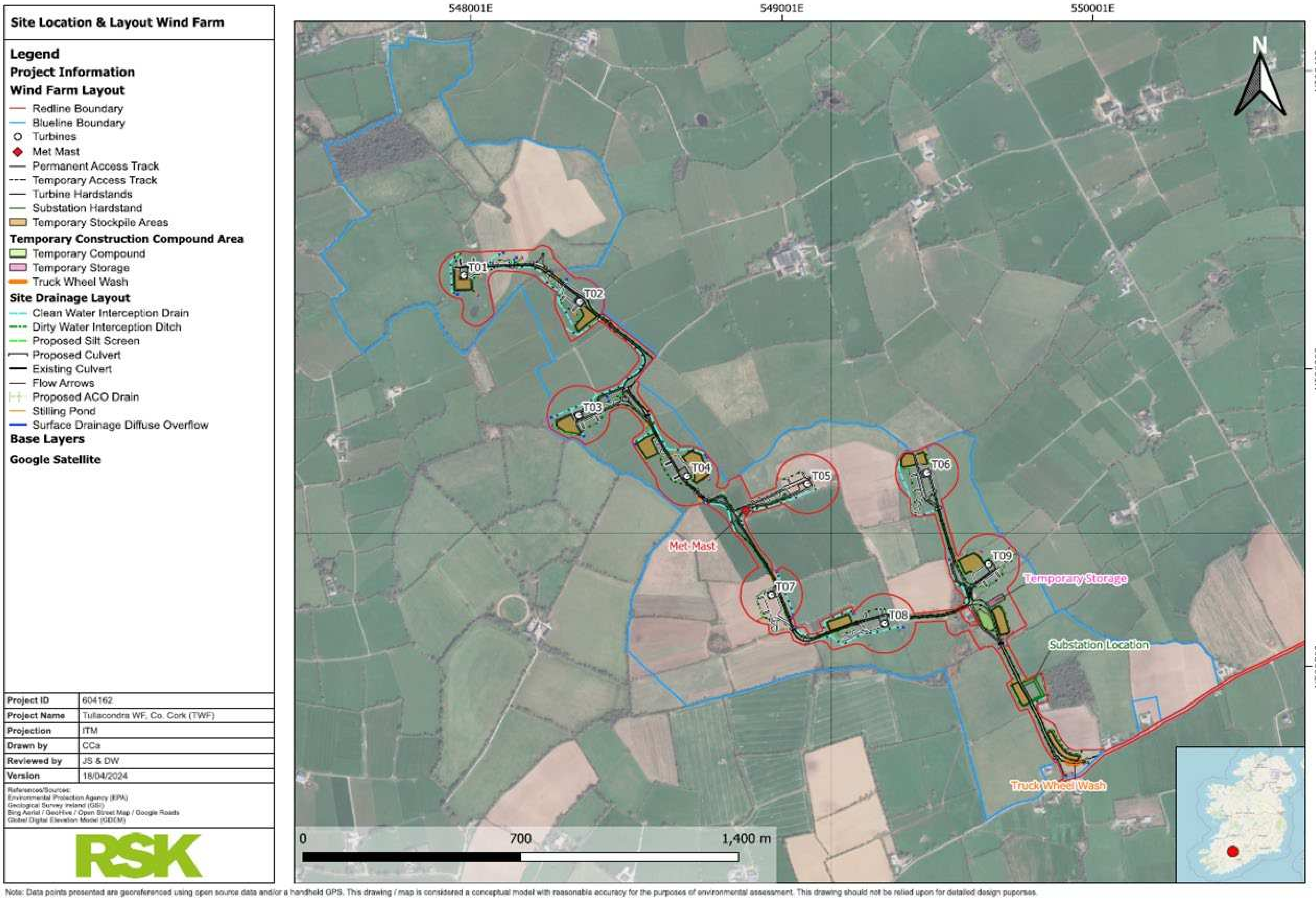



**Figure 9.1a: Wind farm layout**

*9.1.2.2 Grid Connection Routes and Underground cabling*

This section considers two GCR options for connecting the wind farm to the electricity grid at the boundary of the Mallow 110kV substation as shown in **Figure 9.1b** and described in (EIAR **Chapter 4 Project Need and Alternatives Considered**).

The works for installation of the underground cabling to connect the wind farm site to the boundary of the Mallow 110kV substation via two option routes will be predominantly within the public road corridor of local and regional roads, crossing the N20 national primary road and the N72 national secondary road.

- Both routes were considered in terms of constraints (EIAR **Volume III, Appendix 10.2a and 10.2b**). The Grid Connection will consist of five cable ducts (three electrical cables, communications cables and copper cables (if required)). These ducts will be installed to EirGrid standards in an excavated trench c. 0.6m wide by 1.25m deep.

In areas where a watercourse or national highway must be crossed, Horizontal Directional Drilling (HDD) will be utilised with a launch and reception pit on either side of the crossing, as presented in **Plate 9.1** and further detailed in EIAR **Volume III, Appendix 10.2a** and **10.2b**.

**Proposed works relating to watercourses**

HDD is proposed at two locations in Grid Route Option 1

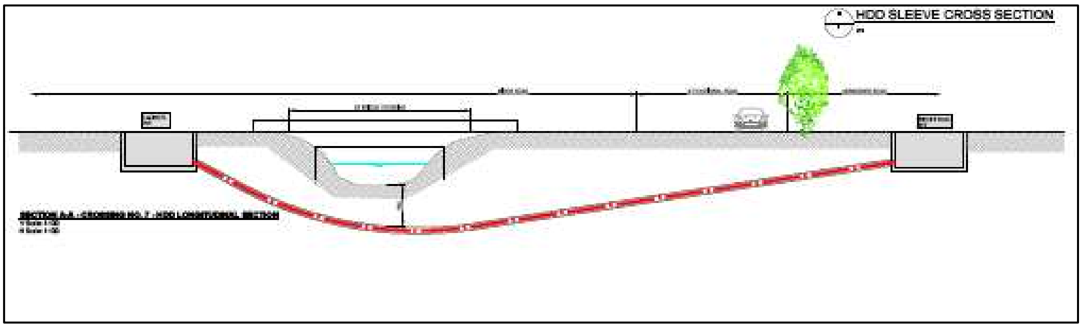
- Crossing with N20 (Refer to Planning Application Documentation **Part 2** – Planning Drawings - **Drawing 20910-NOD-XX-DR-C-8213**)
- Crossing with the Blackwater (Munster) River_140 (also locally known as Caherduggan South) and adjacent N72 Refer to Planning Application Documentation **Part 2** – Planning Drawings: **Drawing 20910-NOD-XX-DR-C-8216**) and presented below~~,~~

HDD is proposed at three locations on Grid Route Option 2

- Crossing with railway track.
- Crossing with N20.
- Crossing the Blackwater (Munster) River_140 (also locally known as Caherduggan South) and adjacent with N72.

These HDD locations are presented in **Figure 9.1c**.

**Plate 9.1: Cross section of the HDD crossing the N72 and the Blackwater (Munster) River_140 (Refer to Planning Application Documentation (Part 2 – Planning Drawing 20910-NOD-XX-DR-C-8216)**




Data pertaining to the GCR is as follows:

- Excavation, Installation and Reinstatement Process: Average of one day to complete a 100m section.
- Joint Bay Dimensions: 4.5m x 2.5m x 1.3m (pre-cast concrete).

Following an assessment of the two GCR option routes, including consideration of likely effects on hydrology and hydrogeology of the receiving environment described above, the chosen route, GCR Option 1, is included in the proposed development for which planning permission is sought, however both routes are fully assessed in this chapter. The construction methodology for GCR Option 1 is presented in EIAR **Chapter 5 Project Description**.

**Figure 9.1b - Site Location and Layout GCR 1 & 2**

**Legend**

**Tullacondra Wind Farm**

**Grid Connection Route (GCR)**

- Mallow 110kV Substation
- GCR Option 1
- GCR Option 2

**Wind Farm Site Layout**

- Redline Boundary

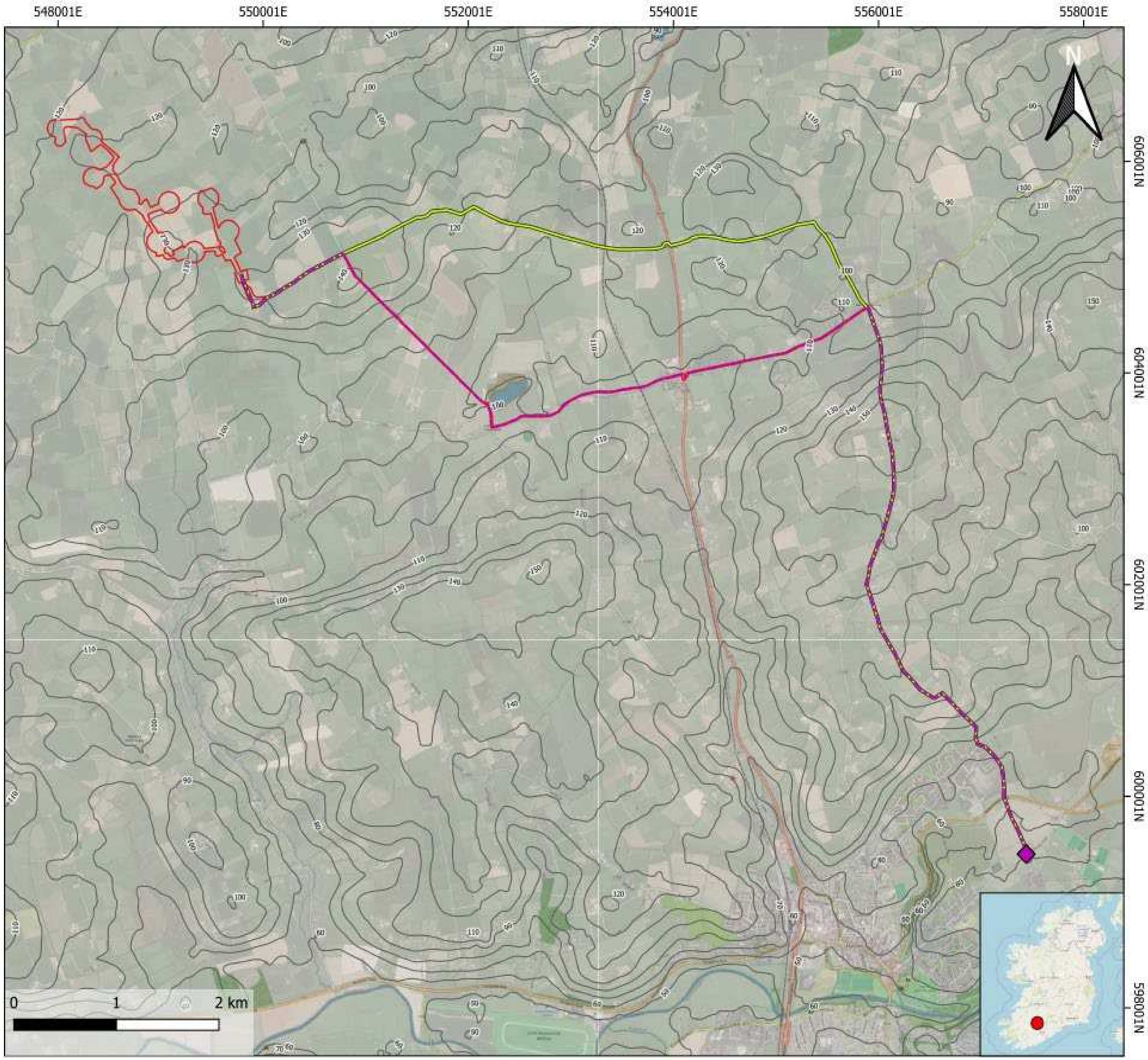
**Topography**

- 10m Elevation Contours

**Base Layers**

**OpenStreetMap**

**Bing Aerial**




| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | CCa |
| Reviwed by | SK |
| Version | 20/11/2023 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)

**Figure 9.1b: Grid Connection Route Options**

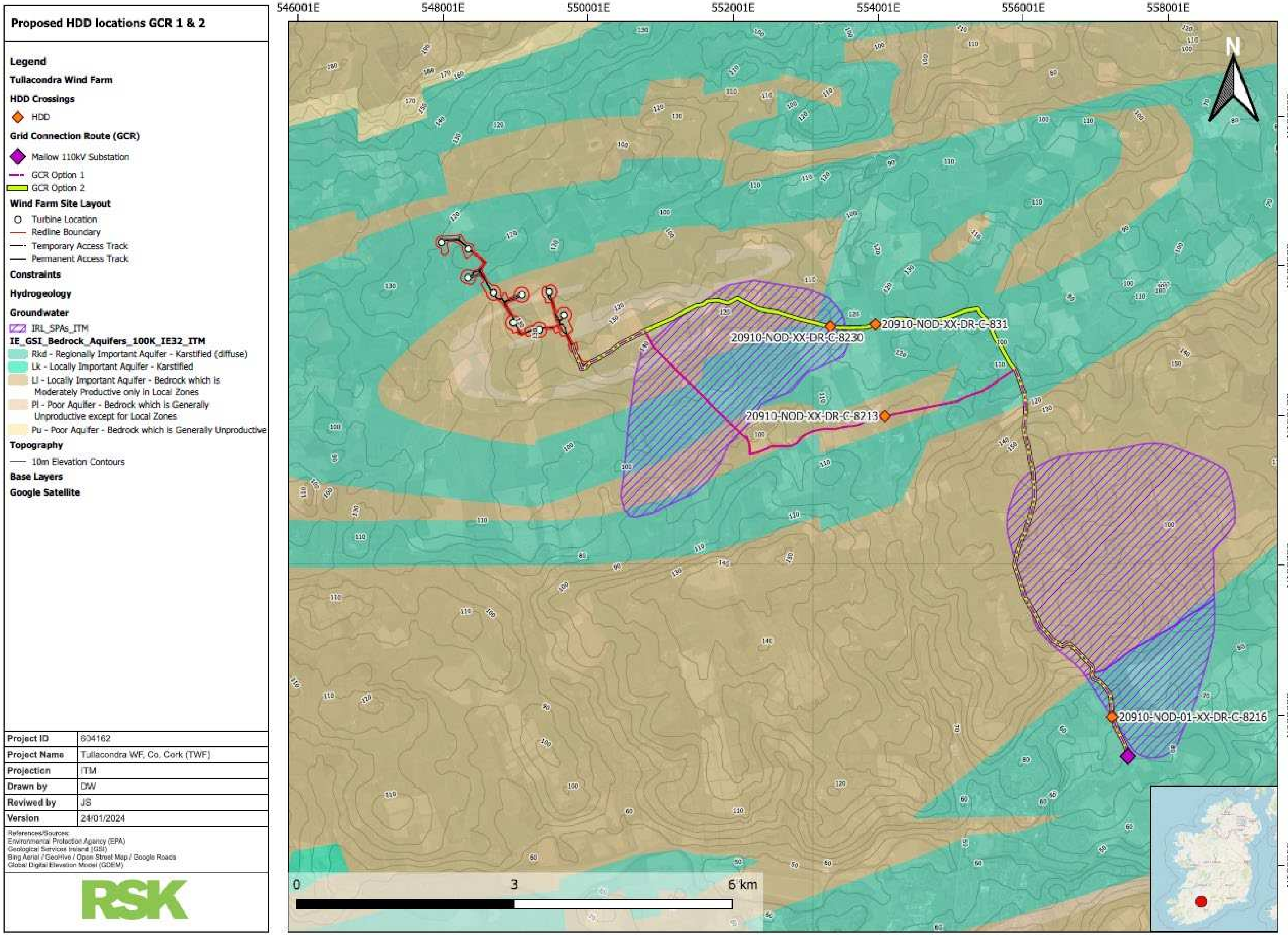



**Figure 9.1c: Proposed HDD locations GCR 1 & 2**

#### 9.1.2.3 Turbine Delivery Route

Two TDR options were assessed as part of the Project, from Foynes Port, Co. Limerick and The Port of Cork, Ringaskiddy, Co, Cork.

The Option 1 TDR to the wind farm site is as follows:

- Loads will depart Foynes Port and travel West-East via the N69 for approximately 30km until it joins the N18.
- Loads will travel south along the N18 for approximately 4km before exiting onto the M20.
- Loads will continue west on the M20 and then join the N20.
- Loads will continue to travel south on the N20 before turning off onto L5523.
- Loads will continue west on the L5523 and L5302 to the proposed site entrance.

The Option 2 TDR to the wind farm site is as follows:

- Loads will depart Ringaskiddy Port and travel Northeast via the N28 for approximately 12km until it joins the N40.
- Wind Turbine Blade loads will travel East along the N40 for approximately 4km before exiting onto the N8.
- Wind Turbine Blade loads will travel West along the N8 for approximately 2.6km before exiting onto the R635.
- Wind Turbine Blade loads will travel North along the R635 for approximately 5km before exiting onto the N20.
- All other Wind Turbine Loads will travel West along the N40 for approximately 3.5km before exiting onto the N8.
- All other Wind Turbine Loads will travel North through Cork along N8 for less than a kilometre before joining onto the N20.
- Loads will continue to travel North along the N20 for approximately 37km before turning off onto L1200.
- Loads will continue north on the L1200 for approximately 7.5km before turning left onto L5302.
- Loads will continue west on the L5302 to the proposed site entrance.
- Temporary road widening (Option 2) will be required on this route, both sides the bridge at the N20 – L1200 Junction, utilising hardcore surface in the form of compacted aggregate hard standing required (EIAR, **Volume III, Appendix 9.9**).

The temporary accommodating works along the TDR option routes involve minor hardcore surfacing and vegetation removal. This does not form part of the development for which planning permission is sought.

### 9.1.3 Statement of authority

The principal members of the RSK EIA team involved in this assessment include the following persons;

- Project Manager & Lead Author: Sven Klinkenbergh – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection). Current Role: Principal Environmental Consultant. Sven joined RSK Ireland after Minerex Environmental (8 years) were acquired by RSK Group in June 2021. Sven's current workflow consists primarily of EIA Hydrology, Hydrogeology, Land, Soils and Geology assessments for a range of projects, a large proportion of which is in renewable energy i.e. wind farms on peatlands. Sven is a qualified project manager and EIA Lead Author with c. 10 years industry experience in the preparation of environmental, geological, hydrological and hydrogeological reports. Sven has also worked on a large number of surface water and groundwater monitoring projects on IPC and similar sites, was team lead for site investigation and soil waste classification projects and has a number of years' experience on construction dewatering projects.
- Project Scientist: Dr. Jayne Stephens - B.Sc. (Environmental Science), PhD (Environmental and Infection Microbiology). Current Role: Environmental Consultant. Experience c. 5 years. Report writing for local authorities and surface water network research with 7 published papers. One year working with RSK clients and similar wind farm projects.
- Technical Advisor Dr. Chris Fennell - B.A (mod) Environmental Science, PhD (Environmental Protection Agency Studentship) "The impact of domestic wastewater treatment system effluent on private water wells: An evaluation of contamination fingerprinting techniques". Role Principal Hydrogeologist Consultant at RSK with over 6 years' experience.

## 9.2 Assessment methodology and significance criteria

### 9.2.1 Introduction

The following calculations and assessments were undertaken in order to evaluate the potential effects of the Project on the hydrology and hydrogeology features or receptors of the receiving environment:

- Characterise the topographical, hydrological and hydrogeological regime of the site from the data acquired through desk study and onsite surveys.
- Water balance calculation.
- Flood risk evaluations.
- Consider hydrological or hydrogeological constraints together with Project design.
- Consider drainage issues, or issues with surface water runoff quality as a result of the Project, its design and methodology of construction.
- Assessment of the combined data acquired and evaluation of any likely effects on the hydrology and hydrogeology aspects of the environment.

### 9.2.2 Relevant legislation and guidance

This study complies with the Environmental Impact Assessment (EIA) Directive as amended which requires EIA for certain types of development before consent is granted.

The Water Framework Directive (as amended) (WFD), which was agreed by the European Union (EU) Member States in 2000, requires all Member States to protect and improve water quality in all waters with the aim of achieving good ecological status for surface waters and good status for groundwaters, whilst maintaining existing status, that is, not allowing deterioration of water quality and achieving at least “good status” in relation to all waters by 2027[1]*. Enacted through Irish legislation, it is currently in its third six-year River Basin Management Plan (RBMP) Cycle in Ireland covering the period between 2022 and 2027.

The Waters of Life EU Integrated Project initiative is one of the underpinning forces behind the realisation of the aims of the WFD, aiming to reverse the loss of high-status water bodies in the Republic of Ireland (ROI). This catchment-based approach aims to use local, tailored, best practices to engage communities in the protection of water bodies in their area.

The Cork County Development Plan (2022-2028) was also consulted and complied with as part of the EIA process. Legislation and guidance documents are listed in EIAR, **Volume III Appendix 9.10**.

### 9.2.3 Study area

The study area for the wind farm site and GCR is any land soils, hydrology, hydrogeology and geology underlying the Blueline Boundary (BLB), GCR and outside these areas of the development where applicable (e.g., the 10km surrounding area) based upon professional judgement and experience). The study area also includes the hydrologically connected rivers and designated areas downstream for up to c.50km and more. Works such as flood risk assessments, stability assessments and desk studies were conducted for the landholding and the 10km surrounding area. Constraints within a 10km radius (professional judgment based on experience), such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs), surface water bodies, springs wells etc. were mapped.

The degree of hydraulic connectivity and presence of karst features within and surrounding the BLB (within 10km) were examined due to their potential direct and indirect impacts on hydrological strata. This includes site drainage, underlining hydrogeology, downstream surface water networks and associated SACs, groundwater under the site and connective karst features.

Connectivity has been investigated via an assessment of surface water drainage on site and how this may facilitate groundwater/aquifer recharge. This investigation had desk and site-based elements by collecting data from open access public sources, and information garnered from site visits. Groundwater features have the potential to discharge to surface water. Inversely there are areas identified on site where there is potential for runoff to groundwater.

### 9.2.4 Desk study

Desktop assessments were undertaken on the hydrology and hydrogeology aspects of the proposed development before and after field investigations. This involved the following components:

[1] *Current RBMP cycle

- Acquisition and compilation of all available and relevant maps of the Project.
- Study and assessment of the proposed locations of turbines and site tracks relative to available data on site topography and slope gradients.
- Study and assessment of the proposed locations of turbines, site tracks and other associated infrastructure units relative to available data on hydrology and hydrogeology.
- Study of geospatial data obtained from various sources including; Environmental Protection Agency (EPA), Geological Survey Ireland (GSI), Teagasc, Ordinance Survey Ireland (OSi), National Parks and Wildlife (NPWS) overlain with the development plan drawings using a Geographic Information System (GIS). Data was assessed at a regional, local and site-specific scale.
- Additional data was obtained and assessed where relevant, for example, rain data obtained from Met Éireann, and river discharge rates and synoptic data sets obtained from the EPA.
- Assessment of site-specific aerial data (BlueSky Lidar data (1m)).

### 9.2.5 Consultations

A scoping exercise was undertaken for the Project. A full list of consultations and responses can be found in EIAR **Chapter 3 Scoping, Consultations, Community Engagement and Key Issues**. These included consultations with the Development Applications Unit of the Department of Housing, Local Government, and Heritage and the Geological Survey Ireland and the Department of the Environment, Climate, and Communications. The Geological Survey Ireland and the Environment, Climate, and Communications indicated relevant datasets that should be considered, which were included in the assessment.

A pre-planning meeting was held online with Cork County Council. The meeting was attended by officers of Cork County Council Planning Authority and the Environmental Section. The Waters of Life project was raised, as a large section of the BLB falls into the catchment and surface water network that is part of the Project, namely the river Blackwater (Munster)_90.

### 9.2.6 Field work

Field inspections were carried out at the proposed wind farm site during June, September and October of 2022. These works consisted of the following:

- Site walk over including recording and digital photography of significant features.
- Drainage distribution and catchment mapping.
- Investigation of suspected karst features
- Field hydrochemistry of the receiving drainage network (electrical conductivity, pH and temperature).
- Recording of GPS co-ordinates for all investigation and monitoring points in the study.

- Baseline sampling of surface water for analytical laboratory testing. Four baseline sampling events were carried out i.e., targeting low and high flow conditions.
- Baseline sampling and estimating of surface water flow and discharge rates during baseline surface water quality monitoring.

A review of the hydrometric gauges on these rivers and OPW flood maps took place in 2024, nothing has changed on site hydrologically, or of note in the rivers downstream of the site. This could be due to the continuous management of the land for agricultural activity on site.

### 9.2.7 Evaluation of effects

The assessment and evaluation of likely significant effects is broken down into three main parts or variables;

- Sensitivity of the receptor.
- Magnitude of the effect.
- Significance of the effect.

These variables are discussed in this chapter, and results are recorded and presented in EIAR **Volume III, Appendix 9.2**.

#### *9.2.7.1 Sensitivity*

Qualifying the importance and sensitivity of an environmental attribute or receptor will align with relevant legal instruments. For example, to qualify surface water features, the EIAR will align with the objectives of the WFD, as amended. This approach equates to qualifying all surface water features as very important and sensitive receptors, and that any adverse impact will be viewed as potentially jeopardising the objectives of the WFD.

Sensitivity is defined as *the potential for a receptor to be significantly affected by a proposed development*. The EPA provides guidance on the assessment methodology[2], including defining general descriptive terms in relation to magnitude of effects however, in terms of qualifying significance of the receiving environment the EPA guidance also states that: “As surface water and groundwater are part of a constantly moving hydrological cycle, any assessment of significance will require evaluation beyond the development site boundary[3].

To facilitate the qualification of hydrological and hydrogeological attributes, guidance specific to hydrology and hydrogeology as set out by National Roads Authority (NRA)

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[2] EPA (2022) Guidelines on the Information to be Contained in Environmental effect Assessment Reports (Supersedes 1997 and 2002 versions)

[3] Environmental Protection Agency (EPA) (2015) Advice Notes for Preparing Environmental Impact Statements DRAFT September 2015. Environmental Protection Agency, Ireland

[4][5]and guidance specific to landscape as set out by Scottish National Heritage (SNH) [6], has been used in conjunction with EPA guidance.

The following table presents rated categories and criteria for rating site attributes:

**Table 9.1: Criteria for Rating Site Attributes – Hydrology and Hydrogeology Specific**

| Importance | Criteria |
|---|---|
| **Extremely High** | Attribute has a high quality or value on an international scale. |
| **Very High** | Attribute has a high quality, significance or value on a regional or national scale. |
| **High** | Attribute has a high quality, significance or value on a local scale. |
| **Medium** | Attribute has a medium quality, significance or value on a local scale. |
| **Low** | Attribute has a low quality, significance or value on a local scale. |

Considering the above categories of rating importance and associated criteria, the following table presents rated sensitivity categories, adapted and as recommended in section C.8 of the Scottish Natural Heritage handbook on environmental impact assessment[6].

**Table 9.2: Criteria for Rating Site Sensitivity – Adapted from www.sepa.co.uk**

| Sensitivity | Criteria |
|---|---|
| **High Sensitivity** | Receptor is of high environmental importance or of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as 'High' and salmonid spawning grounds present. All public drinking water supplies, including drinking water rivers, lakes, GSI Public – Source protection areas and NFGWS Group Scheme Source Protection Areas. Nutrient sensitive rivers and downstream sensitive receptors such as Shellfish areas. Receptor has a very low capacity to accommodate the proposed form of change. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer. |
| **Medium Sensitivity** | Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Receptor has a low capacity to accommodate the proposed form of change. GSI groundwater vulnerability "High" classification and "Locally" important aquifer. |
| **Low Sensitivity** | Heavily engineered or artificially modified waterbodies, that may dry up during summer months. No public or private water supplies. Receptor has some tolerance to accommodate the proposed change. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance. |

[4] National Roads Authority (NRA) (2008) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

[5] National Roads Authority (NRA) (2008) Guidelines on the information to be contained in Environmental Impact Assessment Reports

[6] Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook V5

### 9.2.7.2 *Magnitude*

In terms of hydrology and hydrogeology, magnitude is qualified in line with relevant guidance, as presented in the following tables (**Table 9.3** and **Table 9.4**)[7]. These descriptive phrases are considered development specific terms for describing potential effects (in the hydrological/hydrogeological environment) of the development, and do not provide for baseline trends (associated with 'do nothing' scenarios). These descriptive phrases are utilised to qualify effects in terms of weighting effects relative to site attribute importance, and scale where applicable.

**Table 9.3: Qualifying the Magnitude of effect on Hydrological Attributes**

| Magnitude of effect | Description | Example/s |
|---|---|---|
| **Large Adverse** | Results in loss of attribute and/or quality and integrity of attribute | Loss or extensive change to a waterbody or water dependent habitat, or<br>Calculated risk of serious pollution incident >2% annually, or<br>Extensive loss of fishery |
| **Moderate Adverse** | Results in effect on integrity of attribute or loss of part of attribute. | Partial reduction in amenity value, or<br>Calculated risk of serious pollution incident >1% annually, or<br>Partial loss of fishery |
| **Small Adverse** | Results in effect on integrity of attribute or loss of part of attribute. | Slight reduction in amenity value, or<br>Calculated risk of serious pollution incident >0.5% annually, or<br>Minor loss of fishery |
| **Negligible** | Results in an effect on attribute but of insufficient magnitude to affect either use or integrity. | Calculated risk of serious pollution incident <0.5% annually |
| **Minor Beneficial** | Results in minor improvement of attribute quality. | Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually |
| **Moderate Beneficial** | Results in moderate improvement of attribute quality. | Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually |
| **Major Beneficial** | Results in major improvement of attribute quality. | Reduction in predicted peak flood level >100mm |

[7] National Roads Authority (NRA) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

**Table 9.4: Qualifying the Magnitude of effect on Hydrogeological Attributes**

| Magnitude of effect | Description | Example/s |
|---|---|---|
| **Large Adverse** | Results in a loss of attribute. | Removal of large proportion of aquifer, or<br>Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or<br>Ecosystems, or<br>Potential high risk of pollution to groundwater from routine run-off |
| **Moderate Adverse** | Results in effect on integrity of attribute or loss of part of attribute. | Removal of moderate proportion of aquifer, or<br>Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or<br>Ecosystems, or<br>Potential medium risk of pollution to groundwater from routine run-off. |
| **Small Adverse** | Results in minor effect on integrity of attribute or loss of small part of attribute. | Removal of small proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems, or<br>Potential low risk of pollution to groundwater from routine run-off. |
| **Negligible** | Results in an effect on attribute but of insufficient magnitude to affect either use or integrity. | Calculated risk of serious pollution incident <0.5% annually |

### *9.2.7.3 Significance Criteria*

The significance of potential effects arising as a product of the Project are defined in accordance with the criteria provided by the EPA[8], as presented in the following table. These descriptive phrases are considered general terms for describing potential effects of the Project, and provide for considering baseline trends, for example a *Moderate* effect is one which *is consistent with the existing or emerging trends*.

According to the EPA Guidelines (2022) all likely significant effects are to be adequately considered and clearly communicated.

Based on the defined significance, where an effect has been classified as Moderate, Significant, Very Significant or Profound it is considered Significant. An effect is considered Not significant if the significance level is Imperceptible, Not Significant or Slight.

[8] Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental effect Assessment Reports

**Table 9.5: Describing the Magnitude of Effects**

| Magnitude of effect | Description |
|---|---|
| **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 Effects** | An effect which causes noticeable changes in the character of the environment without affecting its sensitivities. |
| **Moderate Effects** | An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends. |
| **Significant Effects** | 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 Effects** | An effect which obliterates sensitive characteristics. |

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential effects, rating of significant environmental effects is done in accordance with relevant guidance as presented in **Table 9.6**. This matrix qualifies the magnitude of potential effects based on weighting same depending on the importance and/or sensitivity of the receiving environment. Qualifying terms (**Table 9.6**) are used in describing potential effects of the Project. This is largely driven by the potential for effects to extend down gradient, beyond the boundaries of the site of the development in terms of hydrology and hydrogeology. As outlined in section 9.2.3 the study area is the site and the surround 10km, however this can increase to over 50km as it follows the hydrologically connected surface water networks or groundwater systems.

**Table 9.6: Weighted Rating of Significant Environmental Effects**

| Sensitivity (Importance of Attribute) | Magnitude of effect | | | |
|---|---|---|---|---|
| | **Negligible (Imperceptible)** | **Small Adverse (Slight)** | **Moderate Adverse (Moderate)** | **Large Adverse (Significant to Profound)** |
| **Extremely High** | Not Significant | Significant | Profound | Profound |
| **Very High** | Not Significant | Significant / Moderate | Very Significant/ Significant | Profound |
| **High** | Not Significant | Moderate / Slight | Significant / Moderate | Very Significant/ Significant |
| **Medium** | Not Significant | Slight | Moderate | Significant |
| **Low** | Imperceptible | Not Significant | Slight | Slight / Moderate |

## 9.3 Assessment of significance of effects

### 9.3.1 Assessing the potential magnitude of effects

Sensitivity can be variable and influenced by the degree of connectivity or exposure of those High Importance receptors to potential sources of adverse effects. This considers the source-pathway, receptor principal. In relation to the Project, the receiving environment in terms of **Groundwater** is considered to be of **High Importance and Medium to High Sensitivity**. The receiving environment in terms of **Surface Water** is considered to be of **High Importance** and **Medium** to **High Sensitivity.**

In terms of determining and assessing the magnitude of effects on surface water features, categories of magnitude relate to the potential effect of the Project on the status of the attribute. Examples include the attribute driving the classification of sensitivity such as WFD status and quality of the surface water feature/s; the risk of not reaching or maintaining WFD objectives; and the potential for the surface water system to support or function as part of designated protected areas (SAC, SPA, NHA etc).

In terms of determining and assessing the magnitude of effects on groundwater features, categories of magnitude relate to the potential effect on the status of the attribute (i.e. the attribute driving the classification of sensitivity) is the aquifer potential classification and use as a drinking water source, the proximity of the site to groundwater wells; quality of the groundwater feature/s; the risk of not reaching or maintaining WFD objectives, the GSI groundwater vulnerability classification and the potential for the groundwater system to support, or function as part of designated protected areas (SAC, SPA, NHA etc).

## 9.4 Baseline description

### 9.4.1 Site description and location

The proposed wind farm site is located in the townlands of Polnareagha and Ardskeagh (Templemary E.D.); and Tullacondra and Croughta, (Kilmaclenine E.D.), approximately 2km south of Lisgriffin Cross, Co. Cork. The proposed turbine locations are shown in **Figure 9.1a**. The development is situated on a 58.6 hectare site located in north Cork approximately 2km south of Lisgriffin Cross (EIAR **Chapter 5 Project Description**), as shown in **Figure 9.1a.** The site is characterised by primarily mixed farmland habitat with hedgerows and occasional areas of scrub, ponds and lakes and man-made drains and ditches.

The proposed grid connection comprises works in and alongside public roads to install cabling approximately 13.5km to connect the wind farm to the boundary of the Mallow 110kV substation located in St. Joseph's Road, Mallow (**Figure 9.1b**).

### 9.4.2 Topography

Topography at the wind farm site is generally flat with undulating hills. The area in which the turbines will be located ranges in elevation from 133m AOD in the south to 120m AOD in the north. Topography is discussed in greater detail in relation to stability and geohazards in EIAR **Chapter 10 Soils and Geology**.

### 9.4.3 Regional and local hydrology

#### *9.4.3.1 Catchments for the proposed development*

The wind farm site and both GCRs are situated within the:

- Blackwater (Munster) WFD surface water catchment (ID: 18; Area: 3,308km$^2$).

A majority of the TDR Option 1 is situated within the:

- Shannon Estuary South WFD surface water Catchment (ID: 24; Area 2,033km$^2$) and
- Blackwater (Munster) WFD surface water Catchment (ID: 18; Area: 3,308km$^2$).

The TDR Option 2 is situated entirely within first catchment listed before entering the second catchment along the N20 national road:

- Lee, Cork Harbour and Youghal Bay WFD surface water Catchment (ID: 19; Area: 2,181km$^2$) and
- Blackwater (Munster) WFD surface water Catchment (ID: 18; Area: 3,308km$^2$).

Baseline databases for the TDRs include surface water crossings EIAR **Volume III, Appendix 10.3a** and **10.3b.**

Surface water runoff associated with the wind farm site drains into three sub catchments, five river sub basins and four rivers are presented in **Figure 9.2a** and **Figure 9.2b**. They are broken down as follows:

1) **Sub Catchment:** Awbeg [Buttevant]_SC_020

   *River Sub Basins*: Awbeg (Buttevant)_020 and Awbeg (Buttevant)_030

2) **Sub Catchment**: Blackwater [Munster]_SC_090

   *River Sub Basins*: Ballyclogh Stream_010 and Lisduggan_North_010

3) **Sub Catchment**: Blackwater [Munster]_SC_060

   *River Sub Basin*: Blackwater (Munster)_090

Mapped surface waters (EPA / WFD) i.e., mapped stream, rivers or lakes, are limited on the wind farm site to;

- Awbeg (Buttevant)_20 river is located 922m north of the BLB.
- Two mapped lakes (EPA ID: 18_58 & 18_59, **Figure 9.2a**) situated northeast of the site boundary (c. 725m from T2). Anecdotal evidence suggests these 'lakes' features which are outside the Red Line Boundary (RLB), are permanent features and with no mapped river associated with the feature it is assumed that these features are surface water ponds or groundwater fed features, and a possible Groundwater Dependent Terrestrial Ecosystem. In addition, a number of flooded quarries are located within 5km of the wind farm site including Ballybeg Quarry. Access to the surface water feature was not possible during field surveys. This feature is not impacted directly by the Project but is considered a sensitive receptor.

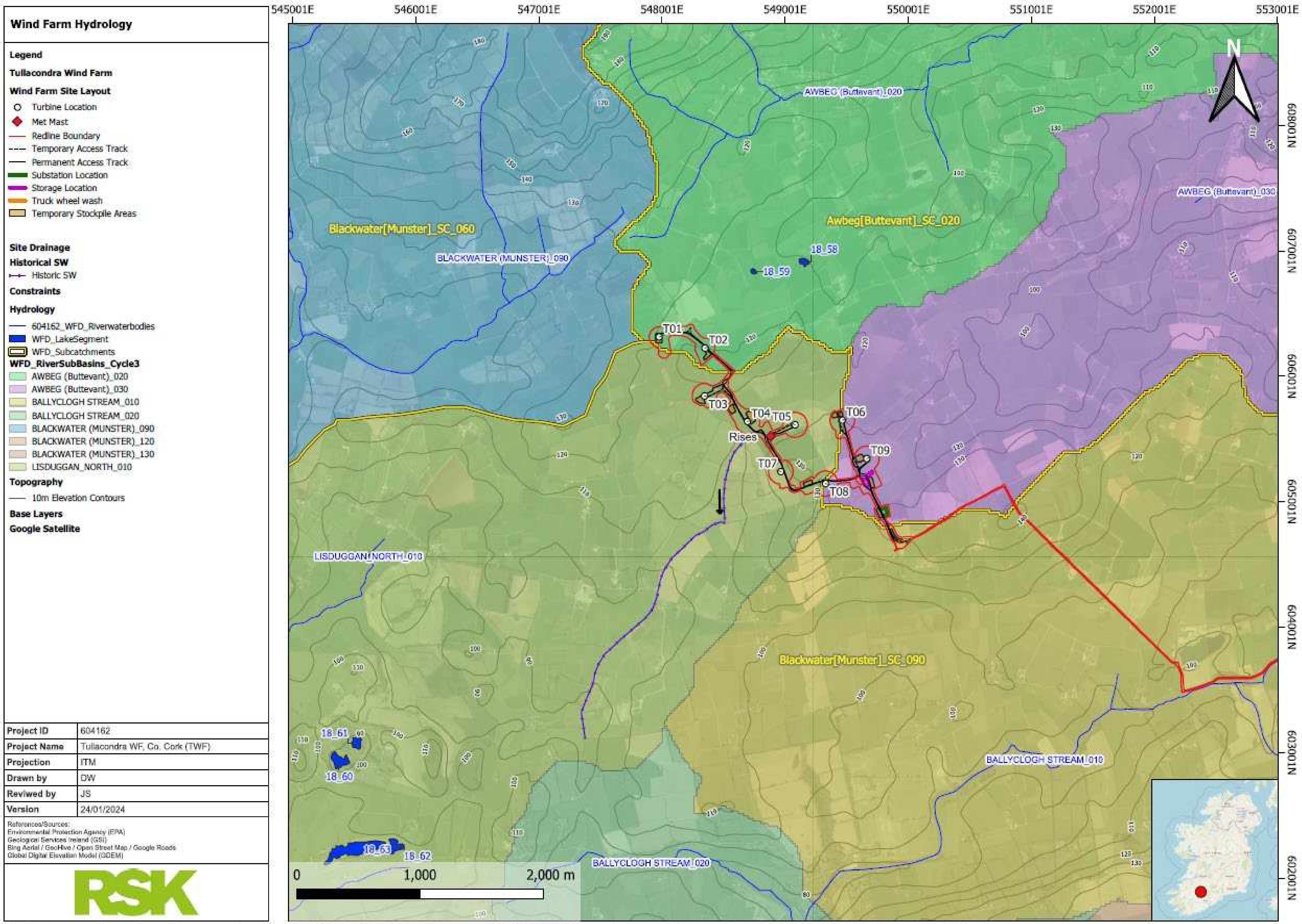
Historic maps indicate a stream 'rises' within the RLB. Typically, the rising location indicates a permanent flow from this point. The 'rise' of this feature is c. 90m downstream of the development footprint, and where the footprint intersects an existing primary drain and culvert. This is presented in **Figure 9.2a**. The stream appears to flow towards the Ballyclogh stream, however some sections of the stream 3-4km downstream are likely to be 'losing' streams with recharge to the bedrock.

All surface waters draining from the site eventually combine in the Blackwater (Munster) River_170, from which waters eventually flow to the Upper and Lower Blackwater Estuary, the Youghal Estuary through to Youghal Bay and into the Celtic Sea.

An important consideration in terms of site hydrology and drainage is the occurrence of karst features. These are discussed further in section 9.4.8.

GCR Option 1 is located to the north of the Ballyclogh Stream_010. Both GCR options cross the Blackwater (Munster) River_140 (also locally known as Caherduggan South) as presented in **Figure 9.2b**.

Surface water networks associated with particular turbine locations are presented in the Surface Water Flow Chart in **Figure 9.3.**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.2a: Wind farm site hydrology**

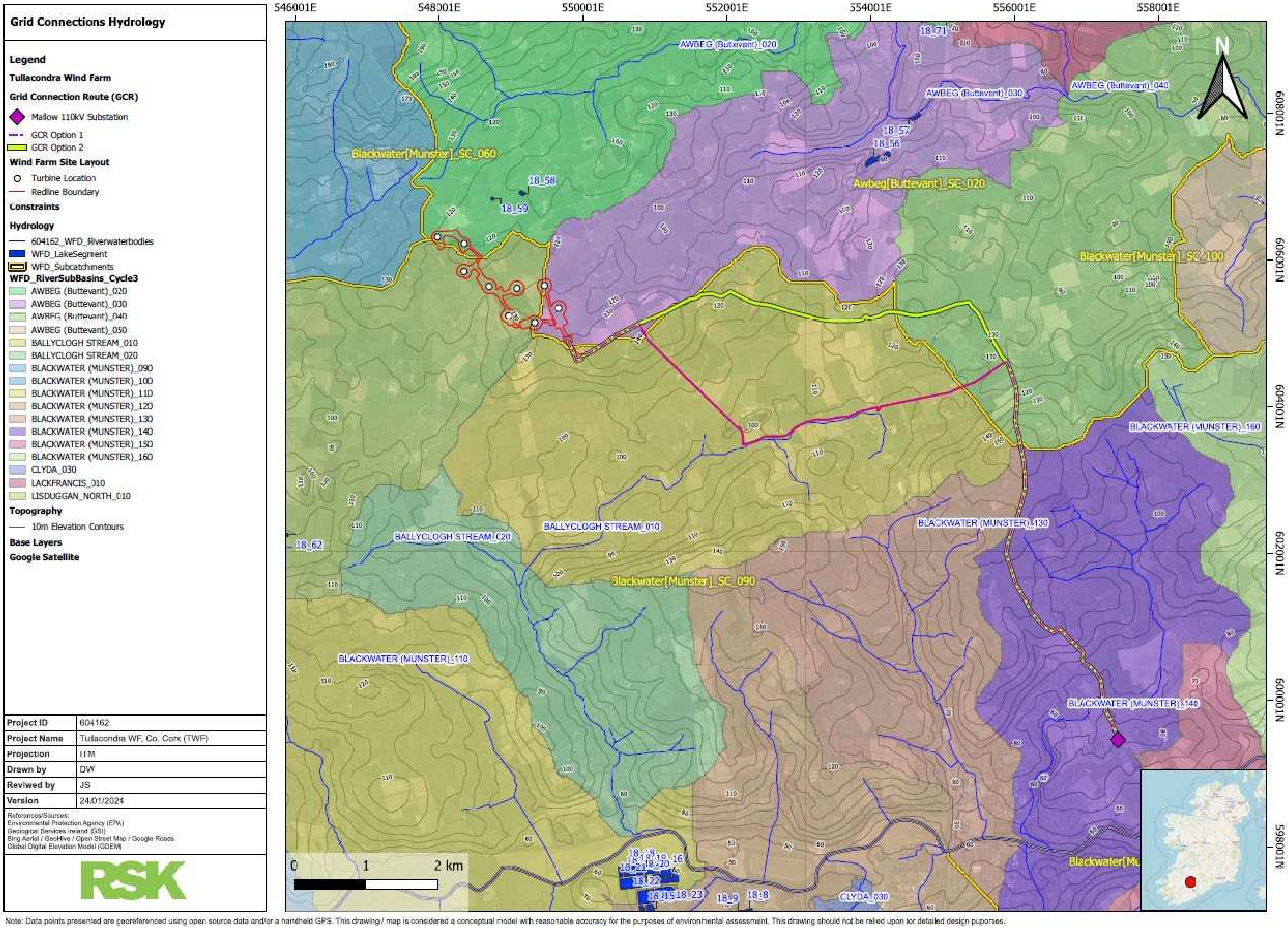



**Figure 9.2b: GCR option routes hydrology**

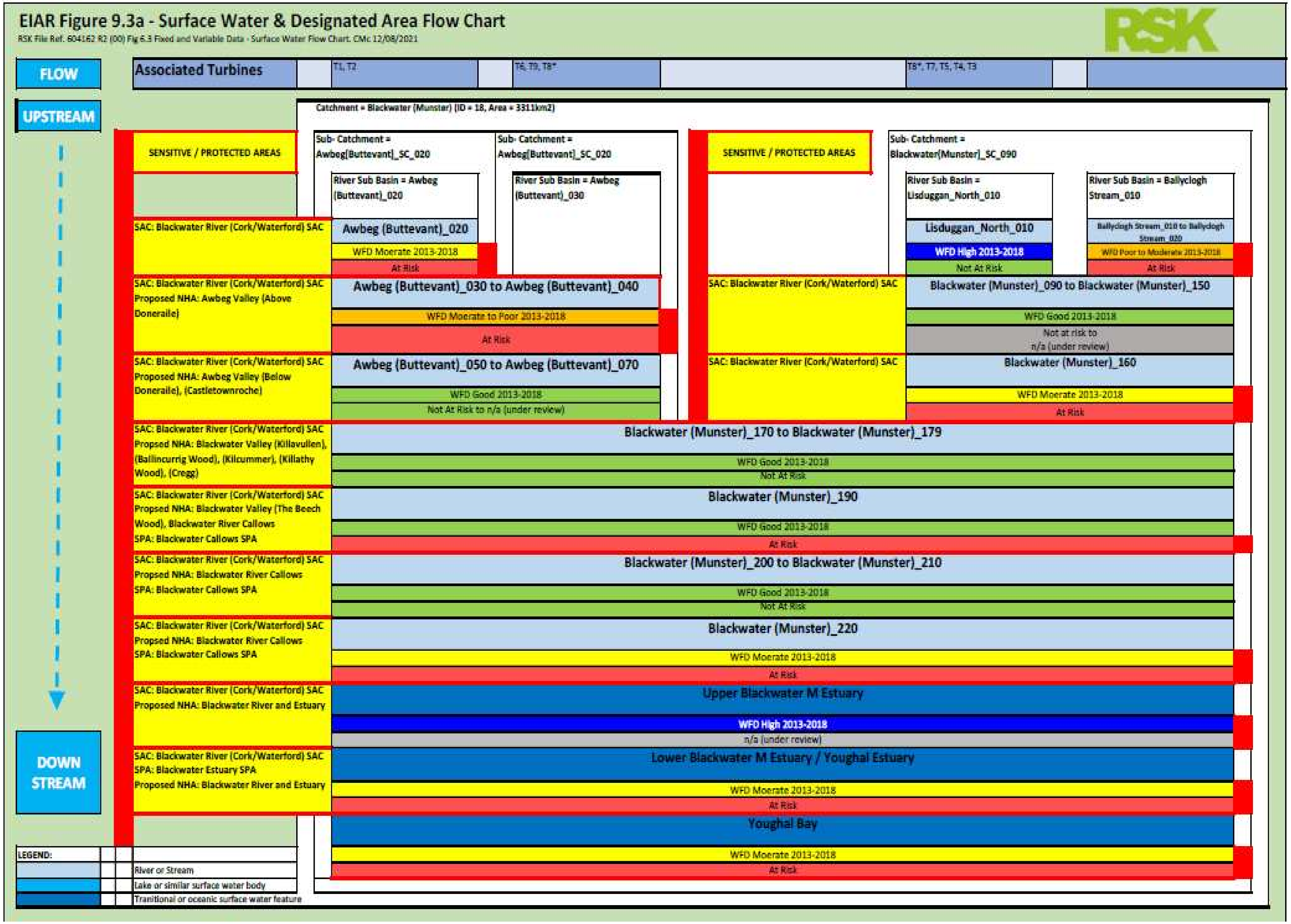



**Figure 9.3: Surface water flow chart**

### 9.4.4 Groundwater bodies

The northern portion of the wind farm site, including at turbine locations T1, T2 and T3, is underlain by the Mitchelstown Groundwater body (Code IE_SW_G_082). The southern portion of the site (and locations T4, T5, T6, T7, T8 and T9) is underlain by the Kilmaclenine Groundwater Body (Code IE_SW_G_044). These are shown in **Figures 9.4a** and **Figure 9.5a**.

