Castleconnell
Flood Relief Scheme

EIAR – Volume 2 Main Report

Final Report

November 2024

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OPW Oifig na nOibreacha Poiblí Office of Public Works

Tionscadal Éireann Project Ireland 2040

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Revision History

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S3-P03 / 09th September 2024	Draft Final Report	Steering Group via SharePoint
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Contract

This report relates to the Castleconnell Flood Relief Scheme commissioned by Limerick City and County Council, on behalf of the Office of Public Works. Conor O'Neill and Bernadette O'Connell of JBA Consulting compiled this report, which was prepared by the competent experts listed in Table 1-1 of Chapter 1.

Purpose

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Abbreviations

AA	Appropriate Assessment
ACA	Architecture Conservation Area
AEP	Annual Exceedance Probability
CFRAM	Catchment Flood Risk Assessment and Management
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FRS	Flood Relief Scheme
GHS	Geological Heritage Site
GIS	Geographic Information System
GSI	Geological Survey Ireland
HEFS	High-End Future Scenario
LCCC	Limerick City & County Council
MCA	Multi-Criteria Assessment
MRFS	Mid-Range Future Scenario
NHA	Natural Heritage Area
NIAH	National Inventory of Architectural Heritage
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
OPW	Office of Public Works
PCD	Public Consultation Day
PE	Population Equivalent
pNHA	Proposed Natural Heritage Area
QI	Qualifying Interest
RBMP	River Basin Management Plan
RPZ	Root Protection Zone
SAC	Special Areas of Conservation
SFRA	Strategic Flood Risk Assessment
SOP	Standard Protection
SPA	Special Protection Areas
UWWTP	Urban Wastewater Treatment Plant
WFD	Water Framework Directive
WWTP	Wastewater Treatment Plant
ZoI	Zone of Influence

1 Introduction

1.1 Context

This Environmental Impact Assessment Report (EIAR) has been prepared on behalf of Limerick City and County Council (LCCC) and the Office of Public Works (OPW) in relation to a proposed Flood Relief Scheme (FRS) in Castleconnell, Co. Limerick.

Limerick City and County Council intends to apply for planning permission for a Flood Relief Scheme along the Old River Shannon in Castleconnell, Co. Limerick. The proposed development comprises a flood relief scheme to minimise the risks currently posed to people, the community, social amenity, environment, and landscape. The terms *proposed development* and *proposed scheme* are used interchangeably in this EIAR to refer to the Castleconnell Flood Relief Scheme.

There are five stages in the project:

- Stage I – Scheme Development and Design
- Stage II – Planning Process
- Stage III – Detailed Design and Tender
- Stage IV – Construction.
- Stage V – Project Close-Out (Handover to Client).

This Environmental Impact Assessment Report (EIAR) is produced as part of Stage II of the project.

1.2 Project Background

1.2.1 Objective of the Scheme

The overarching objective of the project is:

"*…to assess, develop and design an appropriate viable, cost-effective and sustainable flood relief scheme which aims to minimise risk to human beings, the existing community, social amenity, environment and landscape character."*

The scheme is being developed primarily to protect affected properties against fluvial flooding. The River Shannon is the primary source of flood flows at Castleconnell, with Parteen Weir and Lough Derg exerting considerable influence. Lough Derg's natural outlet is the River Shannon, with the ESB controlling the flow over Parteen Weir. The Kilmastulla River, the Black River, Cedarwood Stream, and Stradbally Stream are additional rivers that influence the region.

Over time, as a result of a modified flow regime, the River Shannon downstream of Parteen Weir has significantly changed geomorphic characteristics with the manmade development of river features which have further developed into semi-permanent features and islands with heavy vegetation growth. The riverbed is also regularly intersected by inline rock weirs creating a stepped profile through the reach at Castleconnell. Castleconnell Village and the surrounding area was badly flooded in the winter of 2009 following record rainfall over the large River Shannon catchment. Further flood events were experienced in 2015, 2016 and 2020.

The target Standard of Protection (SOP) is the 1% Annual Exceedance Probability (AEP) fluvial event.

During flood events under "standard operational conditions", we have assumed four turbines are in operation and 345m³/s is regulated to the turbines. The headrace flow assumption of 345m^3/s is based upon previous estimates in the Shannon CFRAM studies as informed by the ESB. The operational conditions of the power station were discussed in a meeting held between JBA, ESB, OPW and LCCC on 22th of April 2020. In this meeting the ESB advised that in high flow conditions, 345m³/s can be delivered down the headrace to the power station, but a number of factors should be taken into account and this is not a fixed quantity and could

be lower. With this assumed head race flow a ”504” Event was established for the Old River Shannon at the HEP downstream of Parteen Weir (HEP ref 25_3886_1), with a 1% AEP peak flow of 504 m3/s. This flow is similar in scale to that experienced in the 2009 flood event.

For the purpose of the design of the Castleconnell FRS, an allowance has been made for operational conditions at Ardnacrusha that could, within reasonable contemplation, occur. In the event of one turbine being out of operation for maintenance or as a result of a mechanical failure, ¾ of the 345m³/s (258 m3/s) has been assumed to continue down the head race and the rest, ¼ (87m³/s) would pass over Parteen Weir into the Old River Shannon. In a planned situation, a spillway can be opened at Ardnacrusha and the flows along the canal maintained. However, as the spillway is not automatic, in an unplanned situation it cannot pass the full flow immediately. Therefore, a reduced flow down the head race must be considered in the design of the scheme. This scenario was discussed with ESB and based on their past operational experience the design team adopted a suite of operational conditions to define the potential uncertainties within the design flow. Extended turbine maintenance has been necessary during previous flood seasons, in February/March 2020 for example, where one turbine was out of commission during the 2022 winter season.

This supports why the design team has had to consider the headrace inflow quantum carefully in selecting the design flow in the Old River Shannon. These limitations in operational conditions outlined above will result in greater discharge passing over the weir at Parteen into the River Shannon resulting in a 1% AEP peak flow of 591 m3/s. This is adopted as the Baseline Design Event for the River Shannon at the HEP downstream of Parteen Weir (HEP ref 25_3886_1).

This approach has been adopted to ensure that appropriate contingency is accommodated in the design of the flood relief scheme to afford a high level of flood protection to Castleconnell Village and the scheme area, allowing for limitations in operational conditions at the power station

1.3 Scheme Overview

1.3.1 Proposed Development

An overview of the proposed development is shown in Figure 1-1. Generally, the FRS will comprise a series of walls and embankments along the banks of the River Shannon in Castleconnell, along with several demountable flood barriers, road raising works, and removal of vegetation and diversion of a culvert on the Cedarwood Stream, a tributary of the River Shannon in the northern part of Castleconnell.