GCR Option 1 is underlain by Mitchelstown (Code IE_SW_G_082) Kilmaclenine (IE_SW_G_044) and Rathmore West (Code IE_SW_G_070) groundwater bodies. GCR Option 2 is underlain by Mitchelstown and Rathmore groundwater bodies. These are presented in **Figure 9.4b** and **Figure 9.5b**.

### 9.4.5 Water Framework Directive water body status, risk & objectives

WFD risk and status for the groundwater and surface water features noted are presented in Figures **9.4a - 9.5b**. Sub-catchments downstream of rivers adjacent to the study area are presented in **Table 9.7**.

Further downstream, all surface waterbodies draining the wind farm and GCR combine in the Blackwater (Munster) River_120. The WFD 2016-2021 status for this river (Good) deteriorates to Moderate and 'At risk' in places due to agricultural and hydromorphological pressures[9].

The groundwater body (Mitchelstown) underlying the northern portion of the site (T1, T2, T3) is classified as 'Good' according to the WFD 2016-2021 assessment. The remaining southern half of the site (T4, T5, T6, T7, T8 and T9), is underlain by the Kilmaclenine groundwater body which is mapped as having 'Good' WFD groundwater body status (2016-2021).

The Waters of Life EU Integrated Project endeavours to ensure the implementation necessary to meet the aims of the WFD. The key objective is to reverse the loss of high-status water bodies in the ROI. The Waters of Life EU Integrated Project utilises a catchment-based approach while using local and tailored best practices to engage communities in the protection of water bodies in their community. An example of this can be found in the Awbeg river Kilbrin sub-catchment adjacent to the site BLB.

[9] EPA (2019) "18_24 Blackwater[Munster]_SC_140 Subcatchment Assessment WFD Cycle 2"*Environmental Protection Agency Catchment Science & Management Unit*.

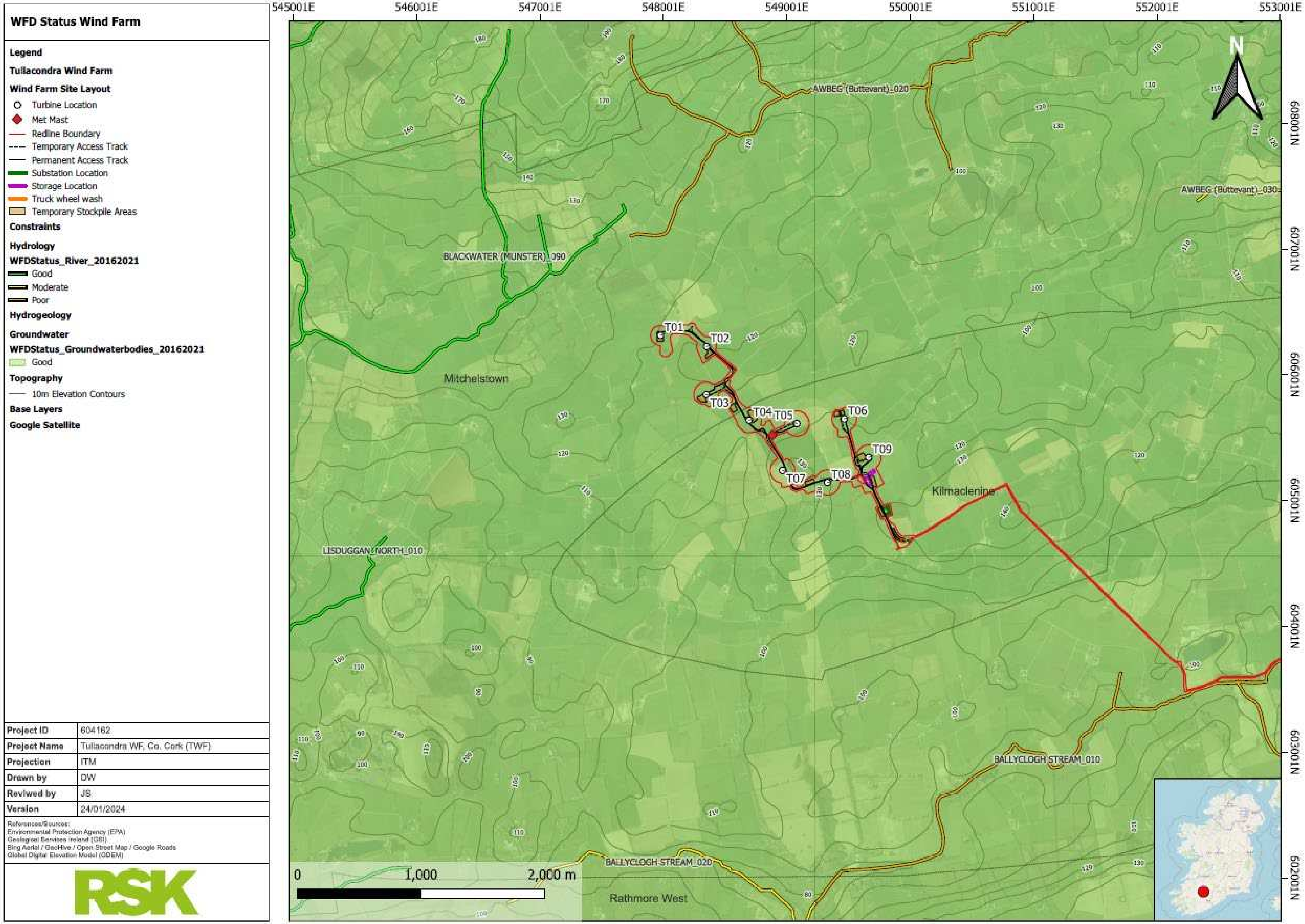
**Table 9.7: WFD Status and Risk of Surface waters**

| Subcatchment | River | EPA Code | Current WFD status | Previous WFD status | WFD Risk | Protected Areas intersecting River Waterbodies |
|---|---|---|---|---|---|---|
| Awbeg [Buttevant]_SC_020 | Awbeg [Buttevant]_SC_020[10] | IE_SW_18A050700 | Poor | Moderate | 'At risk' with significant pressures from 'Combined Sewer Overflows from Urban Wastewater' and 'Diffuse Sources of Urban Run-Off' | Within Blackwater River (Cork/Waterford) SAC |
| Awbeg [Buttevant]_SC_020 | Awbeg [Buttevant]_030 | IE_SW_18A05900 | Moderate | Moderate | At risk' with significant pressures from 'Hydromorphology through Channelisation and Riverbank Erosion | Within Blackwater River (Cork/Waterford) SAC |
| Blackwater [Munster]_SC_090 | Ballyclogh Stream_010 | IE_SW_18B080300 | Poor | Poor | At risk' with significant pressures from 'Hydromorphology through Dams, barriers, locks and weirs' | Within Blackwater River (Cork/Waterford) SAC |
| Blackwater [Munster]_SC_090 | Lisduggan_North_010 | IE_SW_18L450760 | Good | High | 'Not at risk' without any significant pressures | Within Blackwater River (Cork/Waterford) SAC |
| Blackwater [Munster]_SC_060[11] | Blackwater [Munster]_SC_090[12] | IE_SW_18B021200 | Good | Good | At risk' with significant pressures from 'Agriculture'; 'Agglomeration PE of 500 to 1,000 from Urban Wastewater' and 'Hydromorphology through Embankments' | Overlapping / Partly within Blackwater Protected Area of River Blackwater (Munster) Salmonid waters. |

[10] Catchments.ie (2019) WFD Cycle 2 Catchment Blackwater (Munster), Subcatchment Awbeg[Buttevant]_SC_020, Code 18_20

[11] Catchments.ie (2019) WFD Cycle 2 Catchment Blackwater (Munster), Subcatchment Blackwater[Munster]_SC_060, Code 18_2

[12] Catchments.ie (2019) WFD Cycle 2 Catchment Blackwater (Munster), Subcatchment [Munster]_SC_090, Code 18_22




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.4a: WFD status of waterbodies within the wind farm site**

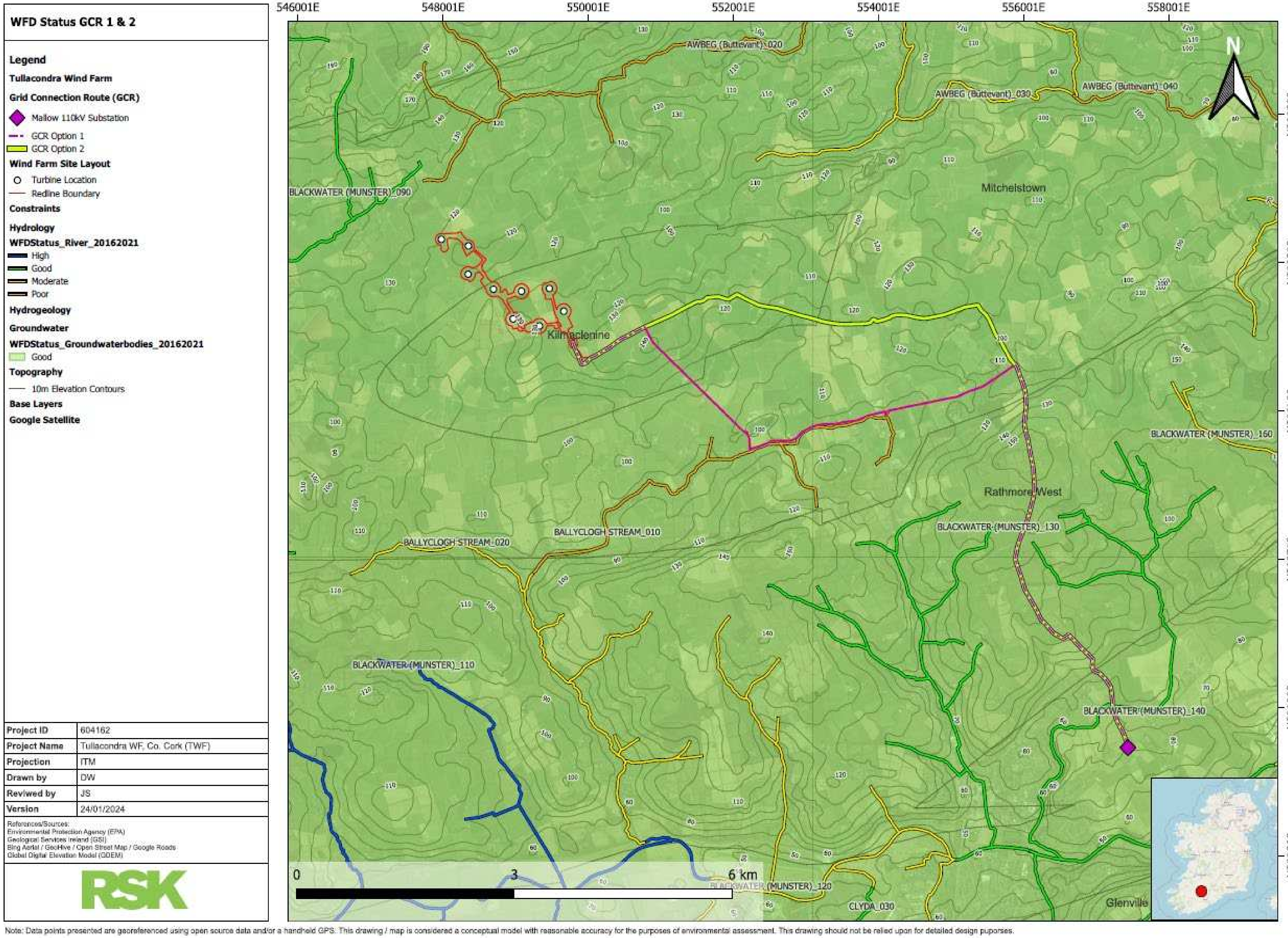
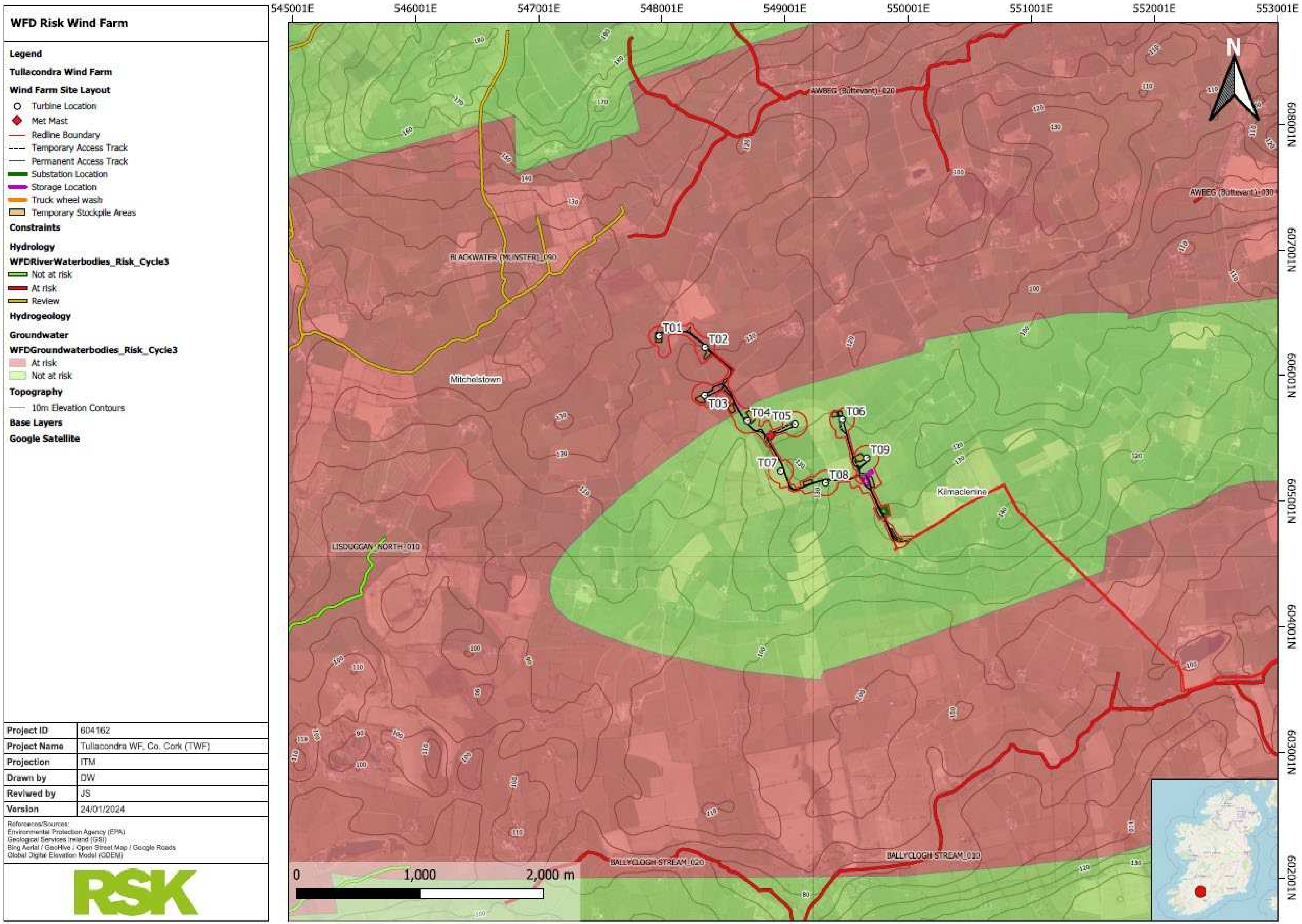



**Figure 9.4b: WFD status of waterbodies in vicinity of GCR options 1 & 2**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.5a: WFD risk of waterbodies in the wind farm site**

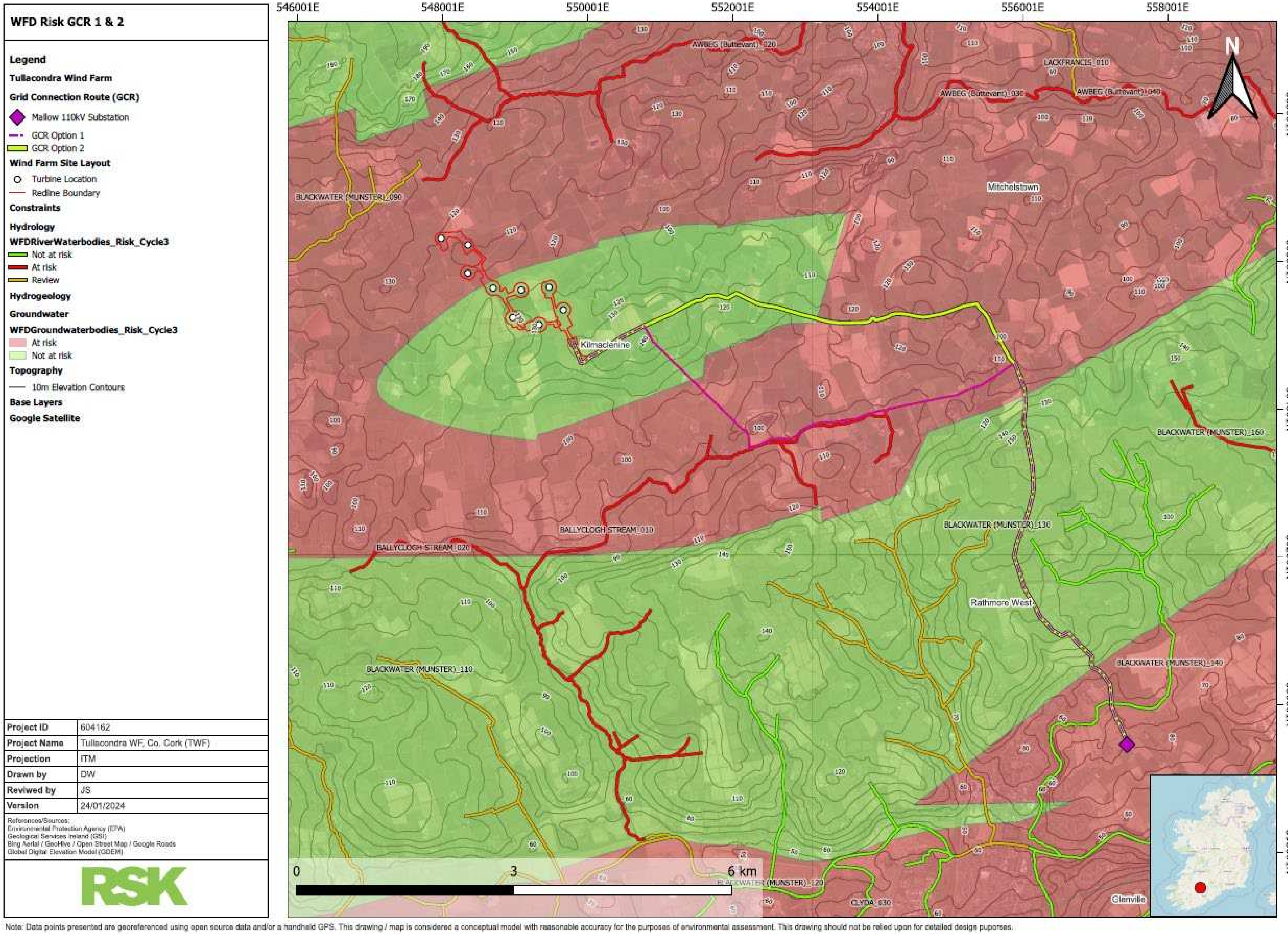



**Figure 9.5b: WFD risk for waterbodies in vicinity of GCR options 1 & 2**

### 9.4.6 Drainage & hydrological regime

#### *9.4.6.1 Drainage*

The wind farm site is characterised generally by a network of historical drainage, and historical features (**Plate 9.2**), non-mapped natural and artificial drainage channels, and some connections to groundwater southwest of the Project. Many of the drains are “dry drains” that contain no water for much of the year.

Drainage channels identified during desk study assessment and site surveys are presented in **Figure 9.6a** (Site) and **Figure 9.6b** (GCR 1 & 2). Photographs of some significant features are presented in EIAR **Volume III, Appendix 9.3**.

Drainage channels are mapped using four categories presented in **Table 9.8**;

**Table 9.8: Drainage classifications**

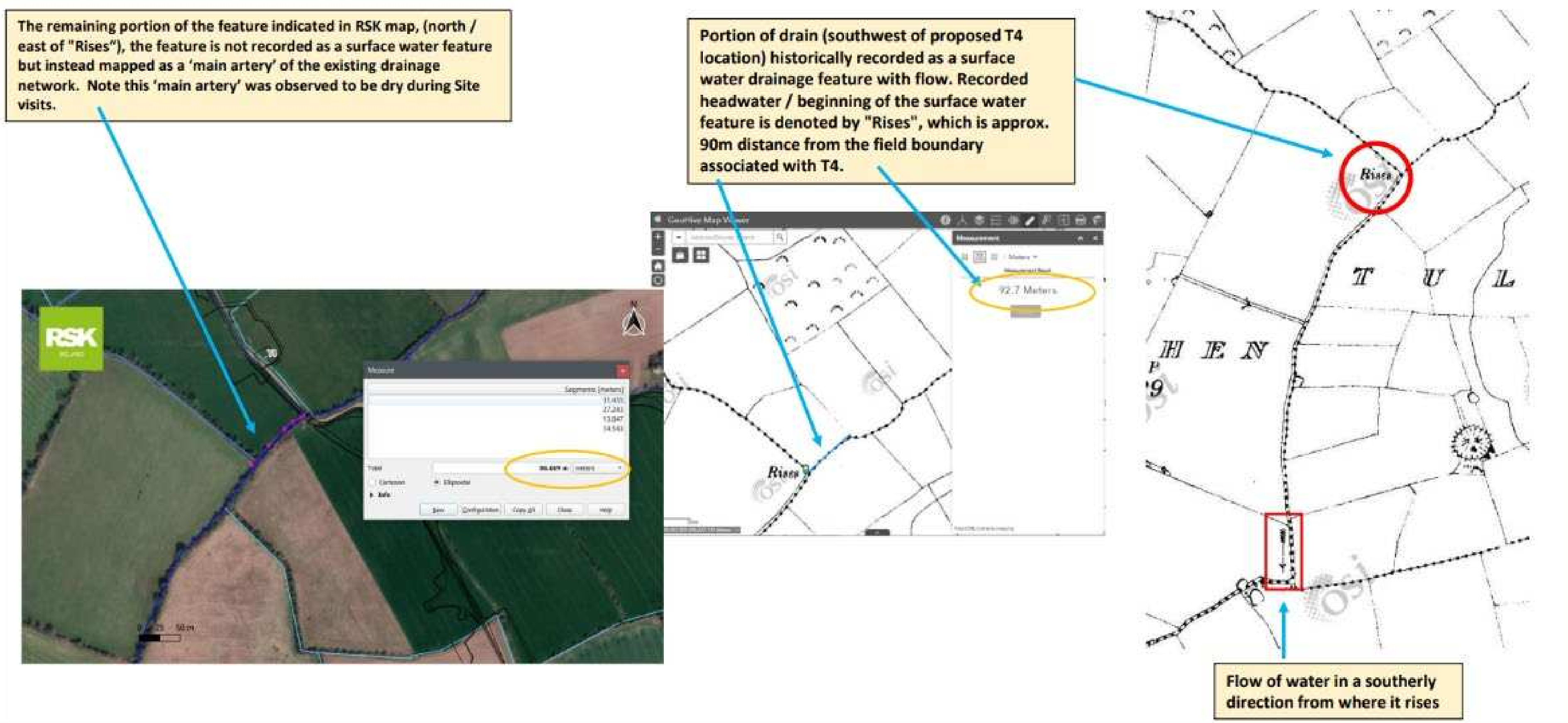
| Drain classification | Definition |
|---|---|
| Historically Mapped Surface Water | 25-inch maps located on GeoHive (Not mapped by EPA/WFD) (**Figure 9.2**) |
| Primary Drainage | Main artery of drains on site |
| Secondary Drainage | Connections to primary drains |
| Tertiary Drainage | Connection to secondary drains |

In line with the limited drainage network identified within the site, 12 existing watercourse crossings (culverts) and new watercourse crossings, which will form part of the Project drainage network were recorded. Existing surface water crossings associated with surface water features and primary drainage features are also identified and are presented as part of the constraints mapping. Refer to **Figure 9.17**. The WFD river subbasins mapped by EPA do not correspond/line up with drainage ditches mapped from onsite surveys in some places. Furthermore, some field boundary lines do not have drains.

Drainage channels at the wind farm site quickly drain the area with the exception of some localised surface water ponding and ‘perched’ standing water in some areas (i.e., local-scale pluvial flooding), EIAR **Volume III, Appendix 9.3 – Tile 6**. Particular areas of the wind farm site have perched surface water or ‘wet’ conditions including the general area to the north / northwest of T1 and the area in the south of T8 adjacent to existing farm building and described as ‘wet’ or ‘marshy’ ground. It should also be noted that a primary drain does flow towards and is connected to a mapped lake ID:18_58, as shown in **Figure 9.17b**.

A historically mapped surface water feature was identified in the Ordnance Survey Ireland (OSi) 6” Cassini map, and forms part of one of the main drainage channels associated with the site. This feature, EIAR **Volume III, Appendix 9.4 – Tile 25**, is mapped as ‘rising’ or beginning approximately 90m southwest of the location of T4.

**Plate 9.2: Historic drainage features**




| | | | | | |
|---|---|---|---|---|---|
| Site Name:<br>**Tullacondra Green Energy Project, Co. Cork** | **Project No.** | 604162 | **Drawn By:** | Colleen McClung<br>Graduate Project Scientist | RSK |
| | **Client:** | Tullacondra Green Energy Ltd | | | |
| Figure Name:<br>**Appendix 9.5 - Conceptuel & Information Graphics – Tile 25 Historic Surface Water Feature Cassini 6-inch map** | **Date:** | 27/02/2023 | **Reviewed By:** | Sven Klinkenbergh<br>Principal Environmental Consultant | |
| | **Revision:** | 00 | | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

The drainage network associated with the Lisduggan River Basin catchment, which appears to combine into the historically mapped surface water feature, recharges to ground approximately 1.3km downstream (as shown in **Figure 9.9e**). To complete the water balance assessment as part of the Flood Risk Assessment (FRA) (EIAR **Volume III, Appendix 9.5**) the wind farm site was broken up into micro catchments using the River sub basins from the EPA website (as shown in **Figure 9.7**).

#### *9.4.6.2 Existing and proposed watercourse crossings*

Due to the relatively low permeability deep soils, a number of farm drains or watercourses are present on the wind farm site. There are no existing or proposed crossings of marked EPA streams on the wind farm site. Watercourse crossings over non-mapped drains/historic drains include a series of existing and proposed culvert crossings as presented in **Table 9.9**.

A number of new watercourse crossings are associated with the proposed new site tracks. Existing crossings are associated with existing farm access tracks and will require upgrading.

**Table 9.9: Existing and proposed watercourse crossings on Site**

| # | Crossing Number | Type | E ITM | N ITM | Description of Works |
|---|---|---|---|---|---|
| 1 | eWCC-01 | Existing Culvert | 548334.8 | 606069.8 | Extend |
| 2 | eWCC-02 | Existing Culvert | 548570.1 | 605846.5 | Extend |
| 3 | eWCC-03 | Existing Culvert | 548745.3 | 605569 | Extend |
| 4 | eWCC-04 | Existing Culvert | 548274.3 | 606035.6 | Extend |
| 5 | eWCC-05 | Existing Culvert | 548499.9 | 605931.4 | Extend |
| 6 | eWCC-06 | Existing Culvert | 548923.6 | 605088.1 | Extend |
| 7 | eWCC-07 | Existing Culvert | 549259.4 | 605112.2 | n/a |
| 8 | eWCC-08 | Existing Culvert | 549551.9 | 605183.4 | n/a |
| 9 | eWCC-09 | Existing Culvert | 549704.5 | 605080.3 | n/a |
| 10 | nWCC-01 | New Culvert | 549983.5 | 604685.1 | New Culvert |
| 11 | nWCC-02 | New Culvert | 549880.7 | 604696 | New Culvert |
| 12 | n/a (Being Removed) | Existing Culvert | 549694.1 | 605125.1 | Remove |
| 13 | nWCC-03 | New Culvert | 549244.2 | 605147.4 | New Culvert |
| 14 | nWCC-04 | New Culvert | 549467.8 | 605565.7 | New Culvert |
| 15 | nWCC-05 | New Culvert | 549491.1 | 605586.1 | New Culvert |
| 16 | nWCC-06 | New Culvert | 549067.8 | 605095.1 | New Culvert |
| 17 | nWCC-07 | New Culvert | 549036 | 605128.5 | New Culvert |
| 18 | nWCC-08 | New Culvert | 548911.4 | 605544.2 | New Culvert |
| 19 | nWCC-09 | New Culvert | 548584.3 | 605805.6 | New Culvert |
| 20 | nWCC-10 | New Culvert | 548406.6 | 605882.2 | New Culvert |

| # | Crossing Number | Type | E ITM | N ITM | Description of Works |
|---|---|---|---|---|---|
| 21 | nWCC-11 | New Culvert | 548444.3 | 606153.3 | New Culvert |
| 22 | nWCC-12 | New Culvert | 548253.4 | 606323.1 | New Culvert |
| 23 | nWCC-13 | New Culvert | 548145.1 | 606349.6 | New Culvert |
| 24 | nWCC-14 | New Culvert | 548045 | 606346.6 | New Culvert |
| 25 | eWCC-10 | Existing Culvert | 548412.7 | 605895.6 | n/a |
| 26 | nWCC-15 | New Culvert | 548409.5 | 605905.5 | New Culvert |
| 27 | nWCC-16 | New Culvert | 548584.7 | 606036.2 | New Culvert |
| 28 | nWCC-17 | New Culvert | 548962.4 | 605320.2 | New Culvert |
| 29 | eWCC-18 | Existing Culvert | 549552 | 605111 | Extend |

Watercourse crossings listed above were identified by means of assessing the site layout where it intersects existing drainage mapped as part of this assessment. There remains the potential for new culverts subject to detailed design, particularly if associated with minor drainage which will be subject to modification and diversion in some instances.

#### *9.4.6.3 Watercourse Crossings for Grid Connection*

Both of the GCR options cross over the Blackwater (Munster) River_140 (also locally known as Caherduggan South). This water crossing will utilise Horizontal Directional Drilling (HDD), see EIAR **Chapter 5 Project Description** (section 5.2.9).

**Table 9.10: Watercourse Grid Connection Routes**

| Crossing Number | Type | E ITM | N ITM |
|---|---|---|---|
| WCC_301 | River - HDD | 557227 | 600016 |
| WCC_401 | River - HDD | 557227 | 600016 |

The section of GCR shared by Options 1 & 2 crosses a section of Blackwater (Munster) River_140 (also locally known as Caherduggan South) as shown in the planning drawings (Refer to Planning Application Documentation **Part 2** – Planning Drawings **Drawing No. 20910-NOD-XX-XX-DR-C-08211** to **Drawing No. 20910-NOD-XX-XX-DR-C-08216** for the Option 1 GCR crossings.

**Surface Water & Drainage Survey - Wind Farm Tile 00**

**Legend**

**Project Information**
- SW Sampling Locations

**Hydrogeology**
**Karst Landforms 40k (GSI)**
- Enclosed Depression
- Spring
- Swallow Hole

**Data Collected on site**
**Karst Site Works**
**Observed Features - Geology, Karst, etc.**
- Depression, Dry but Reeds/Marshy
- Depression, Standing Water
- Karst Feature
- Depression, Topographical

**Historic Feature**
- Historic Quarry

**Mapped Drainage**
**Drains Lables**
- Rises
- Flow direction
- Non-Mapped Waterbodies

**Non-mapped Drains**
- Historic SW
- Indicative Historic SW
- Tertiary
- Secondary
- Primary
- Historic SW (not observed)
- Drainage 15m Buffer
- Non-mapped Waterbodies 15m Buffer
- 25m Buffer Indicative Historic SW

**Wind Farm Layout**
- Redline Boundary

**Constraints**
**Hydrology**
- River Waterbodies Cycle 3 (EPA) - main rivers
- Lake Segment (EPA)

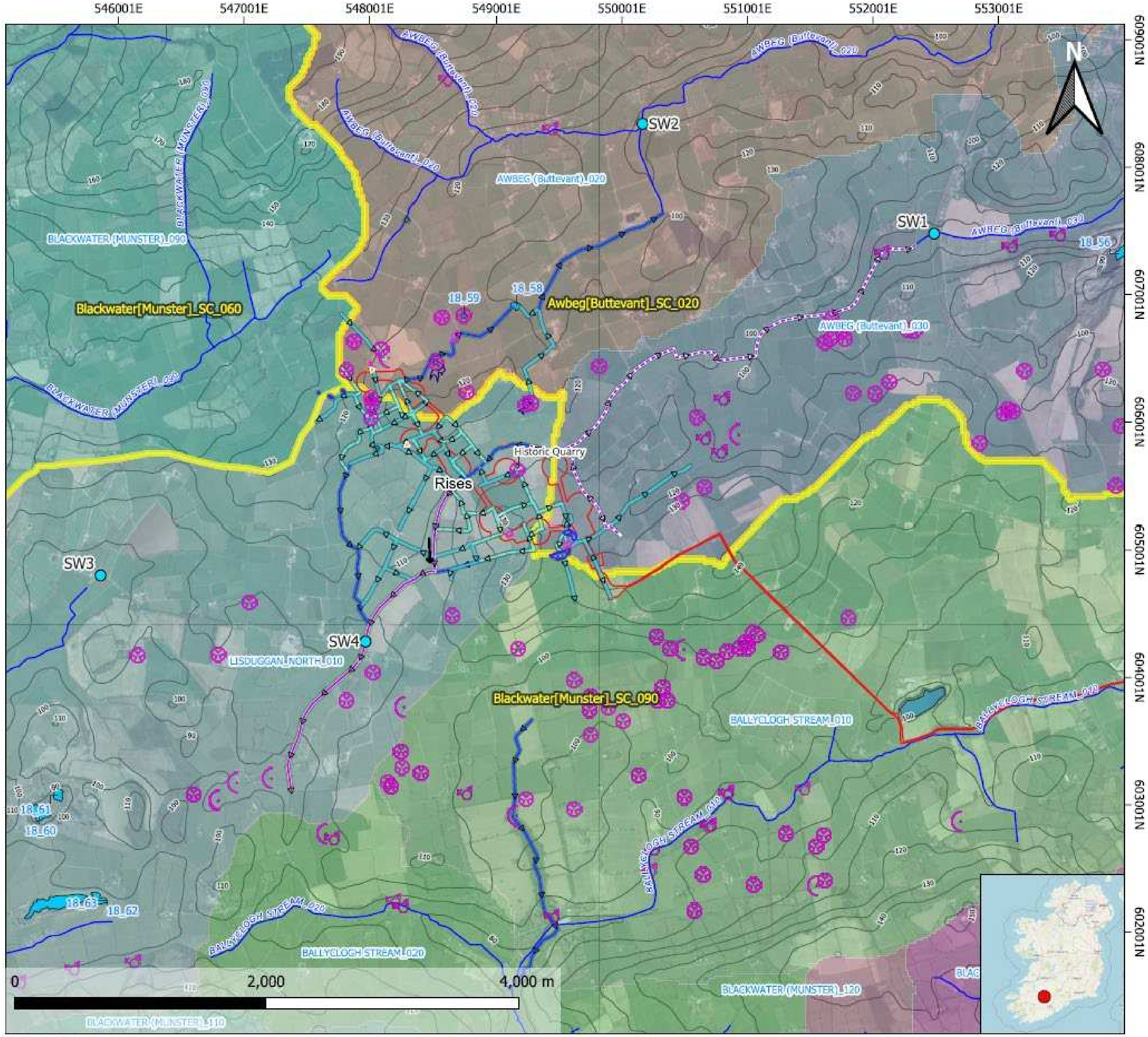
**River SubBasins Cycle 3 (EPA)**
- AWBEG (Buttevant)_020
- AWBEG (Buttevant)_030
- BALLYCLOGH STREAM_010
- BALLYCLOGH STREAM_020
- BLACKWATER (MUNSTER)_090
- BLACKWATER (MUNSTER)_110
- BLACKWATER (MUNSTER)_120
- BLACKWATER (MUNSTER)_130
- LISDUGGAN_NORTH_010
- Subcatchments (EPA)

**Topography**
- DEM 10m Contour

**Base Layers**
**Google Satellite**

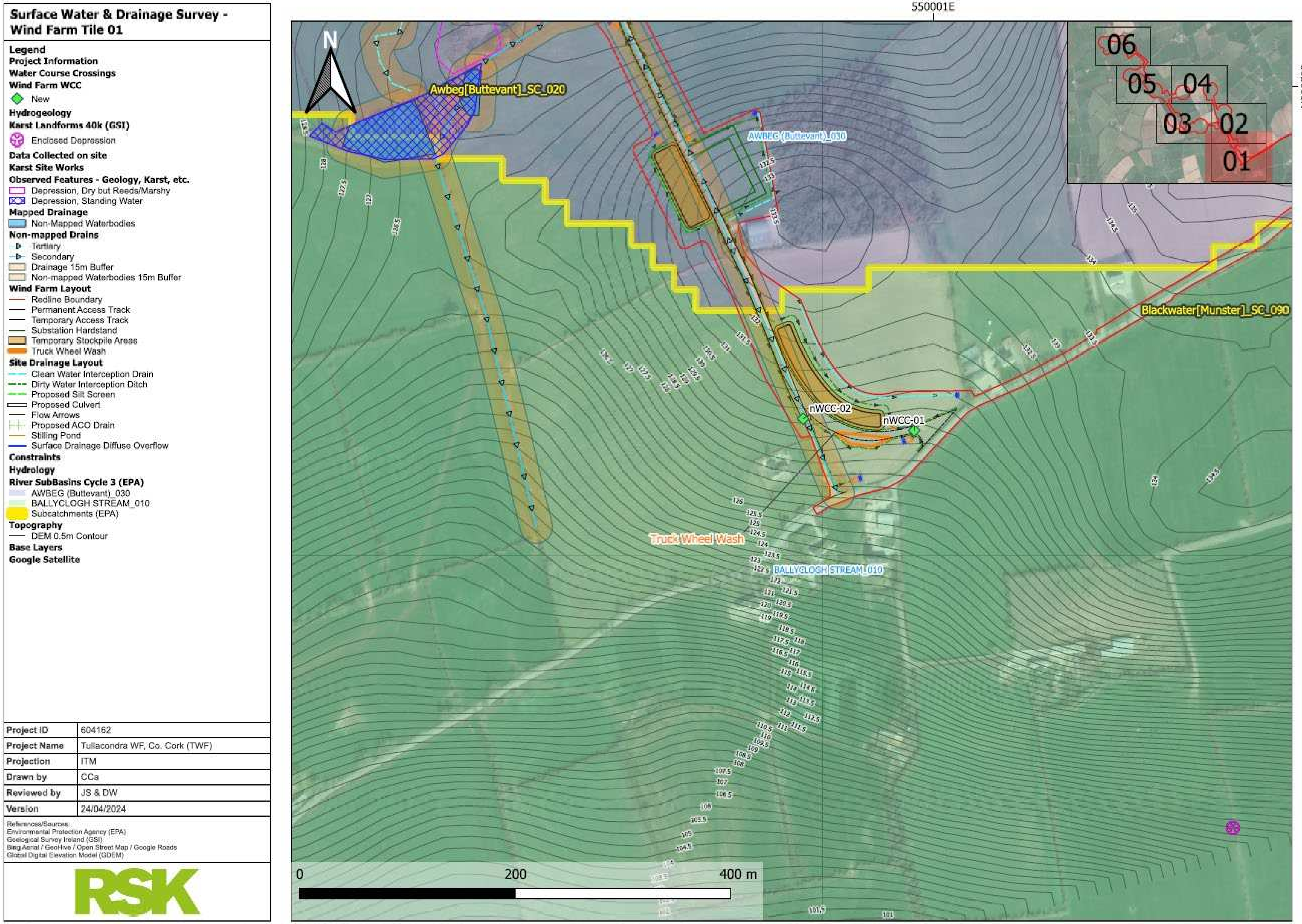
| | |
|---|---|
| **Project ID** | 604162 |
| **Project Name** | Tullacondra WF, Co. Cork (TWF) |
| **Projection** | ITM |
| **Drawn by** | CCa |
| **Reviewed by** | JS & DW |
| **Version** | 16/04/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Survey Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.6a: Surface water & drainage survey - wind farm - tile_00**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.6a: Surface water & drainage survey - wind farm - tile_01**

**Surface Water & Drainage Survey - Wind Farm Tile 02**

**Legend**
**Project Information**
**Water Course Crossings**
**Wind Farm WCC**
- Existing
- New

**Data Collected on site**
**Karst Site Works**
**Observed Features - Geology, Karst, etc.**
- Depression, Dry but Reeds/Marshy
- Depression, Standing Water

**Mapped Drainage**
- Non-Mapped Waterbodies

**Non-mapped Drains**
- Historic SW
- Tertiary
- Secondary
- Drainage 15m Buffer
- Non-mapped Waterbodies 15m Buffer

**Wind Farm Layout**
- Redline Boundary
- Turbines V11
- Permanent Access Track
- Temporary Access Track
- Turbine Hardstands
- Substation Hardstand
- Temporary Stockpile Areas

**Temporary Construction Compound Area**
- Temporary Compound
- Temporary Storage

**Site Drainage Layout**
- Clean Water Interception Drain
- Dirty Water Interception Ditch
- Proposed Silt Screen
- Proposed Culvert
- Existing Culvert
- Flow Arrows
- Stilling Pond
- Surface Drainage Diffuse Overflow

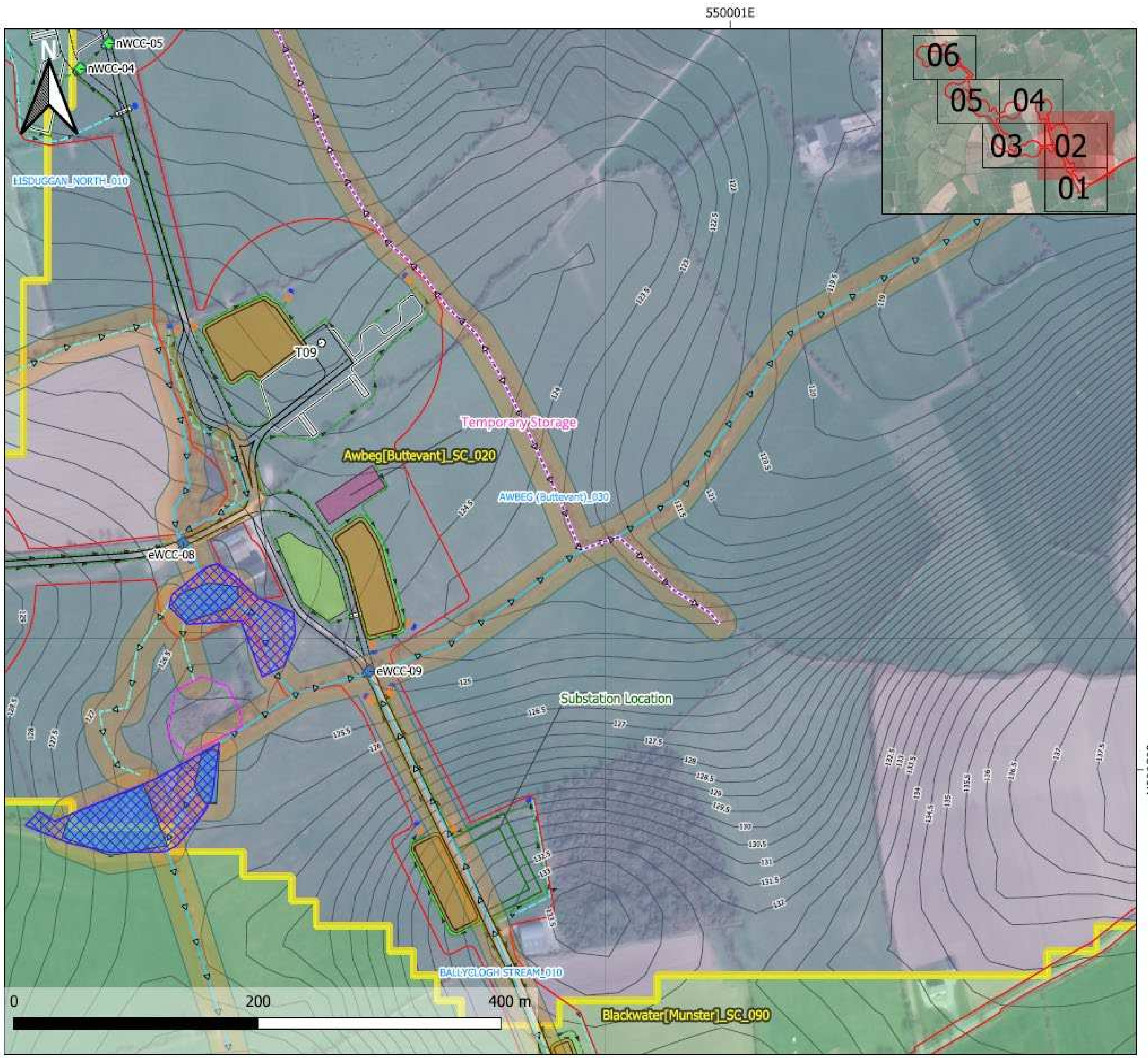
**Constraints**
**Hydrology**
**River SubBasins Cycle 3 (EPA)**
- AWBEG (Buttevant)_030
- BALLYCLOGH STREAM_010
- LISDUGGAN_NORTH_010
- Subcatchments (EPA)

**Topography**
- DEM 0.5m Contour

**Base Layers**
**Google Satellite**

| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | CCa |
| Reviewed by | JS & DW |
| Version | 24/04/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Survey Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.6a: Water & drainage survey - wind farm - tile_02**

## Surface Water & Drainage Survey - Wind Farm Tile 03

**Legend**

**Project Information**

**Water Course Crossings**

**Wind Farm WCC**
- Existing
- New

**Data Collected on site**

**Karst Site Works**

**Observed Features - Geology, Karst, etc.**
- Depression, Dry but Reeds/Marshy
- Depression, Standing Water

**Mapped Drainage**

**Drains Lables**
- Rises
- Non-Mapped Waterbodies

**Non-mapped Drains**
- Indicative Historic SW
- Tertiary
- Secondary
- Primary
- Drainage 15m Buffer
- Non-mapped Waterbodies 15m Buffer
- 25m Buffer Indicative Historic SW

**Wind Farm Layout**
- Redline Boundary
- Turbines V11
- Met Mast
- Permanent Access Track
- Temporary Access Track
- Turbine Hardstands
- Temporary Stockpile Areas

**Site Drainage Layout**
- Clean Water Interception Drain
- Dirty Water Interception Ditch
- Proposed Silt Screen
- Proposed Culvert
- Existing Culvert
- Flow Arrows
- Stilling Pond
- Surface Drainage Diffuse Overflow

**Constraints**

**Hydrology**

**River SubBasins Cycle 3 (EPA)**
- AWBEG (Buttevant)_030
- BALLYCLOGH STREAM_010
- LISDUGGAN_NORTH_010
- Subcatchments (EPA)