The proposed walls and embankments will run generally from north to south, mostly between the river and the built-up area of Castleconnell. At the northern end of the scheme, new flood walls will be constructed along the boundary of two houses (Rivergrove B&B and Grange House), with minor changes to the layout of one garden to facilitate the new walls, and minor changes to drainage infrastructure. A new flood wall will also be constructed around Mall House, and along the length of the Mall Road, to the entrance of Island House.

Island House will require alterations to its entrance in the form of road raising and a demountable flood barrier. South of the entrance, the new flood wall on Mall Road will continue, with a realigned footpath inside it. At Maher’s Pub, the flood wall will continue, before transitioning into an earth embankment at Meadowbrook. This will merge into higher ground at Stormont House, which will require a low-level flood wall, and road raising along its driveway.

At the entrance to Coolbane Woods, road raising will occur, and an earth embankment will be constructed along the back of the houses. A demountable flood barrier is also required at the Coolbane Woods junction. This barrier will be put in place only during flood events, and will mean that this road will be closed any time the barrier is in place. An alternate route into Castleconnell from the south will be in use at these times.

The final part of the proposed development is removal of overgrown vegetation and diversion of a culvert in the Cedarwood Stream, at the northern end of Castleconnell. The Cedarwood Stream flows into the River Shannon downstream of the proposed works.

A full detailed description of the proposed development is included in Chapter 4 of this EIAR.

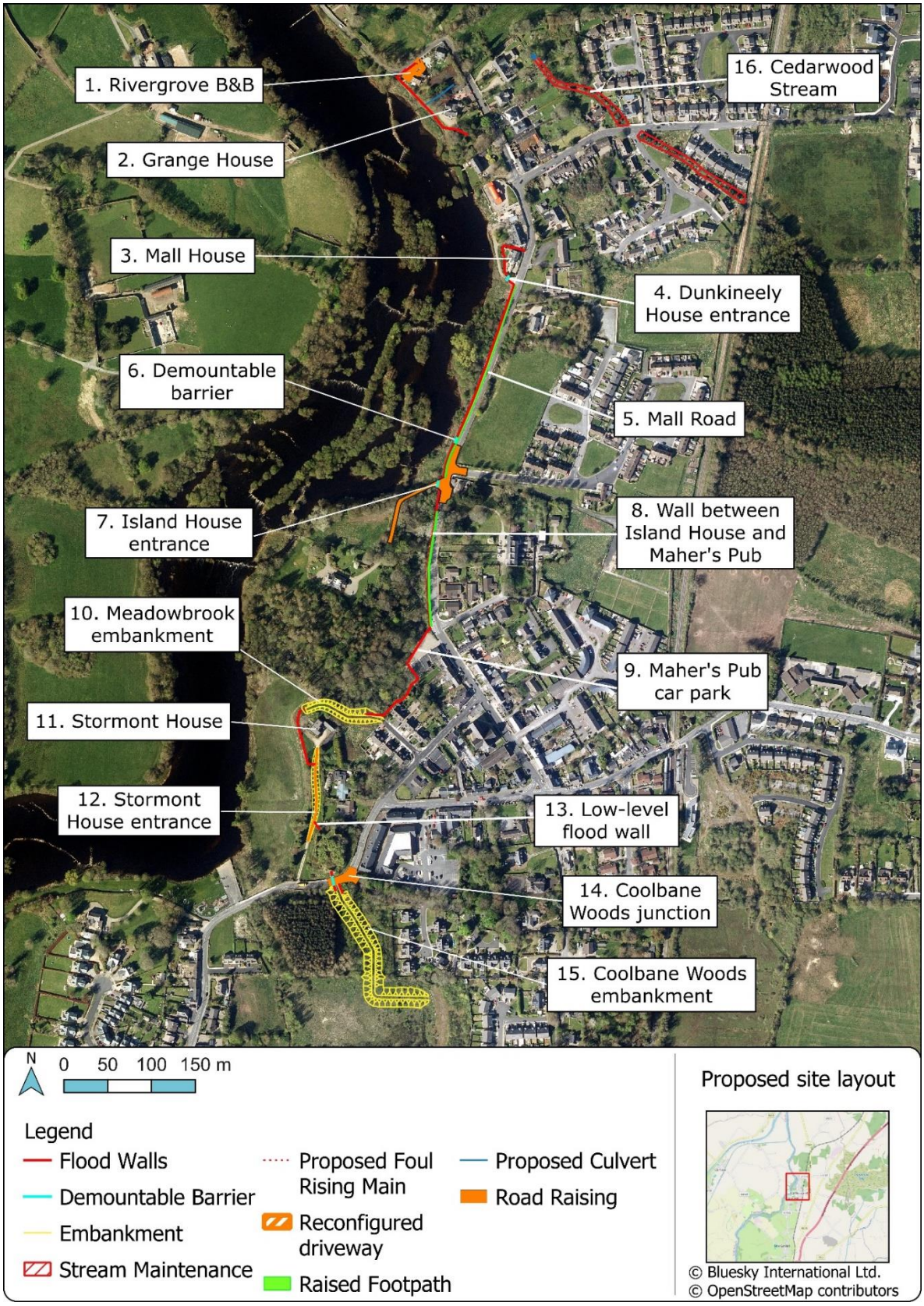

Figure 1-1: Overview of proposed development

1.4 Purpose of this Report

The Environmental Impact Assessment Directive (Directive 2011/92/EU, amended by Directive 2014/52/EU, hereafter the 'EIA Directive') requires that, before development consent is given, projects likely to have effects on the environment by virtue of their nature, size or location are made subject to a requirement for development consent and an assessment of their effects on the environment. This is referred to as an 'Environmental Impact Assessment' (EIA). Where an EIA is required, the developer must prepare an EIAR, and the EIA Directive sets out minimum information which the EIAR must include.

Schedule 5 of the Planning and Development Regulations 2001 (as amended, hereafter the 2001 Regulations') set out a wide range of development categories with associated thresholds for which an EIA is required.

Part 2 of Schedule 5 of the Planning and Development Regulations 2001, as amended, includes:

10. Infrastructure projects

(f) (ii) Canalisation and flood relief works, where the immediate contributing sub-catchment of the proposed works (i.e., the difference between the contributing catchments at the upper and lower extent of the works) would exceed 100 hectares or where more than 2 hectares of wetland would be affected or where the length of river channel on which works are proposed would be greater than 2 kilometres.