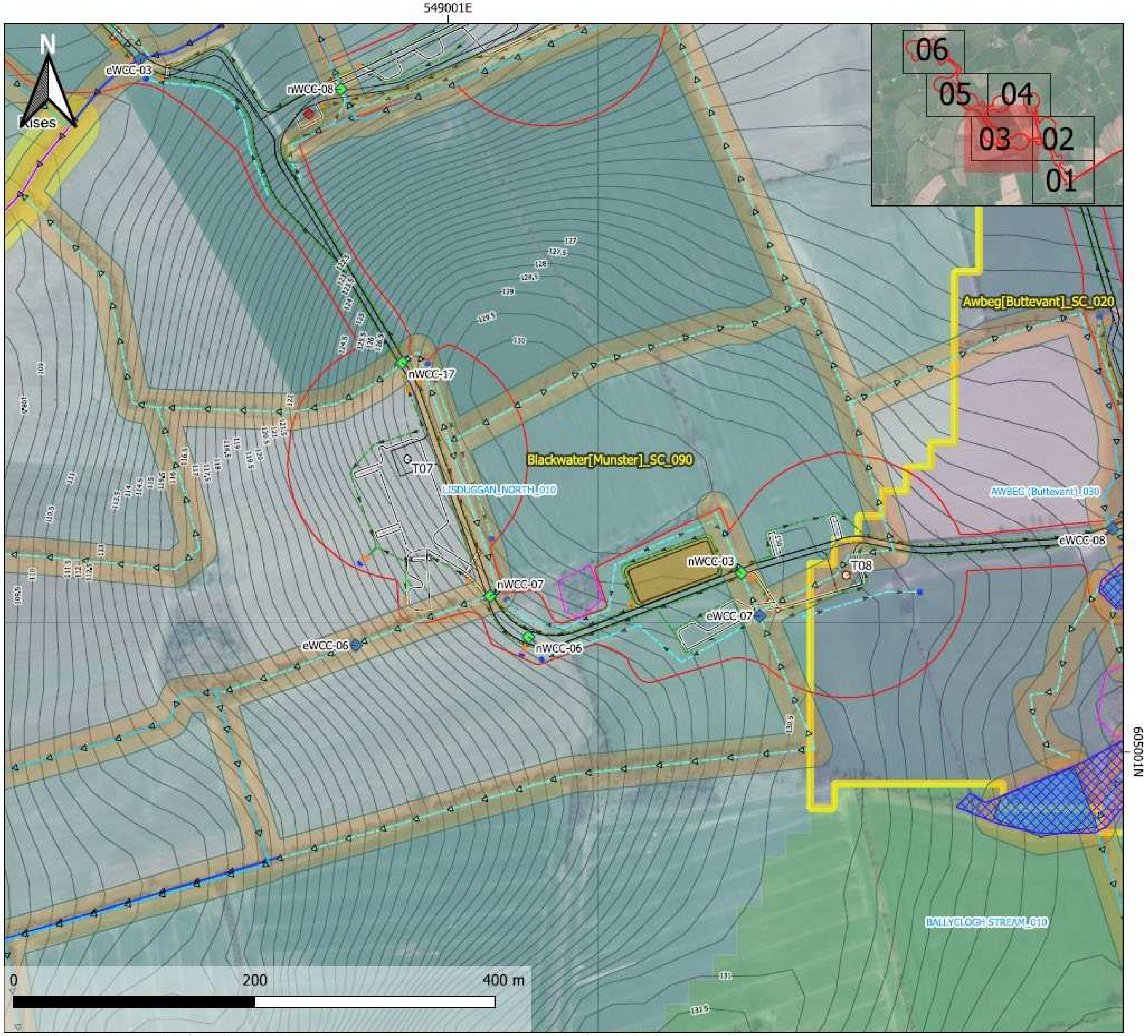
**Topography**
- DEM 0.5m Contour

**Base Layers**

**Google Satellite**

| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | CCa |
| Reviewed by | JS & DW |
| Version | 24/04/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Survey Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.6a: Water & drainage survey - wind farm - tile_03**

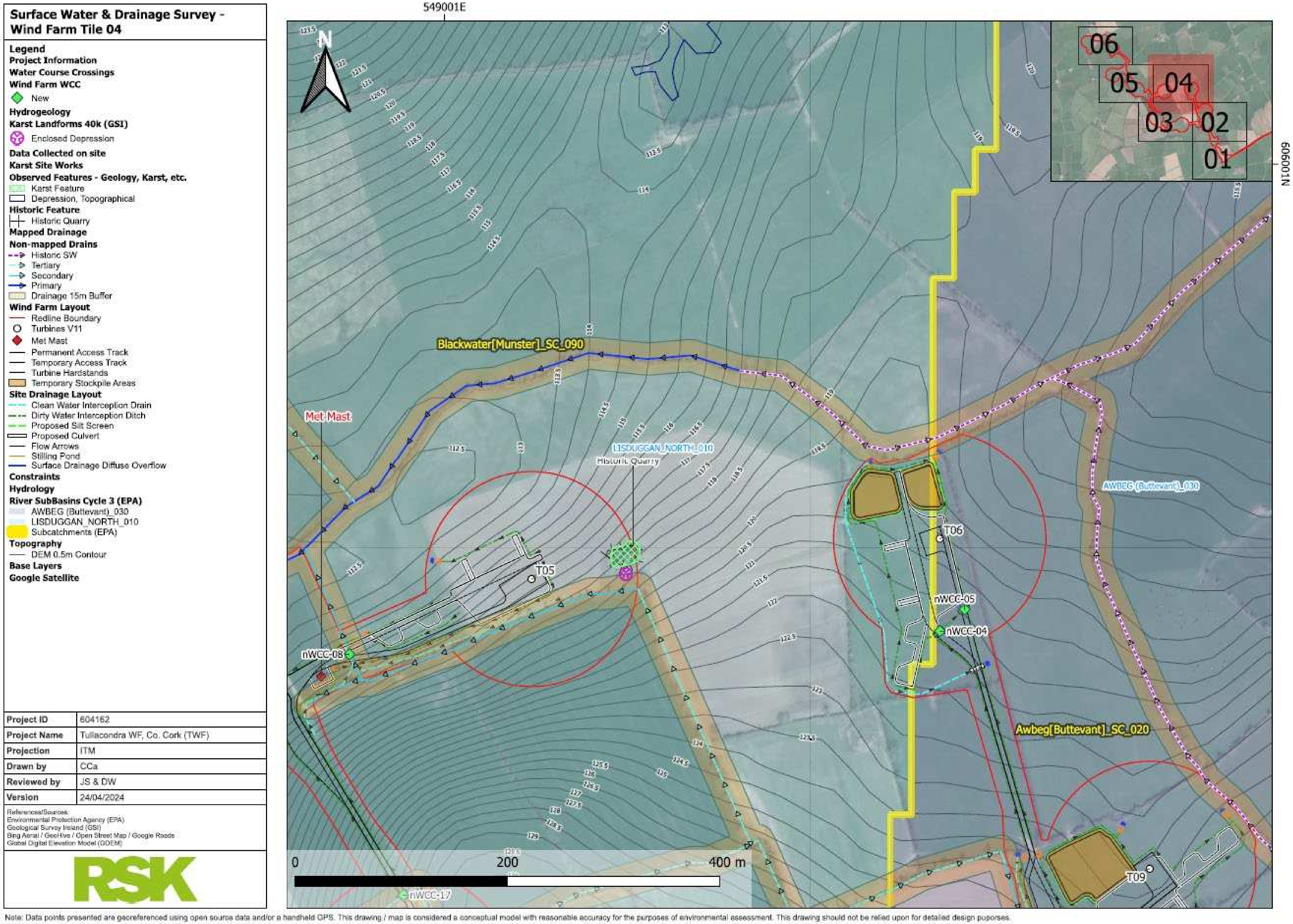



**Figure 9.6a: Water & drainage survey - wind farm - tile_04**

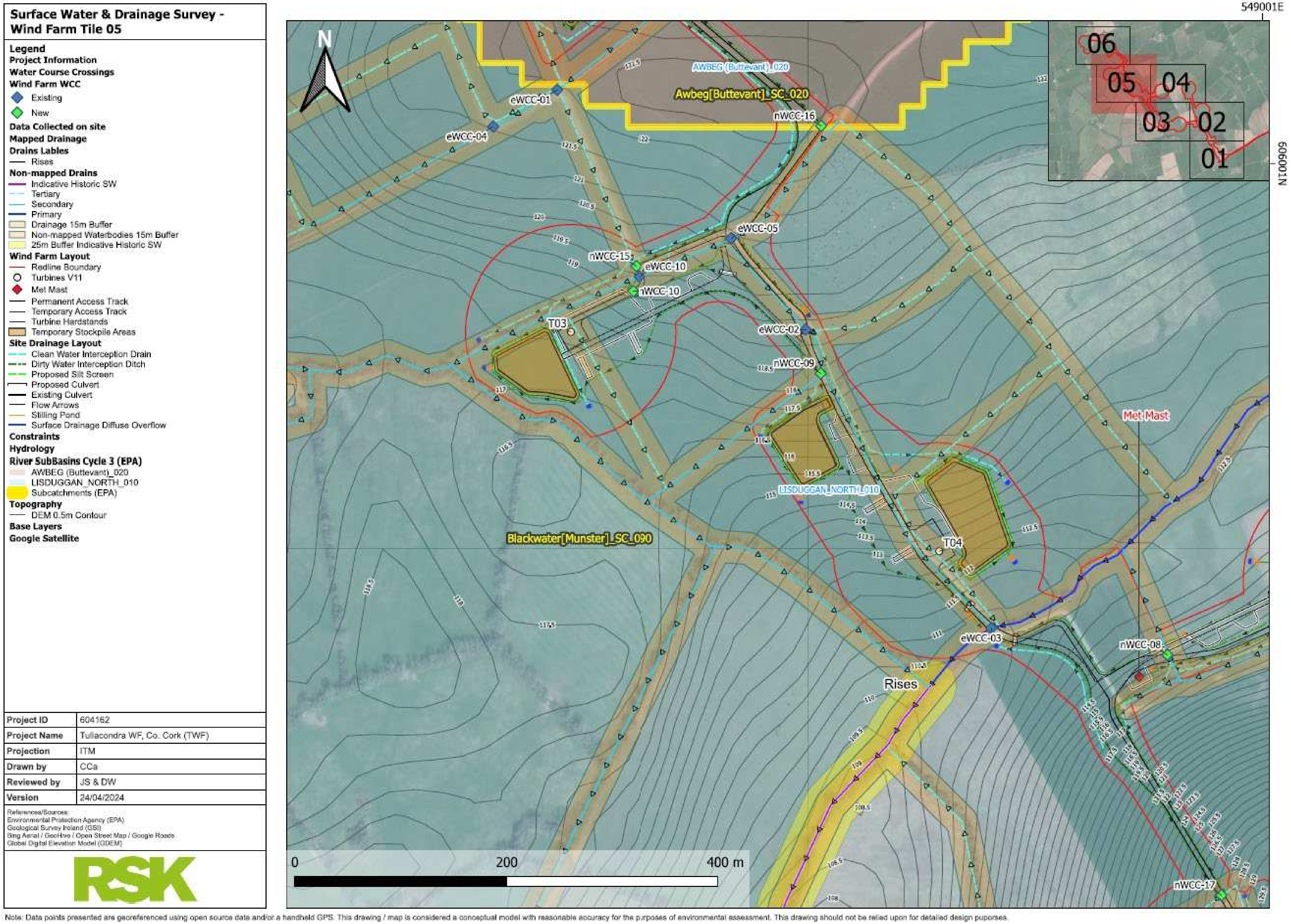



**Figure 9.6a: Water & drainage survey - wind farm - tile_05**

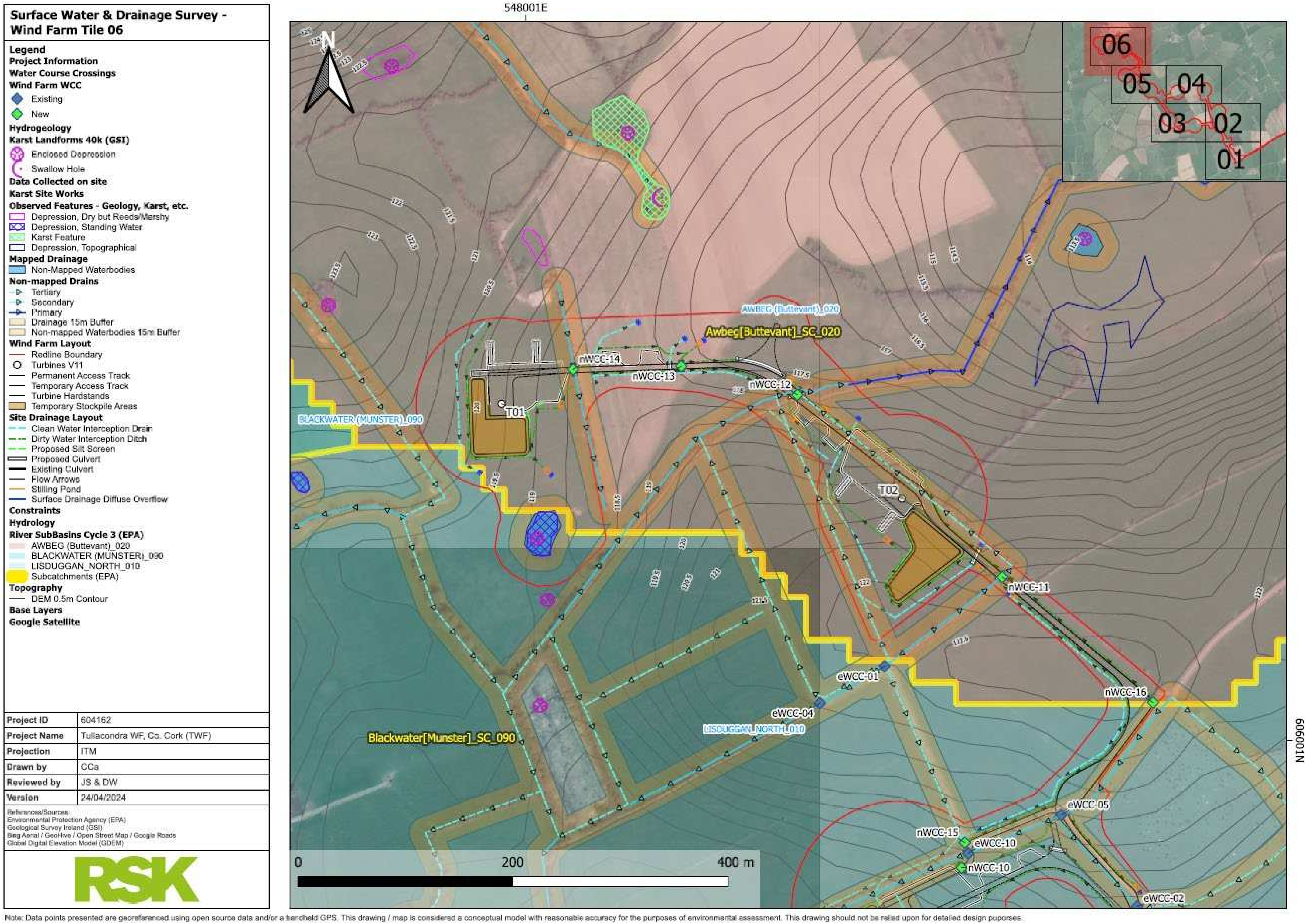



**Figure 9.6a: Water & drainage survey - wind farm - tile_06**

**Surface Water Survey GCR 1 & 2 - Tile_01**

**Legend**
**Tullacondra Wind Farm**
- SW Sampling Locations

**Water Course Crossings**
**Wind Farm WCC**
- Existing
- New

**Mapped Drainage**
**Drainagelabels**
- 1
- 2

**Non-Mapped drains**
- Historic SW
- Tertiary
- Secondary
- Primary
- Historic SW (gone/not observed)

**Grid Connection Route (GCR)**
- GCR Option 1
- GCR Option 2

**Wind Farm Site Layout**
- Turbine Location
- Met Mast
- Redline Boundary
- Temporary Access Track
- Permanent Access Track
- Substation Location
- Storage Location
- Truck wheel wash

**Site work**
**Observed Features - Geology, Karst, etc.**
- Depression, Archaeological
- Depression, Dry but Reeds/Marshy
- Depression, Standing Water
- Karst Feature, Swallow Hole
- Depression, Topographical
- Minor Borrow Pit

**Constraints**
**Hydrology**
- 604162_WFD_Riverwaterbodies
- WFD_Subcatchments

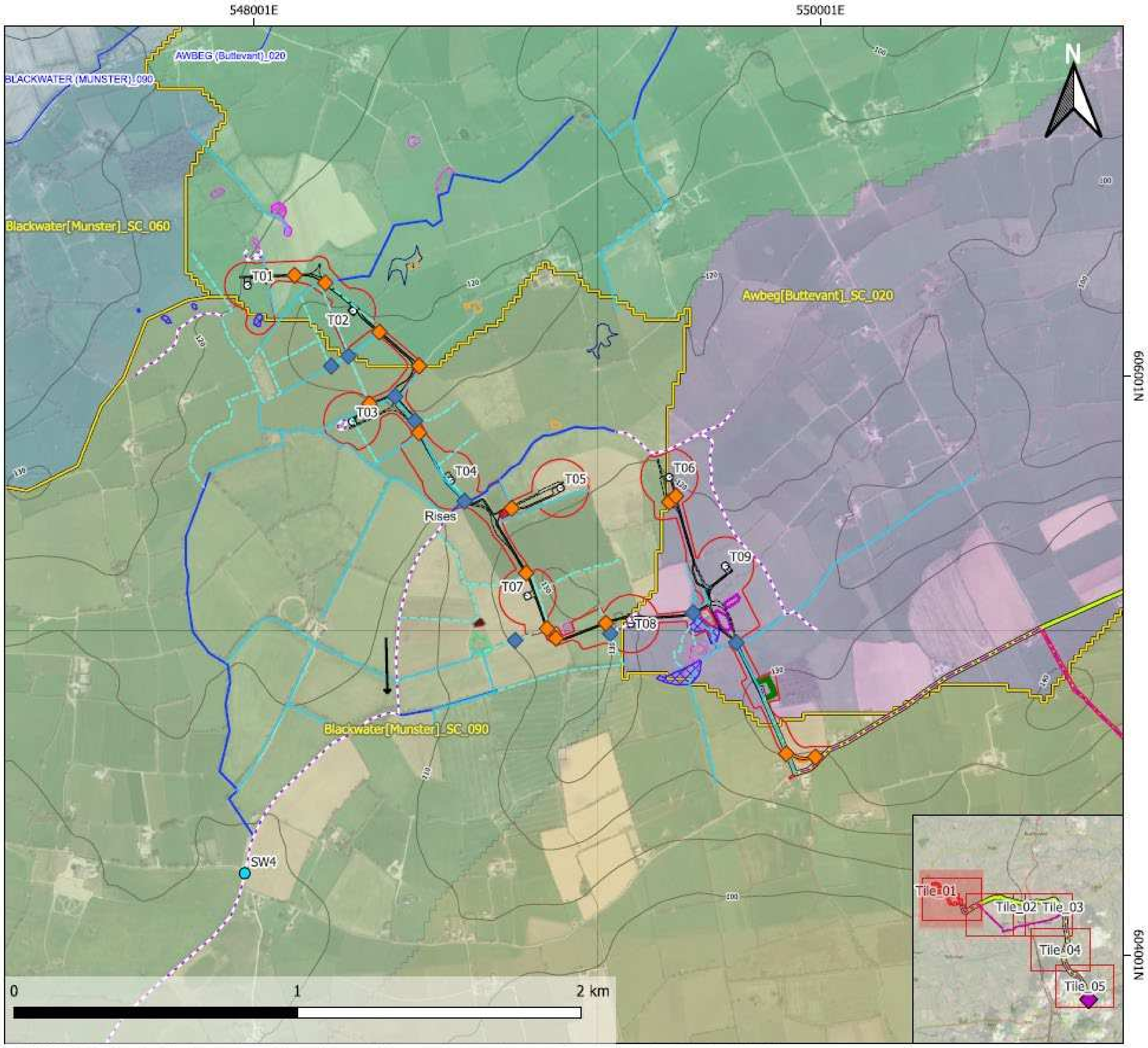
**WFD_RiverSubBasins_Cycle3**
- AWBEG (Buttevant)_020
- AWBEG (Buttevant)_030
- BALLYCLOGH STREAM_010
- BLACKWATER (MUNSTER)_090
- LISDUGGAN_NORTH_010

**Topography**
- 10m Elevation Contours

**Base Layers**
**Google Satellite**

| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | DW |
| Reviewed by | JS |
| Version | 24/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

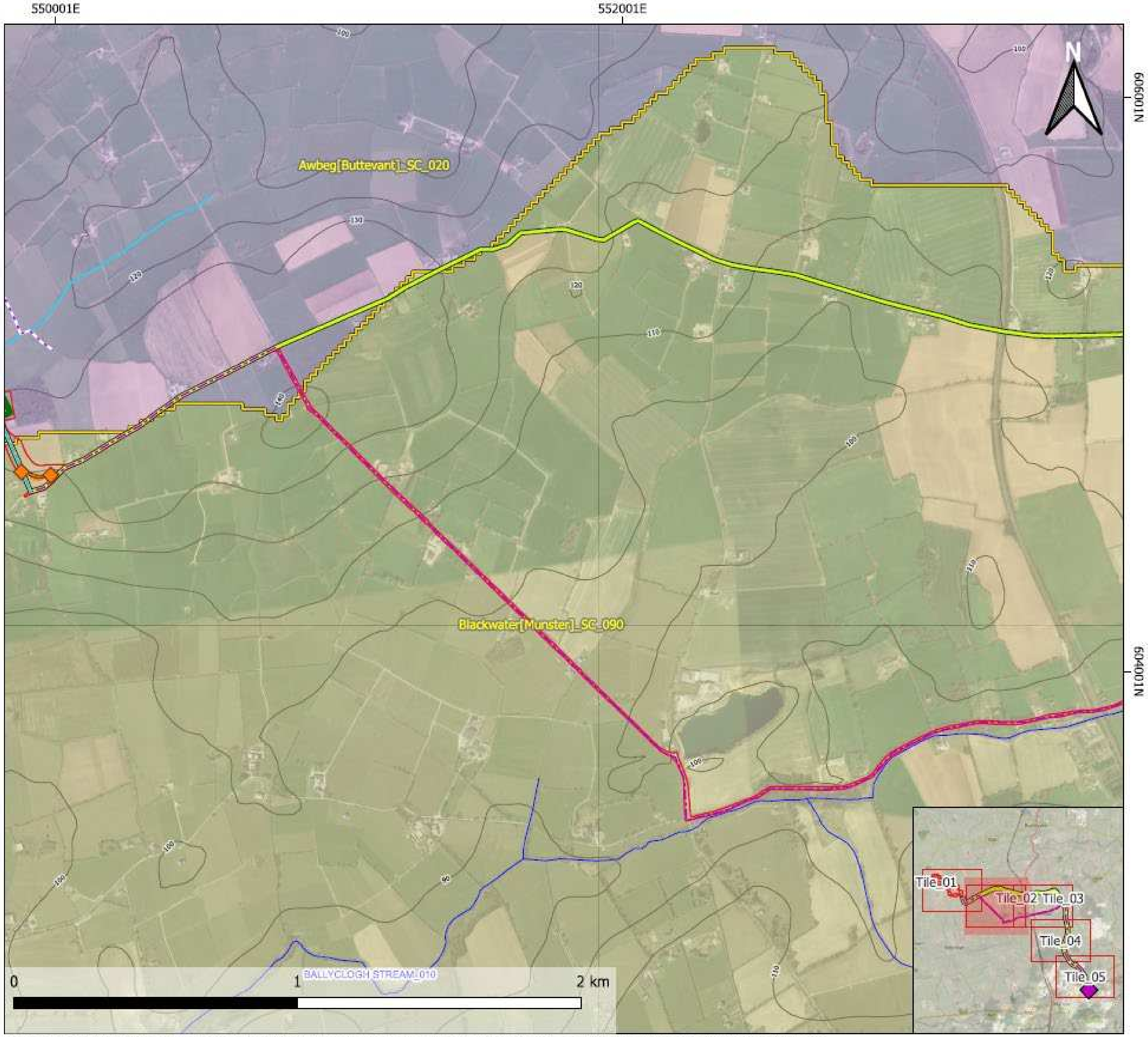
**Figure 9.6b: Surface water survey GCR options 1 & 2 - tile_01**

# Surface Water Survey GCR 1 & 2 - Tile_02

**Legend**
**Tullacondra Wind Farm**
**Water Course Crossings**
**Wind Farm WCC**
New
**Mapped Drainage**
**Non-Mapped drains**
Historic SW
Secondary
**Grid Connection Route (GCR)**
GCR Option 1
GCR Option 2
**Wind Farm Site Layout**
Redline Boundary
Temporary Access Track
Permanent Access Track
Substation Location
Truck wheel wash
**Constraints**
**Hydrology**
604162_WFD_Riverwaterbodies
WFD_Subcatchments
**WFD_RiverSubBasins_Cycle3**
AWBEG (Buttevant)_030
BALLYCLOGH STREAM_010
**Topography**
10m Elevation Contours
**Base Layers**
**Google Satellite**

| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | DW |
| Reviwed by | JS |
| Version | 24/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.6b: Surface water survey GCR options 1 & 2 - tile_02**

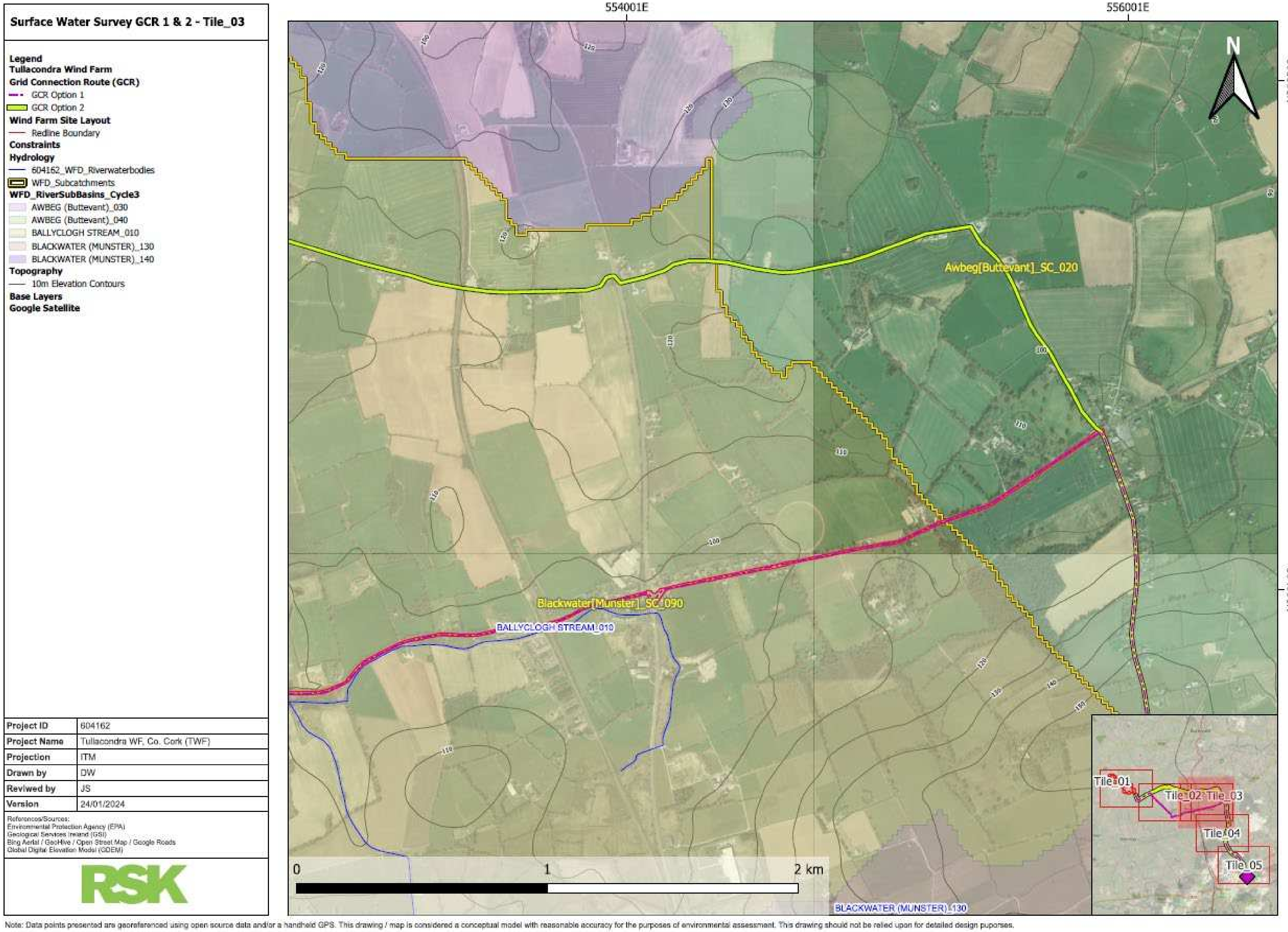
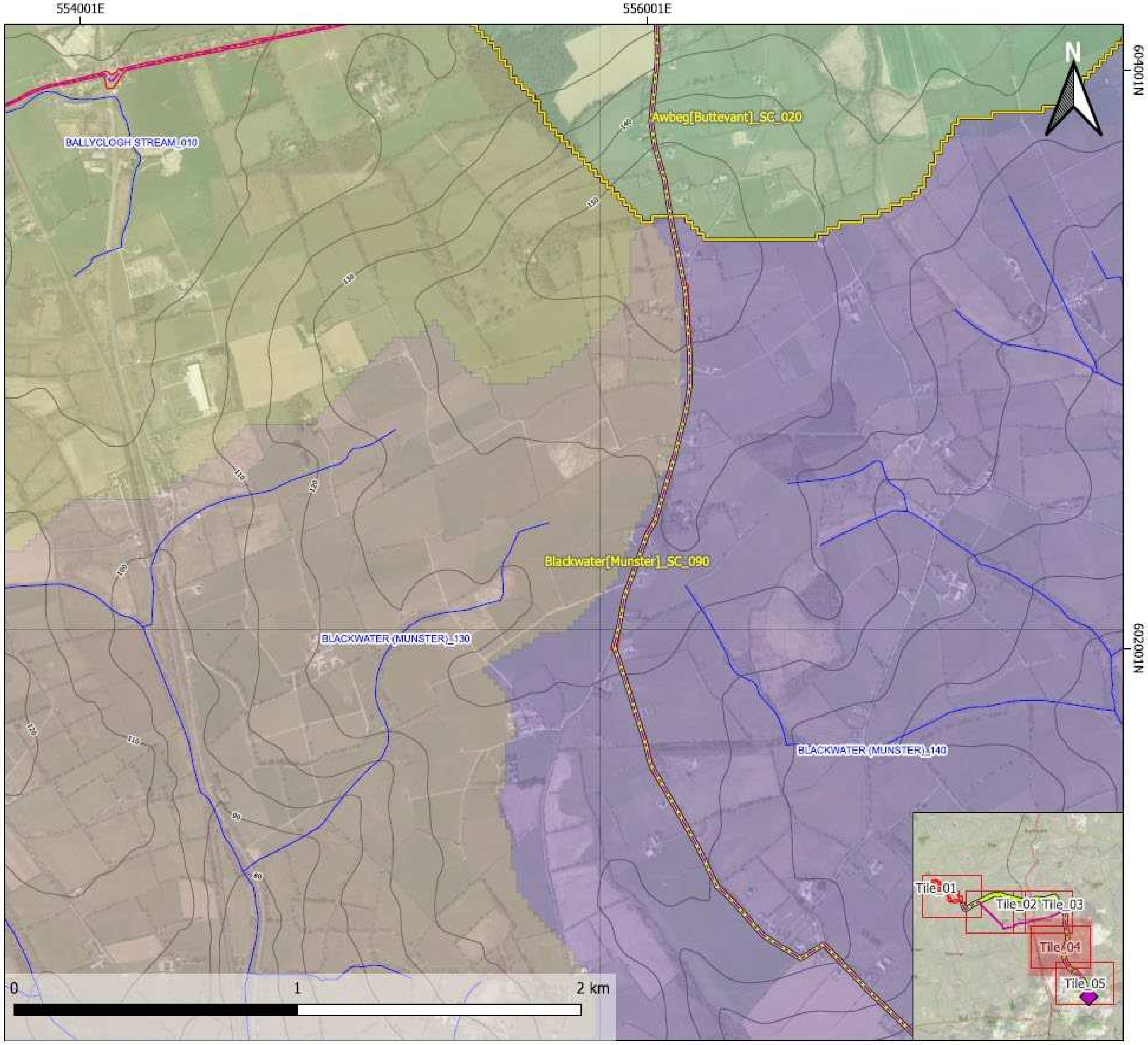



**Figure 9.6b: Surface water survey GCR options 1 & 2 - tile_03**

## Surface Water Survey GCR 1 & 2 - Tile_04

**Legend**
**Tullacondra Wind Farm**
**Grid Connection Route (GCR)**
GCR Option 1
GCR Option 2
**Wind Farm Site Layout**
Redline Boundary
**Constraints**
**Hydrology**
604162_WFD_Riverwaterbodies
WFD_Subcatchments
**WFD_RiverSubBasins_Cycle3**
AWBEG (Buttevant)_040
BALLYCLOGH STREAM_010
BLACKWATER (MUNSTER)_130
BLACKWATER (MUNSTER)_140
**Topography**
10m Elevation Contours
**Base Layers**
**Google Satellite**




| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | DW |
| Reviwed by | JS |
| Version | 24/01/2024 |

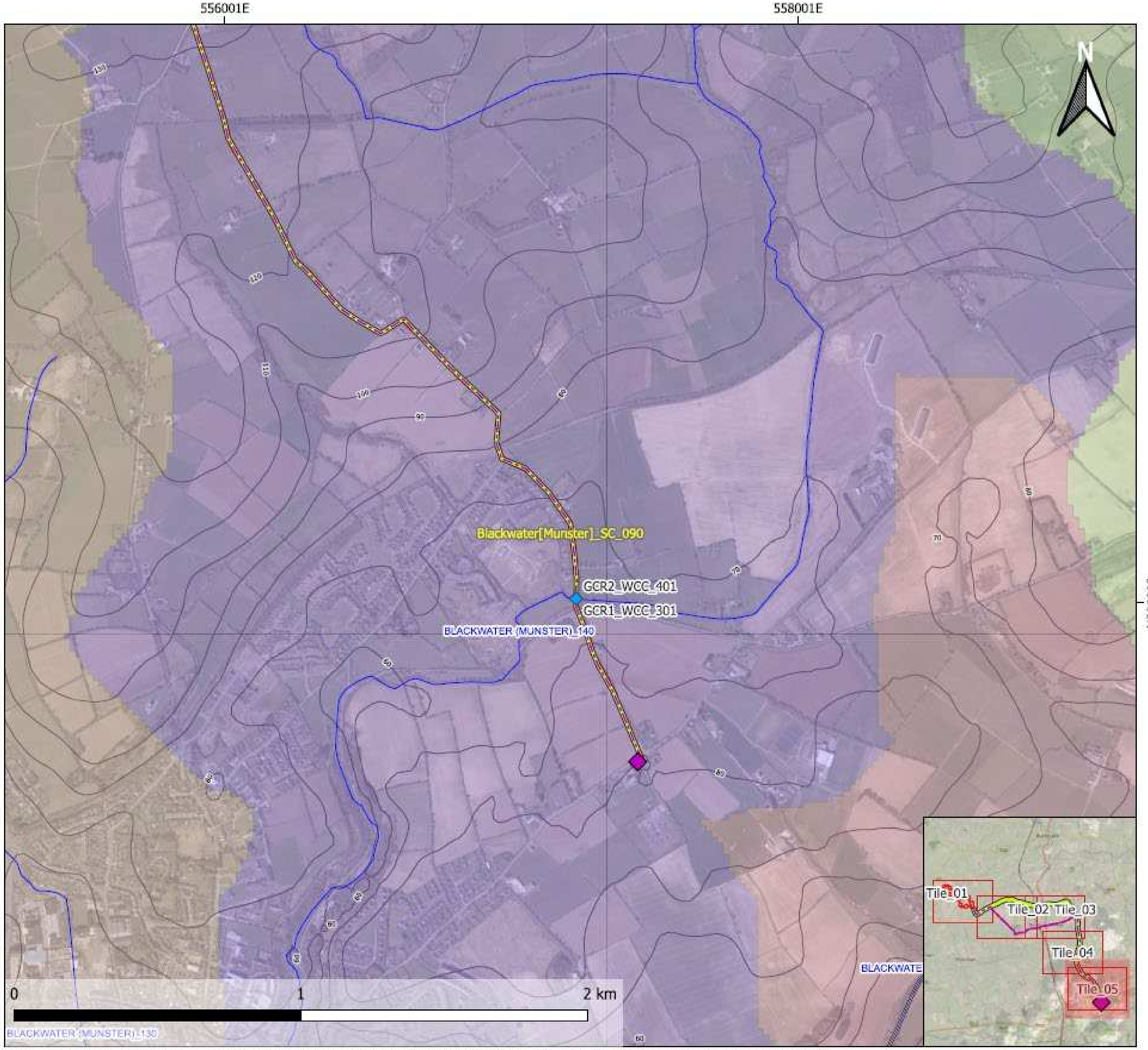
References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)

Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puposes.

**Figure 9.6b: Surface water survey GCR options 1 & 2 - tile_04**

**Surface Water Survey GCR 1 & 2 - Tile_05**

**Legend**
**Tullacondra Wind Farm**
**Water Course Crossings**
GCR1 WCC
GCR2 WCC
**Grid Connection Route (GCR)**
Mallow 110kV Substation
GCR Option 1
GCR Option 2
**Wind Farm Site Layout**
Redline Boundary
**Constraints**
**Hydrology**
604162_WFD_Riverwaterbodies
WFD_Subcatchments
**WFD_RiverSubBasins_Cycle3**
BLACKWATER (MUNSTER)_130
BLACKWATER (MUNSTER)_140
BLACKWATER (MUNSTER)_150
BLACKWATER (MUNSTER)_160
**Topography**
10m Elevation Contours
**Base Layers**
**Google Satellite**

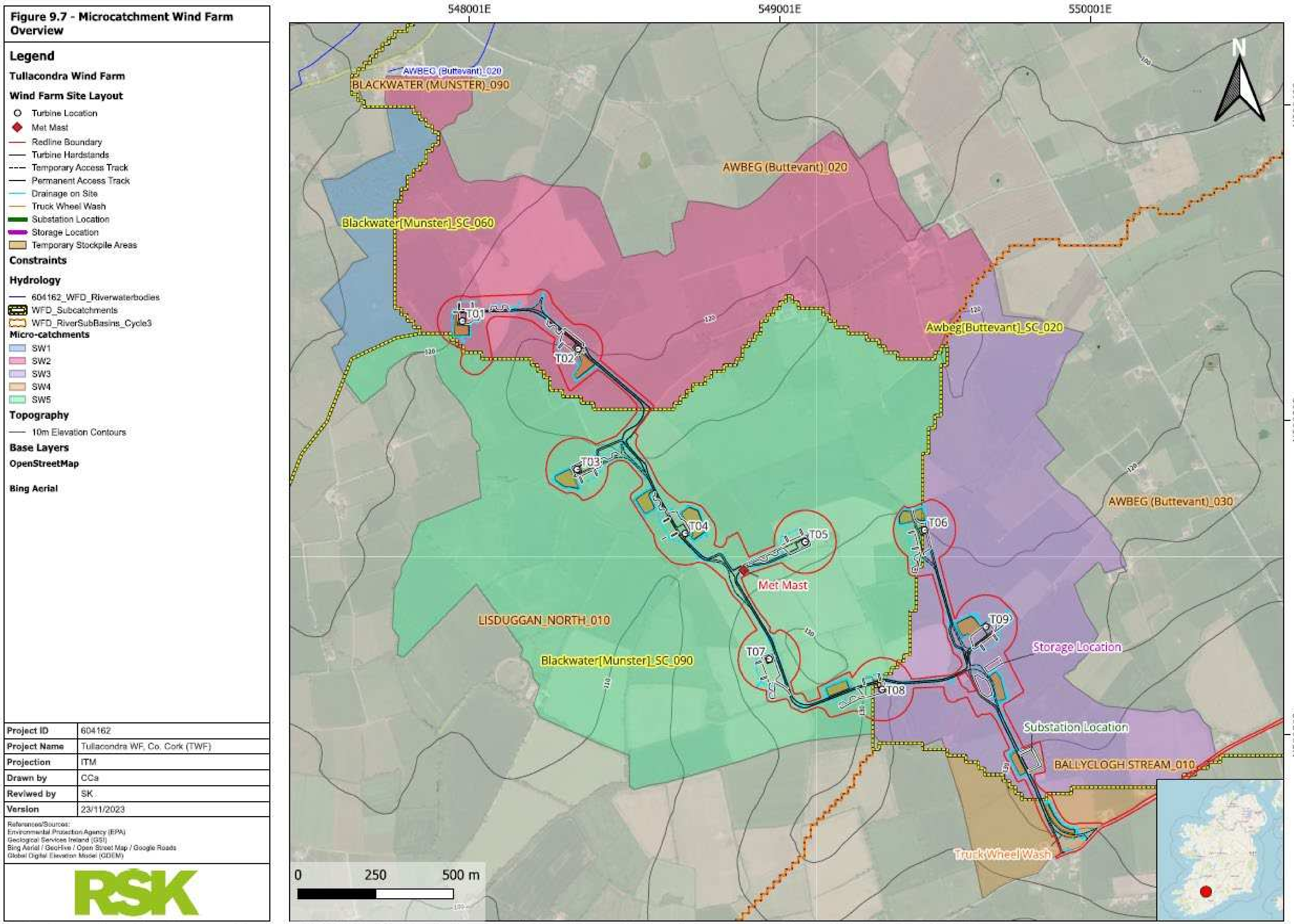



| | |
|---|---|
| **Project ID** | 604162 |
| **Project Name** | Tullacondra WF, Co. Cork (TWF) |
| **Projection** | ITM |
| **Drawn by** | DW |
| **Reviwed by** | JS |
| **Version** | 24/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)

Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.6b: Surface water survey GCR options 1 & 2 - tile_05**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.7: Microcatchment wind farm site overview**

## 9.4.7 Surface water hydrochemistry

Baseline surface water sampling was carried out at four locations; SW1 to SW4 inclusive (**Figure 9.6b**) which are representative of drainage and surface water network channels associated with the wind farm site (as shown in **Figure 9.6a**). With reference to EIAR **Volume III, Appendix 9.6**, data on surface water flow and hydrochemistry at representative baseline sampling locations during two sampling events indicated events with high levels of nutrient loading, of various inputs, in all four locations. Laboratory certificates are presented in EIAR **Volume III, Appendix 9.7**.

Surface water quality observed at all four monitoring locations is generally of a similar standard and is generally of moderate quality when screened against relevant reference concentrations of the Surface Water Regulations SI no.77/2019. The following is noted:

- Ammoniacal Nitrogen as N at three monitoring locations (Min Max Range; 0.05 – 0.12 mg/l Ammoniacal Nitrogen as N). Elevated concentrations were recorded during both monitoring events. Nitrite as NO2 was elevated on the 7/9/2022 at three locations.
- Total suspended solids detected during the first round of sampling during 'Wet/High Flow' conditions were identified as being above the relevant reference limit by a magnitude of twelve at SW04 where 300 mg/l was reported.
- Phosphorus (total unfiltered) was elevated during the second 'Dry/Low Flow' sampling event during 11/10/2021. High water quality status of surface water quality contains ≤ 0.010mg P/l (mean) and Good status consists of ≤ 0.025mg P/l (mean). Concentrations of 0.059 mg/l total Phosphorus at SW4 and 1.90 mg/l at SW2 are noted to be high for baseline conditions.

Elevated concentrations of Ammoniacal Nitrogen and Phosphorous compounds as observed at all monitoring locations is indicative of current agricultural land use.

## 9.4.8 Hydrogeology

### *9.4.8.1 Bedrock aquifer*

Bedrock aquifers associated with the wind farm site and GCR option routes are presented in **Figures 9.8 (a – b).**

The northern portion of the site (encompassing T1, T2 and T3) is underlain by Waulsortian Limestones which are characterised by massive, unbedded lime-mudstone. The associated aquifer is classed as a 'Regionally Important Karstified (diffuse) Aquifer' (Rkd) with a mapped aerial extent of 2,350km$^2$. In Ireland, aquifers in which karst features are more significant are classed as Rk which includes two sub-types, termed Rkc and Rkd[13].

Rkd aquifers are characterised as karstified aquifers in which flow is more diffuse and storage is higher. Examples of Rkd aquifers include those in the pure limestones in Cork, Kilkenny, Offaly and Waterford[14].

[13] Drew, D. 2018. Karst of Ireland: Landscape Hydrogeology Methods. Published by Geological Survey Ireland.

[14] Drew, D. 2018. Karst of Ireland: Landscape Hydrogeology Methods. Published by Geological Survey Ireland.

While bulk aquifer characteristics can be estimated for karstified aquifers, the location and typology of the flow pathways can be difficult to accurately characterise. Consequently, in such aquifers, hydraulic properties can vary greatly over short distances. Typically, in Rkd aquifers there are many high yielding wells (commonly >400 $m^3$/d), and the development of productive bored wells is less difficult compared to Rkc aquifers where yields are much more variable.

The southern portion of the wind farm site (encompassing T4, T5, T6, T7 and T8) is underlain by both a Locally Important Aquifer (Ll) which describes bedrock which is moderately productive only in local zones and a Poor Aquifer (Pl) which describes bedrock which is generally unproductive except for local zones. The Ll aquifer is associated with dark muddy limestone and shale of the Ballysteen Formation and red conglomerate, sandstone and mudstone of the Old Red Sandstone Formation. The Pl aquifer is associated with sandstone, mudstone and thin limestone of the Lower Limestone Shale Formation.

Ll and Pl aquifers are characterized by the following[15]:

- dominated by impure limestones, shales and sandstones, granites and other rock types.
- dominated by poor yielding boreholes (less than 40 $m^3$/d), with fewer and fewer productive boreholes (which tend to be unsustainable over long pumping periods/dry weather spells).
- a high drainage density with low base flow.
- often many small springs and seepages present, that dry out in long periods.

The GCR option routes are underlain by the same classes of aquifers (Rkd and Ll) as the site, as shown in **Figure 9.8b.** Groundwater flow is discussed in section 9.4.11.

[15] Kelly, C., Hunter Williams, T., Misstear, B.M and Motherway, K (2015) Irish Aquifer Properties – A reference manual and guide. Prepared on behalf of the Geological Survey of Ireland and the Environmental Protection Agency.

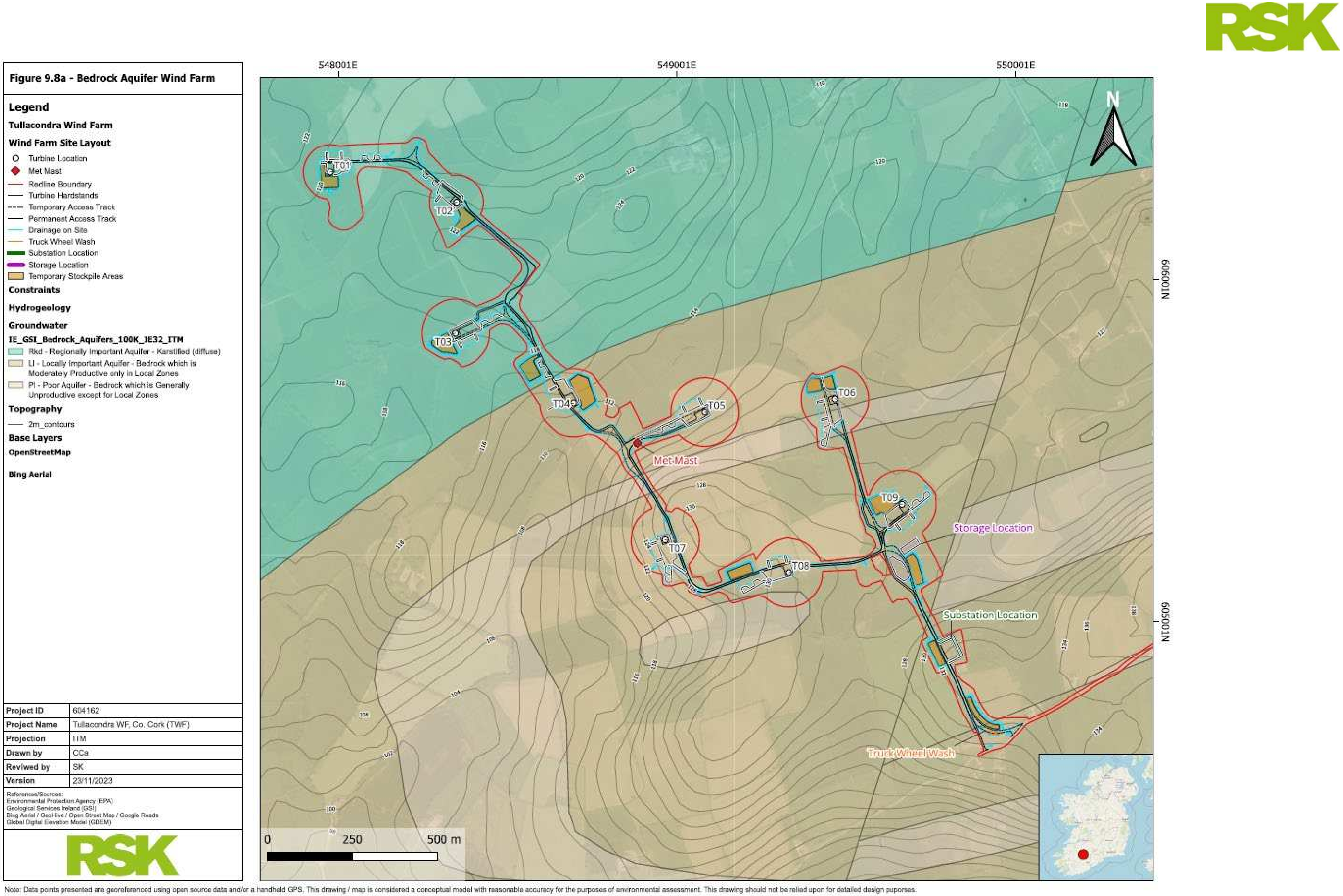
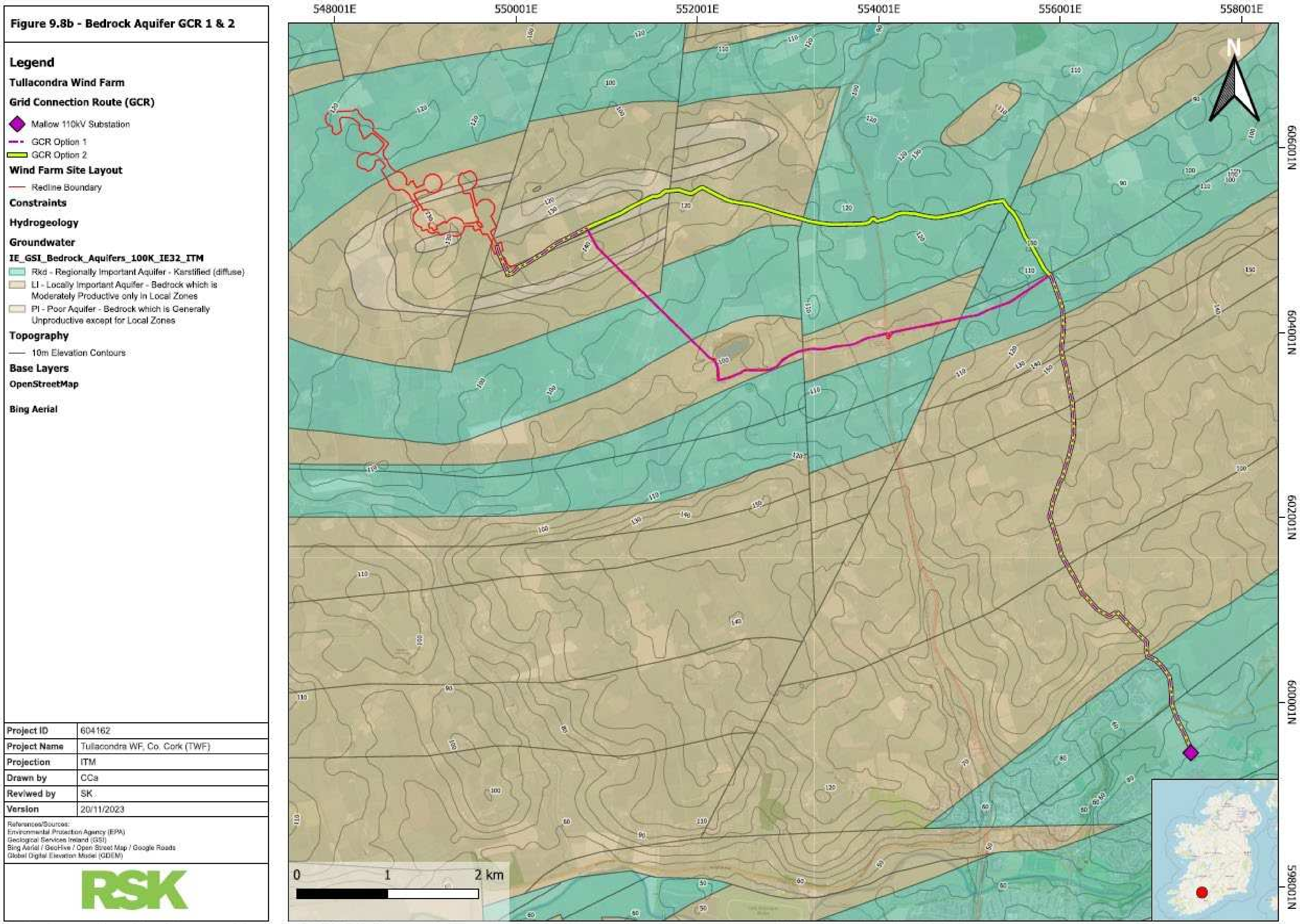



**Figure 9.8a: Bedrock aquifer wind farm site**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.8b: Bedrock aquifer GCR options 1 & 2**

#### 9.4.8.2 *Karst features*

An initial desk-study of the GSI database carried out in 2022 identified various karst features (i.e., potential enclosed depressions and swallow holes) to east of the site (**Table 9.11** and **Figure 9.9a).**

A survey of karst features was carried on the wind farm site to identify potential features that had not been mapped by the GSI. A number of depressions and topographical anomalies were identified. The features identified are presented in **Figure 9.9b** and **Table 9.12**. Each feature was given a field I.D number and description. The elevation of the feature was noted, and this was then compared to the nearest wind farm infrastructure unit elevation.

Two of these features were suspected karst swallow holes which fall within the BLB. One was located east-northeast of T5. The second is located >100m north of T1 (**Figure 9.9a**). Both features are upslope of works and as such the risk of works or runoff draining to these receptors is low. Therefore, there is no direct hydrological connection to the potential karst features. Historical maps indicate a disused quarry located at the same location of the suspected karst feature at T5. Photos of these are presented in EIAR **Volume III, Appendix 9.3 – Tile 7-8**. As mentioned in section 9.4.6 there is a historical watercourse flowing southwest from the BLB which appears to 'go to ground' (**Figure 9.9e**). Based on a review of the information it appears to be a losing stream.

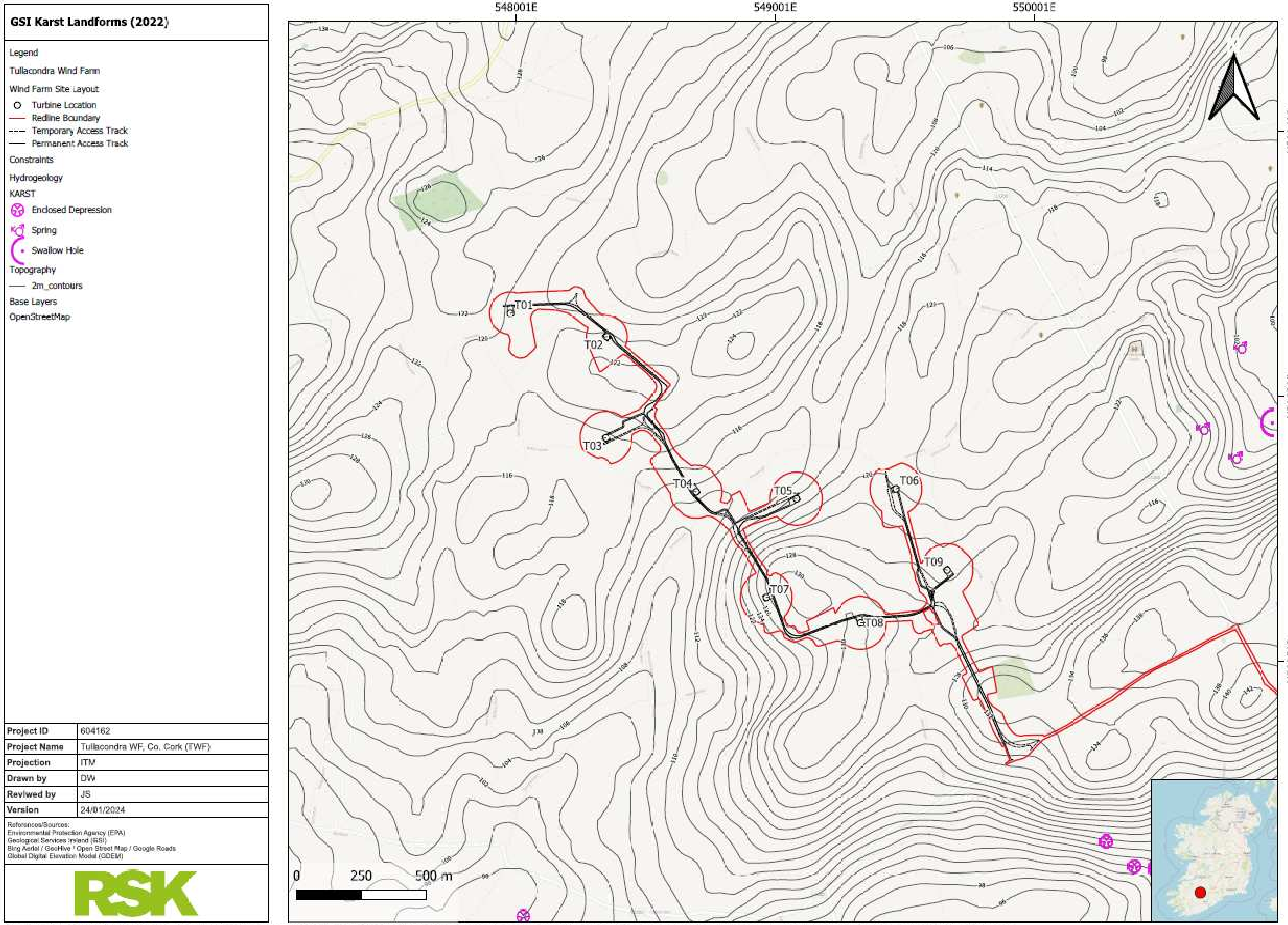
Following the site walkover survey, a geophysical survey (2D resistivity) was carried out to determine if there were any possible voids or weathered rock underneath the proposed turbine locations. Refer to EIAR **Volume III, Appendix 10.1**. The areas highlighted in pink and yellow presented in **Figure 9.9c** as working draft constraints map, were investigated on the ground before determining if there is hydrological connectivity to the works of the Project.

A recent (2024) review of GSI karst features map found it has since been updated to include a greater number of karst features in the area (**Figure 9.9d** and **Table 9.13**). The previously unmapped features that were identified by the RSK Ireland site survey in relative proximity to T1 and T5 have been added to the GSI and are now referred to as a swallow hole and enclosed depression, respectively.

The karst features identified closest to the GCRs is presented in (EIAR **Volume III, Appendix 9.8)**. These features are >15m from the GCR (i.e. outside the buffer zones_ (Refer to EIAR **Chapter 4 Project Need and Alternatives Considered**). However, there are sections of GCR Option 1 that is underlain by a Source Protection Area: Mountnorth Regional Water Supply Scheme (RWSS). Both GCRs are underlain by the Source Protection Area: Oliver Cross Public Water Supply (PWS). Oliver Cross PWS is not currently on the EPA abstraction points register. Source Protection Areas are presented in **Figure 9.9e**.

**Table 9.11: Karst features mapped on GSI as of 2022**

| Karst database | | | | | Proximity to infrastructure | | |
|---|---|---|---|---|---|---|---|
| ID | Description | X (ITM) | Y (ITM) | Elevation (m) | Closest infrastructure | Distance (m) | Elevation of infrastructure (m) |
| IE_GSI_Karst_40K_8467 | Spring | 550652 | 605877 | 116 | T09 | 1122 | 123 |
| IE_GSI_Karst_40K_6955 | Spring | 550778 | 605769 | 107 | T09 | 1191 | 123 |
| IE_GSI_Karst_40K_3207 | Swallow Hole | 550900 | 605902 | 104 | T09 | 1355 | 123 |
| IE_GSI_Karst_40K_4117 | Spring | 550796 | 606184 | 101 | T09 | 1408 | 123 |




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.9a: GSI mapped karst landforms 2022**

Table 9.12: Karst feature survey results (2022)

| Karst database | | | | | Proximity to infrastructure | | |
|---|---|---|---|---|---|---|---|
| ID | Description | X (ITM) | Y (ITM) | Elevation (m) | Closest infrastructure | Distance (m) | Elevation (m) |
| 1 | Suspected Karst Feature, Swallow Hole, small stream from the north sinks at feature. | 548099 | 606544 | 119.7 | T01 | 259.0 | 119.7 |
| 2 | Suspected Karst Feature | 549171 | 605637 | 118.2 | T05 | 91.4 | 116.4 |
| 3 | Depression, Standing Water | 549502 | 604978 | 126.4 | T08 | 239.1 | 130.0 |
| 4 | Depression, Dry but Reeds/Marshy | 549111 | 605132 | 129.0 | T07 | 180.6 | 127.6 |
| 5 | Depression, Standing Water, low Surface water conductivity (90 uS/cm therefore a surface water feature | 548016 | 606193 | 118.7 | T01 | 127.2 | 119.7 |
| 6 | Depression, Archaeological | 548803 | 605076 | 116.5 | T07 | 233.0 | 127.6 |
| 7 | Depression, Standing Water | 547791 | 606241 | 120.8 | T01 | 201.5 | 119.7 |
| 8 | Depression, Standing Water | 547692 | 606197 | 120.6 | T01 | 309.6 | 119.7 |
| 9 | Depression, Standing Water | 547594 | 606228 | 120.6 | T01 | 394.0 | 119.7 |
| 10 | Depression, Dry but Reeds/Marshy | 548009 | 606460 | 120.0 | T01 | 148.7 | 119.7 |
| 11 | Depression, Dry but Reeds/Marshy | 547874 | 606633 | 122.0 | T01 | 335.1 | 119.7 |
| 12 | Depression, Dry but Reeds/Marshy | 548676 | 606674 | 112.6 | T02 | 553.7 | 120.3 |

| Karst database | | | | | Proximity to infrastructure | | |
|---|---|---|---|---|---|---|---|
| **ID** | **Description** | **X (ITM)** | **Y (ITM)** | **Elevation (m)** | **Closest infrastructure** | **Distance (m)** | **Elevation (m)** |
| 13 | Depression, Dry but Reeds/Marshy | 548567 | 606812 | 113.5 | T02 | 624.2 | 120.3 |
| 14 | Depression, Dry but Reeds/Marshy | 549570 | 605044 | 125.4 | T08 | 259.3 | 130.0 |
| 15 | Depression, Standing Water | 549592 | 605121 | 126.6 | T09 | 235.3 | 123.0 |
| 16 | Depression, Topographical | 548535 | 606384 | 113.9 | T02 | 242.2 | 120.3 |
| 17 | Depression, Topographical | 549233 | 606121 | 113.2 | T06 | 524.9 | 120.0 |

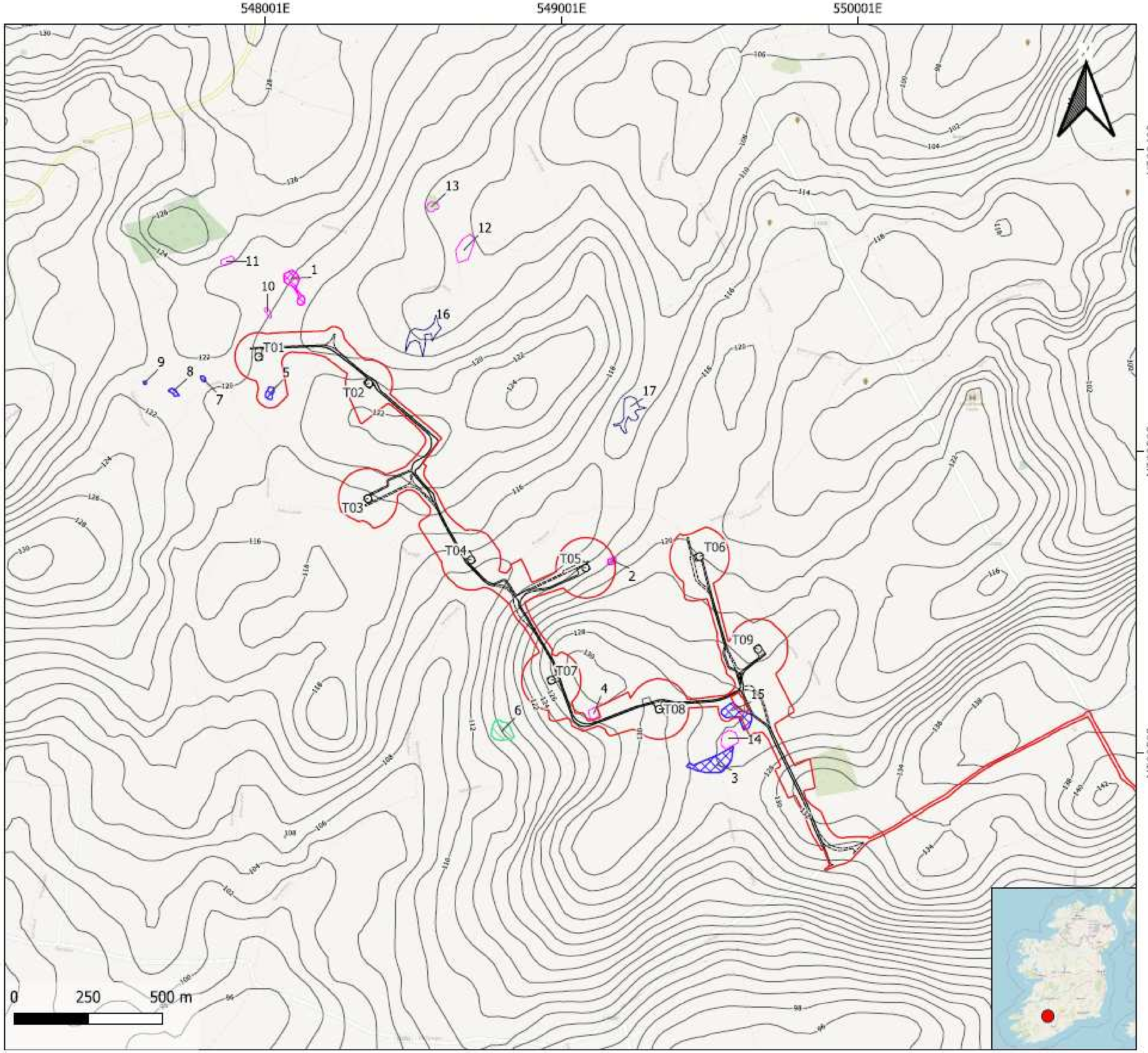
**Site Observations**

Legend
Tullacondra Wind Farm
Wind Farm Site Layout
- Turbine Location
- Redline Boundary
- Temporary Access Track
- Permanent Access Track

Constraints
Geology
Observed Features - Geology, Karst, etc.
- Depression, Archaelogical
- Depression, Dry but Reeds/Marshy
- Depression, Standing Water
- Karst Feature, Swallow Hole
- Depression, Topographical

Topography
- 2m_contours

Base Layers
OpenStreetMap




| | |
|---|---|
| **Project ID** | 604162 |
| **Project Name** | Tullacondra WF, Co. Cork (TWF) |
| **Projection** | ITM |
| **Drawn by** | DW |
| **Reviwed by** | JS |
| **Version** | 24/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)

Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.9b: Site survey observations 2022**

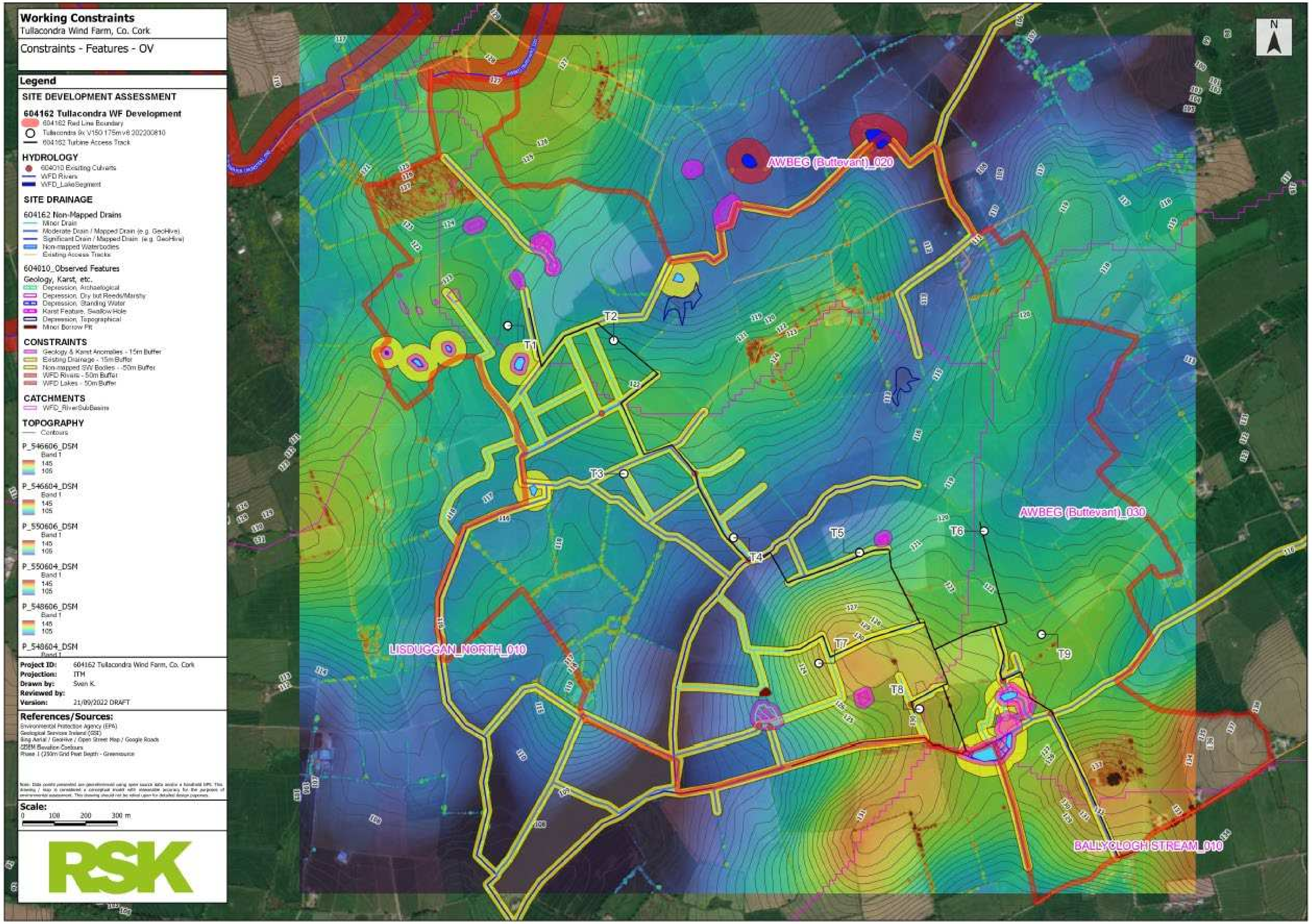
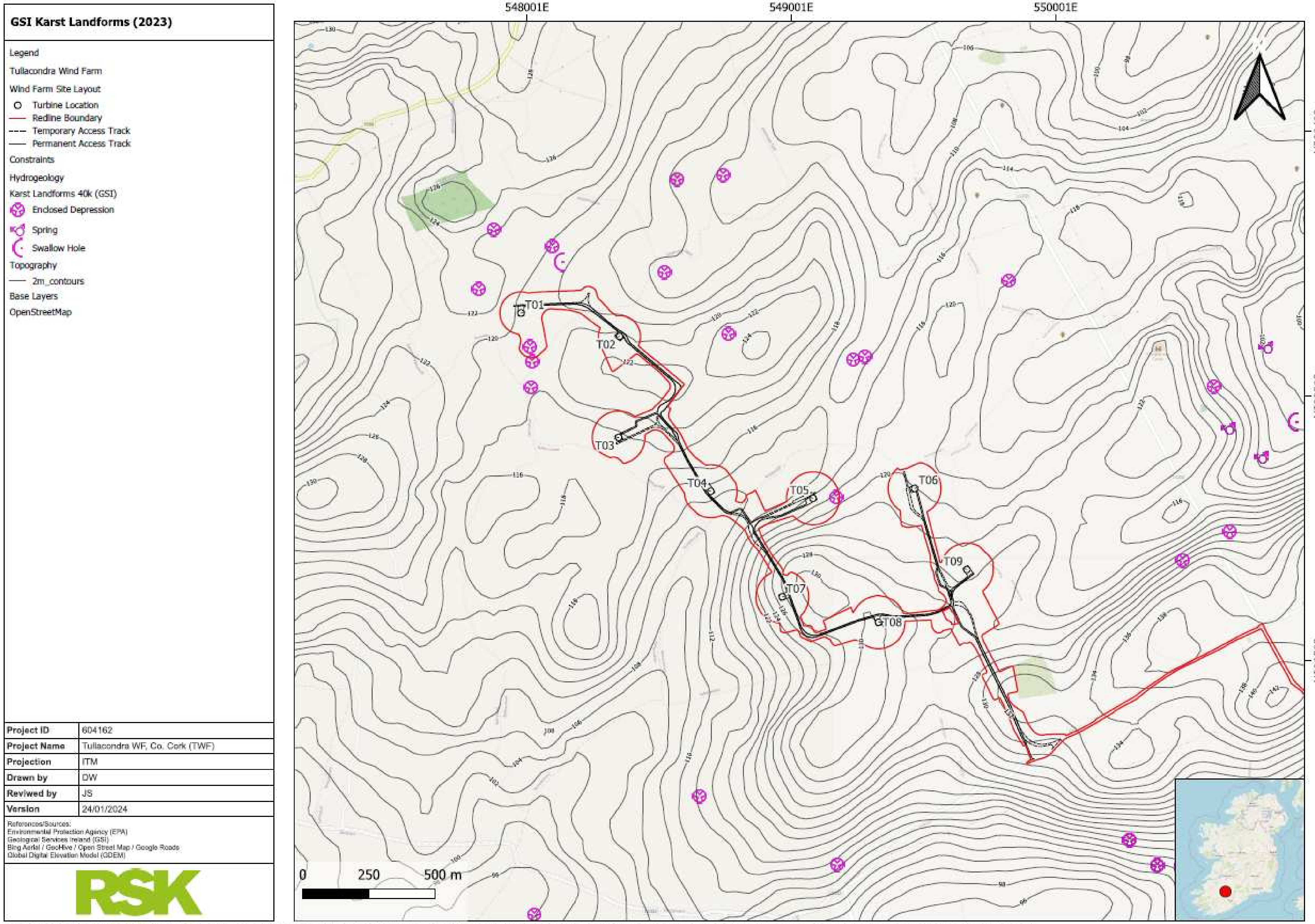



**Figure 9.9c: Draft constraints. Topographical analysis**

**Table 9.13: GSI mapped karst features (2023) compared with identified karst features found on site**

| ID | 2023 | 2022 | Survey ID | Description | X (ITM) | Y (ITM) | Elevation (m) at karst | Closest infrastructure | Distance (m) | Elevation (m) at infrastructure |
|---|---|---|---|---|---|---|---|---|---|---|
| IE_GSI_Karst_40K_16482 | Y | | 2 | Enclosed Depression & Disused Quarry | 549172 | 605619 | 119 | T05 | 89 | 116 |
| IE_GSI_Karst_40K_16860 | Y | | 5 | Enclosed Depression | 548011 | 606189 | 119 | T01 | 130 | 120 |
| IE_GSI_Karst_40K_16857 | Y | | | Enclosed Depression | 547817 | 606407 | 123 | T01 | 186 | 120 |
| IE_GSI_Karst_40K_16859 | Y | | | Enclosed Depression | 548021 | 606132 | 119 | T01 | 188 | 120 |
| IE_GSI_Karst_40K_16481 | Y | | 1 | Swallow Hole | 548123 | 606507 | 119 | T01 | 241 | 120 |
| IE_GSI_Karst_40K_16863 | Y | | 1 | Enclosed Depression | 548097 | 606567 | 120 | T01 | 279 | 120 |
| IE_GSI_Karst_40K_16861 | Y | | | Enclosed Depression | 548015 | 606033 | 119 | T01 | 284 | 120 |
| IE_GSI_Karst_40K_16856 | Y | | | Enclosed Depression | 548522 | 606468 | 113 | T02 | 296 | 120 |
| IE_GSI_Karst_40K_16858 | Y | | 11 | Enclosed Depression | 547876 | 606629 | 122 | T01 | 331 | 120 |
| IE_GSI_Karst_40K_16485 | Y | | | Enclosed Depression | 548765 | 606236 | 123 | T02 | 414 | 120 |
| IE_GSI_Karst_40K_16484 | Y | | 17 | Enclosed Depression | 549282 | 606149 | 114 | T06 | 531 | 120 |
| IE_GSI_Karst_40K_16550 | Y | | 17 | Enclosed Depression | 549235 | 606139 | 113 | T06 | 540 | 120 |

| ID | 2023 | 2022 | Survey ID | Description | X (ITM) | Y (ITM) | Elevation (m) at karst | Closest infrastructure | Distance (m) | Elevation (m) at infrastructure |
|---|---|---|---|---|---|---|---|---|---|---|
| IE_GSI_Karst_40K_16611 | Y | | 13 | Enclosed Depression | 548568 | 606820 | 113 | T02 | 632 | 120 |
| IE_GSI_Karst_40K_16862 | Y | | | Enclosed Depression | 548744 | 606835 | 112 | T02 | 725 | 120 |
| IE_GSI_Karst_40K_16552 | Y | | | Enclosed Depression | 550480 | 605379 | 129 | T09 | 816 | 123 |
| IE_GSI_Karst_40K_16095 | Y | | | Enclosed Depression | 548653 | 604487 | 112 | T07 | 817 | 128 |
| IE_GSI_Karst_40K_16483 | Y | | | Enclosed Depression | 549823 | 606438 | 118 | T06 | 863 | 120 |
| IE_GSI_Karst_40K_16551 | Y | | | Enclosed Depression | 550659 | 605488 | 127 | T09 | 1004 | 123 |
| IE_GSI_Karst_40K_8467 | Y | Y | | Spring | 550652 | 605877 | 116 | T09 | 1122 | 123 |
| IE_GSI_Karst_40K_3342 | Y | | | Spring | 550652 | 605877 | 116 | T09 | 1122 | 123 |
| IE_GSI_Karst_40K_16610 | Y | | | Enclosed Depression | 550601 | 606036 | 111 | T09 | 1163 | 123 |
| IE_GSI_Karst_40K_6955 | Y | Y | | Spring | 550778 | 605769 | 107 | T09 | 1191 | 123 |
| IE_GSI_Karst_40K_8466 | Y | | | Spring | 550778 | 605769 | 107 | T09 | 1191 | 123 |
| IE_GSI_Karst_40K_3207 | Y | Y | | Swallow Hole | 550900 | 605902 | 104 | T09 | 1355 | 123 |
| IE_GSI_Karst_40K_8465 | Y | | | Swallow Hole | 550900 | 605902 | 104 | T09 | 1355 | 123 |
| IE_GSI_Karst_40K_4117 | Y | Y | | Spring | 550796 | 606184 | 101 | T09 | 1408 | 123 |
| IE_GSI_Karst_40K_7171 | Y | | | Spring | 550796 | 606184 | 101 | T09 | 1408 | 123 |




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.9d: GSI mapped karst landforms 2023**

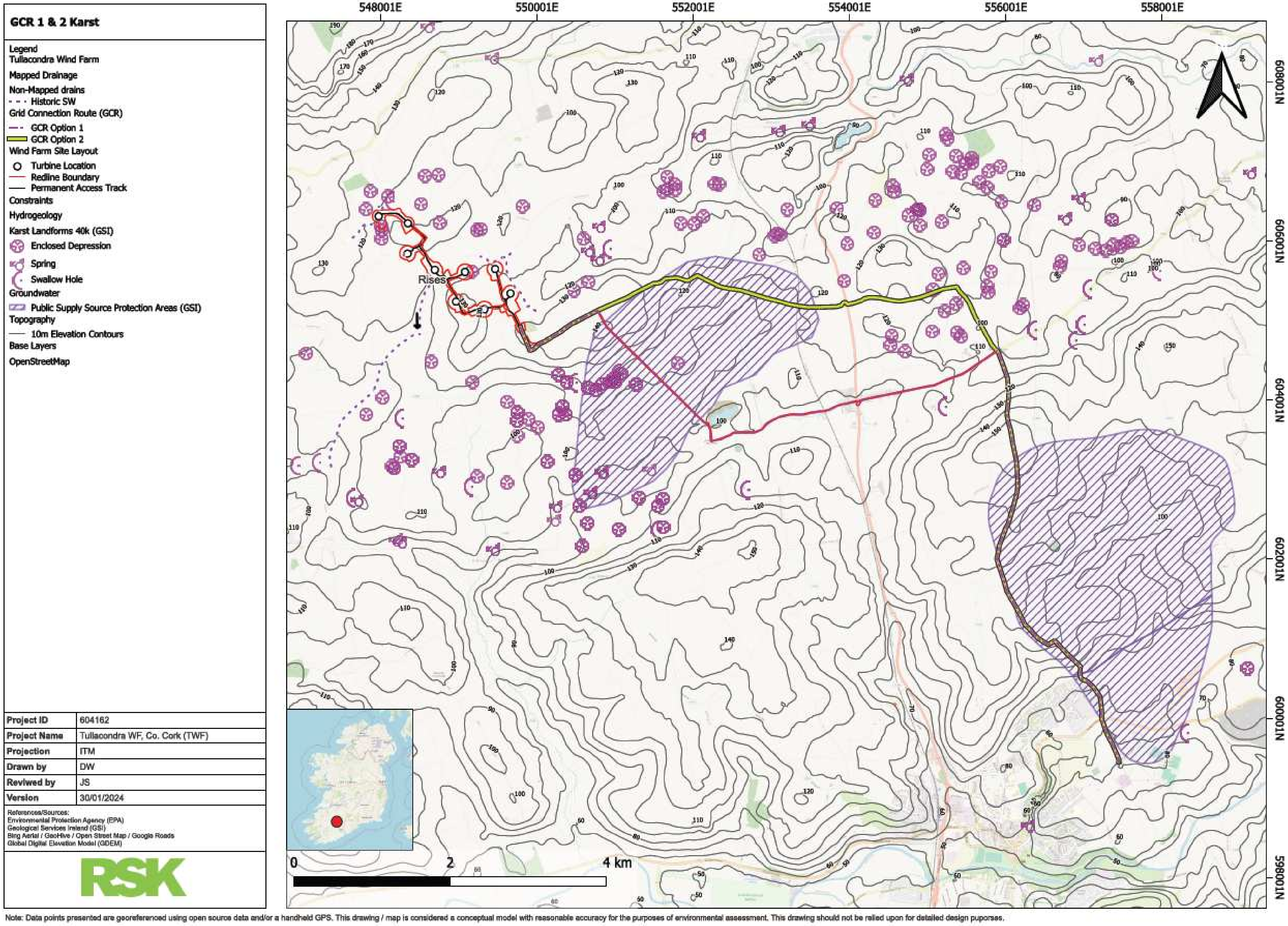



**Figure 9.9e: GSI mapped karst landforms along GCR options 1 & 2 (2023)**

*9.4.8.3 Aquifer vulnerability*

The term 'vulnerability' is used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

The GSI vulnerability mapping guidelines (**Table 9.14**) allow for the assignment of vulnerability ratings from "extreme" to "low", depending upon the subsoil type and thickness. An additional "X" category is used to denote areas of bedrock outcrop or subcrop, or within 30m of a location of point recharge such as a karst feature.

**Table 9.14: Groundwater vulnerability mapping guidelines (Lee et al. 2008[16]).**

| Depth to rock | Hydrogeological Requirements for Vulnerability Categories | | | | |
|---|---|---|---|---|---|
| | Diffuse recharge | | | Point Recharge | Unsaturated Zone |
| | high permeability (*sand/gravel*) | Moderate permeability (*sandy subsoil*) | low permeability (*clayey subsoil, clay, peat*) | (*swallow holes, losing streams*) | (*sand & gravel aquifers only*) |
| 0–3 m | **Extreme** | **Extreme** | **Extreme** | **Extreme (30 m radius)** | **Extreme** |
| 3–5 m | **High** | **High** | **High** | **N/A** | **High** |
| 5–10 m | **High** | **High** | **Moderate** | **N/A** | **High** |
| >10 m | **High** | **Moderate** | **Low** | **N/A** | **High** |

*i N/A = not applicable.*
*ii Release point of contaminants is assumed to be 1–2 m below ground surface.*
*iii Permeability classifications relate to the engineering behaviour as described by BS5930.*
*iv Outcrop and shallow subsoil (i.e. generally <1.0 m) areas are shown as a sub-category of extreme vulnerability.*
*(amended from Deakin and Daly (1999) and DELG/EPA/GSI (1999))*

The Namurian Subsoils on the wind farm site are considered as Moderate permeability (**Figure 9.10b).** The wind farm site is underlain by areas classified with Rock near surface or karst (X) 'Extreme (E)'; 'High (H)'; and 'Moderate (M)' vulnerability ratings (as shown in **Figure 9.10a**). A summary of the mapped groundwater vulnerability associated with each turbine location is presented in Table 15.

Further details on the expected overburden and bedrock material are presented in **Table 10.6** of EIAR **Chapter 10 Soils and Geology.** Subsoil permeability at the wind farm site is presented in **Figure 9.10b.**

A linear feature, consistent with site drainage channels, has been assigned an "X" groundwater vulnerability rating. This is due to connectivity to a karst feature further downstream or to a sinking stream. This linear feature passes to the west of locations T4 and T3 and crosses the red line boundary between T1 and T2.

[16] Lee, M., Hunter Williams, N., Meehan, R., Kelly, R., Kabza, M., Murphy, O and Spillane, M (2008) Groundwater Vulnerability Mapping. Irish National Hydrology Conference.

Also presented in Table 15 is a summary of the depth to bedrock obtained from geophysical 2D resistivity survey of each location. Based off site specific data and mapping there are some differences between the vulnerability map and the geophysical survey data, which is likely a result of the limited accuracy of groundwater vulnerability maps. For instance, at location T3, the high vulnerability rating (and moderate subsoil permeability rating) indicates subsoil depth of between 3-5m, however, the geophysical survey indicates depths of >15m. The vulnerability rating should therefore be moderate. The site-specific data from the geophysical survey (see **Table 10.6** in EIAR **Chapter 10 Soils and Geology**) should be considered the most accurate representation of site conditions. The grid connection routes similarly traverse land with groundwater vulnerability ratings ranging from moderate (M) to extreme (E/X) vulnerability as shown in **Figure 9.11a**. Subsoil permeability of the GCR options are presented in **Figure 9.11b**. Furthermore, the GCR also passes over EPA mapped Source Protection Areas for ground water abstraction. Refer to EIAR **Volume III, Appendix 10.2b** for identified constraints along the GCR Option 1 and 2. Refer to EIAR **Volume III, Appendix 10.3a and 10.3b** for identified constraints along the TDR Option 1 & 2.

**Table 9.15: Groundwater vulnerability rating associated with each turbine location.**

| Turbine No. / Unit | Mapped Groundwater Vulnerability (GSI) | Depth to bedrock (m) (Geophysical Survey) | Updated based on Geophysics and Karst Features |
|---|---|---|---|
| T1 | High | 10.0 | Moderate to High |
| T2 | Extreme | 9.0 | High |
| T3 | High | >15.0 | Moderate |
| T4 | Moderate / High | >15.0 | Moderate |
| T5 | High | 3.5-7.0 | High |
| T6 | Moderate | >15.0 | Moderate |
| T7 | Extreme | 2.0 - 3.0 | Extreme |
| T8 | High | >15.0 | Moderate |
| T9 | Moderate | 10.0 | Moderate |
| Substation | Bedrock | 2.0 - 6.0 | High to X |

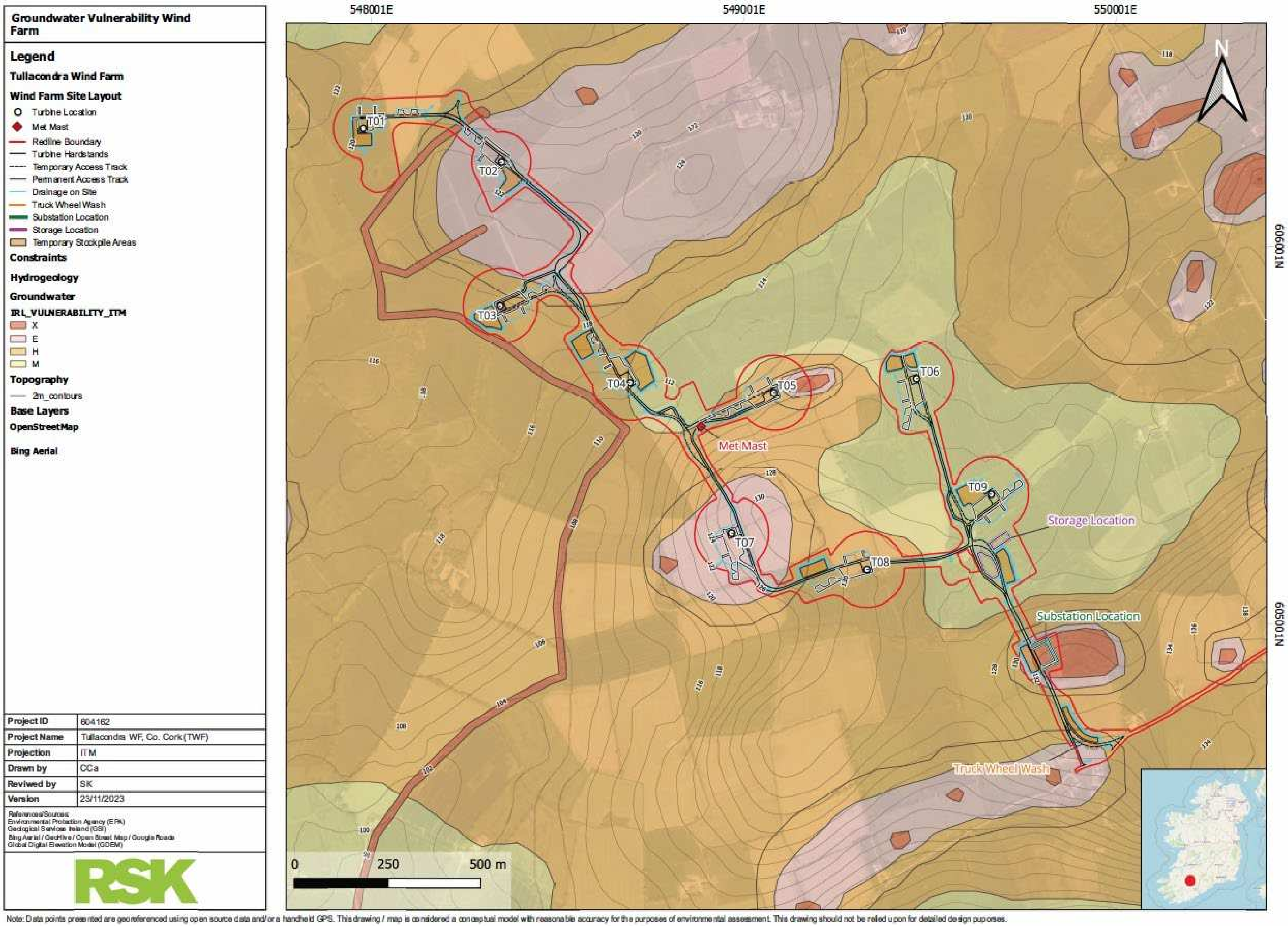


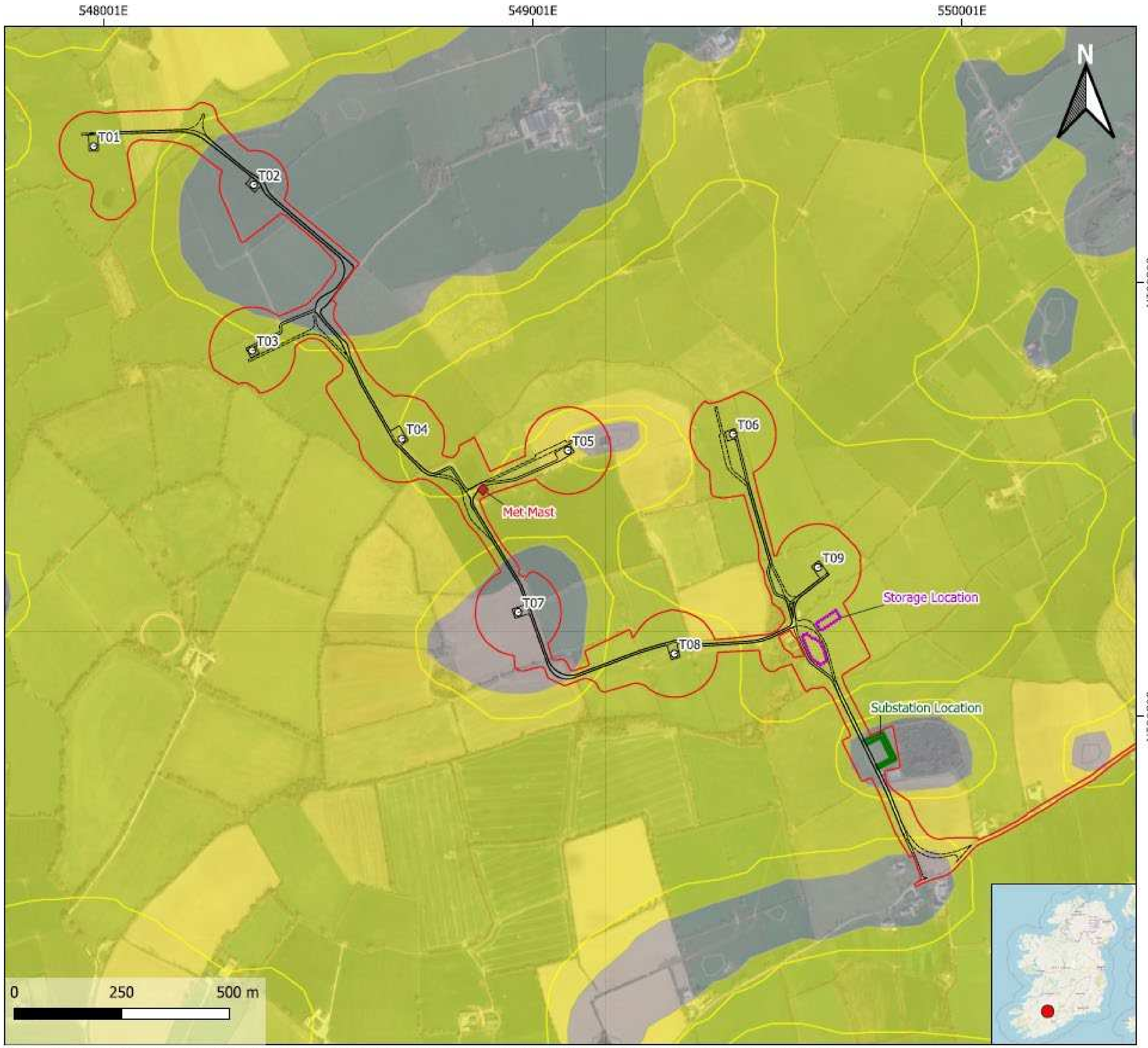

**Figure 9.10a: Groundwater vulnerability wind farm**

## Subsoil Permeability Wind Farm

Legend
Tullacondra Wind Farm
Wind Farm Site Layout
- Turbine Location
- Met Mast
- Redline Boundary
- Temporary Access Track
- Permanent Access Track
- Substation Location
- Storage Location

Constraints
Geology
IE_GSI_Subsoil_Permeability_40K_IE26_ITM
- Moderate
- Not mapped

Base Layers
Google Satellite




| | |
|---|---|
| **Project ID** | 604162 |
| **Project Name** | Tullacondra WF, Co. Cork (TWF) |
| **Projection** | ITM |
| **Drawn by** | DW |
| **Revived by** | JS |
| **Version** | 24/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)

Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.10b: Subsoil permeability wind farm**

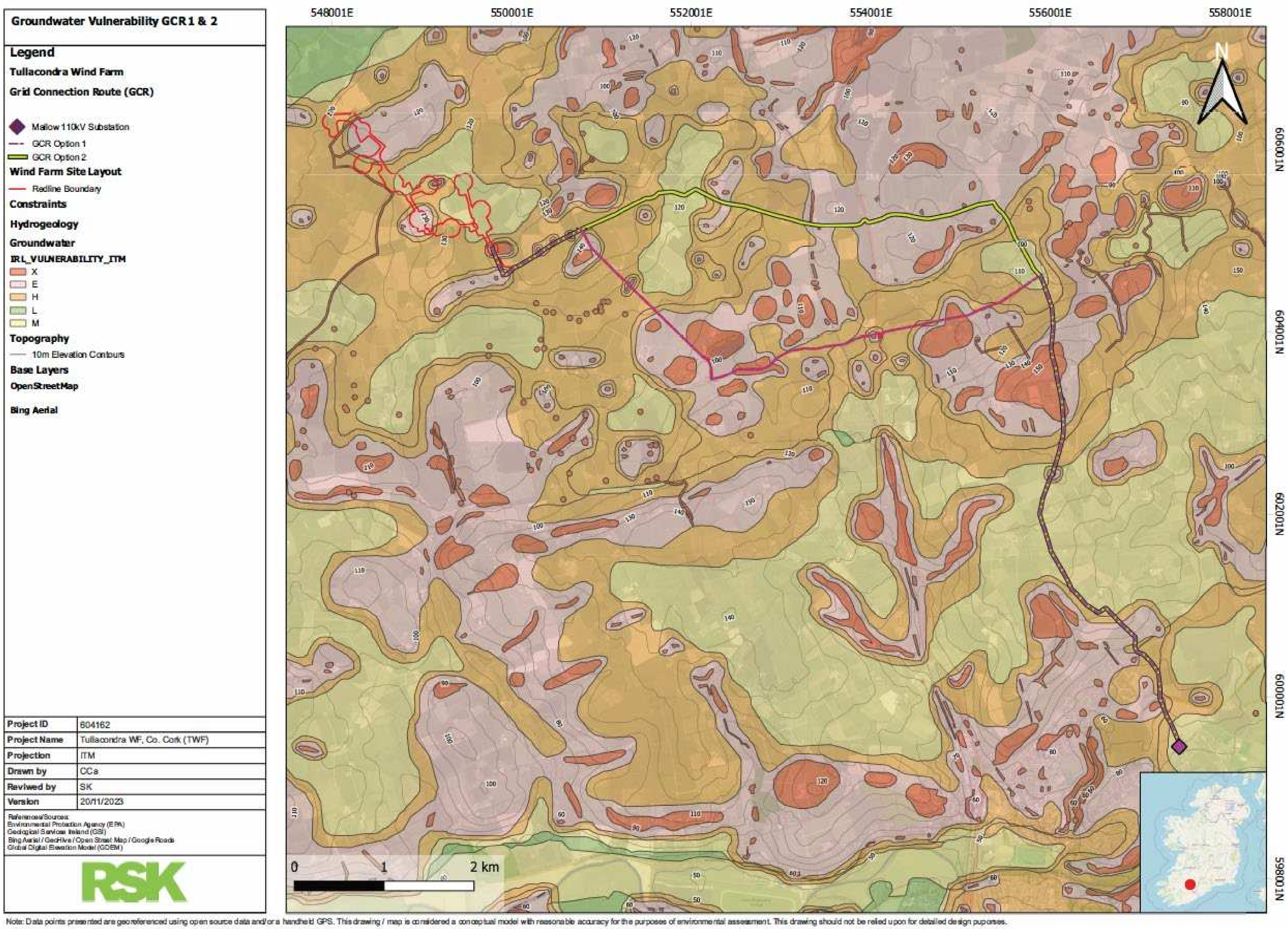



**Figure 9.11a: Groundwater vulnerability GCR options 1 & 2**

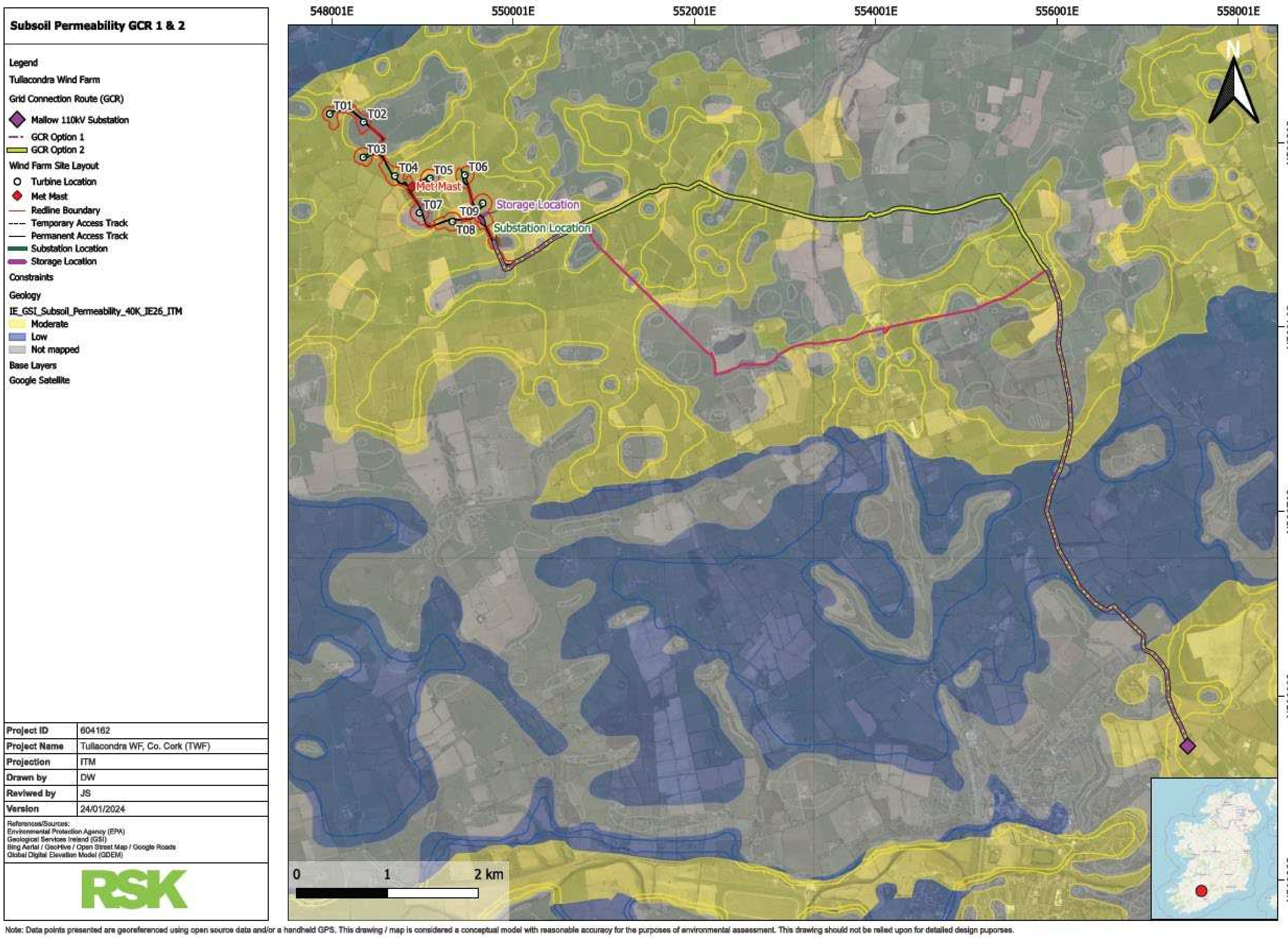



**Figure 9.11b: Subsoil permeability GCR options 1 & 2**

*9.4.8.4 Recharge*

Groundwater recharge properties of the area can be derived from the groundwater recharge map provided by the GSI (**Figure 9.12a**). With respect to climatic variables, the map is generated from Met Éireann's 30-year average rainfall and actual evapotranspiration for the period 1971-2000. For the wind farm site and GCR, the map shows effective rainfall (total rainfall – actual evapotranspiration) ranging from 627 to 737 mm/yr.