This category contains three thresholds; if any of these thresholds are exceeded, the proposed development must undergo a mandatory EIAR. As such, they will be addressed in turn.

> "where the immediate contributing sub-catchment of the proposed works (i.e., the difference between the contributing catchments at the upper and lower extent of the works) would exceed 100 hectares".

Works are proposed on a stretch of the River Shannon at Castleconnell Village: from upstream at Rivergrove B&B, along the Mall Road, and downstream to Coolbane Woods Residential Areas. The contributing sub-catchment of this stretch of river is on the eastern side of the Shannon and is c. 160 hectares. The scheme therefore exceeds the 100-hectare threshold.

> "where more than 2 hectares of wetland would be affected"

JBA ecologists have undertaken a Fossitt habitat survey of the scheme area and defined the habitats in the areas to be affected. The survey results (detailed further in Section 8) note that 1.441 hectares of wetland are likely to be impacted during construction phase of the proposed development. The scheme is therefore under the 2-hectare wetland threshold.

> "where the length of river channel on which works are proposed would be greater than 2 kilometres"

Works are proposed on a stretch of the River Shannon at Castleconnell Village, from the Coolbane Woods at the south, to Rivergrove B&B in the north, for a length of 894m. Works are also taking place along the Cedarwood Stream for a length of approx. 298m. The total length of river channel affected is approx. 1,192m, which is under the 2 kilometres threshold.

The proposed flood relief scheme is above the first part of the threshold, i.e., the immediate contributing sub-catchment is above 100 hectares. Therefore, an EIAR has been automatically triggered for this proposed development.

1.5 EIAR Scoping

The purpose of scoping is to identify what information should be contained in an EIAR and what methods should be used to gather and assess that information. It should provide focus for the EIAR and ensure that all relevant issues are identified and addressed in the EIAR.

The document 'Environmental Impact Assessment of Projects Guidance on Scoping' (European Commission, 2017) outlines that although scoping can be considered as a discrete stage in the EIA process, one which ends with the issuing of the terms of reference for the EIA Report, the activity of scoping should continue throughout, so that the scope of work can be amended in light of new issues and new information. The scope of an EIA Report must be flexible enough to allow new issues, which may emerge either during the process or as a result of design changes or through consultations, to be incorporated.

A Scoping Report was prepared for the proposed scheme and was shared with a list of statutory and non-statutory consultees for comment. The Scoping Report outlined the proposed methodology of each chapter of the EIAR, provided a preliminary description of the baseline environment, and the potential impacts for each chapter.

1.6 Format and Methodology of the EIAR

This EIAR comprises 3 volumes as follows:

- Volume 1, Non-Technical Summary;
- Volume 2, Environmental Impact Assessment Report; and
- Volume 3, Environmental Impact Assessment Report Appendices

This EIAR comprises the presentation of an extensive range of information and analysis from the EIAR Team. The EIAR is split into the following Chapters:

- Chapter 1 – Introduction
- Chapter 2 – Legislation and Planning Policy
- Chapter 3 – Examination of Alternatives
- Chapter 4 – Description of Proposed Development
- Chapter 5 – Consultation
- Chapter 6 – Construction Impacts – Air Quality, Noise and Vibration, and Climate
- Chapter 7 – Population and Human Health
- Chapter 8 – Biodiversity
- Chapter 9 – Land and Soil
- Chapter 10 – Water – Surface and Groundwater
- Chapter 11 – Material Assets
- Chapter 12 – Cultural Heritage
- Chapter 13 – Landscape and Visual Amenity
- Chapter 14 – Interactions
- Chapter 15 – Cumulative Impacts

Each competent expert has prepared their relevant chapters which are primarily set out in the following format:

- Methodology;
- Receiving Environment
- Potential Impact of the Proposed Development;
- Mitigation Measures;
- Residual Impacts;
- Interactions; and
- Potential Cumulative Impacts.

1.7 EIAR Team

The EIAR has been compiled by JBA Consulting with input from a range of competent experts, the details of which are outlined in Table 1-1. Each consultant is appropriately qualified and competent in accordance with Article 5(3)(a) of the EIA Directive and Section 172(1B) of the Planning and Development Act 2000, as amended.

Table 1-1: EIAR team

Chapter	Consultant	Author
Introduction	JBA Consulting	Leanne Leonard BEng (Hons) MIEI *Leanne has over 10 years of industry experience in engineering consultancy. In that time, she has worked on numerous large-scale flood relief schemes as a designer and project manager, as well as SuDS design, drainage design, and asset inspection. Leanne is a Member of the Institution of Engineers of Ireland.* Conor O'Neill BA (Mod) MSc Adv Dip *Conor has 4 years of environmental consultancy experience. He has been involved in all aspects of EIAR, from Screening and Scoping to EIAR co-ordination and chapter authoring for numerous projects including the Deansgrange, Castleconnell, and Carrickmines-Shanganagh River Flood Relief Schemes, along with other developments including transport infrastructure, residential, and commercial.* Bernadette O'Connell BA MSc CMLI PgCert *Bernadette has 35 years of engineering and environmental consultancy experience, has project managed EIARs for a range of strategic infrastructure projects including King's Island FRS, Castleconnell FRS and Mountmellick FRS and has acted as an Expert Witness at oral hearings.*
Legislation and Planning Policy	Coakley O'Neill Town Planning Ltd	Aiden O'Neill BSc (Hons) PG Dip MIPI *Aiden is a planning consultant with over twenty-eight years of post-qualification experience in the UK (8) and Ireland (20). Aiden set up Coakley O'Neill Town Planning with Dave Coakley in February 2010, and have since been particularly involved in advising on residential, commercial, retail and industrial developments, airport infrastructure, services infrastructure and waste infrastructure, across the full range of planning services*.
Examination of Alternatives	JBA Consulting	Ana Tomori BSc MSc MSc CIWEM (student membership) *Ana has over 10 years of international experience in engineering and environmental consulting. She has been involved in EIA for several flood relief schemes in Ireland, specifically the Examination of Alternatives chapters and Water chapters.* Leanne Leonard BEng (Hons) MIEI Bernadette O'Connell BA MSc CMLI PgCert
Description of Proposed Development	JBA Consulting	Conor O'Neill BA (Mod) MSc Adv Dip Leanne Leonard BEng (Hons)
Consultation	JBA Consulting	Conor O'Neill BA (Mod) MSc Adv Dip Bernadette O'Connell BA MSc CMLI PgCert

Construction Impacts	AONA Environmental Consulting Ltd	Mervyn Keegan BSc Dip Env Sc MSc Env Sc Pg Dip *Mervyn has 23 years' experience in environmental consulting. He is a member of the Institute of Acoustics, the Institute of Environmental Sciences, and the Institute of Air Quality Management. Mervyn has appeared as an Expert Witness at oral hearings, public inquiries, and legal hearings, and has prepared Noise, Air Quality, and Odour Impact Assessment Reports across a range of development types including roads, residential, industrial, quarries, mines, and wind energy.* Olivia Maguire BSc MSc Env Sc BSc *Olivia is a Senior Consultant with over 17 years' experience in environmental consulting. Olivia is a Member of Institute of Environmental Management & Assessment and a Member of Occupational Hygiene Society of Ireland with a B.Sc. Occupational Safety and Health, M.Sc. Environmental Science, B.Sc. (Hons) Geography, and is a qualified ISO 14001: Lead Environmental Auditor.*
Population and Human Health	JBA Consulting	Justin Nangle BSc Hons Env Sc *Justin is an environmental scientist with 2 years' consulting experience, working on residential, commercial, and transport projects in that time. He has also worked on Strategic and Site-Specific Flood Risk Assessments. Before this he acted as an asset inspection engineer and GIS surveyor.* Conor O'Neill BA (Mod) MSc Adv Dip
Biodiversity	JBA Consulting	Hannah Mulcahy BSc MSc *Hannah is a Senior Ecologist with over 6 years of consulting experience. She is an expert in plant identification and has written numerous AA Screening Reports, Natura Impact Statements, Preliminary Ecological Appraisals, and Ecological Impact Assessments. Her consultancy experience has included detailed vegetation surveys, bat surveys, mammal, bird and pollinator surveys.* Anne Mullen BSc Env (Hons), MSc Ecological Assessment Ecology MCIEEM *Anne has 19 years of experience writing and reviewing Natura Impact Statements, Ecological Impact Statements, Species and Habitat Management Plans, Screenings for Appropriate Assessments. She has also been surveying for rare plants and invertebrates of conservation interest, including marsh fritillary, bat emergence surveying, derogation licences, bird surveying including tape playback for red grouse, hedgerow condition surveys, Q-values and other water quality testing.*
Land and Soil	JBA Consulting	Jemima Kivikoski BSc Hons PgDip *Jemima is an environmental scientist with 2 years of experience in consulting. Since joining JBA, Jemima has been involved in all aspects of EIA, including Screening, Scoping, and full EIAR chapter authorship. Projects she has worked on include Active Travel Schemes, residential, commercial, and transport development, and several large flood relief schemes.* David Casey BSc MSc MCIWEM *David has 13 years of experience preparing and reviewing Flood Risk Assessments and Environmental Impact Statements, notable the Soils & Geology and Hydrology & Hydrogeology chapters, as well as Strategic Flood Risk Assessments (SFRA's) on behalf of county councils and has aided in the development of the OPW Western CFRAM Study*.

Water – Surface and Groundwater	JBA Consulting	Luigi Arbore BSc MSc MEngSc *Luigi is an environmental scientist and engineer with over 3 years of experience in consulting. Since graduating with an MSc in Environmental Science and an MEngSc in Water, Waste and Environmental Engineering, he has worked on numerous water-related projects including large flood relief schemes, Flood Risk Assessment, and hydrology and hydrogeology studies.* Ana Tomori BSc MSc MSc CIWEM David Casey BSc MSc MCIWEM
Material Assets	JBA Consulting	Justin Nangle BSc Hons Env Sc Conor O'Neill BA (Mod) MSc Adv Dip
Cultural Heritage	Courtney Deery	Yolande O'Brien BA (Hons) PhD MIAI *Yolande has 6 years of cultural heritage consultancy experience, and prior to this participated in research surveys and excavations for research projects in Ireland and France. She has produced and contributed to EIARs, route selection studies, and research and desk studies on archaeology, cultural heritage, and architecture for a range of residential, commercial, and infrastructural developments and flood relief schemes. Fieldwork in this role has included excavation, site inspections, fieldwalking, and the monitoring and recording of geotechnical investigations and topsoil removal.* Siobhan Deery BA, MA, Dip Planning & Env. Law, Licence Eligible Archaeologist MIAI, MICOMOS *Siobhan is a co-director of Courtney Deery Heritage Consultancy. She has 23 years of experience as a cultural heritage consultant, specialising in surveying and evaluating archaeological monuments, historic buildings, sites, and landscapes for conservation, environmental impact assessment, management, and development control. She is a licence-eligible archaeologist, and has carried out numerous archaeological testing, monitoring and excavations on a range of site types, settings and periods in both rural and urban contexts. She has managed cultural heritage EIARs for large-scale infrastructural projects and smaller schemes from the scoping stage to research, fieldwork, statement of impacts and mitigation measures for the EIAR process through to the oral hearing stage including consultation with design teams, stakeholders and statutory consultees.*
Landscape and Visual Impact	JBA Consulting	Conor O'Neill BA (Mod) MSc Adv Dip Christos Papachristou MSc MA CMLI *Christos has over 12 years' landscape architectural and horticultural experience working in Ireland, the UK and internationally. He lectured in UCD on LVIA and tutored on ornamental wildflower meadow establishment. He is a chartered landscape architect in the UK. He is also a member of the Irish Landscape Institute and the Greek Geotechnical Chamber. Christos specialises in LVIAs, EIAR and standalone, and has worked on several large flood relief schemes, including acting as EIAR coordinator for Kilkee FRS.*
Interactions	JBA Consulting	All of the above
Cumulative Impacts	JBA Consulting	All of the above

1.8 Description of Effects

This EIAR follows the guidance set out in the Environmental Protection Agency's (EPA) *Guidelines on the information to be contained in Environmental Impact Assessment Reports* (2022) in relation to describing accurately the full range of likely significant effects. Figure 1-2 is taken from the EPA's EIAR Guidelines (2022) and provides a classification of significance of effects (or impacts).

The EPA Guidelines (2022) outline that the probability of effects can be described as likely or unlikely and the duration of effects can range from momentary, brief, temporary, short-term, medium-term, long-term, permanent, or reversible while the frequency describes how often the effects will occur (Figure 1-3). The quality of effects can be described as positive, neutral or negative/adverse with varying degrees of significance (Figure 1-4).