The volume of effective rainfall likely to reach groundwater (i.e., recharge) is estimated from recharge coefficients compiled by the Irish Working Group on Groundwater[17], which are based on soil drainage, subsoil permeability, vulnerability and aquifer type.

Most of the wind farm site has been assigned a recharge coefficient of 20%. For the northern portion of the site (including T1, T2 and T3) which is underlain by the Rkd classified aquifer this gives rise to estimated recharge ranging from 401-405 mm/yr. However, for the southern part of this site (including T4, T5, T6, T7, T8 and T9) a recharge cap has been applied due to the LI and PI aquifer classification as their intrinsic properties limit their ability to accept recharge which in turn is rejected as runoff. Consequently, recharge caps of 100 mm/yr and 200 mm/yr are applied to the PI and LI aquifers, respectively.

The linear feature that has been assigned an "X" groundwater vulnerability rating (section 9.4.8.3) has been assigned a recharge coefficient of 85% which gives rise to recharge estimates ranging from 601-700 mm/yr. As outlined with respect to vulnerability, this is likely due to assumed connectivity to karst features.

In summary, primarily due to aquifer characteristics, recharge rates differ significantly between the north and south of the wind farm site. In areas to the south where recharge caps are applied to LI and PI aquifers, significant quantities of the effective rainfall will drain off the site as surface water runoff. In contrast, intrinsic properties of the Rkd aquifer to the north will facilitate higher levels of recharge.

Recharge rates vary significantly over the potential GCRs and are similarly controlled by the underlying aquifer properties. Of note are areas that have been assigned an 85% recharge coefficient due to karst aquifer properties. Groundwater recharge for the GCRs is presented in **Figure 9.12b**.

[17] Working Group on Groundwater, 2005. Guidance on the Assessment of the Impact of Groundwater Abstractions.

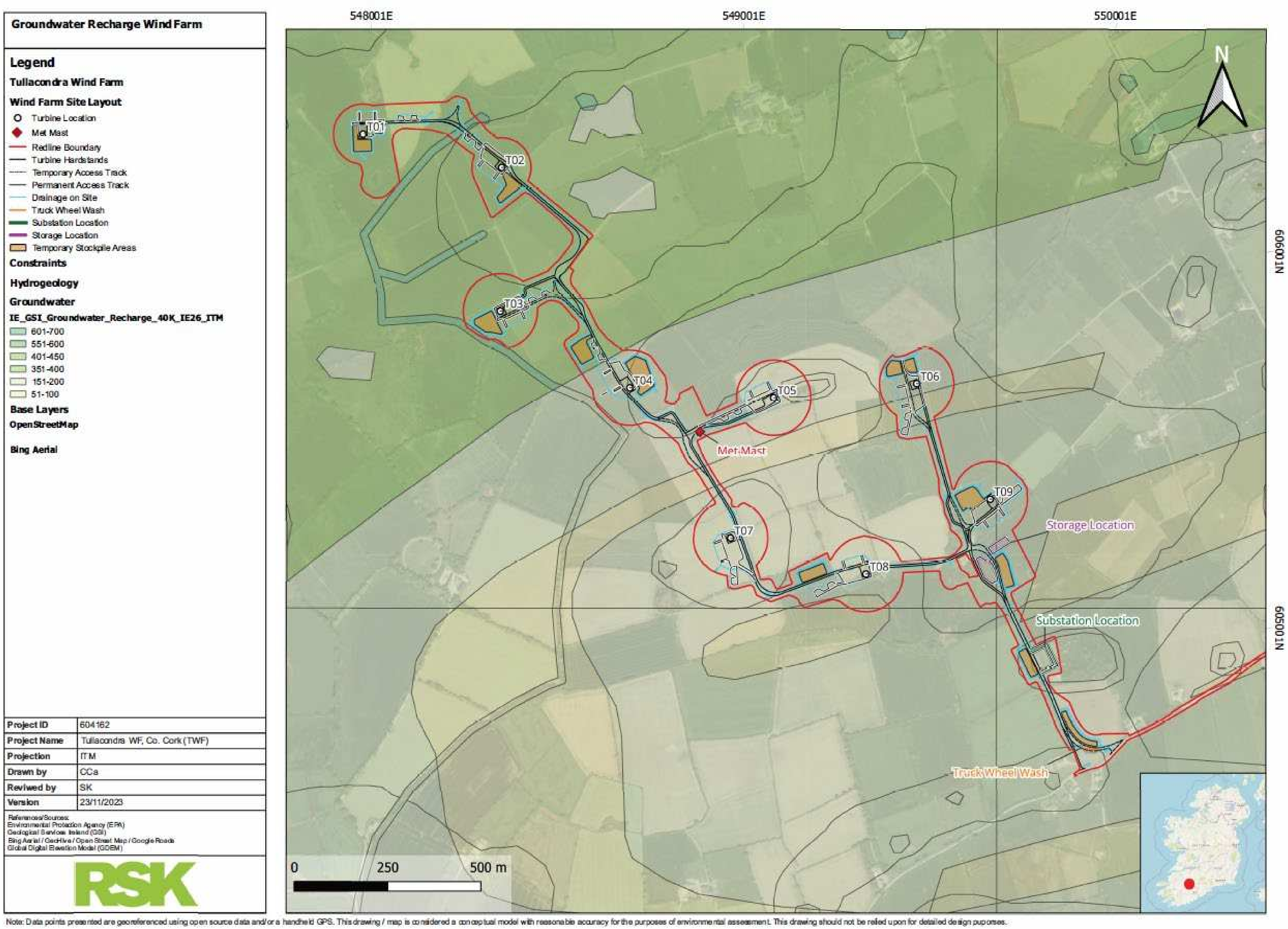



**Figure 9.12a: Groundwater recharge wind farm**

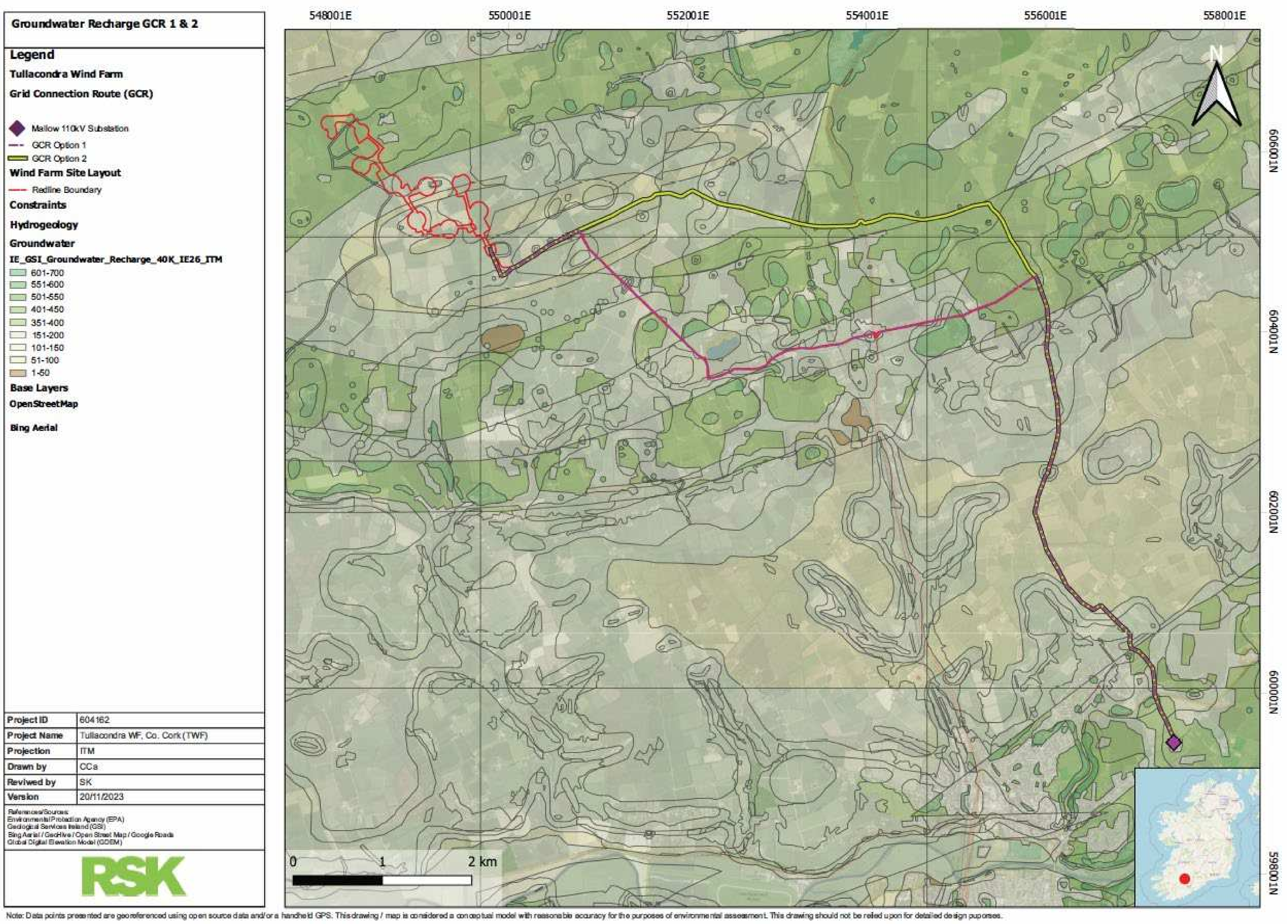



**Figure 9.12b: Groundwater recharge GCR options 1 & 2**

#### 9.4.8.5 *Connections to groundwater*

The historical drainage feature associated with the wind farm site is presented in **Figure 9.6a** containing potential surface water runoff is assumed to recharge to groundwater at a location southwest of the RLB. This is underlain by a regionally important karst aquifer. This is not to a groundwater source protection area.

### 9.4.9 Flood risk identification

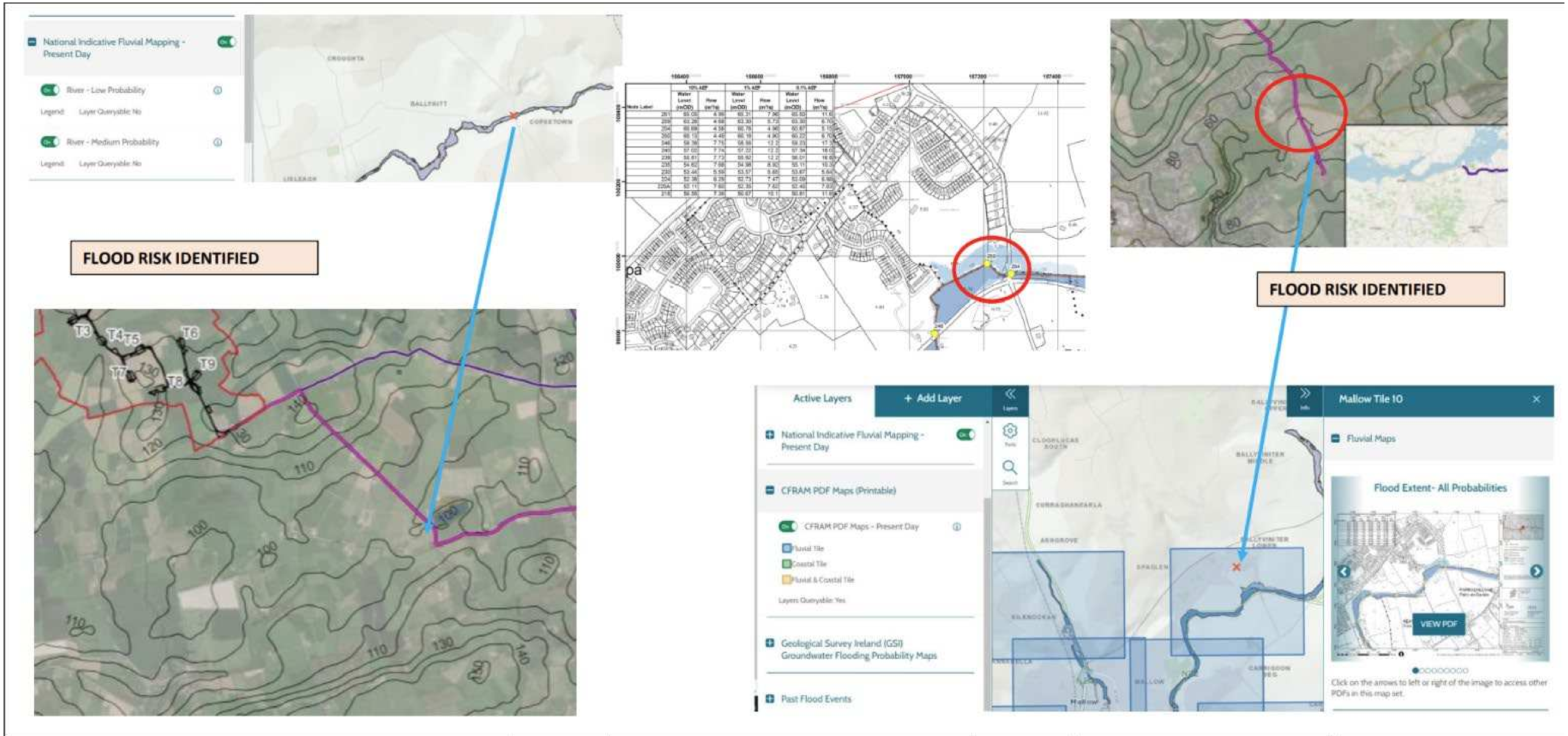
A standalone site FRA Stages 1 & 2 for the wind farm site has been prepared as part of this EIAR (EIAR **Volume III, Appendix 9.5)**. This FRA details site-specific rainfall and evapotranspiration rates as well as a preliminary water balance assessment for the estimated baseline runoff conditions and the estimated post development conditions at the site. A preliminary flood risk screening is presented in **Figure 9.13.**

The following is copied from the FRA conclusions:

**FRA Stage 1**

- The proposed site is not within a probable fluvial flood zone A, B, or C. However there has been risk of fluvial flooding identified in proximity of the GCR (**Plate 9.3**).

**Plate 9.3: Flood risk identified along GCR Option 1**




| | | | | |
|---|---|---|---|---|
| Site Name:<br>**Tullacondra Green Energy Project, Co. Cork** | **Project No.** | 604162 | **Drawn By:** | Colleen McClung<br>Graduate Project Scientist |
| | **Client:** | Tullacondra Green Energy Ltd | | |
| Figure Name:<br>**Appendix 9.4 - Conceptuel & Information Graphics – Tile 28 Identified Flood Risk Along Grid Connection Route** | **Date:** | 27/02/2023 | **Reviewed By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Revision:** | 00 | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

- There is no risk from groundwater flooding on the wind farm site. The closest mapped past groundwater flooding is c.0.55km SE from T6.
- The nearest past flood event is located 0.9km East to T6 in 2005.
- The nature of the Project is industrial as opposed to residential or leisure, and as such, this type of development is categorized as a 'Less Vulnerable Development', according to Flood Risk Management Guidelines. Therefore, the development is considered an 'appropriate' development for Flood Zone C, i.e., any area residing outside of Flood Zones A and B.
- The Project has the potential to lead to a net decrease in recharge potential and net increase in the hydrological response to rainfall at the site, potentially leading to adverse effects on flood risk areas downstream of the site. The extent of the risk of flooding and potential effect of a development on flooding elsewhere (downstream) requires FRA Stage 2.

**FRA Stage 2**

- A 1 in 100-year storm event scenario results in a net increase of surface water runoff equating to 0.17 $m^3$/second or 0.83% relative to the site area associated with the development, calculated using the BLB. This net increase relative to the scale of the site or the scale of the associated catchment is considered an **adverse but imperceptible or negligible** effect of the Project.
- The proposed development will include in its design and use the latest best practice guidance to ensure that flood risk within or downstream of the site is not increased as a function of the development[18], i.e., a neutral effect at a minimum. This means that the attenuation capacity in the constructed drainage network associated with the development will have capacity to attenuate the calculated net increase during a 1 in 100-year storm event.
- A detailed Surface Water Management Plan (SWMP) has been prepared as part of the CEMP (EIAR **Volume III, Appendix 5.1**) and will be updated prior to the construction phase commencing, with a view to ensuring that the surface water runoff at the site is managed effectively and does not exacerbate flood risk to the surrounding areas downstream. The CEMP will be updated in consultation with the Local Planning Authority, Inland Fisheries Ireland and the NPWS.
- As the associated drainage - some of which is permanent for the lifetime of the development, will be attenuated for greenfield run-off, the Project will not increase the risk of flooding elsewhere in the catchment. Based on this information, the Project complies with the appropriate policy guidelines for the area and is at no risk of flooding.

[18] Office of Public Works (OPW) (2009) The Planning Systems and Flood Risk Management: Guidelines for Planning Authorities

| Category | Flood Risk Preliminary Screening<br>(RSK File Ref. 604162-Hydro-R01-(01))<br>(SK, JS 17/07/2023) | Annual Exceedance Probability (%) | Chance of Occurrence in any Given Year | Return Period (Years) | Considers Flood Defences | Considers Climate Change | Site Assessment Screening result, flood zone on site? | Comment |
|---|---|---|---|---|---|---|---|---|
| National Indicitive Fluvial Mapping Present Day | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | Assumed Yes | No | |
| National Indicitive Fluvial Mapping Present Day | Medium Probability | 1 | 1 in 200 | 100 | Assumed Yes | Yes | No | |
| National Indicitive Fluvial Mapping Mid End Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | Yes | No | |
| National Indicitive Fluvial Mapping Mid End Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Assumed Yes | Yes | No | |
| National Indicitive Fluvial Mapping High End Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | Yes | No | |
| National Indicitive Fluvial Mapping High End Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Assumed Yes | Yes | No | |
| CCFRAM River (Fluvial ) Flood Extents Present Day | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | Assumed No | No | |
| CCFRAM River (Fluvial ) Flood Extents Present Day | Medium Probability | 1 | 1 in 100 | 100 | Assumed Yes | No | No | |
| CCFRAM River (Fluvial ) Flood Extents Present Day | High Probability | 10 | 1 in 10 | 10 | Assumed Yes | No | No | |
| CCFRAM River (Fluvial ) Flood Extents Mid Range Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | YES | No | |
| CCFRAM River (Fluvial ) Flood Extents Mid Range Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Assumed Yes | YES | No | |
| CCFRAM River (Fluvial ) Flood Extents Mid Range Future Sceanorio | High Probability | 10 | 1 in 10 | 10 | Assumed Yes | YES | No | |
| CCFRAM River (Fluvial ) Flood Extents High End Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | YES | No | |
| CCFRAM River (Fluvial ) Flood Extents High End Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Assumed Yes | YES | No | |
| CCFRAM River (Fluvial ) Flood Extents High End Future Sceanorio | High Probability | 10 | 1 in 10 | 10 | Assumed Yes | YES | No | |
| Past flood events | single | | | | Assumed Yes | No | No | |
| Past flood events | reoccuring | | | | Assumed Yes | No | Yes | 0.9km east of T6 |
| Past flood events | Groundwater | | | | Assumed Yes | No | Yes | 0.55km east of T6 |
| CCFRAM Coastal Flood Extents Present Day | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | No | No | |
| CCFRAM Coastal Flood Extents Present Day | Medium Probability | 1 | 1 in 100 | 100 | Assumed Yes | No | No | |
| CCFRAM Coastal Flood Extents Present Day | High Probability | 10 | 1 in 10 | 10 | Assumed Yes | No | No | |
| CCFRAM PDF Maps | | | | | | No | No | |
| National Coastal Flood Hazard Mapping PRESENT DAY | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed No | No | No | |
| National Coastal Flood Hazard Mapping PRESENT DAY | Medium Probability | 0.5 | 1 in 200 | 200 | No | No | No | |
| National Coastal Flood Hazard Mapping PRESENT DAY | High Probability | 10 | 1 in 10 | 10 | No | No | No | |
| National Coastal Flood Hazard mapping Mid Range Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Assumed Yes | YES | No | |
| National Coastal Flood Hazard mapping Mid Range Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Yes | YES | No | |
| National Coastal Flood Hazard mapping Mid Range Future Sceanorio | High Probability | 10 | 1 in 10 | 10 | Yes | YES | No | |
| National Coastal Flood Hazard mapping High End Future Sceanorio | Low Probability | 0.1 | 1 in 1000 | 1000 | Yes | YES | No | |
| National Coastal Flood Hazard mapping High End Future Sceanorio | Medium Probability | 0.5 | 1 in 200 | 200 | Yes | YES | No | |
| National Coastal Flood Hazard mapping High End Future Sceanorio | High Probability | 10 | 1 in 10 | 10 | Yes | YES | No | |

**Figure 9.13: Preliminary Flood Risk Screening**

### 9.4.10 Wells

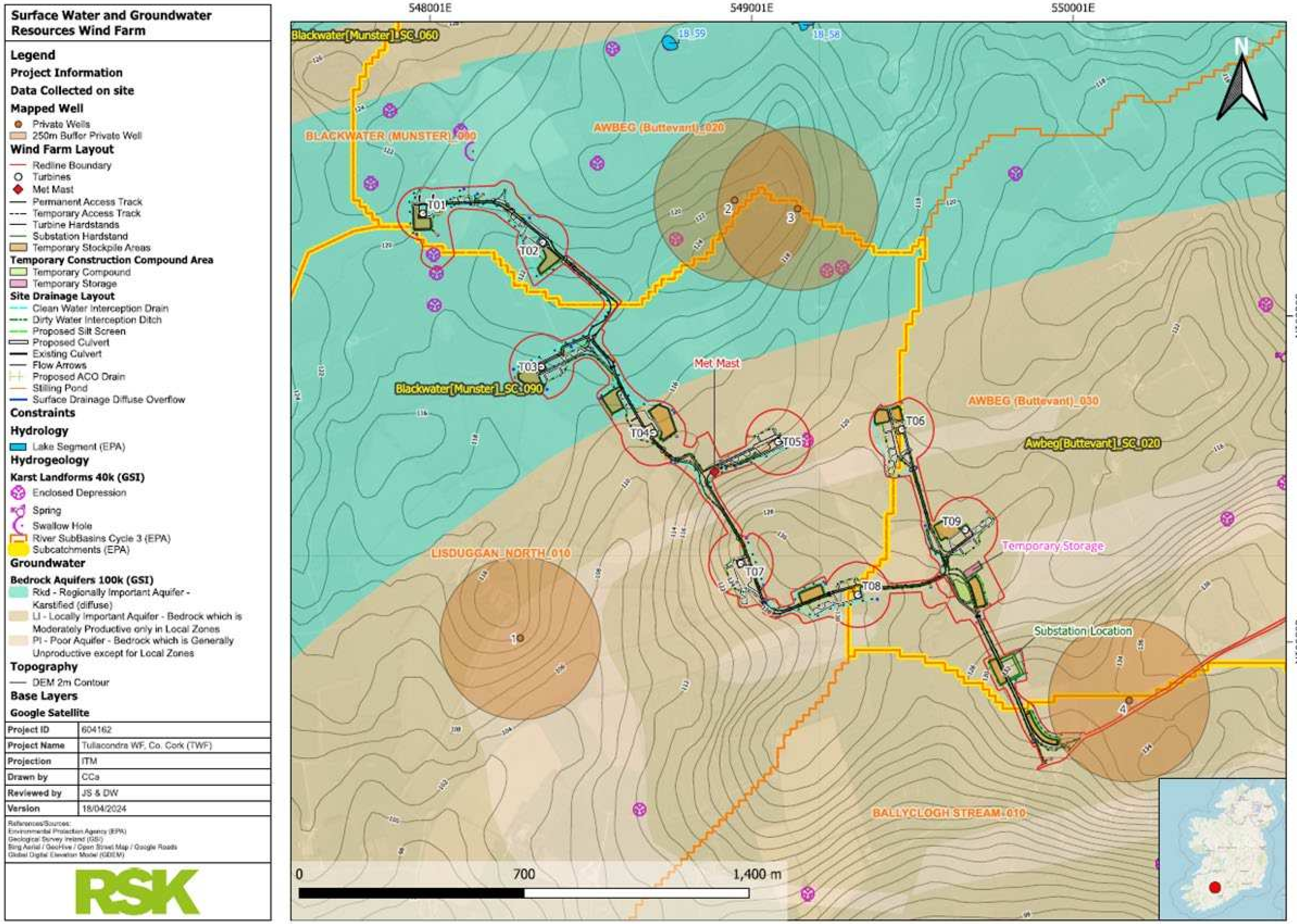
Consultation with the GSI well database indicates there are no mapped wells within the wind farm site boundary, as shown in **Figure 9.14a**. A review of the water supply zones indicates water is supplied locally from the Mount North and Box Cross supplies.

The closest mapped wells are a house with a private well (1) located to the west of T7 circa 650m – 750m from the RLB, private wells (2 & 3) to the east of T2, circa 600m & 800m respectively, a private well (4), located approximately 730m from T9 and 170m east of the RLB of the wind farm site. This suggests that any potential effect from the development is low risk for wells in the immediate vicinity, although there is potential for farmyards and local dwellings to have private wells.

The groundwater aquifer underlying the northern section of the wind farm site (Regionally Important Aquifer- karstified (Rkd)) also underlies portions of the Mountnorth RWSS along the GCR option routes. The southern section of the wind farm site is underlain by Locally Important Aquifer (LI) with portions of Poor Aquifer (PI).

The GCR option routes pass through two Source Protection Areas as mapped by the GSI; the Mountnorth Regional Water Supply Scheme, Inner Protection Area (SI) c. 1km southeast of the site boundary of the proposed development and the Oliver's Cross Public Water Supply Scheme SPA, Outer protection area (SO) and (SI) c.7.4km. Based on the EPA water abstraction register, Olivers Cross groundwater supply is not in operation.

Additionally, the majority of the GCR traverses land underlain by both a LI aquifer and a Rkd aquifer. Consultation with the GSI Groundwater Abstraction Well database has identified seven recorded wells along the proposed GCR Option 2. However, when a 250m buffer is applied to each individual well, four intersect with the proposed works. Refer to **Figure 9.14b** and EIAR **Volume III, Appendix 10.2a & 10.2b**). Refer to EIAR **Volume III, Appendix 10.3a & 10.3b** for this information in relation to the TDR Option 1 and 2.




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.14a: Surface water and groundwater resources wind farm**

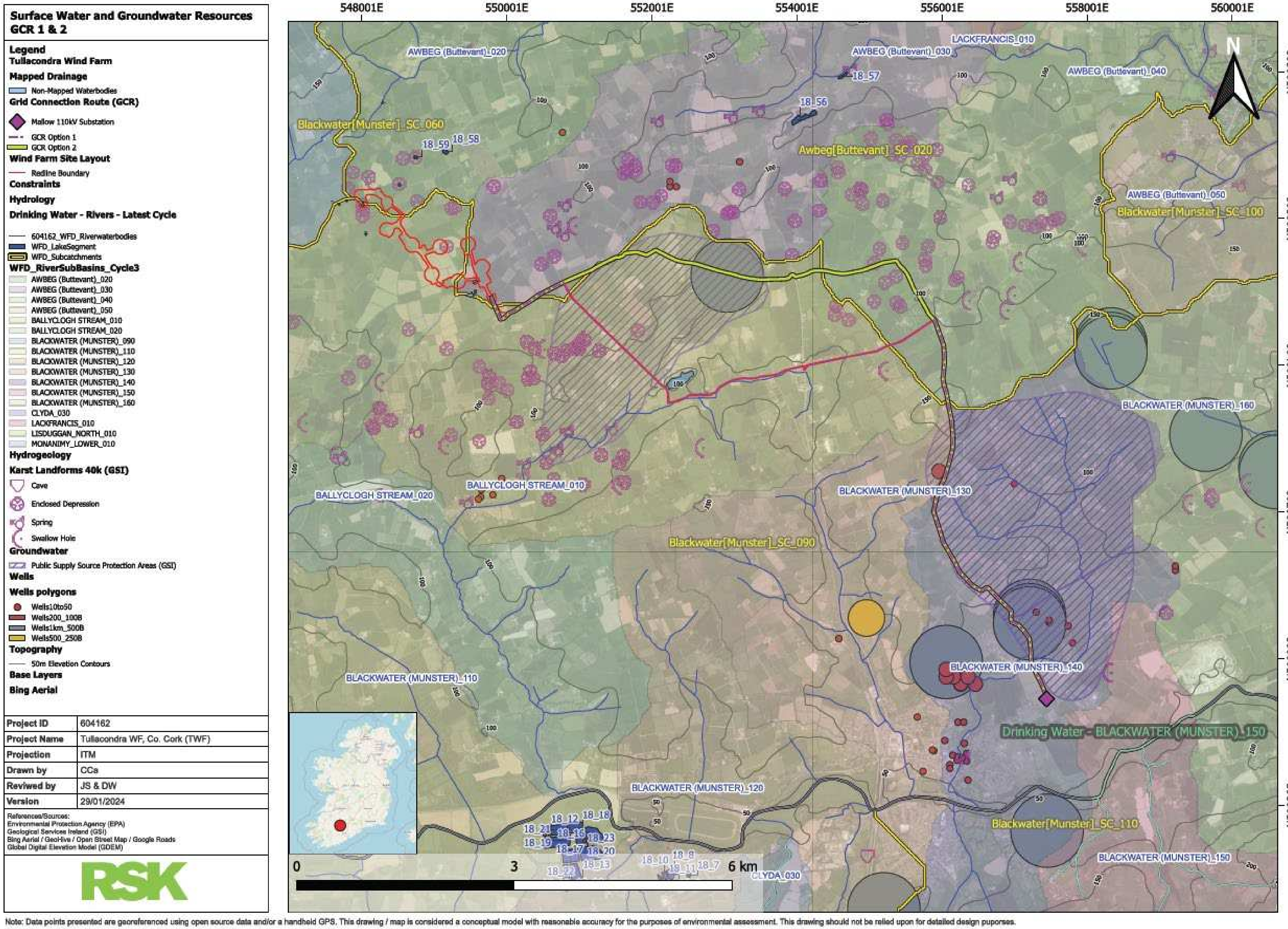



**Figure 9.14b: Surface water and groundwater resources GCR options 1 & 2**

## 9.4.11 Groundwater levels, flow direction & groundwater hydrochemistry

Groundwater flow through aquifers is described by the Groundwater Flow Equation – Darcy's Law, which describes a coefficient of hydraulic conductivity (permeability) (K) [m/d], an important aquifer characteristic. However, karstified aquifers, such as those common in Ireland and at the wind farm site in question, pose difficulties in defining such aquifer parameters. While bulk aquifer characteristics can be estimated, the location and typology of the fracture/conduit network, and in turn groundwater flow, is difficult to accurately characterise.

Understanding of local hydrogeology is significantly enhanced by past investigations in the area, most notably for the preparation of a Groundwater Source Protection Zones for the Mountnorth Regional Water Supply Scheme[19]. The assessment included extensive field walkovers, water tracing, water level measuring, flow measurements and mapping techniques. While the Mountnorth source appears to be situated in a different bedrock formation (Hazelwood/Copstown Limestone Formations) much of the mapped zone of contribution (ZoC) covers areas of the same mapped Rkd aquifer class.

The report notes that while karst features are recorded in the area, relative to other karstified areas in the country they are not particularly numerous. As part of the delineation of the ZoC, groundwater levels were obtained from private boreholes and quarries to identify groundwater flow patterns in the ZoC. While a localised flow direction was identified in the ZoC, it was concluded that there is a complicated and variable groundwater flow pattern at both a regional and local scale that is dependent on weather conditions and geology. Tracer testing was completed by the EPA also[19]. However, no traces were identified in the monitored springs.

Section 9.4.8.2 outlines surface karst features on the wind farm site. The closest features are in the vicinity of T1 and to the southeast of T5, which are not hydrologically linked to turbine locations. There is a swallow hole north of T1, which lies at the same elevation of the turbine location, however, the swallow hole is not hydrologically connected to T1. In addition to diffuse groundwater recharge, such features will act as areas of point groundwater recharge, with subsequent groundwater flow controlled by the morphological properties of the karstified network. Groundwater flow from such features on site would commonly be towards springs as discharge points, though diffuse discharge into rivers could also occur. Several springs are located c.0.8km east of the site (**Figure 9.9d**).

The EPA Report[19] concluded that a groundwater divide coincides with a surface water divide in the Old Red sandstones of the Kilmaclenine anticline (**Figure 9.15**). This divide would approximately pass through the wind farm site and potentially control groundwater flow from the identified point recharge locations to either the north or south depending on the locations relative to the divide. Groundwater levels in the Regionally important aquifer (RkD) varied from 70 to 85 mOD.

[19] Environmental Protection Agency (2012) Establishment of Groundwater Source Protection Zones Mountnorth Regional Water Supply Scheme Mountnorth Spring and Borehole.

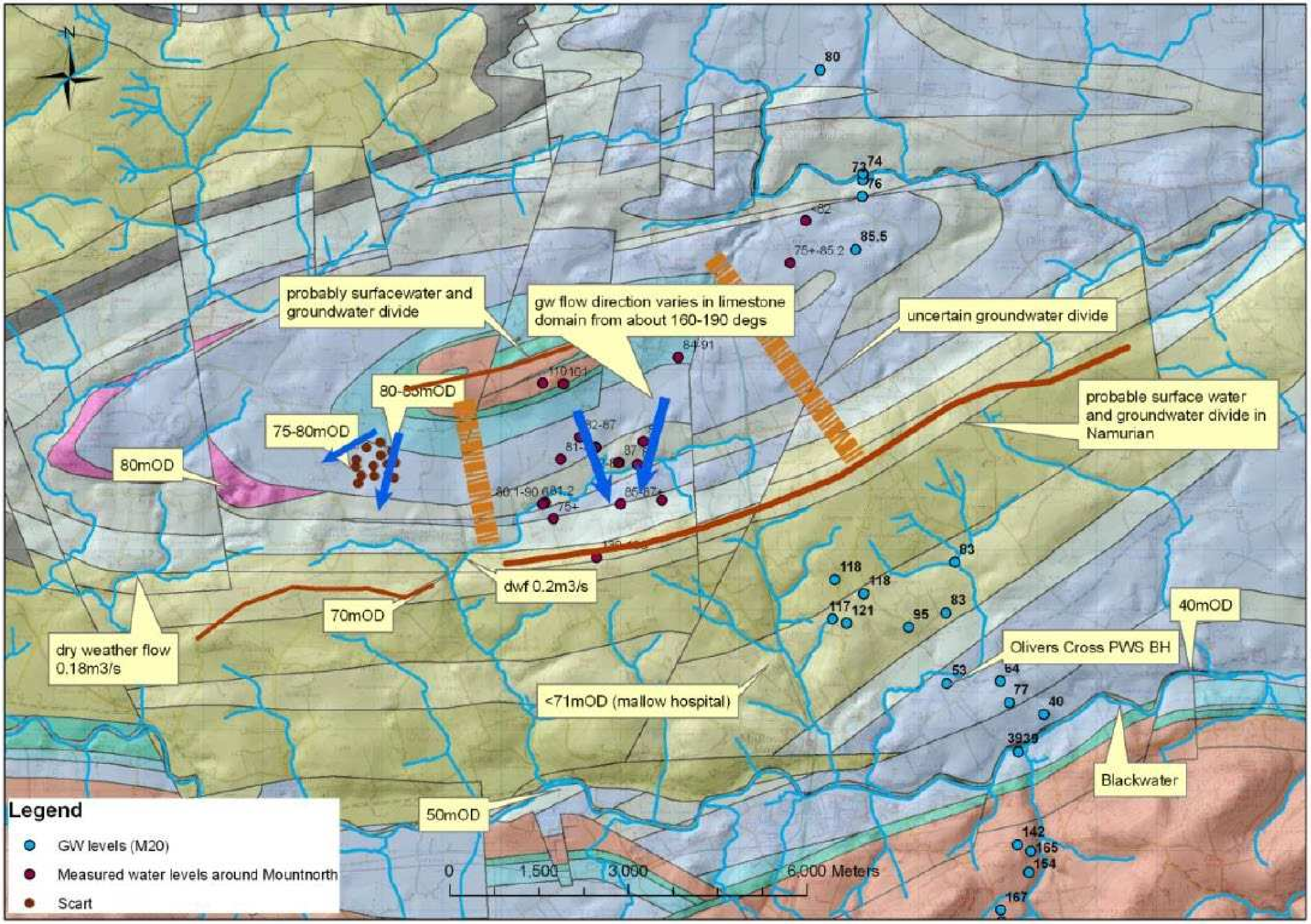



**Figure 9.15 Conceptual regionally groundwater flow[20]. (www.gsi.ie).**

[20] Environmental Protection Agency (2012) Establishment of Groundwater Source Protection Zones Mountnorth Regional Water Supply Scheme Mountnorth Spring and Borehole.

### 9.4.12 Designated sites

*9.4.12.1 Wind farm and grid connection route*

The wind farm site as well as the GCR options are not positioned within, directly adjacent to or immediately upstream of any designated or protected area (SPA, SAC, NHA). The nearest downstream designated areas include the following as outlined in **Figure 9.16a** and **Figure 9.16b**.

- Blackwater River (Cork/Waterford) SAC (EPA Site Code: 002170) situated on Awbeg (Buttevant) approximately 4.5km east of the site.
- Blackwater River (Cork/Waterford) SAC (EPA Site Code: 002170) situated on Blackwater (Munster) approximately 8km southwest of the site.
- Blackwater River (Cork/Waterford) SAC (EPA Site Code: 002170) situated on Ballyclogh Stream approximately 7.5km south of the site.
- All surface waterbodies draining the site eventually flow through the Blackwater River (Cork/Waterford) SAC and other various pNHAs and SPAs until reaching Youghal Bay and the Celtic Sea.

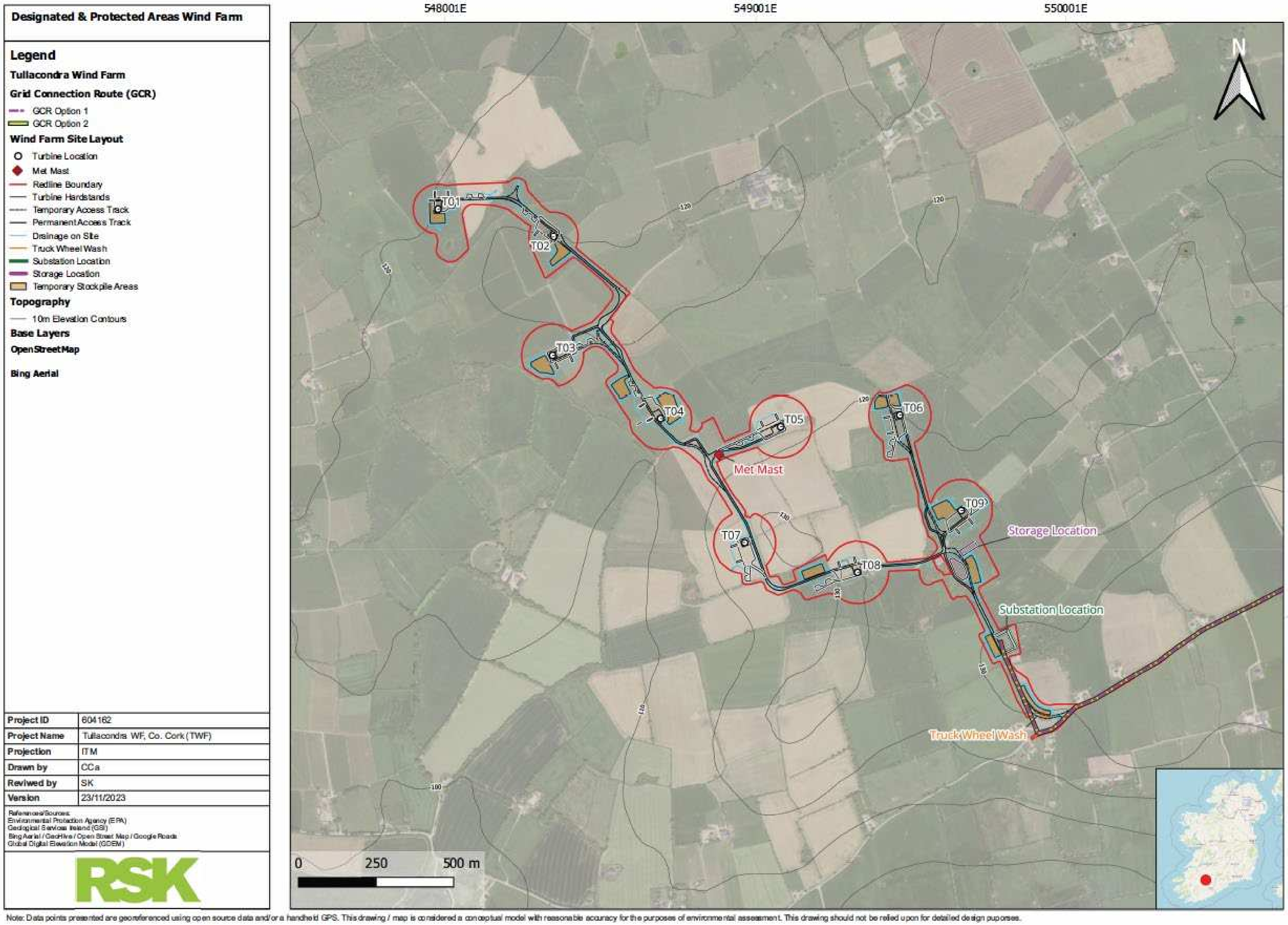



**Figure 9.16a: Designated & protected areas wind farm**

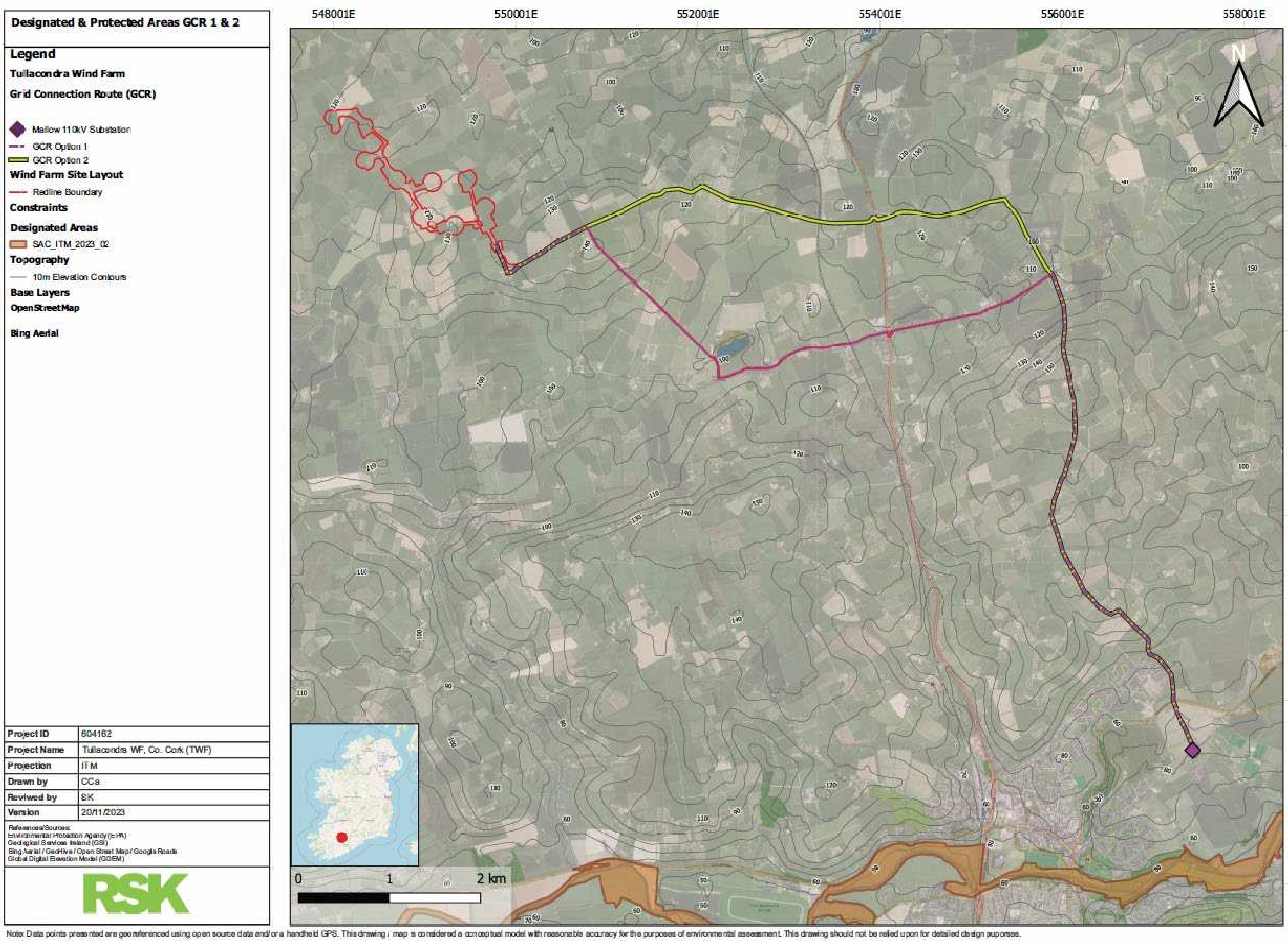



Figure 9.16b: Designated & protected areas GCR options 1 & 2

### 9.4.13 Water resources

Drinking water rivers designated in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007) which are protected for the purposes of drinking water abstraction are presented in **Figure 9.14b.** The nearest downstream (surface water) drinking water rivers are presented below. Neither are located within the River Subbasin or Sub Catchment associated with the site; however, they are hydrologically connected and are located 35km downstream of the wind farm site and 5km downstream of one of the HDD locations on the GCR.