In addition to the EPA's 2022 Guidelines, the following documents were also used as support during the preparation of the EIAR:

- Department of Housing, Planning and Local Government (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (August 2018)
- European Commission (2017) Environmental impact assessment of projects: Guidance on the preparation of the environmental impact assessment report (Directive 2011/92/EU as amended by 2014/52/EU)

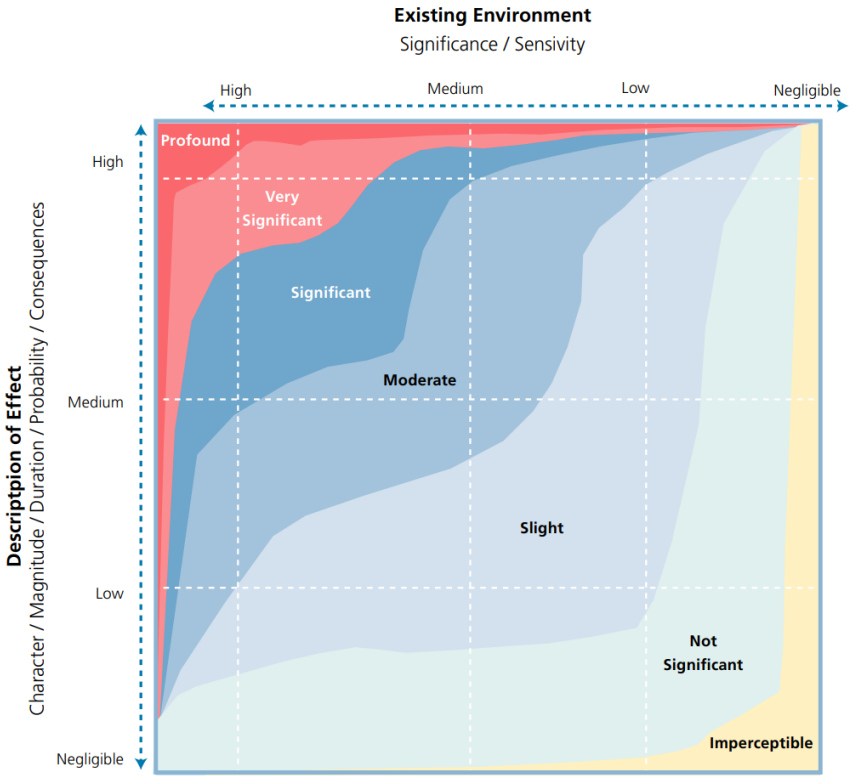

Figure 1-2: Determining the significance of effects (EPA, 2022)

Describing the Probability of Effects Descriptions of effects should establish how likely it is that the predicted effects will occur so that the CA can take a view of the balance of risk over advantage when making a decision.	**Likely Effects** The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects 'Duration' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful.	**Momentary Effects** Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of Effects Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).

Figure 1-3: Description of Probability and Duration of Effects (EPA, 2022)

Quality of Effects It is important to inform the non-specialist reader whether an effect is positive, negative or neutral.	**Positive Effects** A change which improves the quality of the environment (for example, by increasing species diversity, or improving the reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral Effects No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative/Adverse Effects A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem, or damaging health or property or by causing nuisance).
Describing the Significance of Effects 'Significance' is a concept that can have different meanings for different topics – in the absence of specific definitions for different topics the following definitions may be useful (also see *Determining Significance*).	**Imperceptible** An effect capable of measurement but without significant consequences.
	Not Significant An effect which causes noticeable changes in the character of the environment but without significant consequences.
	Slight 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.
Describing the Extent and Context of Effects Context can affect the perception of significance. It is important to establish if the effect is unique or, perhaps, commonly or increasingly experienced.	**Extent** Describe the size of the area, the number of sites and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)

Figure 1-4: Description of effects (EPA, 2022)

1.9 Difficulties in Compiling Specified Information

No significant difficulties were encountered in compiling the necessary information for the EIAR.

1.10 Limitations and Assumptions

No specific limitations or assumptions were encountered in the preparation of this EIAR.

1.11 Viewing and Purchasing the EIAR

Copies of this EIAR, the Non-Technical Summary (NTS) and all associated documentation will be available for viewing at the offices of Limerick City and County Council, and on the scheme website: https://www.castleconnellfrs.ie/.

2 Legislation and Planning Policy

2.1 Introduction

This section of the Environmental Impact Assessment Report considers the proposed development in the context of national, regional, and local planning policy, and the legislation governing the proposed works.

2.2 European Union (EU) Law and Policy

2.2.1 EU 'Floods' Directive 2007

The EU Directive on the assessment and management of flood risk, often referred to as the 'Floods Directive', came into force in 2007 and works in tandem with the Water Framework Directive for the protection of water quality.

The requirements of the EU 'Floods' Directive, have been implemented in Ireland as the assessment and management of floods through the Catchment Flood Risk Assessment and Management (CFRAM) Programme. Under CFRAM the Office of Public Works has published a series of documents and policies and plans that set out measures flood risk and the most at-risk communities. CFRAM recommends a proactive approach to flood risk and protection.

In terms of major Flood Relief Schemes, works are typically designed and built to a standard that protects against the 1 in 100-year flood event, and for coastal areas the 1 in 200-year flood event. As Castleconnell is highly susceptible to fluvial flooding the 1 in 100-year standard is considered appropriate for these works. Consistent with the Directive, the proposed development is defined to provide protection to properties in the study area from the 1 in 100-year fluvial flood event.

Castleconnell is detailed within the Flood Risk Management Plan for the Shannon Upper and Lower River Basin, this is set out in detail in Section 2.3.3. The plan sets out specific details in relation to flood risk management for the southwest region to meet Ireland's obligations under the 2007 EU 'Floods' Directive.

2.3 Planning Legislation and Policy Provisions

This section sets out the relevant guidance and policy objectives that have been considered in relation to the proposed flood defence works at Castleconnell. Firstly, this section considers the legislation governing the Irish planning system, specifically as it relates to flood management works, then moving on to discuss the broad level national strategic objectives, guidelines and policies adopted by the Irish Government in relation to spatial development, physical infrastructure and climate change agreements. Secondly, this section provides an overview of the regional context of the proposed works, and lastly will consider local objectives and development standards as indicated within the city development plan.

2.3.1 The Planning and Development Act 2000 (as amended), and the Planning and Development Regulations 2001, as amended

The Planning and Development Act 2000 (as amended) forms the basis of the Irish planning system, setting out the detail of planning guidelines, obtaining planning permission and the process for Environmental Impact Assessment.