1. culvert (Munster) River_150; Code: IE_SW_18B021800
2. Blackwater (Munster) River_150; Code: IE_SW_18B022100

Groundwater encompassing all elements of the Project is (nationally) protected under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007).

- The nearest GSI Public Source of Protection is Mountnorth RWSS c.6.5km from the site and is hydrogeologically connected. It lies within the river sub basin Ballyclogh Stream_010 which the site drains into as outlined in section 9.4.3.
- Olivers Cross PWS is located near the Mallow Substation. Based on the EPA water abstraction register, Olivers Cross groundwater supply is not in operation due to historical issues with contamination and is unlikely to come back into service.
- The nearest downstream GSI Public Source of Protection is Fermoy_Coolroe PWS c.36km downstream from the site and is hydrologically connected via the Ballyclogh stream_020 which flows through the Blackwater (Munster) River_110 down to Blackwater (Munster) River_170 and into this PWS.
- Both the Mountnorth RWSS and the Olivers Cross PWS are hydrologically connected to the GCR Options. Karst features mapped by the GSI along the GCR options are presented in EIAR **Volume III, Appendix 9.8**. **Figure 9.14b** indicates which mapped karst features are located in the Source Protection Areas.

### 9.4.14 Receptor sensitivity

All receptors associated with the Project i.e., groundwater, streams and rivers, are considered receptors of High Importance but with variable sensitivity (i.e., Moderate to Very High) receptors when considering:

- WFD status (2016-2021) generally ranging from Moderate to Poor. The principal objective of the WFD is to achieve good status or higher in all waters and to ensure that status does not deteriorate in any waters.
- The downstream designations (sensitive protected areas e.g., SAC, SPA) associated with the catchment and the sensitive habitats and species associated with same. Refer to EIAR **Volume III, Appendix 7.2** for further information on Fresh Water Pearl Mussel located in the Munster/Blackwater catchment.
- The designation of all waterbodies within the boundary of the wind farm site and downstream surface water bodies and all groundwater bodies as sources of drinking water.

- There are 11 Salmonid Rivers and one Nutrient sensitive River connected hydrologically, which are presented in **Table 9.16**.
- Sensitivity varies due to a range of environmental properties;
  - In relation to mapped WFD surface waters, there is no immediate connection to such receptors at the wind farm site however there are mapped lakes within 1km of the site and which are hydrologically connected via non-mapped drainage.
  - In relation to groundwater there is varying degree of aquifer vulnerability, however there are numerous areas of extreme vulnerability including general overburden thickness in areas, karst features including swallow holes which present direct connection, and some portions of the drainage network which are identified as extreme vulnerability due to the connection to groundwater downstream via off site swallow holes or sinking streams.
- Designated Shellfish areas in the Youghal Bay; downstream of the site in the Lower Blackwater Estuary / Youghal Harbour
  1. Ballymacoda Bay; Code: IE_SW_020_0000

**Table 9.16: Sensitive Surface Water Receptors downstream of the Wind Farm**

| Sensitive River receptor | Name | EPA Code | Distance downstream from the project |
|---|---|---|---|
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B021510 | c.5km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B021600 | c.9.26km |
| Nutrient sensitive River | Urban Wastewater Treatment Directive Sensitive Area - Blackwater River | IERI_SW_2001_0022 | c.9.26km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B021720 | c.9.5km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B021800 | c.13.6km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B021900 | c.15km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022000 | c.20.7km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022100 | c.33km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022300 | c.37km |

| Sensitive River receptor | Name | EPA Code | Distance downstream from the project |
|---|---|---|---|
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022450 | c.43.5km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022500 | c.50km |
| Salmonid River Regs | Blackwater [Munster] | IE_SW_18B022700 | c.59km |

Ultimately, all surface waters and groundwaters associated with the wind farm site are considered sensitive and important attributes in their own right and must be protected in accordance with the WFD to achieve and maintain at least ‘Good’ status. However, waterbodies associated with additional receptor sensitivities such as designated protected areas (e.g., SAC, SPA), should be considered at the highest level on the sensitivity scale, due to the increased risk associated with specific additional ecological attributes they possess. For instance, while a potential effect, e.g., sediment stockpile collapse into a surface waterbody, could have a temporary effect on the river or stream itself where suspended solids would be washed away from the incident and ‘diluted’ with the assimilative capacity of the river. On the other hand, the effects could be long lasting and potentially lead to the collapse of a species, such as freshwater invertebrates like mayflies, stoneflies (used as good water quality indicators).

In line with the source-pathway-receptor (SPR) model, risk to receptors must consider both the hazard/source, and likelihood of adversely effecting any given sensitive receptor, and therefore parameters such as, distance from potential source of hazard to receptor, pathway directness and/or connectivity, and assimilative capacity of the receiving water body will also be considered.

**Figure 9.3** outlines how the runoff from site could enter the surface water network and which rivers and downstream designated sites are connected. Microcatchments as seen in **Figure 9.7** breaks the site up into catchments where runoff is captured.

Runoff from micro catchment SW1 is contained with WFD subcatchment Blackwater [Munster]_SC_60 and River subbasin Blackwater (Munster)_090. As this is outside of the RLB, no works will take place in this micro catchment.

Runoff from micro catchment SW2 is contained with WFD subcatchment Awbeg [Buttevant]_SC_20 and River subbasins Awbeg (Buttevant)_020 and Awbeg (Buttervant)_30 (**Figure 9.6a**). Runoff in this part of the site drains through tertiary, secondary and primary drains before entering the Awbeg (buttevant)_ 20 and Awbeg (Buttervant)_30 rivers. Drainage at the site associated with the Awbeg (Buttervant)_20 river basin is connected to and flow through a mapped lake (EPA ID: 18_58). These river system flow for approximately 5km before connecting into the Blackwater River (Cork/Waterford) SAC.

Runoff from micro catchment SW3 is contained with WFD subcatchment Awbeg [Buttevant]_SC_20 and River subbasin Awbeg (Buttevant)_030. Runoff in this part of the site drains through tertiary, secondary and historic drains for c.4km before it enters the Awbeg (buttevant) 40 surface water, which is part of the Blackwater River (Cork/Waterford) SAC.

Runoff from micro catchment SW4 is contained with WFD subcatchment Blackwater {Munster]_SC_090 and River subbasin Ballyclough Stream_010. Runoff in this part of the site drains through secondary and primary drains for c.2.7km, and thereafter could discharge to Ballyclough stream_010 and Ballyclough stream_020 surface water, which later downstream joins the Blackwater (Munster)_090 river system, part of the Blackwater River (Cork/Waterford) SAC. These secondary drains are upslope of karst features to the south and therefore ground connections outside the development cannot be ruled out.

Runoff from micro catchment SW5 is contained with WFD subcatchment Blackwater {Munster]_SC_090 and River subbasin Lisduggan North_010. Runoff in this part of the site through tertiary secondary, primary and a historic drain (which recharges to groundwater 1.3km downstream). The closest mapped river is c.4.7km from site, a surface water classed as a primary drain, discharges to the Lisduggan_010 river system which flows into downstream joining the Blackwater (Munster)_090 river system which is part of the Blackwater River (Cork/Waterford SAC).

In terms of groundwater sensitivity and susceptibility, as discussed in section 9.4.8.3, all groundwater associated with the site is protected as a source of drinking water.

The bedrock aquifers underlying the southern area of the proposed site and surrounding area range from Poor aquifer except for local zones (PI) to Locally Important (LI), which can be expressed as an aquifer with relatively poor production and low connectivity (PI) and relatively low to moderate production and connectivity (LI) respectively, and therefore the risk of potential adverse effects on groundwater will be limited to localised zones within the site.

The bedrock aquifer in the northern portion of the site is classified as 'Regionally Important Aquifer - Karstified (diffuse) (Rkd)'. These areas of the RLB are classified as 'Very High' in accordance with **Table 9.1**. It is noted, with reference to section 9.4.10**,** that no wells have been identified within the 250m buffer zone of shallow excavations along the GCR, using the GSI database. Refer to EIAR **Volume III, Appendix 10.2.**

In terms of surface water sensitivity, as stated above, the vast majority of potential contaminants or unmitigated adverse effects will infiltrate to surface water and or groundwater bodies, however sensitive receptors are of variable distance from the development and the pathways are of variable condition for each proposed turbine location and for any part of the development.

## 9.5 Assessment of likely significant effects[21]

### 9.5.1 Do nothing scenario

The Do Nothing scenario is the effect on the site should the Project not be constructed. Site investigations and assessment of the baseline hydrological and hydrogeological conditions at the site indicate that parts of the site have already experienced changes to baseline conditions through the installation of drainage networks associated with agriculture (EIAR **Volume III, Appendix 9.3 Tile 5**).

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[21] Scottish National Heritage (SNH) (2013) A Handbook on Environmental effect Assessment

Should the Project not proceed, the existing land-use practice of agriculture and cattle grazing, will continue with associated gradual alteration of the existing environment and associated pressures on surface water and groundwater quality.

### 9.5.2 Construction phase likely significant effects

Potential impacts leading to likely significant effects during construction include increased runoff, release of suspended solids, release of nutrients, release of hydrocarbons and storage, release of horizontal directional drilling material, release of wastewater sanitation contaminants, release of construction or cementitious material, excavation dewatering and construction water, and diversion and enhancement of drainage and watercourse crossings.

A summary of the assessment of likely significant effects is included in EIAR **Volume III, Appendix 9.2.**

#### *9.5.2.1 Increased runoff*

The Project has the potential to result in increased rates of runoff during the construction phase relative to baseline conditions. This is a function of the progressive excavation and removal of vegetation cover and replacement with gravel hardstanding surfaces (semi permeable) and installation of constructed drainage along the development footprint and thus removing the hydraulic absorption / buffer control from this part of the site. Such an increase in surface water runoff, or an increased hydrological response to rainfall, has the potential to exacerbate flooding events and effect on hydro morphology of waterbodies downstream of the development, and/or to exacerbate flooding and erosion within the boundary of the site.

Increased hydraulic loading can arise from the following locations within the wind farm site:

- Run off from the substation building and associated compounds.
- Run off from the construction of site tracks.
- Run off from the contractors lay-down area and temporary welfare facilities, including parking areas.
- Run off from turbine foundation bases and associated hardstand areas.
- Run off from linear site track construction.
- Run off from the meteorological (Met) mast foundation area.
- Additional surface drainage channels.
- Modified surface drainage channels.

**Assessment for surface water**

Based off the runoff calculations in the FRA and section 9.4.9, in the absence of mitigation, the effect on surface waters, classed as high sensitivity, is considered **likely, adverse, localised, direct & indirect, temporary, reversible, small adverse in magnitude**, with a significance level of **slight to moderate** for the wind farm site. Minimal land take is associated with the GCR, considering almost all the proposed works will traverse already existing public roadways (i.e., site tracks to be constructed as part of the development), public and local road networks or private lands.

Land take may be required for the TDR in the form of widening of existing portions of roads, however, considering the small scale of disturbance (shallow excavation, superficial paving) the effect is considered **temporary** and a significance level of **slight**. Similarly, an increase in the rate of runoff from the construction of both these routes is unlikely due to utilisation of pre-existing road infrastructure. Mitigation measures will be implemented, minimising the potential effect on hydrology and hydrogeology.

**Assessment for groundwater**

In the absence of mitigation, the increase in runoff is likely to result in adverse effects on groundwater due to percolation of water through soils and bedrock and is considered a **likely, localised, indirect, temporary, moderate adverse effect** with a significance level of **moderate**..

9.5.2.2 *Release of suspended solids*

Excavation and construction activities such as stockpiling material and vehicular movements of plant machinery introduce the risk of solids being entrained in runoff. Runoff contaminated with suspended solids will add turbidity to the receiving surface water body, can block fish gills and smother spawning grounds, reduce light penetration for flora growth, promote bacteria and algae production.

Excavation at the site will be relatively shallow (<3m) and therefore the potential for encountering large volumes of groundwater during excavations is low, significant dewatering works are not anticipated. However, there is the potential for perched groundwater, groundwater seepage, and rainwater or runoff collecting in open excavations which will need to be dealt with through dewatering and treatment where necessary. The dewatering of excavations during construction is likely to have adverse effects on surface water runoff quality in the absence of mitigation measures. Where dewatering is required, the receiving engineered drainage and attenuation features such as stilling ponds will likely receive water discharges elevated in suspended solids of medium sensitivity.

During excavation, removal of vegetation (road widening), storage and reuse of soil materials, it is likely that a high volume of suspended solids will be entrained by surface water runoff and intercepted by surface water networks , particularly during sustained rainfall events and when in close proximity to receptors, i.e., temporary material storage areas.

The most vulnerable areas to surface water quality deterioration through the release of elevated suspended solids are considered to be:

- Drainage channels adjacent to turbine hardstand and infrastructure development particularly in close proximity to existing drainage channels (T8, T9 and site tracks from T3 to T5), refer to **Figure 9.6a**.
- Proposed GCR crossing points of N72 and adjacent River (HDD) and at N20 (HDD) near New Twopothouse Village, along with any existing culverts identified along the Option 1 route.

- Proposed GCR crossing point at Ballyviniter (Upper) bridge (L5320). Placing required infrastructure within the road is the preferred method.

The worst-case scenario includes runoff from stockpile areas entraining suspended solids. However, these areas are mitigated through interceptor drains, further discussed in section 9.6.2.1. The storage areas adjacent to the substation, site entrance and T3 drainage are within 15m of drains, the watercourse crossing at T4, the tertiary drain present at T8 and therefore will require mitigation measures such as isolating the area and installing silt fences and additional monitoring frequently. The storage area near T6 is close to and slightly upslope from a historical drain. No additional measures are required at T5, which is not hydrologically connected to the eastern karst feature/historic quarry. There are no hydrological connections to the karst feature north of T1.

The aspects of the development most likely to impact surface water quality and result in deterioration are:

- Exposed soils / subsoils generally, including new drainage channels, temporary stockpiles.
- Turbine hardstand and infrastructure development, particularly in close proximity to surface water receptors, and in areas characterised by extensive existing drainage networks which present a direct connection to mapped surface water features.
- Construction of infrastructure within drainage buffer zones (site tracks and internal cabling will cross buffers in a perpendicular direction i.e., so as to minimise any potential effects), and/or instream works associated with proposed watercourse crossing locations. Buffer zones are described in section 9.6.1.1.

Vehicular movements and excavation work associated with the construction phase (earthworks) of the Project have the potential to affect soil stability particularly at a localised scale. Some temporary accommodation works for access in the form of strengthening/hardcoring of road margins/verges and roundabout islands will be necessary on the TDR (refer to EIAR **Chapter 16 Traffic and Transport**). There is the potential for loss or damage of topsoil as a result of the temporary accommodation works along the TDR. An indirect effect of soil erosion is the potential for increased sediment run off in surface and groundwaters. Earthworks in relation to reinstatement must also be considered. In addition to potentially direct adverse effects on ecological sensitivities downstream of the site, runoff of suspended solids will potentially affect the WFD status and objectives associated with the surface water networks both within and downstream of the proposed development including the Blackwater River (Cork/Waterford) SAC.

This effect is considered to be in contrast to baseline conditions although it is also temporary. Although temporary, considering the mobility characteristics associated with flowing surface waters, it is not considered reversible.

**Assessment for surface water**

Considering the 'Moderate' quality of the baseline surface waters draining from the site and the spoil storage areas, in addition to the medium sensitivity of the associated surface water networks. In the absence of mitigation, any introduction of contaminants is considered a **likely, localised, direct and indirect, reversible, large adverse effect** with a significance level of **significant**, effect of the Project.

The most vulnerable areas to groundwater quality deterioration through the release of elevated suspended solids are considered to be where direct links from surface waters to groundwater through historic drains were identified, south of T4. Other areas that must be considered is northeast of T5, (>15m <25m) to the proposed site track where a karst feature/historic quarry is located. With appropriate mitigation measures outlined in section 9.6.2.2 in place and via the implementation of environmental engineering controls, this effect will be reduced.

**Assessment for groundwater**

The release of suspended solids does not have the potential to result in adverse effects on groundwater in areas of moderate to high vulnerability due to the natural process of filtration associated with percolation of water through soils and bedrock and is considered an un**likely, localised, indirect, temporary, moderate adverse effect** with a significance level of **moderate**. In the absence of mitigation, these are the likely effects that will occur.

*9.5.2.3 Release of nutrients*

It is noted that the presence of elevated nutrients was detected during the two-surface water quality monitoring rounds (EIAR **Volume III, Appendix 9.6**). Surface layers of soils are likely to retain more phosphorus, so that the subsoils are less likely to shed phosphorus. Deep soils to moderately well drained soils are likely to retain more phosphorus. The nitrogen level in the samples is an indicator of the ongoing agricultural use of the lands. Ammoniacal nitrogen rapidly reduces in the onsite drainage features. The nitrogen levels in the samples are a reflection of the ongoing agricultural use of the lands. Nitrogen mobility means that subsoils are not likely to have high Nitrogen levels. The main risk with sediment is small particles in the water column in salmonid and FWPM waters.

Nutrient enrichment, or excessive loading of nitrogen and phosphorus in waters can lead to eutrophication of the aquatic environment and eventually to fish mortality due to lower oxygen levels in the water. If increased nutrients entered the groundwater body system that could have knock on effects to other surface waters associated with that groundwater body[22].

**Assessment for surface water**

The release of nutrients from displaced/disturbed soil to surface waters of medium sensitivity, is considered a **likely, adverse, localised, indirect to direct, temporary, reversible, large adverse effect** with a significance level of **moderate** and will require mitigation measures to ensure residual effects are not significant. The release of nutrients in the context of the development is connected with the release of solids entrained in runoff, and these effects will be mitigated.

**Assessment for groundwater**

Considering the groundwater connections and the distance to this high sensitivity receptor, the sensitivity has been downgraded to medium. In the absence of mitigation measures, this is considered a possible, **indirect, localised, temporary, moderate**

[22] https://www.sciencedirect.com/science/article/pii/S0304389422024992

**adverse effect** with a significance level of **moderate**. Potential incidents of nutrient release at the site are in contrast to baseline conditions and these effects will be mitigated.

*9.5.2.4 Release of hydrocarbons and storage*

Hydrocarbons are a pollutant risk due to their inherent toxicity to all flora and fauna. Hydrocarbons chemically repel water and do not readily dissolve in polar solvents such as water. Most hydrocarbons are light non-aqueous phase liquids (L-NAPL's) that are less dense than water. If hydrocarbons are accidentally released to water, they will therefore float on the water's surface. Hydrocarbons adsorb onto the majority of natural solid objects they come in contact with, such as soil, vegetation and animals. Hydrocarbons will burn most living organic tissue they come in contact with due to their volatile chemistry. Hydrocarbons also represent a nutrient supply for adapted micro-organisms, this process in turn can rapidly deplete dissolved oxygen and thus result in fish kills or mortality of water based vertebrate and invertebrate life.

During the construction phase, vehicles and plant associated with excavation, material transport, and construction activities introduce the risk of hydrocarbon spillages and leaks from fuels and oils. The risk is increased when regular refuelling is required which in turn implies the requirement of a designated refuelling area at the construction compound.

All groundwater bodies are considered vulnerable and sensitive to hydrocarbons. However, the regionally important karstified aquifer underlying locations T1, T2 and T3 is considered more vulnerable and sensitive when compared to locally important aquifers (T4 – T9). This is due to the highly variable and high connectivity of groundwater flow paths in karstified geology. In comparison, locally important aquifers do not possess the same flow or connectivity properties, and potential effects are likely to be more localised. Minor spills or leaks in soils can be efficiently addressed and remediated. However, it is very important to note the elevated sensitivity and enhanced connection to groundwater at the site (section 9.4.10 and 9.4.13). Hydrocarbons released due to an environmental incident are likely to infiltrate soils/subsoils potentially reaching the water table and in turn adversely impacting on groundwater quality, through seepage over time or through run off pathways to surface water features or karst features on or downstream of the site.

**Assessment for surface water**

With regards to surface waters at the site of medium sensitivity and downstream receptors of medium sensitivity, in the absence of mitigation, an accidental hydrocarbon spillage is **considered likely (possible), direct, short term, reversible small adverse effect** with a significance level of **moderate to significant**. Implementing appropriate mitigation measures the risk of an accidental spill can be greatly reduced.

**Assessment for groundwater**

In terms of groundwater of medium to high sensitivity, in the absence of mitigation, an accidental hydrocarbon spillage is considered to be a **possible, direct or indirect, localised, short term to long term, potentially irreversible, small adverse effect** with a significance level of **moderate.**

*9.5.2.5 Release of Horizontal Directional Drill (HDD) Materials, drill arisings and breakout and drilling fluid returns*

HDD is used to avoid closing infrastructure and to reduce the potential effects at surface water crossings. HDD is proposed at two locations along the GCR, under the N20 (option 1), under the Blackwater (Munster) River_140 (also locally known as Caherduggan South) (Option 1 & 2) and N72 which are adjacent to each other. The HDD will pass beneath both. The locations are summarised as follows:

- The location of the HDD under the N20 is situated on the Regionally Important Karst aquifer, classed as an area of High Vulnerability (GSI).
- The location of the HDD at the Blackwater (Munster) River_140 (also locally known as Caherduggan South) – N72 crossing is situated on the Locally Important and Locally productive aquifer which is also classed as an area of High Vulnerability (GSI).

In the absence of mitigation, potential risks associated with HDD include:

- **Hydrocarbon spills** from broken hydraulic hoses used during the drilling/boring process which could have an effect on surface water through runoff of contaminated material.
- **Temporary stockpiling:** Spoil arising from drilling activities will require temporary stockpiling and has the potential to be entrained by surface water runoff (suspended solids) if not managed appropriately. It also has the potential to mobilise additional solids via eroding soils, or other contaminants giving rise to surface water contamination from uncontrolled runoff and potentially impacting groundwater through infiltration of runoff.
- **Breakout and drilling fluid returns**: Small-scale quantities of drilling fluids (bentonite) or inert surfactants are used in the HDD process. These drilling fluids are commonly composed of a mixture of bentonite clay, which can be harmful to the environment[1]. Loss of bentonite could locally have an effect on surface water or groundwater. Drill fluid returns/frac outs can occur as a result of poor drilling methods, and/or improper mud formulation used in bore drilling which can cause stability issues within the bore. Given the local lithology of the site with underlying sandy, clayey tills, and the potential for weathered or karstified bedrock, potentials for breakouts must be considered. Breakouts can lead to failure in returns at either end of the bore path and subsequent drill mud being released outside the bore to the receiving environment (i.e., soils, subsoils, ground and/or surface waters).
- **Drilling Fluid disposal**: Drilling mud containing spoil recovered from the bored path can be retrieved at the launch and reception sites of the bore. This bentonite contaminated spoil can be treated in one of two ways. It can either be transferred off-site to an approved and authorised EPA license facility (in accordance with the Waste Management Act 1996 as amended) to be properly disposed of; or the spoil can be pumped to a mechanical separation container. This involves drill mud being stored within a holding tank until separation of particulates can be achieve only then can the fluid be discharged to the surrounding area. Very fine

[1] Moore Group (2016) “Appropriate Assessment of Cork Lower Harbour Main Drainage Project Estuary Crossing by Horizontal Directional Drilling”, Moore Group Environmental Services on behalf of Irish Water, Ref No. 15184.

solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and long periods of time to settle, therefore, such particles are unlikely to settle despite at sufficient rates.

An accidental contaminant spillage would have a significant, long term to permanent, adverse effect on surface water and associated groundwater features should leaks occur at sensitive receptor locations, which is connected to surface water and ground water receptors downstream. However, this potential effect is considered to be naturally reversible (natural attenuation over a medium to long term period of time), or theoretically reversible (through remediation and restoration activities over a short to medium term period of time). With appropriate environmental engineering controls and measures, this potential risk can be significantly reduced.

A worst-case scenario could possibly occur whereby the proposed works of HDD could result in a direct, adverse, potentially significant, effect of the development. This effect could result from any number of indirect anthropogenic sources, most commonly would be from: inadvertent drill returns containing bentonite clay, as mentioned above or by hydrocarbon spillages. Such spillages could potentially affect either surface water or groundwater depending on the nature of the contaminant, and to varying degrees depending on the hydrological and hydrogeological characteristics of the site area.

**Assessment for surface water**

Potential incidents of release of contaminants at the site to surface water receptors of high sensitivity are, in the absence of mitigation, considered a **likely, direct, short-term, reversible, small adverse effect** with a significance level of **slight.**

**Assessment for groundwater**

Potential incidents of release contaminants at the site to groundwater receptors of medium sensitivity are, in the absence of mitigation, considered as a **possible, indirect, localised, short-term to long-term, moderate adverse effect** with a significance level of **moderate**.

*9.5.2.6 Release of wastewater sanitation contaminants*

The installation of temporary sanitation facilities during construction will be required. Therefore, the development has the potential to result in the accidental leakage of wastewater or chemicals associated with wastewater sanitation onto soils and ultimately into surface waters during the construction phases of the Project.

Accidental release of wastewater to surface waters (or groundwater) would likely result in an increase in biochemical oxygen demand (BOD) which in turn would lower the dissolved oxygen concentration and adversely effect on aquatic life. Wastewater sanitation chemicals used in temporary facilities are also pollutant risks due to their inherent toxicity to aquatic flora and fauna and their potential to adversely effect on the productivity or status of surface water systems. There will be a WC with connection to a sealed wastewater holding tank fitted with a high-level alarm. Factors that can increase the risk to receptors include:

- The condition, emptying schedule and maintenance of the facilities.
- The level of toxicity of the chemical agents used to aquatic flora and fauna.

**Assessment for surface water**

considering the quality of the surface water draining from the site (baseline), and the 'Medium' sensitivity, of downstream receptors and their 'medium' sensitivity, any introduction of contaminants, in the absence of mitigation measures is considered a **possible, direct and indirect, localised, short-term to long-term, small adverse effect** with a significance level of **slight**. Potential incidents of contaminant release at the site are in contrast to baseline conditions**.** With appropriate environmental engineering controls and mitigation measures outlined in section 9.6.2.5 these potential effects can be significantly reduced.

**Assessment for groundwater**

Considering the groundwater connections and the distance to this high sensitivity receptor, the sensitivity has been downgraded to medium. In the absence of mitigation measures there is considered a **possible, indirect, localised, short-term to long-term, small adverse effect** with a significance level of **slight**. Potential incidents of release contaminants at the site are in contrast to baseline conditions**.**

*9.5.2.7 Release of construction or cementitious materials*

The construction phase of the Project has the potential to result in the accidental spillage or deposition of construction waste into the surrounding soil environment. This in turn has the potential for waste materials to leach out toward preferential drainage flow paths that may ultimately be connected to the surrounding surface water network.

The accidental release of cementitious wastes such as concrete, or cement etc., in the absence of mitigation, can result in a significant change to surface water or groundwater hydrochemistry which can adversely impact on sensitive downstream aquatic flora fauna (further information of downstream ecology is outlined in EIAR **Chapter 7 Biodiversity**). The risk of cementitious materials impacting on water quality are highest when the materials are freshly deposited and is 'wet'. Once set, the potential for chemical reactions is dramatically reduced and the in situ, set and undisturbed concrete is considered not significant.

The process of handling construction or Cementitious materials results in the accidental spillage or deposition of construction waste into soils and in turn could have an effect on water quality.

**Assessment for surface water**

the accidental spillage or deposition of construction materials such as wet concrete, on medium sensitive surface water receptors, in the absence of mitigation measures, is considered a **possible, direct and indirect, short-term, localised, reversible, moderate adverse effect** with a significance level of **moderate**, which is in contrast to baseline. In the absence of mitigation, these are the likely effects that will occur.

With the implementation of appropriate mitigation measures and environmental engineering controls outlined in section 9.6.2.6, these potential risks will be significantly reduced.

**Assessment for groundwater**

Considering the groundwater connections and the distance to this high sensitivity receptor, the sensitivity has been downgraded to medium. In the absence of mitigation this is considered a **possible, indirect, localised, short-term to long-term, small adverse effect** with a significance level of **slight**. Potential incidents of release contaminants at the site are in contrast to baseline conditions**.**

*9.5.2.8 Constructed drainage, diversion or enhancement of drainage*

The Project will likely result in the diversion, alteration and/or enhancement of the existing drainage networks at the site during the construction of the Project relative to baseline conditions. The existing drainage network at the site is mapped and presented in **Figure 9.6a**. Diversion of artificial drainage channels will be required at locations where the development layout intercepts existing artificial drainage networks. Other drainage includes channels to and from the settlement pond areas constructed on site.

Construction of drainage channels and enhancement of existing drainage associated with the Project have the potential for a localised effect on the hydrological/hydrogeological regime at the site. If poorly managed during construction phase of a development, the installation of drainage channels and associated infrastructure such as new culverts or attenuation features can lead to excessive *wetting and/or drying* in areas of the site which does not conform to baseline conditions i.e., localised flooding or excessive draining. In the absence of mitigation, instream works have the potential to cause significant disturbance within the drainage channel, or introduce contaminants directly to the surface water feature, potentially leading to significant effects to water quality, and potentially adverse effects to downstream ecological attributes sensitive to contaminant loading, including suspended solids.

Poor design of drainage features, including culverts, can also lead to gradual effects such as erosion, or changing of hydro morphological characteristics, including bottle necks or small diameter culverts, and expanded to receive rapid velocity discharge in areas with no attenuation features.

**Assessment for surface water**

considering that pre-existing natural and artificially established drainage networks are present at the site and their medium sensitivity, in the absence of mitigation, the diversion, enhancement or introduction of additional drainage features, in the absence of mitigation measures, is considered a **likely, direct, short-term to long term, reversible, small adverse effect** and **not significant**, within the development footprint. It is important to consider indirect or secondary effects when dealing with drainage works.

Mitigation measures including the management of storm and construction water runoff to prevent loading of the receiving network with contaminants is detailed in section 9.6.2.10 and 9.6.1.2.

*9.5.2.9 Watercourse crossings*

There is no proposed crossing of mapped EPA rivers. Construction of any new watercourse crossing will have an inherent risk of resulting in adverse effects to surface waters due to the required ground disturbance through excavations and the movement of heavy plant and machinery and the proximity to the primary sensitive receptor which is the watercourse itself.

The principal risk to ecological sensitivities associated with proposed watercourse crossing works is the potential for adverse effects to water quality downstream of the site, namely the potential for mobilisation of solids, but any ecological value at the watercourse crossing / culvert locations will be maintained or improved where possible. In the absence of mitigation, these effects are considered an **unavoidable, small adverse effect** and **not significant**, and temporary effect of the development which contrasts to baseline conditions.

There are 17 new water crossings over small streams or drainage channels on the site **(Figure 9.6a)** required for the site tracks and the proposed infrastructure as part of facilitating access to the proposed turbines. There is one proposed watercourse crossing (nWCC12) that crosses a secondary drain with an 'X' vulnerability rating, potential effects at this crossing are therefore higher due to potential connectivity to a karst feature further downstream or to a sinking stream, as outlined in section 9.4.8.2. As mentioned previously, the wind farm site has no mapped rivers, and the drainage network dries out during dry spells. The upgrading of the existing culverts identified on site will also be required. A detailed design of these watercourse crossings is presented in design drawings. Refer to Planning Application Documentation **Part 2** – Planning Drawings: **Drawing No. 20910-NOD-XX-XX-DR-C-08301** and **Drawing No. 20910-NOD-XX-XX-DR-C-08302.**

As described in EIAR **Volume III, Appendix 16.1**, TDR Option 1, Node 12 (L5523 Grange East) requires road widening which has connectivity to the Blackwater River (Cork Waterford) SAC via the Ballyclough Stream, however the crossing itself does not require works.

Culvert design considerations will include for the following, and are shown in EIAR **Volume III, Appendix 9.4 – Tile 2** and **Plate 9.4.** The design facilitates adequate hydraulic capacity. This ensures that the design will maintain the existing channel and will facilitate peak discharge events (storm events) without flow being constrained and contributing to flooding or other issues. Values presented in EIAR **Volume III, Appendix 9.5** indicate the potential discharge rate associated with each watercourse crossing during a 1 in 100-year storm event. For existing crossings, the channel width will be maintained.

In line with the above design consideration, allowance will be made for the transport of sediment or storm detritus through the crossing, not just hydraulic capacity. The design facilitates adequate freeboard to OPW requirements[23][24]. The design facilitates passage of woody debris.

With reference to section 9.4.9, some portions of the GCR are within probable flood extents, this will include the watercourse crossings and a limited distance of GCR at those locations. During the construction phase, exposed soils and storage of hazardous materials or equipment presents a hazard if a flood occurs during the phase of works. This poses similar risks and effects to those assessed under Release of Suspended Solids, Release of Hydrocarbons, etc.

[23] www.opw.ie/en/floodriskmanagement/ [Accessed 19/04/2024]

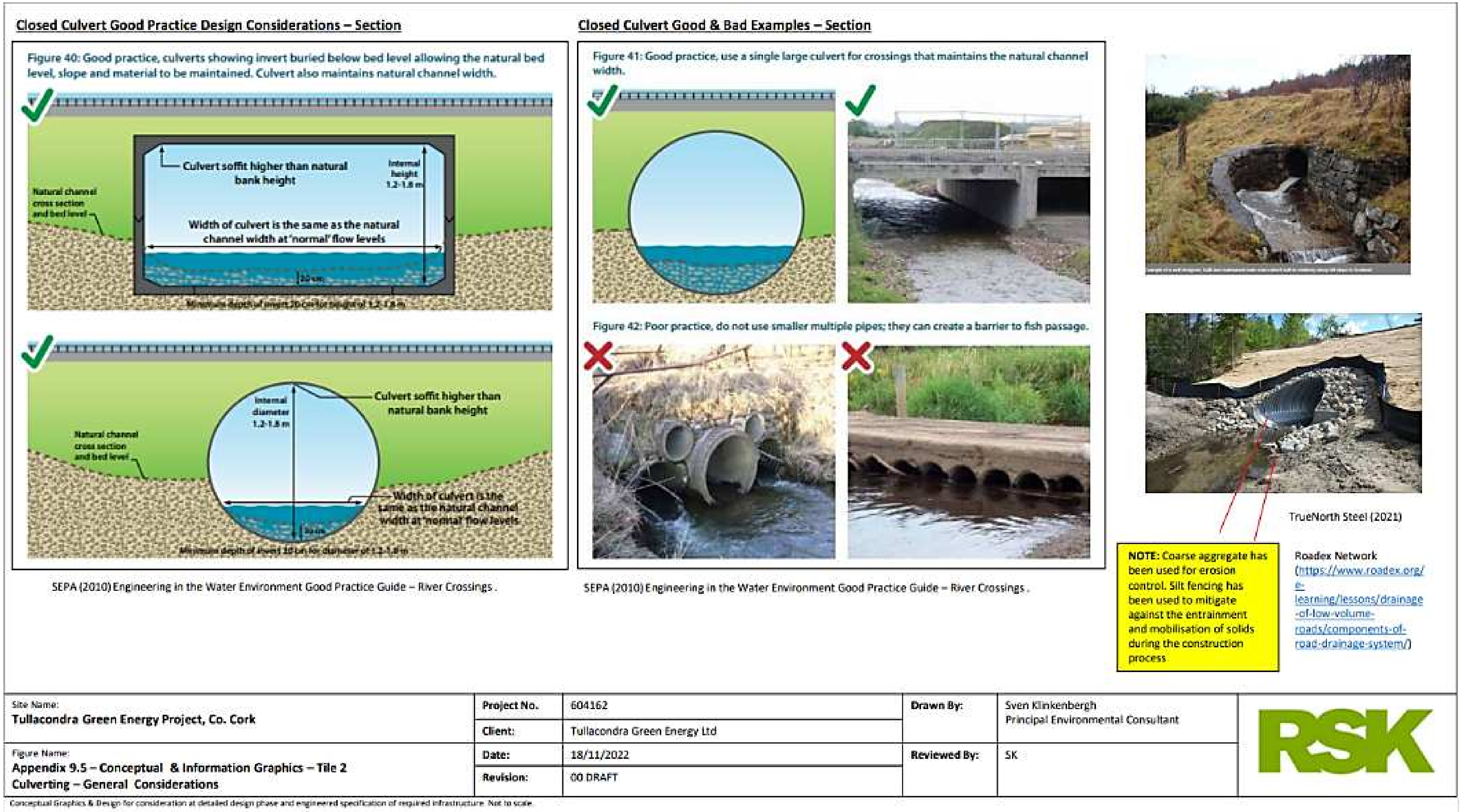
[24] Construction, Replacement or Alteration of Bridges and Culverts, OPW Rev 201905-3 [Accessed 19/04/2024]

Mitigation measures to ensure potential effects are reduced can be found in section 9.6.2.9.

**Assessment for surface water**

Poor planning, design and construction methodology of new watercourse crossings can potentially result in changes in flow, erosion and deposition patterns and rates associated with the surface water feature. This in turn can potentially lead to flow being restricted leading to increased risk of flooding locally. In the absence of mitigation, these are the likely effects that will occur. The upgrading and installation of watercourse crossings on site and their effects on site drainage, classed as medium sensitivity can be considered a **likely, direct, short term to long term, reversible, small adverse effect** with a significance level of **slight**, within the development footprint.

## Plate 9.4: Considerations for culverts



*9.5.2.10 Potential effects on local surface water supplies*

As outlined in section 9.4.13 and presented in **Figure 9.14b** there are two drinking water rivers, which are classed as high sensitivity, hydrologically connected to the site (Wind Farm and GCR) <10km downstream in the same catchment.

A worst-case scenario could occur whereby the proposed works of HDD on the GCR could result in an **indirect, adverse, potentially significant, short-term effect**. This potential effect could result in a temporary impact on water quality, however it would also have medium to short term negative effect on waterbodies flora/fauna downstream. As outlined in section 5 of the Appropriate Assessment (AA) Screening, changes associated water quality and hydrology are identified as a potential pathway for effects to habitats and/or species. Refer to EIAR **Chapter 7 Biodiversity**).

However, given the downstream distance from the wind farm to the downstream drinking water rivers (c.35km) which are highly sensitive receptors these risks are considered to be low. In the absence of mitigation, the potential effects associated with the Project on the downstream drinking water river (Blackwater Munster_150) is considered a **possible, indirect, localised, temporary, small adverse effect** with a significance level of **slight**, in terms of drinking water quality.

In the absence of mitigation and given the distance from the GCR (HDD location N72/Blackwater Munster) to the drinking water rivers (5km), the effect is considered **possible, indirect, localised, temporary, large adverse effect** of **very significant** significance, in terms of drinking water quality.

*9.5.2.11 Potential effects on local groundwater supplies*

The construction activities in proximity to T1, T2 and T3 are situated over a karst aquifer with groundwater vulnerability ranging from 'High' and 'Extreme' in places. A swallow hole located >100m northwest of T1 is not hydrological linked to T1. Construction activities at T4, T5, T6, T7, T8, T9 and the Substation are situated over a locally important aquifer which is moderately productive in local zones, but it is important to note the hydrological connections to karst features and in turn groundwaters downstream (section 9.4.6). Additionally, there is an enclosed depression/quarry northeast of T5. The enclosed depression/quarry is not hydrological linked to T5.

Groundwater vulnerability is classed as Extreme at T7 and the substation; 'High' at T5 and T8, and 'Medium' at T4, T6 and T9 over this aquifer. Construction in these areas also has the potential to affect the groundwater which will occur locally. As outlined in section 9.4.13, the nearest GSI Public Source of Protection is Mountnorth RWSS c.6.5km from the site. Part of the GCR will be located in local roads within the surface water protection zone (SPZ). A further GSI Public Source of Protection area associated with the GCR is Oliver Cross PWS. Based on the EPA water abstraction register, Olivers Cross groundwater supply is not in operation.

The following is noted in relation to the construction activities:

- Excavations will be of c.3.0m depth for Turbine Foundations (EIAR **Chapter 5 Project Description**).

- Governing Industry Guidelines[25] (section 9.2.2) stipulate a groundwater buffer zone of 100m is required from wells used for drinking water abstraction in relation to the proposed site access tracks and cable trenches i.e., shallow excavations.
- Depths of excavations for the GCR cables will be 1.25 mbGL.

The Project has  no potential to impact on groundwater levels proximal to excavation and dewatering activities. Dewatering of excavations in particular can create a localised cone of depression or lowering of the water table in the surrounding area. The degree to which the water table is lowered is dependent on the baseline static water level, is proportionate to the depth of the particular excavations and/or depth at which the pump is placed, and the hydrogeological characteristics of the surrounding geology / aquifer. No abstractions were identified within the RLB. Considering the baseline data and Project characteristics, the risk of lowering groundwater levels is not considered likely and deemed to be **not significant**.

The availability of groundwater in a social or agricultural sense is considered important, therefore the importance of groundwater quantities underlying the site is considered 'Medium to High' sensitivity and importance. In the absence of mitigation, any effect to the availability of groundwater for use (lowering of water level in wells) through dewatering activities is considered a **possible, direct, adverse, temporary in nature, small adverse effect** with a significance level of **slight**. Construction activities will be localised, small in scale and temporary in nature.

Hydrocarbons (e.g., diesel) pose the most significant risk to groundwater quality and can persist for many years. Other contaminants associated with the construction phase are the release of construction or cementitious materials. In areas of extreme vulnerability there is greater potential for contaminants to reach groundwater.

Considering the quality of the groundwater underlying the wind farm site (section 9.4.4), and the 'Medium to High' sensitivity and importance associated with groundwaters nationally and the temporary localised nature of construction activities, in the absence of mitigation any introduction of contaminants is considered a possible, **indirect, adverse, short-term to long term, potentially irreversible, small adverse effect** with a significance level of **slight**.

Mitigation measures are outlined in the design phase and discussed in sections 9.6.1 and 9.6.2.11.

As outlined in section 9.4.11, the groundwater divide coincides with a surface water divide in the Old Red sandstones of the Kilmaclenine anticline (**Figure 9.15**). This divide potentially controls groundwater flow from the identified point recharge locations to either the north or south depending on the locations relative to the divide. Utilising this conceptual model of groundwater flow, dwellings that are located south of the divide and north of the divide can be identified as potential receptors.

It is anticipated that any potential groundwater effects will be significantly attenuated across the distances to the nearest dwellings as outlined in section 9.4.10, in the underlying moderately productive aquifer.

[25] EPA DrINkINg WATEr ADVICE NOTE Advice Note No. 11: Technical Assessments  and Prior Investigations

Several mapped wells were identified within a 250m buffer along the GCR (Option 1 and Option 2), however given the nature of the works on the GCR (shallow excavations) no potential effects are anticipated.

Due to the limited excavations and a combination of low/moderate permeability soils (**Figure 9.10b**), the temporary nature of the construction works, and moderate recharge rates at the site is expected to result in a **likely, temporary, small adverse effect** with a significance level of **slight**, effect of the development which is in contrast to baseline conditions (in terms of the following potential effects; increase in runoff and suspended solids to groundwater). In the absence of mitigation, these are the likely effects that will occur. With appropriate mitigation measures in place, the potential effects on groundwater will be managed at the Project site as a precautionary measure. Mitigation measures specific to management of excavations and arisings are outlined in EIAR **Chapter 10 Soils and Geology**.

### 9.5.3 Operational phase likely significant effects

#### *9.5.3.1 Increased runoff*

The Project has the potential to result in increased rates of runoff during the operational phase relative to baseline conditions as outlined in section 9.5.2.1. The installation of constructed drainage; a clean water interception drain for the purposes of collecting either clean water or construction runoff, has the potential to alter the natural hydro morphology of the site.

Preliminary water balance calculations (EIAR **Volume III, Appendix 9.5**), indicate that the development will lead to a net increase of surface water runoff of approximately 0.17m$^3$/second, or 0.83% relative to the site area during a 1 in 100-year storm event including 20% increase due to climate change. This calculation, as shown in Table 4 in EIAR **Volume III, Appendix 9.5**, assumes that all track and hardstand surfaces would be fully impermeable as a precautionary scenario which is unlikely to be considered as an option during the detailed design phase. The increase in hardstand area associated with the Project will likely impact on the groundwater and hydrogeological flow regimes (including capacity for recharge) at a localised scale but not at a regional scale. In the absence of mitigation, this is considered a **likely, adverse, direct and indirect, short-term to long-term, reversible, negligible effect** and **not significant effect**.

Mitigation measures as outlined in section 9.6.1.2 have the potential to have a positive effect on the hydrological response to rainfall at the site, whereby, if the development can reduce discharge rates at the site at or below estimated greenfield runoff rates. Additionally, these measures along with those outlined in EIAR **Chapter 7 Biodiversity** (summarised in section 7.10.6.1), promote ecological habitats at the site. The potential effect due to a net increase in runoff associated with the Project is considered **not significant.**

### 9.5.4 Decommissioning phase

Decommissioning of the Project would result in the cessation of renewable energy generation at the end of the operational life of the wind farm with the removal of various infrastructural elements. The drainage network of the site will be inspected by a Sustainable Drainage Systems (SuDS) hydrologist, prior to any works commencing. The decommissioning phase will involve the removal of the above ground elements of the wind farm as outlined in EIAR **Chapter 5 Project Description**.

The excavation of topsoil and subsoils is expected during the decommissioning phase, to a lesser extent than the construction phase. The movement of plant, vehicles and equipment is expected to be required during the decommissioning phase, but to a far less extend than during the construction phase. As a result, there remains a risk of elevated suspended solids being discharged in surface water run-off to the downstream receiving environmental during the decommissioning phase. Additionally, the potential risk remains for spills of fuels hazardous chemicals which is a common risk to all developments. The mitigation measures outlined in this chapter will be implemented during the decommissioning phase to reduce the potential for such effects.

In the decommissioning phase, the upper sections of the foundations projecting above ground will be removed, and the remainder of the foundations will be covered by soils typical of the surrounding environment and then reseeded or left to re-vegetate according to ecological requirements. The upgraded and new internal access tracks will be utilised to access farmlands Underground cables will be cut back at the turbine termination points. It is proposed that site access tracks will remain to allow access through the site for farm access.

The drainage system during the decommissioning phase of the proposed development, will align with that of the operational phase. With the passage of time, the constructed drainage network will likely become full of deposited sediment and revegetation will naturally occur which has the potential to render the drainage system less effective over time. The site will therefore revert over time to a more natural drainage regime. All anticipated effects are similar in nature to those already highlighted during the construction phase of the development (section 9.5.2), i.e., release of hydrocarbons, wastewater / sanitation and suspended solids through the temporary facilities present during the decommissioning phases and the excavation of materials.

In the absence of mitigation, this is considered to be a **likely, adverse, localised** effect with a significance level of **slight**.

## 9.6 Mitigation measures and residual effects

The Project has associated potential effects as described in the previous sections of this report. The following sections outline mitigation measures to be implemented during the design, construction, operation and decommissioning phases of the Project. Potential residual effects after mitigation are implemented are also described in the following sections and are summarised in EIAR **Volume III, Appendix 9.2.**

### 9.6.1 Design phase

#### *9.6.1.1 Mitigation by avoidance*

The fundamental mitigation measure to be implemented during each phase of the Project will be avoidance of sensitive hydrological or hydrogeological receptors wherever possible through project design. This key principle is referred to as “mitigation by avoidance”. This principle has been adopted during the design of the turbine and associated infrastructure layout across multiple design iterations. Hydrological constraints maps have been developed which identified areas of the wind farm site (for example karst swallow hole / enclosed depressions) where surface water and drainage constraints resulted in areas of the site being deemed less suitable for development. The constraints map is presented in **Figure 9.17a** and **Figure 9.17b**.

The identified constraints have been extensively discussed in consultation with the RSK Project Team. The final site layout plan has been identified as the optimal layout design available for protecting the existing hydrological regime of the site, while at the same time incorporating engineering and other environmental constraints.

As part of mitigation by avoidance during the design phase, groundwater, surface water, and drainage buffer zones were established where applicable, excluding areas crossed at track locations. Buffer zones are intended to drive the design process by minimising or avoiding the risk to surface water features by restricting construction disturbance to outside these zones, in turn protecting riparian vegetation and providing potential for filtering of runoff from the site and maintaining the baseline hydrological and drainage regime at the site. The surface water and groundwater buffer zones (sometimes referred to as setback distances), has regard to relevant guidance relating to forestry, agriculture, water resources, direct discharges and wind farm development guidance documents (section 9.2.2).

Surface water and groundwater buffers are prescribed and are intended to serve two functions;

1. Where sensitive receptors are identified as part of baseline assessments, buffers are prescribed in order to present and communicate site constraints to the design team and inform the design process.
2. Where multiple constraints associated with multiple planning, environmental or engineering disciplines are present, some portions of the development design will fall within some forms of buffers zones. This is evident with watercourse crossings, which are naturally located over watercourses and within buffer zones. Where buffer zones cannot be avoided, or are in close proximity, the receptor is considered to have elevated sensitivity or exposure, and mitigation will be elevated and in some cases tailored on a case by case basis,

In terms of surface waters and drainage, a series of buffers are applied where relevant;

- A 50m Surface Water Buffer Zone was applied as embedded mitigation. The Buffer applied to EPA Mapped surface water features i.e., mapped streams, rivers, lakes. Source for mapped surface water features; EPA.
- A 15m Drainage Buffer Zone was applied to non-mapped drainage features e.g. agricultural drainage network. These buffers indicate that the feature should be avoided if possible, but if not possible the feature is considered in terms of its connection to downstream receptors i.e. the mapped surface water network; rivers, stream, lakes.

**Figure 9.17a Tile 05** presents (an identified) a historic non-EPA surface water feature which ‘rises’ within close proximity to the proposed development. The surface water features were identified on the historical OSI maps. As a precautionary principle, a 25m buffer has been prescribed to this feature. This feature is located approximately 90m west of the proposed works.

The wind farm surface water buffers are presented in **Figure 9.17a**. GCR surface water buffers are presented in **Figure 9.17b.** TDR Option 1 and 2 are presented in EIAR **Volume III, Appendix 9.9**.

Groundwater buffer zones are dependent on the characteristics of the receptor e.g., public supply source protection zone, and the characteristics of the underlying geology and associated aquifer e.g., poor unproductive aquifer, or regionally important karstified aquifer. Groundwater buffer zones vary however a 25m buffer was chosen (exclusion zone karst swallow holes/enclosed depressions) depending on site specific characteristics. For the purpose of this assessment the following conservative approach on the buffer distances has been applied:

- 25m Surface Karst Feature Buffer Zone e.g., swallow holes. In addition, there is no hydrological connectivity and no discharge to swallow holes on site.
- 250m Groundwater Buffer Zone – Groundwater abstraction points in relation to foundations, proposed access tracks. Source for mapped abstraction points: GSI. Not applicable, none within 250m of the site (Section 9.4.11**, Figure 9.17a**).
- Source Protection Areas – The entire area mapped as a public or group groundwater supply protection area is applicable to the GCR. Source: EPA.

Where mitigation by avoidance is not possible, some of the development infrastructure footprint typically falls within buffer zones (e.g., the Substation, T3, T4 and T8) due to constraints related to other environmental disciplines including; ecology, ornithology, etc. which influence the overall layout. The placing of these constraints is restricted due to the proposed infrastructure itself whereby the proposed turbines require a minimum distance from each other to ensure the potential for wind turbulence affecting downwind locations is minimised. In these buffer zone areas, additional mitigation measures will be applied to ensure the maximum reduction in potential risks to waterbodies.

None of the proposed wind farm works fall within 50m buffers for EPA mapped rivers. In relation to the proposed TDRs; TDR Option 1 presented in EIAR **Volume III, Appendix 9.9**, shows the crossings of mapped rivers; the Awbeg (Buttevant)_020, Awbeg (Buttevant)_030. The river crossings will not require widening. TDR Option 2 presented in EIAR **Volume III, Appendix 9.9**, shows the crossings of mapped rivers. Some other sections of the TDR fall within 50m river buffers.

Method statements and the proposed design of any river crossings will also require agreement from Inland Fisheries Ireland (IFI) in advance of construction which invariably must be constructed within the buffer zones. Refer to EIAR **Chapter 7 Biodiversity**. The mitigation measures described in the following sections will also be applied.

Portions of both GCRs pass through one surface water and two groundwater Source Protection Areas. See EIAR **Volume III, Appendix 10.2a / 10.2b**.

Of note in relation to the GCR Option 1 & 2 is the crossing of Blackwater (Munster) river along the N72 which will be crossed via HDD, and works are to take place outside surface water buffer zones. A launch pit will be constructed within the L53320 public road approximately 18m before the junction with the N72. This location is on the boundary of the Inner Protection of a groundwater source protection area (Ref. Oliver Cross PWS, (Not currently in use)).

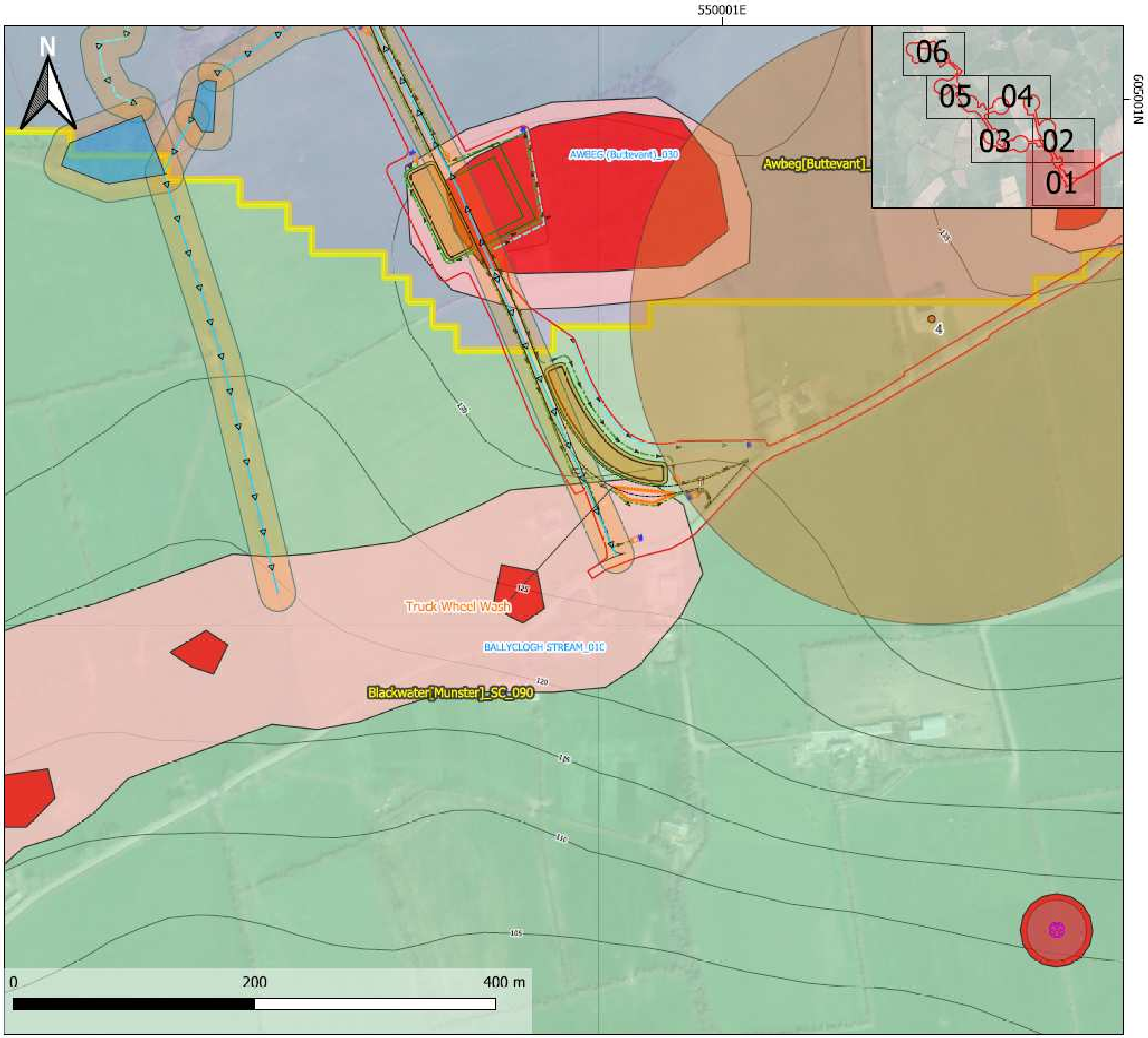
In line with the approach laid out in section 9.1.1, mitigation measures have been designed to reduce Project specific residual impacts to neutral or slight. With appropriate environmental engineering controls and measures, these potential risks will be significantly reduced and are considered to be **not significant**.

## Constraints Map Wind Farm - 01

**Legend**
**Project Information**
**Hydrogeology**
**Karst Landforms 40k (GSI)**
Enclosed Depression
Karst Landforms 25m Buffer
**Data Collected on site**
**Mapped Drainage**
Non-Mapped Waterbodies
**Non-mapped Drains**
Tertiary
Secondary
Drainage 15m Buffer
Non-mapped Waterbodies 15m Buffer
**Mapped Well**
Private Wells
250m Buffer Private Well
**Wind Farm Layout**
Redline Boundary
Permanent Access Track
Temporary Access Track
Substation Hardstand
Temporary Stockpile Areas
Truck Wheel Wash
**Site Drainage Layout**
Clean Water Interception Drain
Dirty Water Interception Ditch
Proposed Silt Screen
Proposed Culvert
Flow Arrows
Proposed ACO Drain
Stilling Pond
Surface Drainage Diffuse Overflow
**Constraints**
**Hydrology**
**Groundwater Vulnerability 1:40000 (GSI)**
Rock at or near Surface or Karst (X)
Extreme (E)
**River SubBasins Cycle 3 (EPA)**
AWBEG (Buttevant)_030
BALLYCLOGH STREAM_010
Subcatchments (EPA)
**Topography**
DEM 5m Contour
**Base Layers**
**Google Satellite**

| | |
|---|---|
| Project ID | 604162 |
| Project Name | Tullacondra WF, Co. Cork (TWF) |
| Projection | ITM |
| Drawn by | CCa |
| Reviewed by | JS & DW |
| Version | 02/05/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Survey Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.17a: Constraints present on wind farm – tile_01**

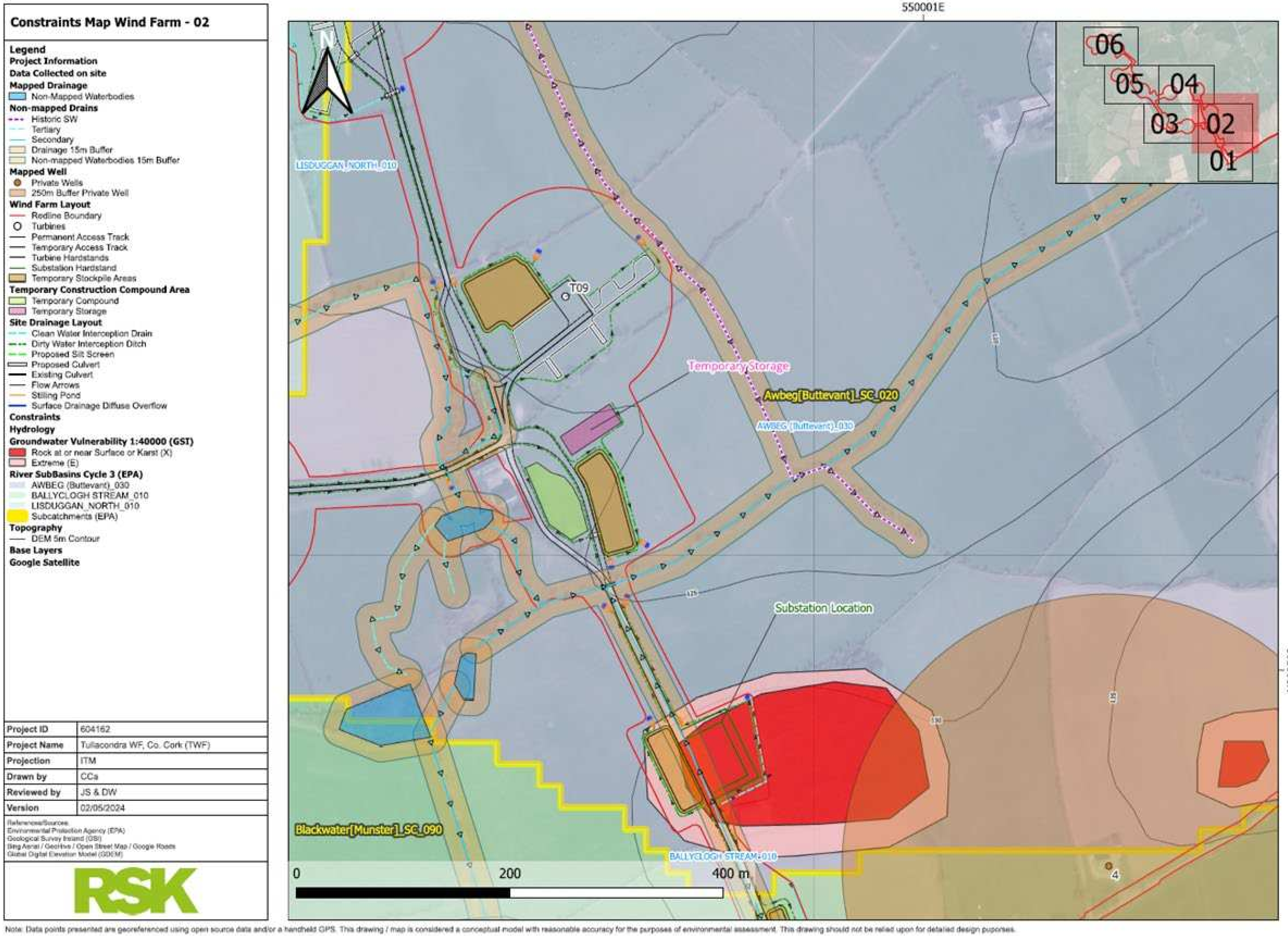
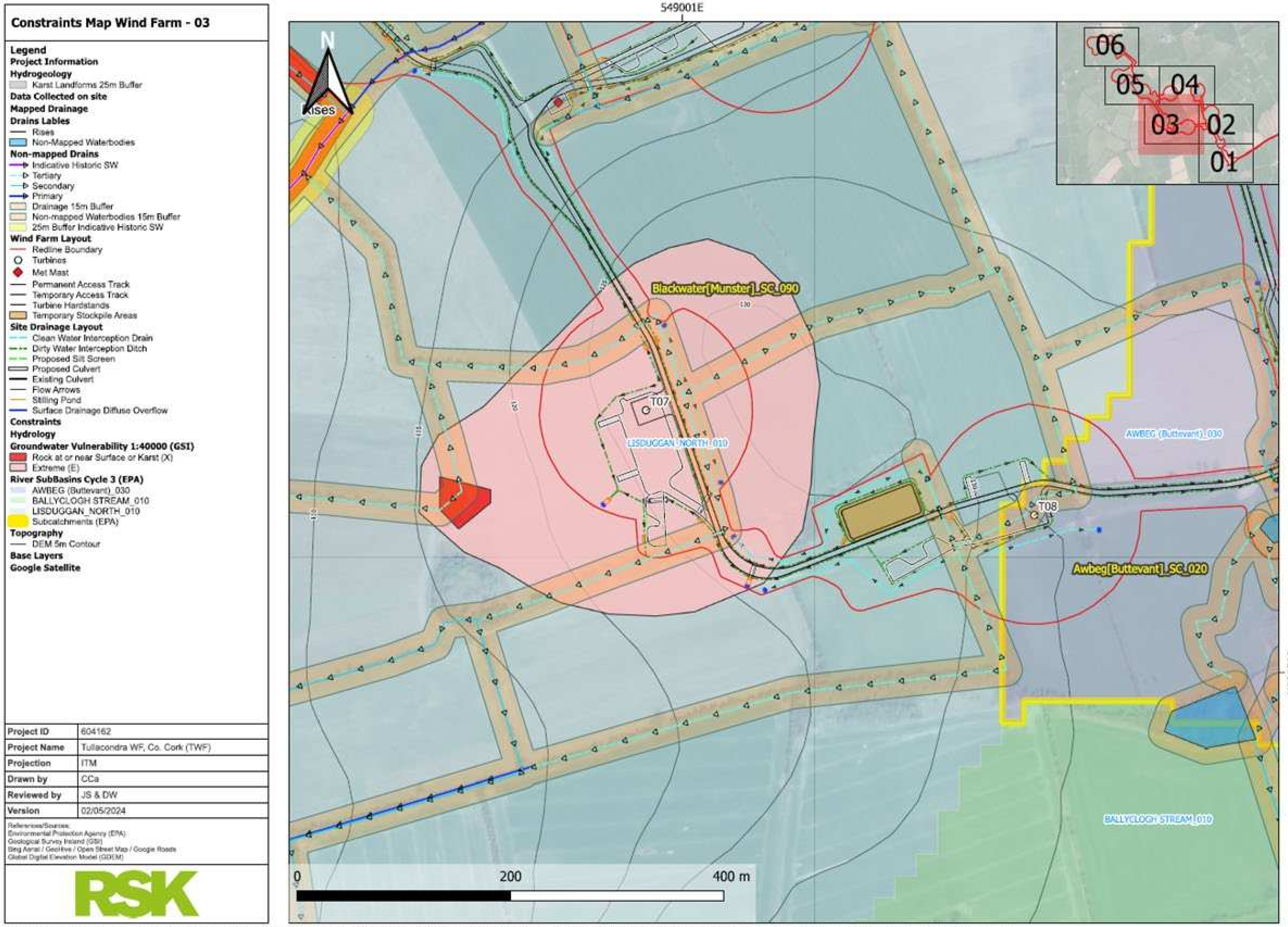



**Figure 9.17a: Constraints present on wind farm – tile_02**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.17a Constraints present on wind farm – tile_03**


Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design purposes.

**Figure 9.17a: Constraints present on wind farm – tile_04**

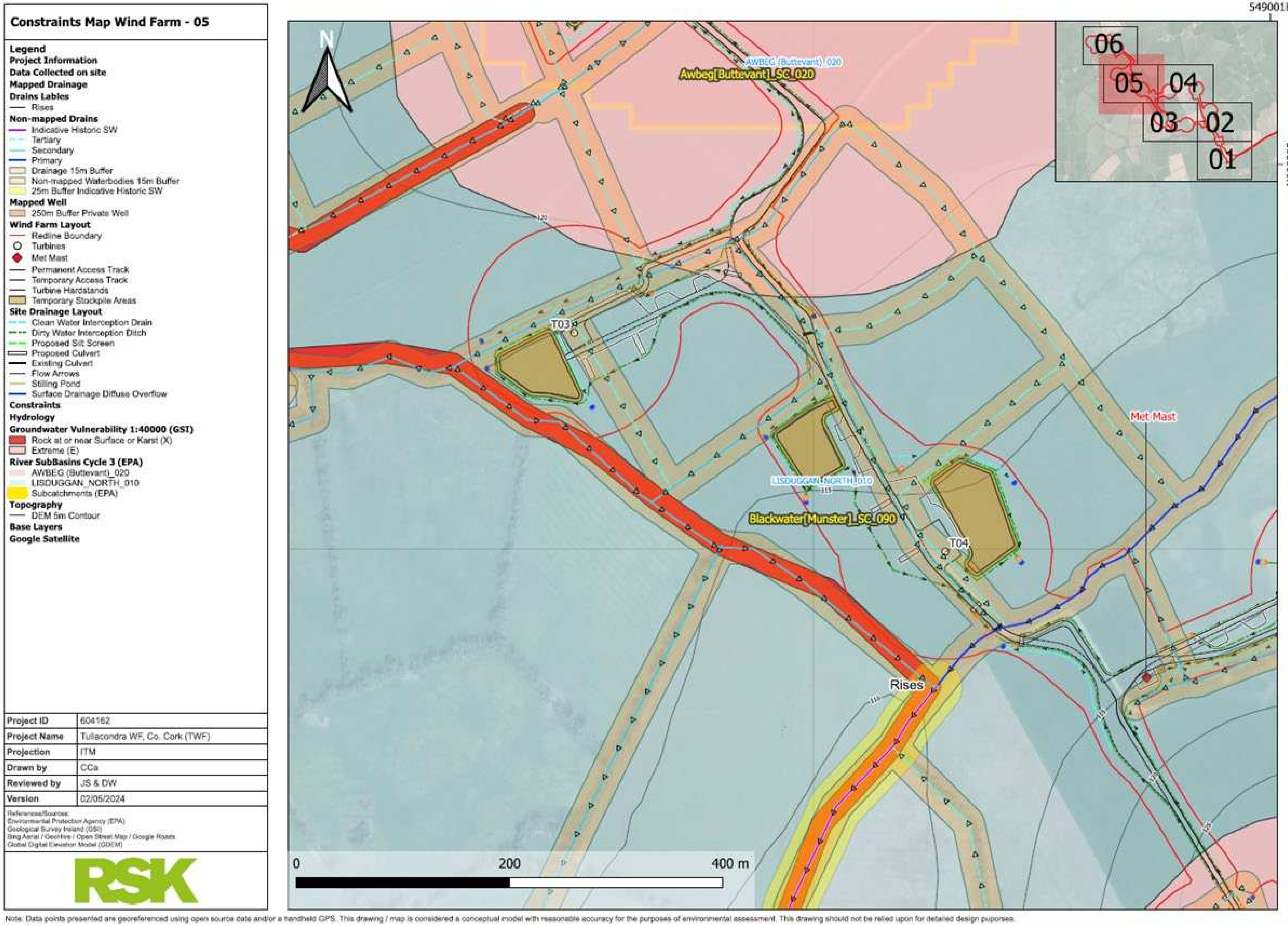



**Figure 9.17a: Constraints present on wind farm – tile_05**

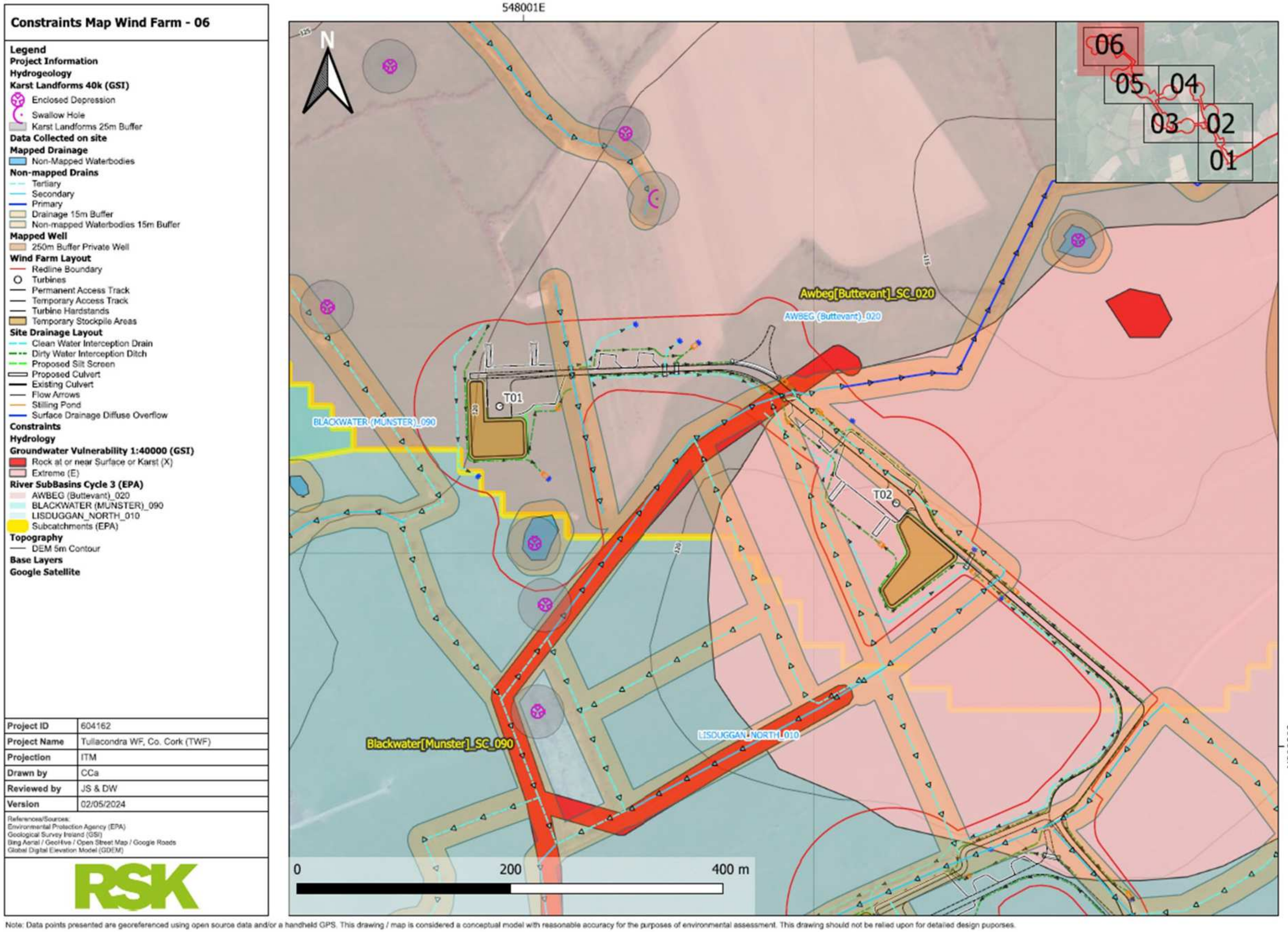
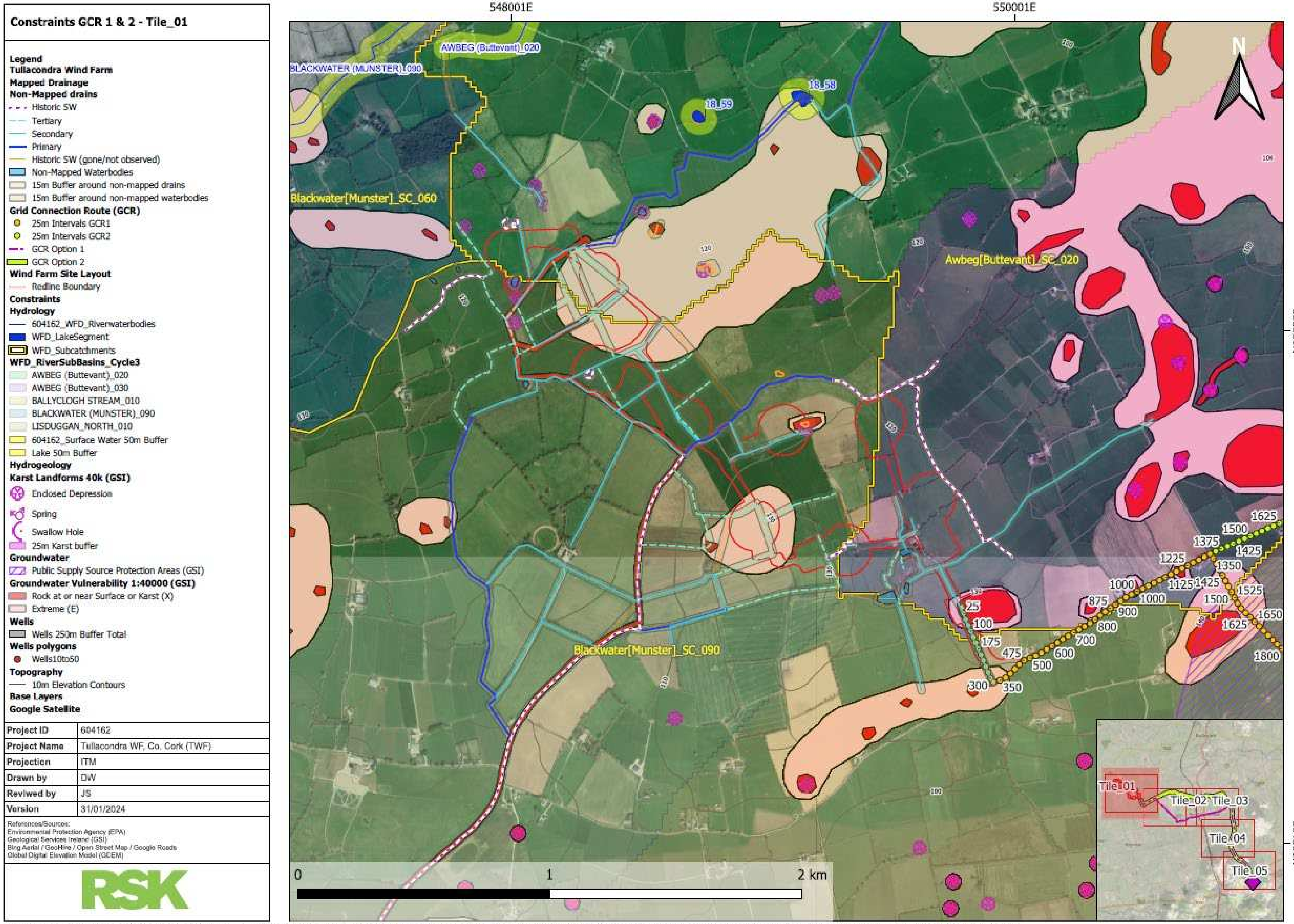



**Figure 9.17a: Constraints present on wind farm – tile_06**

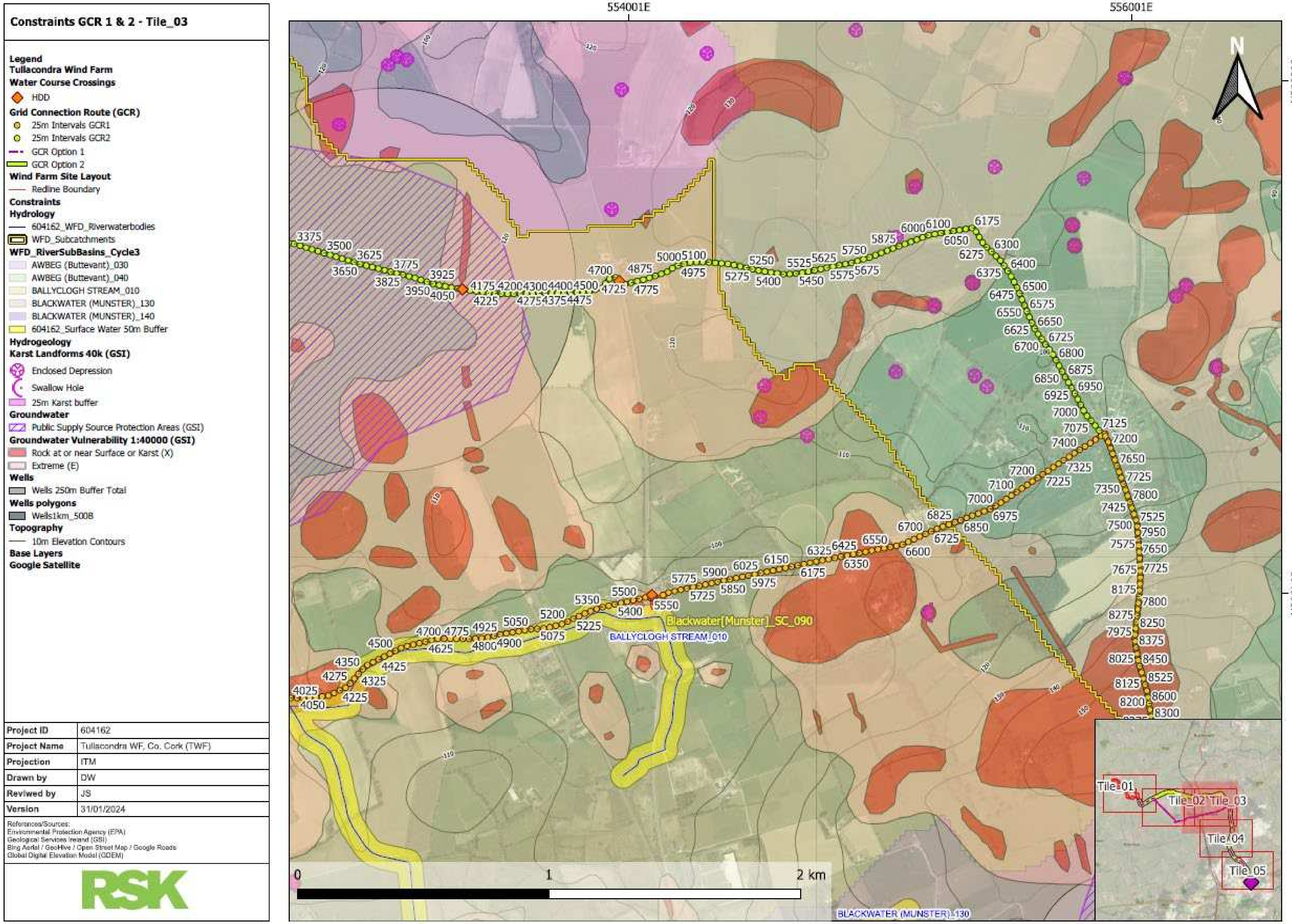



Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.17b: Constraints present on GCR options 1 & 2 – tile_01**


Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.17b: Constraints present on GCR options 1 & 2 – tile_02**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puporses.

**Figure 9.17b: Constraints present on GCR options 1 & 2 – tile_03**

**Constraints GCR 1 & 2 - Tile_04**

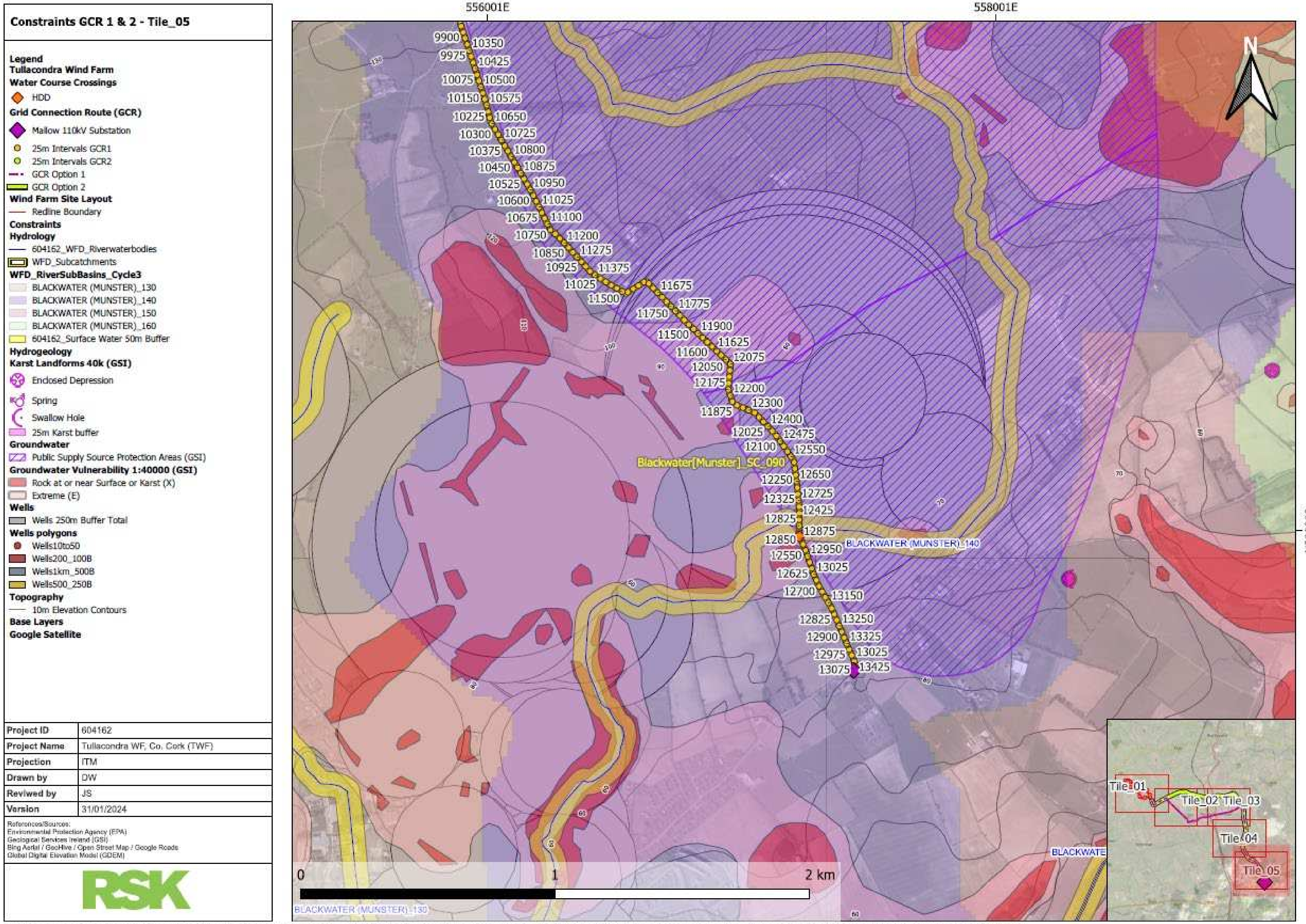
**Legend**
**Tullacondra Wind Farm**
**Water Course Crossings**
HDD
**Grid Connection Route (GCR)**
25m Intervals GCR1
25m Intervals GCR2
GCR Option 1
GCR Option 2
**Wind Farm Site Layout**
Redline Boundary
**Constraints**
**Hydrology**
604162_WFD_Riverwaterbodies
WFD_Subcatchments
**WFD_RiverSubBasins_Cycle3**
AWBEG (Buttevant)_040
BALLYCLOGH STREAM_010
BLACKWATER (MUNSTER)_130
BLACKWATER (MUNSTER)_140
604162_Surface Water 50m Buffer
**Hydrogeology**
**Karst Landforms 40k (GSI)**
Swallow Hole
25m Karst buffer
**Groundwater**
Public Supply Source Protection Areas (GSI)
**Groundwater Vulnerability 1:40000 (GSI)**
Rock at or near Surface or Karst (X)
Extreme (E)
**Wells**
Wells 250m Buffer Total
**Wells polygons**
Wells10to50
Wells200_100B
Wells1km_500B
Wells500_250B
**Topography**
10m Elevation Contours
**Base Layers**
**Google Satellite**

| | |
|---|---|
| **Project ID** | 604162 |
| **Project Name** | Tullacondra WF, Co. Cork (TWF) |
| **Projection** | ITM |
| **Drawn by** | DW |
| **Reviwed by** | JS |
| **Version** | 31/01/2024 |

References/Sources:
Environmental Protection Agency (EPA)
Geological Services Ireland (GSI)
Bing Aerial / GeoHive / Open Street Map / Google Roads
Global Digital Elevation Model (GDEM)


Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puposes.

**Figure 9.17b: Constraints present on GCR options 1 & 2 – tile_04**




Note: Data points presented are georeferenced using open source data and/or a handheld GPS. This drawing / map is considered a conceptual model with reasonable accuracy for the purposes of environmental assessment. This drawing should not be relied upon for detailed design puposes.

**Figure 9.17b: Constraints present on GCR options 1 & 2 – tile_05**

*9.6.1.2 Mitigation by design*

The descriptive mitigation measures outlined in this Chapter will be applied to the development design and construction methodologies with a view to avoiding and/or minimising any potential adverse effects to water quality in the receiving surface water network.

- Nature based solutions
- Constructed drainage
- Check dams
- Stilling ponds
- Consideration of constraints

Details on how such measures will be applied (objectives, design considerations, layout) are contained in a Surface Water Management Plan (SWMP) in the CEMP provided in EIAR **Volume III, Appendix 5.1**. The aims and examples of important considerations in relation to mitigation measures described in the EIAR are further clarified here.

**Nature based solutions**

Nature based solutions (NBS) will be adopted at the wind farm site where possible and have been incorporated into the design. Refer to EIAR **Chapter 7 Biodiversity**. NBS include Sustainable Drainage Systems (SuDS), which will be employed to attenuate runoff and reduce the hydrological response to rainfall at the site. Extending or maximising this approach sufficiently has the potential to attain net beneficial effects i.e., a net reduction in runoff rates at the site, beneficial effects to water quality and reducing flood risk to downstream flood risk areas. Coupling SuDS with ecology and biodiversity enhancement provides opportunities to attain net biodiversity gain.

One of the main objectives of NBS and SuDS is to create an array of runoff stilling areas / standing water and promote diffuse discharge and recharge of runoff at the proposed site. The objective of NBS will be to reverse the effect of the development where there is the opportunity and where it is appropriate through surveying and risk assessment.

**Constructed drainage**

The proposed wind farm drainage will be integrated into the existing surface water network. It is anticipated that the Project is likely to have a slight beneficial effect to the hydrological regime in regard to downstream flood risk areas.

The drainage incorporated into the design will facilitate:

- The collection of surface water runoff from upgradient of the development footprint (clean water interception ditch) and the buffered redistribution of clean runoff downgradient of the development footprint by means of culverts and buffered outfalls to vegetated areas (EIAR **Volume III, Appendix 9.4 – Tiles 16 - 17),** with a view to maintaining or improving the hydrological regime at the wind farm site.
- The collection of surface water runoff from the footprint of the development i.e., the construction area (construction runoff drains) (EIAR **Volume III, Appendix 9.4 – Tile 10**), and management of potentially contaminated runoff in the

constructed treatment train**.** Where possible the buffered outfalls from the treatment train / stilling ponds (EIAR **Volume III, Appendix 9.4 – Tile 13**).

- Diversion of drains will not give rise to increased flow rates from the wind farm site, and they are effectively neutral to the hydrological regime of the wind farm site overall, with these attenuation features.
- In line with the approach laid out in section 9.1.1, mitigation measures have been designed to reduce Project specific residual impacts to neutral or slight which is considered to be **not significant**.

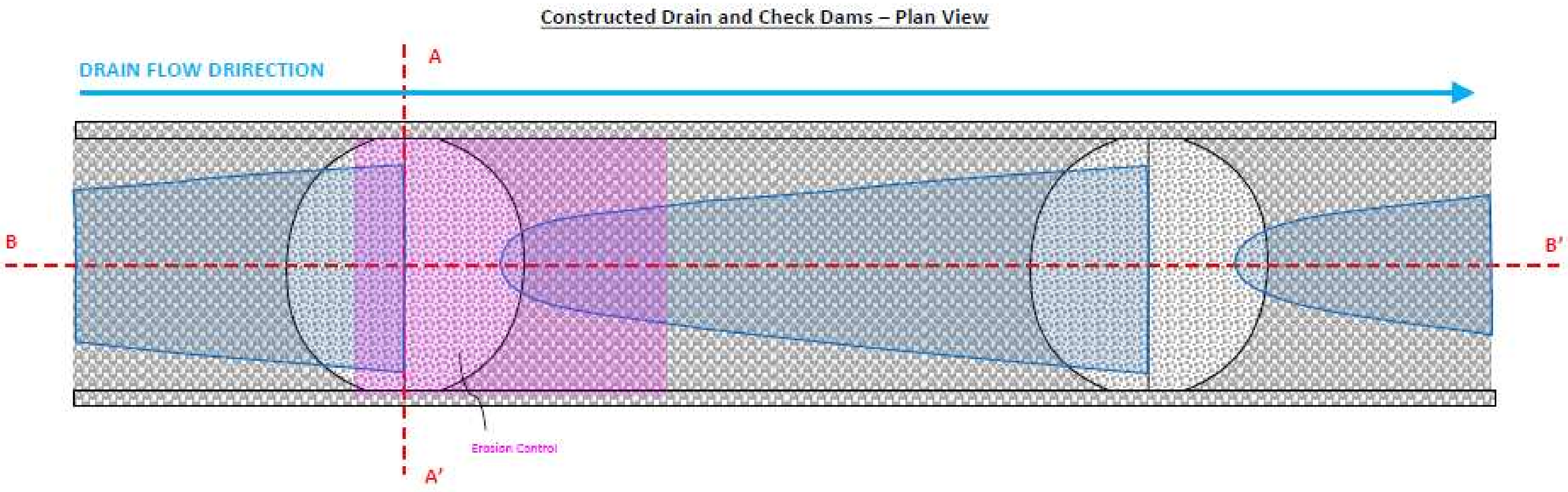
**Check dams**

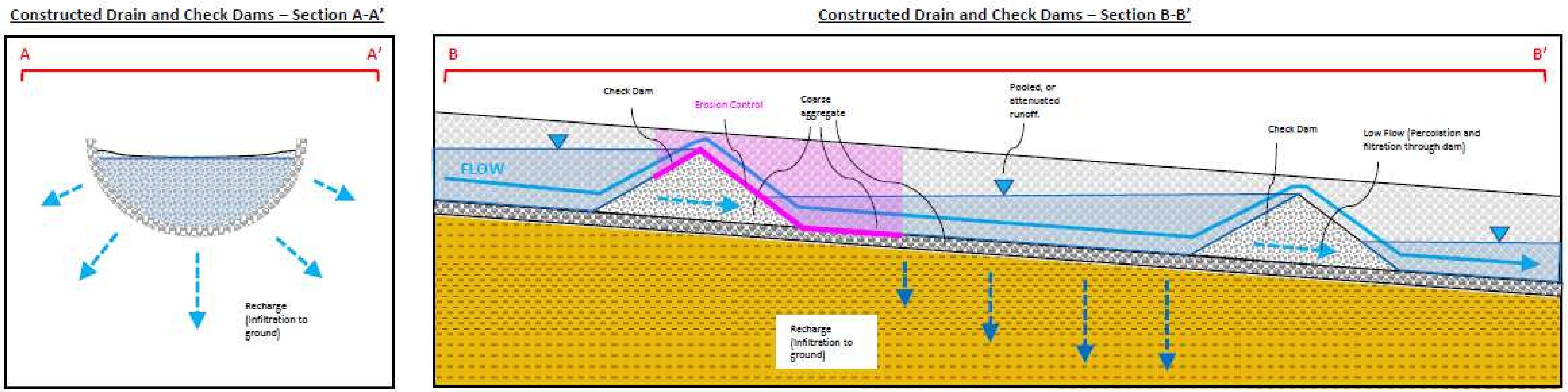
Check dams have been incorporated into the design, in line with best practices of SuDs and will be constructed along the drainage network at regular intervals. Check dams (EIAR **Volume III, Appendix 9.4 – Tiles 4-6 and 14**) (**Plate 9.5**), will be used in the construction and operational phase, made of suitable locally sourced coarse aggregate (similar geology), and are intended to attenuate (impede) surface water runoff in the drainage channel, therefore slowing the velocity of the runoff in turn reducing the potential for erosion in the channel and allowing suspended solids to settle out if present. The nearest local quarries are outlined in EIAR **Chapter 16 Traffic and Transport**. Check dams can help increase infiltration on the site. Check Dams have been designed to reduce Project specific residual impacts to neutral or slight, beneficial**,** which is considered to be **not significant**.

**Plate 9.5: Check Dam Considerations**

**NOTES:**

- The extensive use of check dams is recommended for the following reasons:
  - Management of runoff in terms of reducing flow velocity and minimising in channel erosion, or erosion at drainage outfalls.
  - Maximise attenuation of runoff with a view to enhancing runoff quality i.e. settlement of suspended solids.
  - Maximise attenuation of runoff with a view to reducing the hydrological response to rain fall at the site.
  - Maintain or improve the site hydrological/ hydrogeological regime with a view to maximising recharge to ground and increasing groundwater levels locally. This is particularly relevant for peatland areas.
- Check dams will be constructed with the following features and specifications:
  - A low flow pipe or small orifice to allow for low flows through the check dam.
  - Check dams will be permanent (life of development) and will be constructed with crushed rock with appropriate geo-chemistry (local) for example; coarse aggregate (100-600 mm). Wooden boards, gabions can also be used.
  - Erosion protection and energy dissipaters (cobbles / boulder 100-150mm diameter) which will extend approximately 1.2 – 1.8m downgradient of the dam and applied to both the base and side walls of the drain / swale.
  - Erosion control can be enhanced with the in-combination use of geotextile base layers (but consider low flow through).
  - It is recommended that the drainage channels / swales are entirely lined with coarse aggregate / erosion control. This will enhance mitigation in terms of attenuation, erosion control, and recharge to ground. Alternatively, allowing drains / swales to vegetate will achieve similar effects.

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|---|---|---|---|---|---|
| Site Name: Tullacondra Green Energy Project, Co. Cork | Project No. | 604162 | Drawn By: | Sven Klinkenbergh Principal Environmental Consultant | RSK |
| | Client: | Tullacondra Green Energy Ltd | | | |
| Figure Name: Appendix 9.5 – Conceptual & Information Graphics – Tile 5 Check Dams – General Considerations | Date: | 18/11/2022 | Reviewed By: | SK | |
| | Revision: | 00 DRAFT | | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

**Stilling ponds**

Stilling ponds (EIAR **Volume III, Appendix 9.4 – Tile 13**) have been incorporated into the drainage design. Buffered outfalls (EIAR **Volume III, Appendix 9.4 – Tiles 17),** will be constructed at drainage outfalls associated with the construction runoff drainage network (**Figure 9.6a**). Buffered outfalls will be established at intervals along the clean water interception ditch. Multiple outfalls along the drainage routes facilitates the strategic management of runoff with a view to maintaining the baseline hydrological regime in so far as possible. Similar to check dams; some stilling ponds around operational infrastructure will remain (for the life of the Project / drainage network). They will be made of suitable coarse aggregate and are intended to attenuate surface water runoff in the drainage channel, slowing the velocity of the runoff before discharging to vegetated areas (buffered outfall). Slowing the water velocity allows suspended solids to settle out if present. At low velocity the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding landscape. Stilling ponds and drainage around temporary structures will be reinstated following the construction phase.

In line with the approach laid out in section 9.1.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

*9.6.1.3 Consideration of constraints*

The descriptive mitigation measures outlined, will be applied to the development design and construction methodologies with a view to avoiding and/or minimising any potential adverse effects to water quality in the receiving surface water and groundwater network. Details on how such measures will be applied (objectives, design considerations, layout) will be contained in the Surface Water Management Plan (as part of the CEMP; EIAR **Volume III, Appendix 5.1**).