Limerick City and County Council wishes to prepare a Planning Application to An Bord Pleanála, under Section 175 of the Planning and Development Act, 2000 (as amended), for the construction of a Flood Relief Scheme for Castleconnell, County Limerick.

The prescribed classes of development and thresholds that trigger a mandatory Environmental Impact Assessment (EIA) are set out in Schedule 5 of the Planning and Development Regulations, 2001, as amended. The most relevant criterion is Class 10 of Part 2 of Schedule 5 which states:

10. Infrastructure projects

(f) (ii) Canalisation and flood relief works, where the immediate contributing sub-catchment of the proposed works (i.e. the difference between the contributing catchments at the upper and lower extent of the works) would exceed 100 hectares or where more than 2 hectares of wetland would be affected or where the length of river channel on which works are proposed would be greater than 2 kilometres (S.I. No.600/2001- Planning and Development Regulations 2001).

The requirements in respect of Environmental Impact Assessment are contained within the Planning Act and these are described in detail in Chapter 1. The proposed development is above the first part of the threshold, as the contributing sub-catchment of the stretch of river on which works are proposed is c. 160 hectares.

2.3.2 National Policy

National Planning Framework (NPF)

The NPF sets out a framework of policy objectives to help Ireland achieve its long-term sustainable goals. The strategic plan focuses on integrating Ireland's economic development, spatial planning, infrastructure planning and social considerations. It promotes environmentally focused planning at local level to tackle climate change and the implementation of appropriate measures to mitigate existing issues.

The plan aims to align itself with the UN Sustainable Development Goals, by ensuring that the decision process will safeguard the needs of future generations. These objectives are integrated as part of the National Strategic Outcomes [NSOs] in areas such as climate action, sustainable cities and innovation and infrastructure.

National Strategic Outcome 9 outlines the urgency of upgrading and investing in water management and environmental resources. In which it states:

> *Coordinate EU Flood Directive and Water Framework Directive implementation and statutory plans across the planning hierarchy, including national guidance on the relationship between the planning system and river basin management. Local authorities, DHPLG, OPW and other relevant Departments and agencies working together to implement the recommendations of the CFRAM programme will ensure that flood risk management policies and infrastructure are progressively implemented*.

Flood relief measures are further highlighted under Section 9 of the NPF, titled *Realising our Sustainable Future*. It is envisioned that planning will play a vital role in mitigating development in inappropriate or vulnerable areas and will aid the delivery and design of necessary infrastructure in our towns and cities.

Section 9.3 of the NPF, Protecting, Conserving and Enhancing our Natural Capital further empathises the role the planning process plays in the management of our watercourses and flood risk management, with a view to improving the understanding of flood-risk and ensure flood risk management in accordance with best practice. This is in keeping with National Strategic Outcome (NSO) 9.

> **National Strategic Outcome 9: Sustainable Management of Water and other Environmental Resources**

Strategic Outcome 9 seeks to ensure investment in water infrastructure nationally while also ensuring the protection of our watercourses. With regard to flooding and flood risk management NSO 9 seeks to *'coordinate EU Flood Directive and Water Framework Directive implementation and statutory plans across the planning hierarchy, including national guidance on the relationship between the planning system and river basin management. Local authorities, DHPLG, OPW and other relevant Department and agencies working together to implement the recommendations of the CFRAM programme will ensure that flood risk management policies and infrastructure are progressively implemented'.*

The proposed development will deliver flood defence works to protect Castleconnell from flood events, the proposed works have been developed in a manner which is consistent with objective NSO 9 of the NPF.

The Planning System and Flood Risk Management 2009

The Office of Public Works [OPW] in conjunction with the Department of Environment, Heritage and Local Government [DEHLG] published a set of guidelines in relation to flood risk management. Subject to which the plan advocates a proactive approach to prevent flooding from occurring. This includes, for example, adopting general policies for protection, improve or restore floodplains and the upgrading of flood barriers. Under these guidelines Planning Authorities have a key role in the delivery of effective measures, policies and infrastructure to minimise the risk of flooding.

In this regard, the proposed development by Limerick City and County Council acknowledges the key role of the Council in minimising flood risk.

Climate Change Sectoral Adaptation Plan for Flood Risk Management, 2015

The Climate Change Sectoral Adaptation Plan for Flood Risk Management sets out the policy on climate change adaptation of the OPW, the lead agency for flood risk management in Ireland. The Plan is based on a current understanding of the potential consequences of climate change for flooding and flood risk in Ireland, and the adaptation actions to be implemented by the OPW and other responsible Departments and agencies in the flood risk management sector.

Our Sustainable Future: Framework for Sustainable Development

The Our Sustainable Future: Framework for Sustainable Development sets out the national vision to enhance Ireland's sustainable future, the challenges and targets to be adhered to. In terms of flood management and flood risk assessment, the framework acknowledges this as one of the largest challenges to be addressed in the coming years. As most cities and towns on the island have developed along rivers and coastal areas, the majority of urban centres are exposed to flood risk. As national economic prosperity is heavily reliant on the success of cities, the adoption of flood relief and protection is vital for future growth and will require the integration of comprehensive infrastructure as part of the built environment.

The proposed development, which will provide flood relief in Castleconnell, County Limerick, is aligned with this policy.

Climate Action Plan 2023

Annually, the Climate Action Plan is published by the Government of Ireland which sets out carbon budgets and sectoral emissions ceilings and sets a roadmap for taking decisive action to halve our emissions by 2030.

The Climate Action Plan 2023 identifies the role flood risk mitigation can play in how Ireland adapts as a result of climate change and in mitigating the implications of such. The Plan sets out how the Office of Public works will seek to support the development of appropriate flood mitigation and adaption schemes.

2.3.3 Regional Policy

Mid-West Area Strategic Plan (MWASP) 2012-2030

The aim of the strategic plan is to facilitate and inform the implementation of the statutory processes, the constituent Planning Authorities of the Mid-West Region (Clare County Council, Limerick City and County Councils and North Tipperary County Council) and the Mid-West Regional Authority have developed a non-statutory, 20-year, integrated land-use and transport strategy for the region. This will provide evidence base which can inform transport and planning policy and infrastructure investment decisions in the Region to 2030. The MWASP was prepared to secure the following overall objective:

- Prioritisation of investment in the region;
- Strengthening the Limerick/Shannon Gateway;
- Create and support a well-defined hierarchy of settlement;

- Deliver the required transport infrastructure to meet the Plan objective; and
- Provide economic review and direction of the religion.

The plan recognises the corridor of the River Shannon as the most important emerging tourism asset in the region, the three main areas: the Shannon Estuary, Lough Derg, and lower/mid River Shannon. The plan highlights the potential in the corridor from activity-based tourism, including boating, angling, wildlife watching and walking, all supported by a network of small attractive villages with good local roads and access.

In delivering and implementing the plan, appropriate flood risk and mitigation measures must achieve these objectives. The proposed works in Castleconnell align with the plan's objectives.

Regional Spatial & Economic Strategy, Southern Region

The Regional Spatial and Economic Strategy (RSES) for the Southern Region was adopted in 2020. The plan provides a long-term regional level strategic plan for physical growth, economic investment and social development for the Southern Region and seeks to align national goals set out in the NPF with local considerations.

The RSES supports measures that address climate action, as outlined in the NPF, these will include Renewable Energy, Sustainable Transport and Climate Resilience through Flood Defence. The latter to also provide for Flood Risk Management and to help reduce vulnerability in known flood zones, noting that flooding is a key challenge facing cities and towns in the region.

The following objectives identified within the RSES are of relevance:

RPO 4 Infrastructure Investment:

Infrastructure investment shall be aligned with the spatial planning strategy of the RSES.

RPO 5 Population Growth and Environmental Criteria:

Increased population growth should be planned with regard to environmental criteria, including:

- *Assimilative capacity of the receiving environment;*
- *Proximity of Natura 2000 sites and potential for adverse effects on these sites, and their conservation objectives; and*
- *Areas with flood potential.*

RPO 9 Holistic Approach to Delivering Infrastructure:

It is an objective to ensure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the delivery of compact growth and sustainable mobility as per the NPF objectives including: Water services, digital, green infrastructure, transport and sustainable travel, community and social, renewable energy, recreation, open space amenity, climate change adaptation and future proofing infrastructure including flood risk management measures, environmental improvement, arts, culture and public realm.

RPO 54 Tourism and the Environment:

Development of new or enhanced tourism infrastructure and facilities should include an assessment of the environmental sensitivities of the area including an Environmental Impact Assessment (EIA); Appropriate Assessment (AA) and Strategic Flood Risk Assessment (SFRA) if required in order to avoid adverse impacts on the receiving environment. Where such tourism infrastructure or facilities are developed, the managing authority/agency should ensure that effective monitoring protocols are put in place to monitor and assess the ongoing effect of tourism on sensitive features with particular focus on natural, archaeological and built heritage assets.

RPO 89 Building Resilience to Climate Change:

a) *It is an objective to support measures to build resilience to climate change throughout the Region to address impact reduction, adaptive capacity, awareness raising, providing for nature-based solutions and emergency planning;*
b) *Local Authorities and other public agencies shall continue to work with the Office of Public Works to implement the Flood Risk Management Plans and address existing and potential future flood risks arising from coastal, fluvial, pluvial, groundwater and potential sources of flood risk.*

RPO 113 Floods Directive:

It is an objective to support, at a regional level, the implementation of the Floods Directive to manage flood risks. It is an objective to encourage collaboration between local authorities, the OPW and other relevant Departments and agencies to implement the recommendations of the Catchment Flood Risk Assessment and Management (CFRAM) programme to ensure that flood risk management policies and infrastructure are progressively implemented.

RPO 114 Flood Risk Management Objectives:

It is an objective to:

a) *Ensure that the flood risk management objectives of the Flood Risk Management Plans are fully considered in the development of planning policy and decision-making by local authorities so that flood risk is a key driver in the identification of suitable locations for new development, considering the CFRAM flood maps and other flood maps as available.*
b) *Ensure that developments in upland areas, such as wind farm developments, roadway construction, peatland drainage and forestry proposals, provide sufficient storm water attenuation to avoid the occurrence of river erosion or flooding downstream subject to hydrological and ground/peat stability assessments.*

RPO 115 Flood Risk Management Plans:

Development and Local Area Plans in the Region should take account of and incorporate the recommendations of the Flood Risk Management Plans, including planned investment measures for managing and reducing flood risk. Natural Water Retention Measures should be incorporated where appropriate in consultation with the OPW and other relevant stakeholders.

RPO 115 Planning System and Flood Risk Management:

Consideration must be given to future appropriate land-use policies in accordance with the requirements of the Guidelines, "The Planning System and Flood Risk Management 2009". Strategic and local flood risk assessments and plans should be prepared where appropriate, which should include consideration of potential impacts of flood risk arising from climate change. It is an objective to avoid inappropriate development in areas at risk of flooding and integrate sustainable water management solutions (such as SUDS, non-porous surfacing and green roofs) to create safe places in accordance with the Guidelines.

RPO 116 Flood Risk Management and Biodiversity:

It is an objective to avail of opportunities to enhance biodiversity and amenity and to ensure the protection of environmentally sensitive sites and habitats, including where flood risk management measures are planned. Plans and projects that have the potential to negatively impact on Natura 2000 sites are subject to the requirements of the Habitats Directive.

RPO 117 Flood Risk Management and Capital Works:

It is an objective to supports investment in the sustainable development of capital works under the flood capital investment programme and Flood Risk Management Plans developed under the CFRAM process.

RPO 118 Flood Relief Schemes:

It is an objective to:

a) *Support investment in the sustainable development of Strategic Investment Priorities under the National Development Plan 2018-27 and to ensure that flood risk assessment for all strategic infrastructure developments is future-proofed to consider potential impacts of climate change;*
b) *Support investment in subsequent projects by capital spending agencies to deliver flood relief schemes under the National Strategic Outcome, Transition to a Low Carbon and Climate Resilient Society. Such projects should be future proofed for adaptation to consider potential impacts of climate change.*
c) *Ensure that all infrastructure and energy providers/operators provide for adaptation measures to protect strategic infrastructure (including roads, railways, ports and energy infrastructure) from increased flood risk associated with climate change.*

The RSES, in line with the National Planning Framework, sets out the Metropolitan Area Strategic Plans (MASP) for the key cities which the NPF identifies as having the capacity for significant growth to 2040.

The RSES identifies specific development policies and objectives for the Limerick-Shannon MASP, which seek to ensure that the Limerick-Shannon metropolitan area can develop in a manner which is consistent with the growth envisioned in the NPF. Castleconnell, County Limerick falls within the boundary of the Limerick-Shannon MASP and as such, significant future development is projected for Castleconnell.

The RSES identifies a number of key goals which form the basis of the Limerick-Shannon MASP. Goal 1 is of relevance.

Goal 1: Sustainable Place Framework:

The future growth and ambition for each MASP will be based on the principles of a Sustainable Place Framework. This framework reinforces the positive relationship between the city centre, metropolitan area and wider region as complementary locations, each fulfilling strong roles. It positions quality place making at the core.