**Table 9.17: Mitigation measures applicable for construction areas**

| Turbine No. / Unit | Topography mAOD | Soils | Bedrock Aquifer | Groundwater Vulnerability - GSI | Groundwater Recharge - GSI | Karst Features e.g. Swallow hole | Mitigation Applied (Discussed in section 9.6.2) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Buffer for works and spoil storage | Drainage diversion | Silt screen/fence | SUDS e.g. infiltration trenches | Attenuation feature |
| T1 | 120 | sandy, gravelly clay and silt | Regionally important Aquifer - Karst | High | 351-400 | Swallow hole >100m northeast of T1, no hydrological connection | 15m | Yes | Yes | Yes | Yes |
| T2 | 120 | sandy, gravelly clay and silt | Regionally important Aquifer - Karst | Extreme | 351-400 | | 15m | Yes | Yes | Yes | Yes |
| T3 | 118 | sandy, gravelly clay and silt | Regionally important Aquifer - Karst | High | 351-400 | | Historic drainage (15m) | Yes | Yes | Yes | Yes |
| T4 | 113 | sandy, gravelly clay and silt | Locally Important Aquifer | Moderate and High | 151-200 | | 15m | Yes | Yes | Yes | Yes |
| T5 | 116 | sandy, gravelly clay and silt | Locally Important Aquifer | High, Extreme and 'X' | 151-200 | Enclosed depression/Quarry – no hydrological connection | 15m | Yes | Yes | Yes | Yes |
| T6 | 120 | sandy, gravelly clay and silt | Locally Important Aquifer | Moderate | 151-200 and 51-100 | | N/A | | | Yes | Yes |
| T7 | 128 | sandy, gravelly clay and silt | Locally Important Aquifer | Extreme | 151-200 | | 15m | Yes | Yes | Yes | Yes |
| T8 | 130 | sandy, gravelly clay and silt | Locally Important Aquifer | High | 151-200 | | 15m | Yes | Yes | Yes | Yes |
| T9 | 124 | Clayey silty sand and gravel with areas of sandy, gravelly clay and silt | Locally Important Aquifer | Moderate | 151-200 | | 15m | Yes | Yes | Yes | Yes |
| Substation | 132 | sandy, gravelly clay and silt | Locally Important Aquifer | 'X' Rock at the surface | 151-200 | | 15m | Yes | Yes | Yes | Yes |

### 9.6.2 Construction phase

#### *9.6.2.1 Increased runoff proposed mitigation measures – wind farm and GCR*

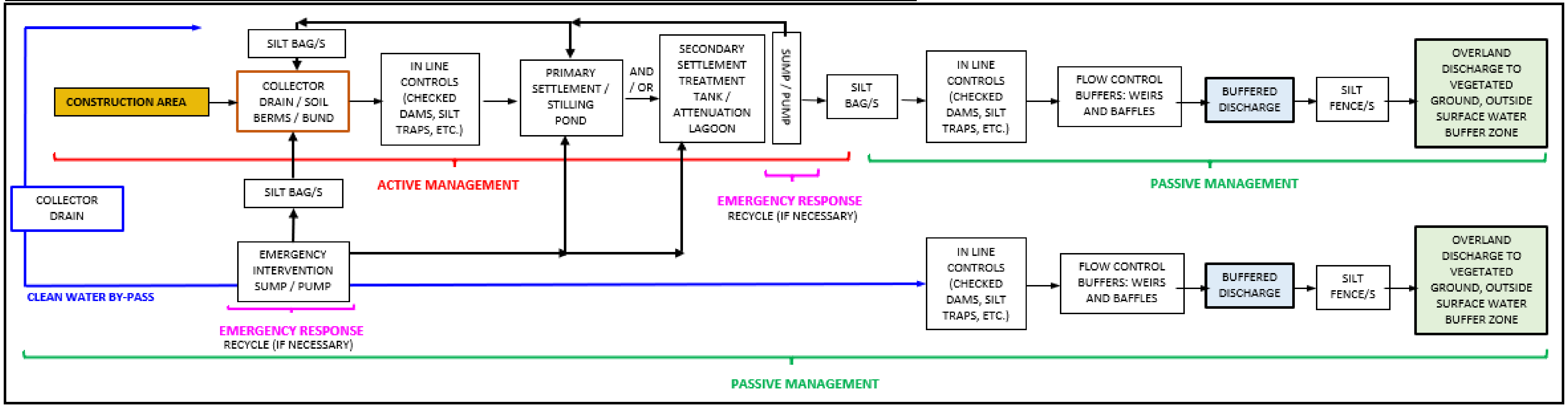
Management and mitigation for earth works is covered in further detail in EIAR **Chapter 10 Soils and Geology**. Mitigation measures to reduce the potential for adverse effects on the water environment arising from earth works and management of spoil include the following:

- A Spoil Management Plan has been prepared as part of the CEMP. It incorporates provision on materials management with a view to establishing material balance (reuse of excavation arisings) during the construction phase, thus minimising the potential for or the length of time excavated materials are exposed and vulnerable to entrainment by surface water runoff. Refer to the CEMP in EIAR **Volume III, Appendix 5.1**
- In sensitive areas for example areas of the GCR or TDR in close proximity to surface waters, excavation of material will be conducted in a controlled manner whereby any temporary deposit of the material in buffer zones can be minimised. For example, vacuum excavation techniques or similar will be used for excavations within Surface Water Buffer zones and other sensitive areas (constraints). All surplus spoil from trenches in public roadways will be removed from site as it is excavated and transported to a licenced facility for disposal.
- Temporary stockpile locations have been identified. Temporary stockpile areas will be managed to facilitate the orderly segregation of material types, be isolated from the receiving surface water network by the use of silt screens etc. and are limited in height (2m), 15m from drains where possible. This takes into account the slope degree and contours on site and is applied to all drains wet or dry to provide safe storage and avoid slippage. The maximum slope angle identified on site, using LiDAR data analysed in GIS software, is 7 degrees.
- Earthworks will not occur during sustained or intense rainfall events. An emergency response system has been developed for the construction phase of the Project (see CEMP), particularly during the early excavation phase. This, at a minimum, will involve 24-hour advance meteorological forecasting (Met Éireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., very heavy rainfall at >25mm/hr), planned responses will be undertaken. These responses will include cessation of construction until the storm event including storm runoff surge has passed over. Following heavy rainfall events, and before construction works recommence, the site will be inspected and corrective measures implemented to ensure safe working conditions, for example dewatering of standing water in open excavations and transfer to treatment train.
- Exposed soils (exposed temporary stockpiles) will be covered with plastic sheeting during all heavy rainfall / storm events and during periods where works have temporarily ceased before completion at a particular area (e.g., weekends, overnight, etc).
- Stockpiles are located away from drains where possible with silt fencing /silt screen in place.

- All drainage infrastructure required for the management of surface water runoff will be established before excavation works commence. Similarly, mitigation measures related to surface water quality will be implemented before excavation works commence.
- Clean Water and dirty water interception ditches**,** will be established to direct/divert surface water runoff from development areas, including temporary stockpiles, and direct same into established treatment trains including stilling ponds EIAR **Volume III, Appendix 9.4 – Tile 13**, buffered discharge points EIAR **Volume III, Appendix 9.4 – Tiles 17,** or other surface water runoff control infrastructure as appropriate. Refer to Planning Application Documentation **Part 2** – Planning Drawings **20910-NOD-XX-XX-DR-C-08005** to Drawing **20910-NOD-XX-XX-DR**-**C-8028**. This is particularly important for effective surface water management associated with proposed infrastructure within the varied surface water buffer zones. These features are referred to as Passive Treatment Systems.
- Conceptual and information graphics presented in **Plate 9.6** and in EIAR **Volume III, Appendix 9.4 – Tile no. 8, 9 and 10** present indicative layout and specification for both passive treatment trains (e.g., clean water interception ditches), active management treatment trains (management and treatment of construction water) and emergency response and intervention.

**Plate 9.6: Treatment train**

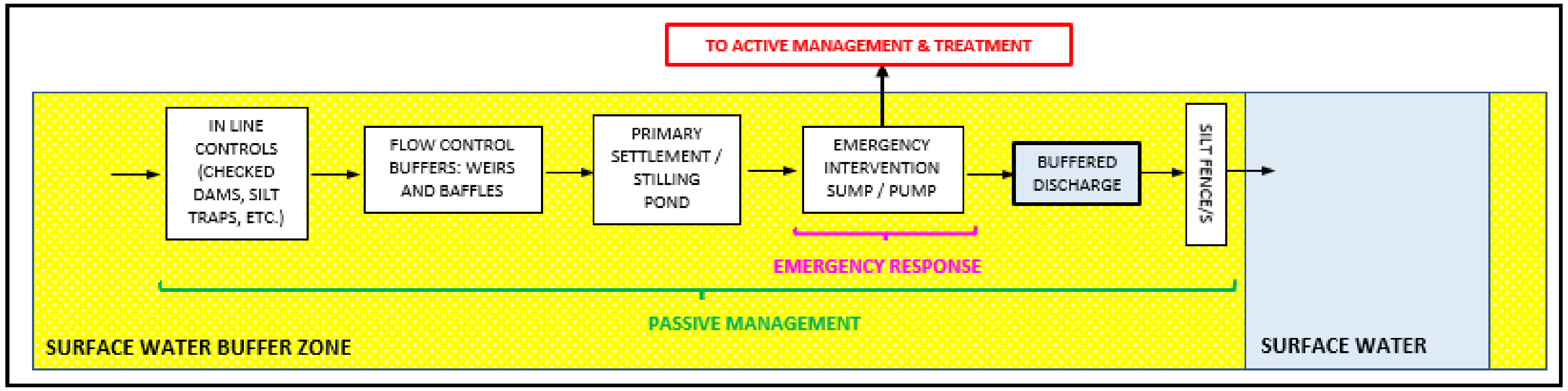
Conceptual Treatment Train Layout for Construction Areas (Access Tracks, Hardstand Areas, Turbine Base, etc.) & Clean Water By-Pass




NOTES:

- Wherever possible, outfalls will be positioned outside of Surface Water Buffer Zones.
- For areas of the development footprint within Surface Water Buffer Zones, in line measures such as silt screens will be over specified e.g. double / triple silt screens, and access to emergency intervention sump / pumps will be facilitated through design and/or emergency response.
- Quality of runoff entering buffer zones will be good i.e. suspended solids <25mg/l. Where runoff quality is poor, emergency response will be to use an intervention sump / pump and pump divert runoff to an area of the drainage network where it will be treated before redistribution and discharge.

Conceptual Treatment Train Layout for Construction Areas & Associated Infrastructure within Surface Water Buffer Zones

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|---|---|---|---|---|
| Site Name: **Tullacondra Wind Farm, Co. Cork** | **Project No.** | 604162 | **Drawn By:** | Sven Klinkenbergh<br>Principal Environmental Consultant |
| | **Client:** | Greensource | | |
| Figure Name: **Appendix 9.6 – Conceptual & Information Graphics – Tile 7 Water Treatment Train Layouts** | **Date:** | 18/11/2022 | **Reviewed By:** | SK |
| | **Revision:** | 00 DRAFT | | |

Conceptual Graphics & Design for consideration at detailed design phase and engineered specification of required infrastructure. Not to scale.

In line with the approach laid out in section 9.1.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight to beneficial and **not significant**.

#### *9.6.2.2 Release and Transport of suspended solids and associated nutrients proposed mitigation measures*

In order to mitigate the effect posed by release of suspended solids to the surface water environment, the following mitigation measures will be implemented[26].The drainage, attenuation and other surface water runoff management systems will be installed concurrent with the main construction activities to control increased runoff and associated suspended solids loads in runoff during intensive construction activities e.g., excavation of turbine base. Conceptual and information graphics associated with mitigating runoff quality are presented in EIAR **Volume III, Appendix 9.4 – Tiles 7 – 9.**

Vehicular movements will be restricted to the footprint of the development and advancing ahead of any constructed hardstand will be minimised in so far as practical. For example, excavation ahead of established hardstands will be in line with expected phases of turbine hardstand and site track construction in terms of both delivery of and installation of material and site activity periods whereby excavations will not be opened ahead of site shut down periods. Measures will also be tailored to ensure site specific conditions e.g. high clay content are taken into account. This will be done with a view to minimising soils / subsoils exposure to rain and runoff. Drainage infrastructure will be installed during meteorologically dry ground conditions. See a brochure on silt management products in EIAR, **Volume III, Appendix 9.10.**

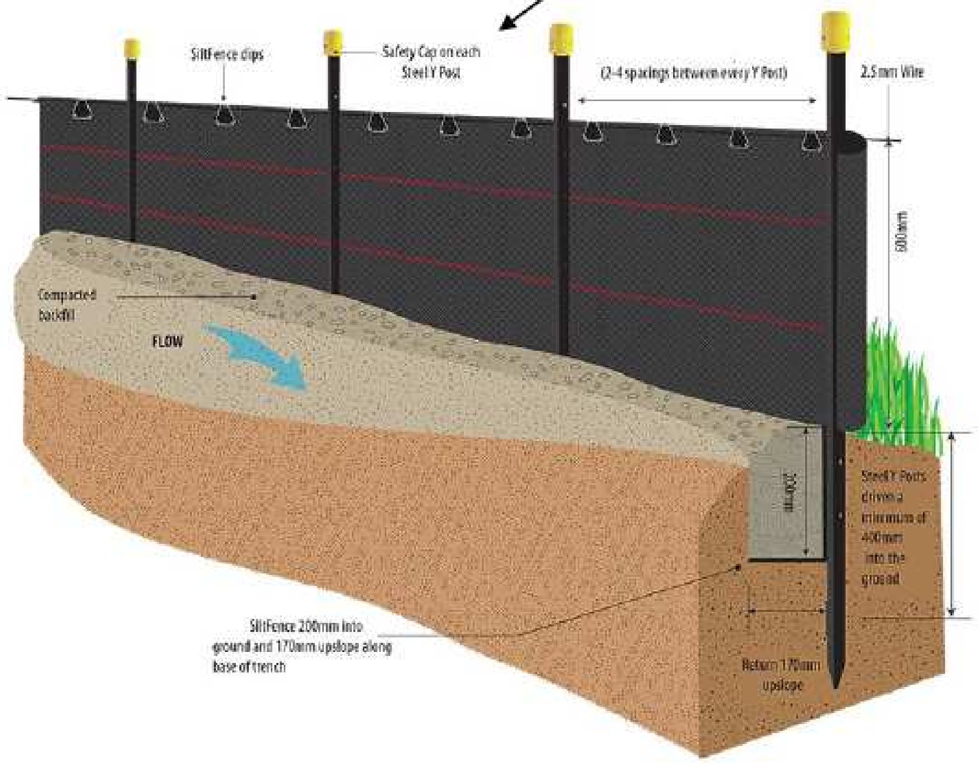
Diffuse surface water runoff quality will be managed as follows:

- Silt fences EIAR **Volume III, Appendix 9.4 – Tiles 12 & 15, Plate 9.7,** will be established along the perimeter of source areas e.g., stockpiles, within the drainage network, and in existing natural drains which are likely to receive surface water runoff. This will reduce the potential for high suspended solids loadings. Double silt fences / screens will be deployed at outfalls within surface water buffer areas. Silt fences will be temporary features but will remain in place for a period following the completion of the construction phase until such time that site conditions are stable.

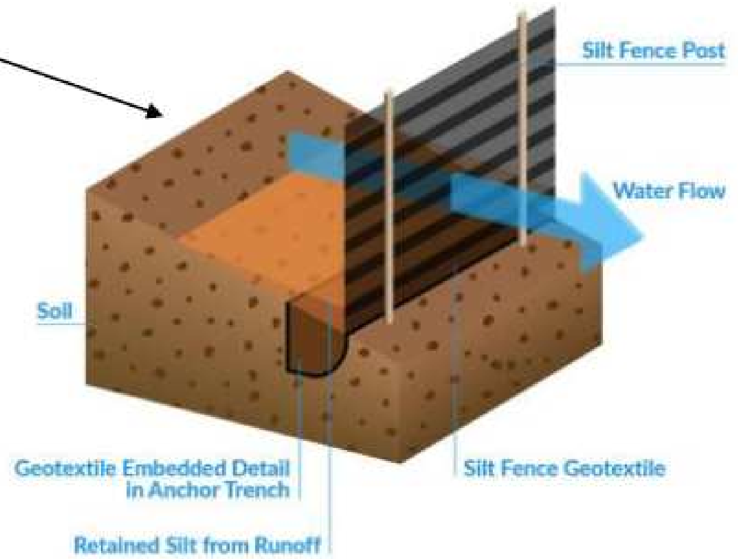
[26] CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance

**Plate 9.7: Silt screens / fencing**

Temporary barrier fabric used to retain erosion of sand, silt, and clay. Geotextile silt fencing acts as a vertical, permeable, interceptor to sediment-laden waters from construction.




Conceptual graphic of a silt fence
Tech Weave (2020) Available at:<https://techweave.com/silt-fences/>




Conceptual graphic of a silt fence
Available at: https://www.pub.gov.sg/Documents/SiltFences.pdf

Example of Silt fencing in use
Bowman Construction Supply (2023) Available at:<https://www.bowmanconstructionsupply.com/products/silt-fence/>

Silt fences control runoff by allowing water to pass through the fabric while collecting leftover sediment.

Example of Silt fencing in use
(EnviroPro, 2022) Available at:
<https://www.enviropro.co.uk/entry/153977/Siltbuster/Terrastop-silt-fences-for-erosion-and-runoff-control/>

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| Site Name: Tullacondra Green Energy Project, Co. Cork | Project No. | 604162 | Drawn By: | Colleen McClung<br>Graduate Project Scientist | RSK |
| | Client: | Tullacondra Green Energy Ltd | | | |
| Figure Name: Appendix 9.4 – Conceptual & Information Graphics – Tile 12 Silt Fencing | Date: | 07/03/2023 | Reviewed By: | Sven Klinkenbergh<br>Principal Environmental Consultant | |
| | Revision: | 00 | | | |

Runoff will be managed as follows:

- In line stilling ponds EIAR **Volume III, Appendix 9.4 – Tile 13,** will buffer the run-off discharging from the drainage system during construction, by retaining water, thus reducing the hydraulic loading to watercourses. These stilling ponds are designed to reduce flow velocity to 0.3m/s at which velocity, silt particle settlement occurs. Stilling ponds will remain along the operational infrastructure (life of development at minimum). The locations of stilling pond have been chosen as a part of the drainage design. Refer to Planning Application Documentation **Part 2** – Planning Drawings -**Drawing No. 20910-NOD-XX-XX-DR-C-08301** and **20910-NOD-XX-XX-DR-C-08302.** Flow control devices such as weirs and baffles will facilitate achieving better attenuation, particularly when considering fluctuating runoff rates.
- In line check dams will be constructed across drains (EIAR **Volume III, Appendix 9.4 – Tiles 4 – 7 and 14)**. Check dams will reduce the velocity of run-off in turn facilitating the settlement of solids upstream of the dam. Check dams will also reduce the potential for erosion of drains. Rock filter bunds may be used for check dams however, wood or straw/hay bales (EIAR **Volume III, Appendix 9.4 – Tile 15**) will also be used if properly anchored, that is; supported with rock or fitted timber to reduce potential for material to be swept away by incoming water. Multiple check dams will be installed, particularly in areas immediately downgradient of construction areas. Check dams will only be constructed in drainage infrastructure and not in significant surface water features i.e., streams or rivers. Check dams (comprised of rock) established will remain along the operational infrastructure.
- Check dams will be installed at 50m intervals within the length of drainage channels. This is dependent on the slope angle and height of check dams constructed, refer to EIAR **Volume III, Appendix 9.4 – Tile no. 4**.
- Erosion protection will be established on the downstream side of the check dam i.e., cobbles or boulder (100-150mm diameter) extending at least 1.2m.
- Check dams will be constructed as part of the drain i.e., reduce the potential for bypassing between the drain wall and check dam.
- Routine inspections and silt removal will take place to present silt building up.
- Water pumped from excavations, or any waters clearly heavily laden with suspended solids will be contained and managed and pumped through the pre-established Active Management treatment train (EIAR **Volume III, Appendix 9.4 – Tile no. 8 and 9**.
- Active monitoring of water quality by turbidity measurement will be undertaken on a regular basis during rainfall events.

Surface water runoff will be discharged to land via buffered drainage outfalls (refer to EIAR **Volume III, Appendix 9.4 Tile 17**. Buffered drainage outfalls will contain hard core material of similar geology to the bedrock at the site to entrap suspended sediment. In addition, these outfalls promote sediment percolation through vegetation in the buffer zone, removing sediment loading to acceptable levels any adjacent watercourses and avoiding direct discharge to the watercourse. A high number of discharge points /

buffered outfalls will be established as part of the design, thus decreasing the loading on any particular outfall. Discharging at regular intervals mimics the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points.

Buffered drainage outfalls will be located outside of surface water buffer zones (**Figure 9.17a** and **Figure 9.17b**). Similarly, outfalls will not be positioned in areas with extensive existing erosion and exposed soils. Buffered outfalls will be fanned and be comprised of coarse aggregate (cobbles / boulders) (EIAR **Volume III, Appendix 9.4 – Tile 16**). These structures will be akin to rip raps (coastal erosion defences/ outfall erosion defences). Silt fences EIAR **Volume III, Appendix 9.4 – Tile 12,** will be established downstream of buffered outfalls with a view to ensuring the effectiveness of the attenuation train, particularly during elevated flow events. Buffered outfalls established will remain along the operational infrastructure of the site.

Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and long periods of time to settle, therefore, such particles are unlikely to settle despite the aforementioned measures. While it is not envisaged that the site will require additional settlement, where difficulties are encountered in achieving 25 mg/l total suspended solids, a proprietary system such as Aska Sykes[27], Siltbuster[28] or gel block[29] (EIAR **Volume III, Appendix 9.10)** will be used. Filtration and settlement systems with and without flocculants will be used to achieve the required discharge. Flocculants will be used to promote the settlement of finer solids prior to redistributing to the treatment train (if required) and discharging to surface water networks.

Flocculant 'gel blocks' are available and can be placed in drainage channels upstream of stilling ponds. Gel blocks are passive systems, self-dosing and self-limiting, however they still require management (by the Contractor's Environmental Manager and supervised by the developer appointed Environmental Clerk of Works (EnvCoW)), as per the manufacturer's instructions. Flocculants are made from ionic polymers. Positively charged ionic polymers (Cationic) are effective flocculants; however, their positive charge makes them toxic to aquatic organisms. Anionic polymers (adverse charge) are also effective flocculants, and are not toxic i.e., environmentally friendly[30]. Therefore, when flocculants are required, the material used will be made from anionic polymer. Gel blocks will be a temporary measure during the construction phase.

Straw bales (similar to stone check dams) (EIAR **Volume III, Appendix 9.4 - Tile 15**), and silt fences (discussed under diffuse runoff) can also be used within drainage channels for the purposes of attenuating runoff and entrained suspended solids, however these measures will be considered temporary and will be used mainly in managing potential acute contamination incidents (e.g. additional features to control runoff during excavation works) or to facilitate temporary works (e.g. corrective actions, discussed in later sections). (Note: the installation of straw bales or silt fences will require checking on a daily basis by the contractor's Environmental Manager and supervision by the

[27] https://askasykes.ie/pumping/siltaway [Accessed 19/04/2024]

[28] https://www.siltbuster.co.uk/solutions/ [Accessed 19/04/2024]

[29] How-to-manage-silt-on-or-near-water.pdf (frogenvironmental.co.uk) [Accessed 19/04/2024]

[30] USEPA (2013) Stormwater Best Management Practice – Polymer Flocculation (Available at: http://www.siltstop.com/pictures/US_EPA_Polymer_Flocculant_Handout__3-14.pdf)

EnvCoW). Stone / boulders will be used in conjunction with these measures to address such issues if appropriate.

The above measures, buffer zones, constructed drainage, check dams, two-stage stilling ponds design for attenuation and buffered outfalls are referred to as the 'treatment train'. Where necessary (when water quality indicates >25mg/l Total Suspended Solids) the treatment train will be augmented through the use of anionic polymer gel blocks. These measures reduce the suspended sediment and associated nutrient loading to surface water courses and mitigates potential effects to water quality and on plant and animal ecologies downstream of the site.

The precautionary and mitigation measures listed here will avoid, reduce or remedy all potential effects on water quality and will ensure that the sensitive receptors in the catchment of the development do not suffer any deterioration in water quality, either during construction, operation, or decommissioning.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual impacts to neutral or slight and **not significant**.

#### *9.6.2.3 Release of hydrocarbons proposed mitigation measures*

The following mitigation measures to reduce potential effects from the environmental release of hydrocarbons and other harmful chemicals to the surface waters will be implemented:

- Refuelling of vehicles will be carried out off site to the greatest practical extent. This refuelling policy will mitigate the potential for effects by avoidance. Due to the remote location nature of the site, it is unlikely that implementation of this refuelling policy will be practical in all circumstances (e.g., bulldozers, cranes, etc.). In instances where refuelling of vehicles on site is unavoidable, a designated and controlled refuelling area will be established at the site. To enable low risk refuelling and storage practices to be carried out during the works.
- The designated refuelling area will be located a minimum distance of 50m from any surface water or site drainage features.
- The designated refuelling area will be bunded to 110% volume capacity of fuels stored at the site (EIAR **Volume III, Appendix 9.4 – Tile 20**).
- The bunded area will be drained by an oil interceptor that will be controlled by a penstock valve that will be opened to discharge storm water from the bund depending on the quality of the water.
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis, including decommissioning following construction.
- Any oil contaminated water will be disposed of at an appropriate licensed waste disposal site.

Notwithstanding the management of refuelling and fuel storage at the designated refuelling area, the potential risk of hydrocarbon spills from plant and equipment or other general chemical spills at other areas of the site remains. As a precautionary measure, to mitigate against potential spills at other areas of the site, the following mitigation measures will be implemented:

- Oil absorbent booms and spill kits will be available adjacent to all surface water features associated with the Project. The controls will be positioned downstream of each construction area and at principal surface water drainage features. Oil booms deployed will have sufficient absorbency relative to the potential hazard.
- Spill kits will contain a minimum of oil absorbent pads, oil absorbent booms, oil absorbent granules, and heavy-duty refuse bags for collection and appropriate disposal of contaminated matter.
- Should an accidental spill occur during the construction or operational phase of the Project, such incidents will be addressed immediately, this will include the cessation of works in the area of the spillage until the issue has been resolved and reporting incidents to the relevant authorities.
- A detailed spill response plan will be prepared as part of the site-specific CEMP.
- Drainage diversion and silt fencing will be installed between construction and receptors such as the swallow hole or enclosed depressions located on/near site.
- For large machinery such as cranes, a drip tray will be used, and spill kits will be on hand.

Implementation of the above mitigation measures will significantly reduce the risk of hydrocarbon contamination being released to the surface water network and groundwater; the potential risk cannot be entirely eradicated. Therefore, precautionary measures and emergency response protocols will be established and outlined in the site-specific CEMP.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

#### *9.6.2.4 Release of Horizontal Direction Drilling fluid proposed mitigation measures*

**Breakout and drilling fluid returns**

Drilling fluids such as Bentonite or Clearbore will be used. Clearbore is an environmentally friendly, Water–Based Mud suitable for tunnelling and drilling operations (Drilling Supplies Europe[2]), or similar will be used in drilling operations. See safety material datasheet for Clearbore drilling fluid in EIAR, **Volume III, Appendix 9.11.**

In the case of a spill, the leak will be stopped, contained and prevented from entering drains or water courses. Any recoverable product will be collected and disposed of properly. If a significant quantity of material enters drains or watercourses, an emergency response will be activated, see section 9.6.2.12. Drilling fluid will be contained within the launch pit.

**Drill fluid disposal**

[2] Drilling Supplies Europe (2022) “ClearBore” Drilling Supplies Europe. Available at: <https://www.drillingsupplieseurope.com/drilling-fluids/clearbore/>

Drilling mud containing spoil recovered from the bored path can be retrieved at the launch and reception sites of the bore. This spoil can be treated in one of two ways. It can either be transferred off-site to an approved and authorized EPA license facility (in accordance with the Waste Management Act 1996 as amended) to be properly disposed of; or the spoil can be pumped to a mechanical separation container. This involves drill mud being stored within a holding tank until separation of particulates can be achieved, only then can the fluid be discharged to the surrounding area.

Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and long periods of time to settle, therefore, such particles are unlikely to settle despite at sufficient rates. To address this, flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks.

Residual effects in relation to the potential release of HDD drill fluid is considered to be neutral or slight and **not significant.**

#### *9.6.2.5 Release of wastewater sanitation contaminants*

Wastewater/sewerage from the staff welfare facilities are required for the duration of the construction and operational phases (substation) of the wind farm Project. The wastewater/sewerage will be collected and held in a sealed storage holding tank, fitted with a high-level alarm. The high-level alarm is a device installed in the storage tank that is capable of sounding an alarm during a filling operation when the liquid level nears the top of the tank.

All wastewaters will be emptied periodically and tankered off-site by a licensed waste collector to an authorised wastewater sanitation plant for treatment. There will be no onsite treatment of wastewater. A wastewater or sewerage leakage is not anticipated in a properly managed site.

Routine inspection of the temporary facilities will be carried out to ensure no overloading and no leakages are occurring. In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

#### *9.6.2.6 Release of construction and cementitious materials proposed mitigation measures*

In order to mitigate the potential effect posed by the use of concrete and the associated effects on surface water in the receiving environment, the following precautions and mitigation measures will be implemented:

- The procurement, transport and use of any cement or concrete will be planned fully in advance of commencing works by the contractor's Environmental Manager and supervised at all times by the developer appointed EnvCoW. This entails minimising quantities on site, planning delivery routes and washout stations.
- Accidental spillages will be directly intercepted by drainage or surface water networks associated with the development.
- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the development where the use of precast concrete will be used include structural elements such as cable joint bays. Elements of the development where the use

of precast concrete is not possible includes turbine and substation foundations. Where the use of precast concrete is not possible the following mitigation measures will apply.

- The use of concrete will be minimised, where possible. The risk of runoff will be controlled and minimised, as concrete will be contained in an enclosed, excavated area.
- Vehicles transporting cement or concrete to the site will exit the site through a designated wash out station, EIAR **Volume III, Appendix 9.4 - Tile 22** and be visually inspected for signs of excess cementitious material. This will prevent the likelihood of cementitious material being accidentally deposited on the public road network.
- Only the chutes from the concrete trucks will be cleaned in bunded areas prior to departure from site, and this will take place at a designated area at the temporary construction compound/storage area. The contents will be allowed to settle, and the supernatant will be removed off site to a licenced wastewater treatment plant.
- Concrete will be poured during metrological dry periods/seasons in so far as practical and reasonably foreseeable and will not proceed during any yellow (or worse) rainfall warning issued by Met Éireann.
- Excavations will be prepared before pouring of concrete by pumping standing water out of excavations outlined in section 9.6.2.7.
- Any shuttering installed to contain the concrete during pouring will be installed to a high standard by experienced persons. Additional measures will be introduced where required to minimise potential leaks, for example the use of plastic sheeting or other sealing products at joints.
- Temporary storage of cement bound sand (if required for construction of the substation building) will be stored at a dedicated storage area only where there is no direct drainage to surface waters and where the area has been bunded e.g., using sandbags and geotextile sheeting or silt fencing to contain any solids in run-off.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of appropriately.

The following mitigation measures are recommended in relation to non-hydrocarbon potential contamination of groundwater:

- All other liquid-based chemicals such as paints, thinners, primers and cleaning products etc. will be stored in locked and labelled bunded chemical storage units.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

#### *9.6.2.7 Excavation dewatering proposed mitigation measures - active construction water management*

In all instances where construction water, or runoff has the potential to entrain solids during excavation and other construction activities, runoff will be contained by means of temporary berms (lined geotextile or similar), bunds (lined) and sumps. This will be referred to as dewatering. Construction water (contaminated) will be pumped to the treatment train (EIAR **Volume III, Appendix 9.4 Tiles 8-10**).

The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g., Total Suspended solids >25mg/l) additional measures will be implemented, for example, pausing works as required and treating construction water by dosing with flocculant to enhance the settlement of finer solids – this will be done in a controlled manner by means of a suitably equipped settlement tank (EIAR **Volume III, Appendix 9.4 Tile 21**). Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the site (EIAR **Volume III, Appendix 9.4 Tiles 16 – 17**). Silt fences will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced (EIAR **Volume III, Appendix 9.4 Tile 12**). The discharge area will be outside of buffered areas (similar to dewatering of excavations. The quality of water discharged will be monitored in real time (telemetry with 15 min sampling rate), as well as laboratory samples taken, analysed and recorded to ensure no deterioration in water quality at the site.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to **not significant**.

##### *9.6.2.8 Excavation dewatering proposed mitigation measures - passive construction water management*

Passive management systems (EIAR **Volume III, Appendix 9.4 Tile 8**) will include some of the features described in active management treatment trains as outlined in previous sections.

Passive systems are intended to function with minimal supervision, however in the management of construction water on this Project, in many cases the diverted water will likely require active management to ensure sensitive receptors are protected. For example, diverted storm-water, if clean can discharge to the receiving vegetated areas or existing drains, but any construction waters effected by contaminants on the site must be managed, and active management / treatment is required.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

##### *9.6.2.9 Watercourse crossings proposed mitigation measures*

None of the proposed wind farm watercourse crossings are associated with 'mapped surface water feature'.

The development of the wind farm includes the construction/upgrading of six watercourse crossings over non-mapped surface water features i.e., farm drains (**Figure 9.6a**). The development will also include a number of new drainage culverts/pipes associated with the proposed site tracks and drainage network. In stream works will be avoided as far as possible, however, infrastructure such as culverts/pipes over natural or artificial drainage channels will require instream works.

The proposed watercourse crossings are near the head waters of the surface water network therefore culvert/pipe specification and construction are of low significance in terms of expected flow, etc. All watercourse crossings will be designed to facilitate peak, or storm discharge rates so as to avoid localised flooding and associated issues during storm events. Data presented in the FRA in EIAR **Volume III, Appendix 9.5,** indicate potential surface water discharge rates during a 1-hour storm event and a 24-hour storm event with a 1 in 100-year return period. Note: Upstream catchment areas are estimated and delineated by assessment of mapped catchment boundaries, topographical contours and existing infrastructure and associated drainage. The above assessment is a conservative estimation which does not consider evapotranspiration, or base flow and groundwater discharge to the respective surface water features.

In relation to the design and construction of watercourse crossings risk assessment and prescription of mitigation measures have been designed in accordance with relevant guidance and reference documents. The requirements of OPW and Inland Fisheries Ireland (IFI) protocols[31] have also been incorporated into the design of the proposed watercourse crossings.

A conceptual graphic for the design of these culverts and drainage connections are presented in EIAR **Volume III, Appendix 9.4 – Tile 3b** and **3c.** With reference to ecology, drains or watercourses requiring culverting do not possess significant ecological value (EIAR **Chapter 7 Biodiversity**). Therefore, all crossings will be closed culverts

Works in relation to watercourse crossings will be planned ahead of commencement of any instream works.

In regard to the GCR, the FRA (EIAR **Volume III, Appendix 9.5**) has identified some portions of the GCR that are within a mapped probable flood zone (EIAR **Volume III, Appendix 9.3 – Tile 27**). To mitigate against any potential for onsite flood risk and consequences:

- Works at this location will be carried out outside of heavy rainfall or flood events, by monitoring the meteorological forecast.
- Monitoring of local weather and flood alerts will be conducted on an ongoing basis. During potential scenarios where flooding is probable, imminent or occurring, the potential for contamination or similar effects will be minimised. This includes limiting exposed soils (in situ / temporarily stored), potentially hazardous materials and equipment, and personnel from the flood 'danger zone' (probable flood area).

Mitigation measures have been designed to reduce Project specific residual effects to **not significant**.

#### *9.6.2.10 Construction and diversion of drainage*

Infrastructure such as culverts over natural or artificial drainage channels will require instream works. Where culverts are required and the subsequent in-stream works are necessary, the following measures will be implemented.

Contracted operators will draft method statements and risk assessments in line with mitigation outlined in this chapter and in consultation with relevant guidance prior to commencing works (as part of the watercourse crossing consent application). Relevant guidance referenced is presented in section 9.2.2. Method statements will be included in

[31] https://www.fisheriesireland.ie/sites/default/files/migrated/docman/2016/Guidelines%20Report%202016.pdf

the CEMP. The IFI protocol will be applied, and events will be timed to ensure works are undertaken during low/no flow.

Diversion of artificial drainage channels will be required at locations where the development layout intercepts existing artificial drainage networks (**Figure 9.6a**).

Many of the existing drainage channels are dry during average climatic conditions which implies that over pumping or diverting of water flow may not be necessary, and works could be timed during these periods, nonetheless the methodology described for instream works will be implemented to mitigate the risk of any flow through the construction area. Any newly installed drain will be fully formed prior to the diversion of existing drainage. Twin wall corrugated pipe will be used for in stream works. All areas where dirty water interception ditches are implemented within drainage buffers (15m) will require the addition of silt screens, these areas include all infrastructure units particularly south of T4 and west of T6 and T9.

The construction area will be isolated, this means; the water feature (drains) will be temporarily dammed upstream of the watercourse crossing and flow will be diverted by means of a flume / pipe by gravity or pumped (this is referred to as over pumping) downstream of the watercourse crossing and construction area. Following the successful upstream damming, a downstream dam or barrier will also be established. The downstream barrier will ensure contaminated runoff in the isolated work area will be contained and managed and will block surface water back flow in lower lying or flatter areas. EIAR **Volume III, Appendix 9.4 – Tile 1** presents a conceptual plan view of an isolated construction area within a surface water feature. Over pumping of a surface water feature is considered diversion of water runoff only and therefore considered similar to discharge of storm water runoff only to sewer (exempt from licensing). However, controls will be in place to ensure environmental effects are minimised in relation to water quality.

In order to ensure isolation and over pumping is carried out effectively, the methodology will ensure that dams are secure / sufficiently supported, and that pumping of water will continue uninterrupted and that pumps are capable of keeping up with the discharge rate of the surface water feature. Pumping systems will require backup and fail-safe protocols e.g., backup pumps and generator. At surface water features e.g., non-mapped drains, isolation and diversion of drainage will be implemented or works undertaken during periods when there is no flow in the system.

Provided the construction water within the isolation area is managed effectively, over pumping of the surface water feature does not pose a significant risk to surface water quality downstream of the watercourse crossing.

Runoff and erosion control within the construction area will be treated with similar mitigations outlined in section 9.6.2.2.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to **not significant**.

#### *9.6.2.11 Groundwater extraction proposed mitigation measures*

Mitigation measures for increased runoff are outlined in section 9.6.2.1, the release of suspended solids and nutrients are outlined in section 9.6.2.2. All mitigation measures will be applied along with mitigation by avoidance. The extraction of groundwater from boreholes for the purpose of potable water supply or any purpose will not be required for either the construction or operational phase of the Project. As a result, no potential effects are anticipated from the extraction of groundwater as a potable water supply.

#### *9.6.2.12 Monitoring and emergency responses– wind farm site and grid connection route*

Monitoring of the wind farm site and GCR will be carried out by an EnvCoW. The EnvCoW will advise on environmental issues and monitoring compliance but will not be responsible for implementing measures. The due duty of implementing measures will be held by the developer/contracted construction operator. Monitoring locations can be seen in **Figure 9.6b** and in in EIAR **Volume III, Appendix 9.12**. The EnvCoW will have the authority to temporarily stop works in a particular area of the site to ensure corrective measures are implemented and adverse environmental effects are minimised if not avoided.

Further details on Monitoring and Emergency Response protocols during the construction phase is outlined in EIAR **Volume III, Appendix 9.12**.

#### *9.6.2.13 Construction phase residual effects*

The residual effect on the surface water receiving environment resulting from the construction phase of the Project is anticipated to be a limited to neutral to slight and **not significant** effect on hydrology and hydrogeology. The potential for release of elevated suspended solids is likely to be exacerbated following heavy rainfall events which occur after sustained dry periods. Any localised reduction in water quality will be mitigated against by the extensive control measures outlined in this chapter and also by natural dilution as distance from the point or diffuse source of contamination increases with distance from the site.

Mitigation by avoidance and the implementation of physical control measures will ensure that contaminant concentrations, particularly elevated suspended solids entrained in run-off, are reduced to below the relevant legislative screening criteria.

Mitigation measures outlined in this chapter lay down the framework to reduce all potential effects of the Project on hydrological and hydrogeological receptors.

### 9.6.3 Operational phase

#### *9.6.3.1 Runoff rates -mitigation measures*

The principles of the mitigation measures described under section 9.6.1 (check dams, stilling ponds etc.), are based on the control and management of runoff discharge rates, which regulate the speed of runoff within the drainage network, buffering the discharge from the drainage network where possible, and maintaining the natural hydrological regime. The same measures ensure potential pollutants are also attenuated and these measures will likely provide beneficial effects in terms of both runoff and water quality.

For example, the following design will be applied at a proposed turbine hardstand locations (refer to Planning Application Documentation - **Part 2** – **Drawing No. 20910-NOD-XX-XX-DR-C-08305** and **Drawing 20910-NOD-XX-XX-DR-C-08306**):

- Collector drains or 'Proposed Roadside Drain'. Collector drains with in-line attenuation features, such as check dams and flow regulators will serve to reduce discharge rates dramatically, effectively backing up water and regulating the rate of discharge.

- Check dams at regular intervals throughout the drainage network (existing, new clean water interception drain and new dirty water interception ditch) will attenuate runoff intercepted by respective drainage channels.
- Buffered outfalls to vegetated areas (filter strips) will utilise the infiltration capacity of the ground prior to the rejected rainfall eventually being intercepted by the receiving surface water system. Refer to Planning Application Documentation - **Part 2** – **Drawing No. 20910-NOD-XX-XX-DR-C-08302**.
- Clean water interception drains will intercept clean water runoff flowing towards construction areas and will divert runoff away from the construction areas. Clean water runoff will be attenuated by means of check dams and discharged to vegetated intermittent buffered outfalls or reconnected to the existing drainage network.

In line with the approach laid out in section 9.2.1, mitigation measures have been designed to reduce Project specific residual effects to neutral or slight and **not significant**.

#### *9.6.3.2 Operational phase residual effects*

Due to the implementation of SuDS measures, there will be no adverse effects from the operational phase.

The finalised drainage design aims to result in attaining net beneficial effects through NBS (section 9.6.1.2), i.e., a net reduction in runoff rates at the site, beneficial effects to water quality and reducing flood risk to downstream flood risk areas. Coupling SuDS with ecology and biodiversity mitigation will also provide opportunities to attain net biodiversity gain. This is considered a direct, neutral to beneficial, permanent, effect of the Project and considered to be **not significant**.

### 9.6.4 Development decommissioning & reinstatement

#### *9.6.4.1 Decommissioning of infrastructure phase/s*

Deconstruction works during the decommissioning phase of the Project pose similar hazards and risks associated with the construction phase but to a far lesser extent, for example, the potential for fuel spills from vehicles is valid but there will likely be less vehicles required. Mitigation measures outlined for the construction phase (section 9.6.2) will also be applied to the decommissioning phase.

Reinstatement of physical infrastructure at the site following the decommissioning phase has the potential to cause adverse effects on the receiving hydrological and hydrogeological receiving environment. With continued land use practices (agriculture) the environment, in respect to soils and subsoils, surrounding the site will also become altered over time across the operational lifetime of the Project. The potential for restoration activities following the decommissioning phase of the Project will be evaluated in detail in line with the decommissioning phase that this can be modified should this be required in the light of prevailing scientific knowledge at the end of decommissioning. The decommissioning works will be similar to the construction phase but over a shorter time period, and the potential effects are neutral to slight and **not significant.**

#### *9.6.4.2 Reinstatement of redundant site track and hardstand areas*

Hardstands will be reinstated following construction to allow farming operations over the hardstand. In order to reduce the potential effect of excavating and removing the entirety of the crane hardstand areas, the majority of the stone structure of the individual crane hardstands will be left in place, with topsoil spread on top of the hardstand to form a vegetated surface layer. The top layer of the crane hardstand areas will have the rock/stone dug out and be left to revegetate naturally. Reinstatement of redundant site tracks and turbine hardstand areas during the decommissioning phase has the potential to result in associated erosion and runoff which can have an effect on the receiving surface water environment.

- Mitigation measures described in this chapter to reduce the potential for run-off of elevated suspended solids will be implemented.
- The mitigation measures for the preparation of the hardstand area surfaces prior to material being deposited discussed in EIAR **Chapter 10 Soils and Geology** will be implemented.
- Monitoring and maintenance of the reinstated areas will be conducted regularly following the initial stages of establishment to ensure that the potential for excessive surface water runoff eroding deposited material along preferential pathways is minimised.

It is proposed that the operational site tracks will be left in situ for use by the landowners following the decommissioning phase. Any localised sections of site track not required, will be reinstated, will have a covering layer of topsoil (depending on adjacent vegetation) being placed on top of the track surface, with vegetated sods used where available.

#### *9.6.4.3 Reinstatement residual effects*

It is anticipated that the appropriate reinstatement of redundant hardstand areas and localised site track will result in a net beneficial effect. This will be achieved through passive continuous improvements at the areas in question. Over time, the reinstated areas will return to agricultural use and will recover to become similar in appearance to the surroundings of the wider site. Therefore, the residual effect of reinstatement at site tracks and former turbine hardstand areas is considered to be a neutral to positive and permanent effect of the Project. However, it is important to note that reinstatement will be managed similar to the construction phase, including appropriate construction phase mitigation and monitoring. This is considered a direct, neutral to beneficial, temporary, effect of the development, which contrasts to the baseline conditions and considered **not significant**.

### 9.6.5 Residual effects

As a result of the design phase utilising mitigation by avoidance and design, along with NBS and mitigation and monitoring measures to be applied in the construction phase, adverse effects on surface and groundwater quantity and quality from the Project are considered to be **not significant**.

### 9.6.6 Cumulative effects

All known existing and proposed projects within the study area that could potentially generate a cumulative effect with the Project during construction, operation and decommissioning were identified and examined as part of this assessment. The full list of projects is contained in EIAR **Chapter 2 EIA Methodology**.

Presuming that all projects are constructed at the same time, with respect to hydrology, the effects of the Project are considered to contribute to the cumulative nature of adverse effects imposed on the surface water network in the catchments associated with nearby developments, such as the Solar Farm, c.2.3km west of TDR Option 2, 3.2km south of Option 1 GCR and approximately 4.6km southeast of the proposed wind farm site. However, considering the pre-existing “Poor” “Moderate” and “Good” WFD status of the surface waters associated with the Project, and the generally moderate-quality baseline water quality results outlined in section 9.4.7, the potential for the Project to have adverse cumulative effects on hydrology is limited to the construction phase if prescribed mitigation measures are not adhered to. It is also assumed that the cumulative effect of the Solar Farm would be not significant if all mitigation measures are followed and that residual effects would be slight and **not significant**.

Considering cumulative effects of pressures on the surface water network, the extension of a Limestone quarry c.2.7km southwest of the wind farm site, and restoration works on a disused quarry 4.5km south of the wind farm site, if an accidental release of contaminants were to occur, there is a potential to temporarily effect surface waterbodies and groundwater bodies in the catchment. It is assumed that the cumulative effect of the Quarry extension would be not significant if all mitigation measures are followed and that residual effects would be slight if an unlikely event were to occur. The objectives of the outlined mitigation measures in this chapter and in the FRA (EIAR **Volume III, Appendix 9.6)** for the Project, are to reduce any potential effect to acceptable levels. Therefore, the Project is considered unlikely contribute to cumulative effects in terms of water quality or flood risk and is considered **not significant**.

Residual cumulative effects with the N/M20 Cork to Limerick Improvement Scheme have been considered with regard to the hydrology of the area and can be determined to have a slight residual effect provided that SuDS and mitigation measures followed**.** There is the potential for temporary adverse effects during the construction phase in particular. However, assuming that these potential effects will be mitigated, monitored and emergency responses escalated as necessary, likely significant cumulative effects are anticipated to be **not significant**.

Residual cumulative effects for the Dublin to Cork Railway Line due to its proximity to the Project and which relates to works along the N20, TDR Option 1 have been considered with regard to hydrology of the area and can be determined to have a slight residual effect provided that SuDS and mitigation measures followed. There is the potential for temporary adverse effects during the construction phase in particular. However, assuming that these potential effects will be mitigated, monitored and emergency responses escalated as necessary, likely cumulative effects are anticipated to be **not significant**.

Residential developments that have been included in the cumulative effects assessment are Clonmore Housing Development, Hazelbrook Housing Development within 10km of the wind farm site and a student housing development within 200m of the TDR Option 2.

It is assumed that the cumulative effect would be **not significant** if all mitigation measures are followed.

The residual cumulative effects from other wind farms (as outlined in EIAR **Chapter 2 EIA Methodology**), in terms of hydrology and hydrogeology are determined to be slight, presuming SuDS and mitigation measures are implemented, monitored and followed using the relevant guidelines and legislation.

Residual effects from residential and developments and works in proximity to the TDR and GCR Options have been considered and can be determined to have slight residual effect. General activities of a development to effect hydrology of an area, is largely seen during the construction phase of these developments. Hydrological pathways are a potential source of cumulative effects, however given the distance of these sites (including the Project) from designated areas and provided mitigation measures again are implemented, monitored and emergency response plans escalated as necessary, the Projects cumulative effects are anticipated to be **not significant**.

With respect to hydrogeology, the potential effects of the Project having been assessed as likely, slight and temporary, for example, in the event of a minor spill of fuel/hydrocarbons, the spill will be contained and remediated efficiently. Therefore, cumulative effects on groundwater quality are anticipated to be unlikely, but the residual risk even if small in scale is important to consider in the context of the elevated sensitivity and importance of the receptor i.e., Regionally Important Karstified Aquifer and Source protection areas.

Assuming the adequate application and execution of mitigation measures outlined, the Project is not considered likely to significantly contribute to cumulative surface water or groundwater effects. Therefore, the likely cumulative effect of the Project on water quality or flood risk is considered to be **not significant**.