Goal 1 of the MASPs seeks to:

- Enhance the quality of our existing places through retrofitting a high standard of infrastructure, services and amenities that improve the liveability and quality of place in existing settlements and communities.
- Build resilience to climate change and flooding.

Pluvial and fluvial flooding and all the attendant risks to infrastructure, homes, businesses and the economic health of Castleconnell. The RSES sets out two principal approaches for mitigation and adaption works, as set out in the policies above, the works subject of this EIAR will reduce the existing vulnerabilities and deliver upgrades to the flood defences, consistent with the RSES.

Shannon Catchment Flood Risk Assessment and Management Study (CFRAM)

The Office of Public Works are working in partnership with their consultants, Local Authorities and other stakeholders to deliver the CFRAM Study for the Shannon River Basin District (RBD).

Work on the study started in January 2011. The Shannon RBD includes the entire catchment of the River Shannon and its estuary, covering some 17,800km^2 and 20% of the island of Ireland. The RBD covers parts

of 17 counties: Limerick, Clare, Tipperary, Offlay, Westmeath, Longford, Roscommon, Kerry, Galway, Leitrim, Cavan, Sligo, Mayo, Cork, Laois, Meath, and Fermanagh.

The study focuses on areas known to have experienced flooding in the past and areas that may be subject to flooding in the future either due to development pressures or climate change. The final output from the study will be Catchment Flood Risk Management Plans, which will define the current and future flood risk in the Shannon RBD and set out how this risk can be managed.

The study identifies that Castleconnell, County Limerick is at risk of fluvial flooding. The study outlines that in Castleconnell, community level interventions are required, which will be progressed through a project level assessment. The study identifies that the works which may be required in Castleconnell include construction of a new flood defence wall, embankment and floodgates; raising roads in key locations; maintain existing flood forecasting and public awareness campaign operated by the ESB.

In this respect, the proposed development is consistent with the findings of the study, to provide flood relief measures at critical locations in Castleconnell.

2.3.4 Local Policy

Limerick City and County Council Development Plan

The Limerick City and County Development Plan 2022-2028 was adopted in July 2022, with a variation in May 2023. The Limerick City and County Development Plan sets out the policies and objectives, with regard to both National and Regional planning policies, the policies and objectives which will guide the development of the Limerick City and County environs to 2028.

The Limerick City and County Development Plan identifies that the role climate change plays in the day to day lives of the citizens of Limerick is becoming more and more evident, noting that there has been increased flood events in some areas. Regarding this, the Development Plan identifies flooding as one of three key areas linked to the plans and objectives of the plan in adapting to the future needs of the environs.

With regard to this, the following policies and objectives are of relevance:

> ***Objective CAF O4 Climate Proofing**:*
>
> *It is an objective of the Council to ensure climate proofing measures are incorporated into the design, planning, layout and orientation and construction of all developments, including the use of sustainable materials, selection of suitable locations and the use of renewable energy sources*.
>
> ***Objective CAF O9 Achieving Climate Resilience**:*
>
> *It is an objective of the Council to promote climate resilience in development and economic activities that are regulated by planning. It is important to ensure that any developments are climate resilient as they will need to function in a climate altered environment. This means that they will be able to withstand increased intensity of storm events and rainfall and through adequate design, location and drainage elements, would not contribute to problems elsewhere, such as increased run off.*
>
> ***Policy CAF P5 Managing Flood Risk**:*
>
> *It is a policy of the Council to protect Flood Zone A and Flood Zone B from inappropriate development and direct developments/land uses into the appropriate lands, in accordance with The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009 (or any subsequent document) and the guidance contained in Development Management Standards and the Strategic Flood Risk Assessment (SFRA). Where a development/land use is proposed that is inappropriate within the Flood Zone, but that has passed the Plan Making Justification Test, then the development proposal will need to be accompanied by a Development Management Justification Test and Site-Specific Flood Risk Assessment in accordance with the criteria set out under The Planning System and Flood Risk Management Guidelines for Planning Authorities 2009*

and Circular PL2/2014 (and any subsequent updates). This will need to demonstrate inclusion of measures to mitigate flood and climate change risk, including those recommended under Part 3 (Specific Flood Risk Assessment) of the Site-Specific Plan Making Justification Tests detailed in the SFRA. In Flood Zone C, the developer should satisfy themselves that the probability of flooding is appropriate to the development being proposed and should consider other sources of flooding, residual risks and the implications of climate change.

***Objective CAF O20 Flood Risk Assessments**:*

It is an objective of the Council to require a Site-Specific Flood Risk Assessment (FRA) for all planning applications in Flood Zones A and B and consider all sources of flooding (for example coastal/tidal, fluvial, pluvial or groundwater), where deemed necessary. The detail of these Site-Specific FRAs (or commensurate assessments of flood risk for minor developments) will depend on the level of risk and scale of development. The FRA will be prepared taking into account the requirements laid out in the SFRA, and in particular in the Plan Making Justification Tests as appropriate to the particular development site. A detailed Site-Specific FRA should quantify the risks, the effects of selected mitigation and the management of any residual risks. The assessments shall consider and provide information on the implications of climate change with regard to flood risk in relevant locations.

***Objective CAF O23 Flood Relief Schemes**:*

It is an objective of the Council to support and facilitate the development of Flood Relief Schemes as identified in the CFRAM 10 Year Investment Programme and ensure development proposals do not impede or prevent the progression of these measures.

Objective CAF O25 Strategic Flood Risk Assessment

It is an objective of the Council to have regard to the recommendations set out in the Strategic Flood Risk Assessment prepared to support the Plan.

The proposed works, and subject of this EIAR, seek to deliver works which would be entirely consistent with the climate change adaptation and flood risk management objectives outlined in the Development Plan.

Within the Limerick City and County Development Plan, Castleconnell is identified as a Level 3 Town within the Limerick settlement hierarchy with the potential for significant future growth. This is with regard to the scale of the town, its location within the Limerick-Shannon MASP (Metropolitan Area Strategic Plan) and the existing infrastructure base within the town to support future growth.

With regard to this, the Development Plan sets a growth target of an additional 590 people and 205 additional households by 2028.

Castleconnell Local Area Plan 2023-2029

The Castleconnell Local Area Plan (LAP) was adopted by the Limerick City and County Council in April of 2023, and came into effect in May of 2023. The Local Area Plan (LAP) sets out the plans and policies which will direct the development of Castleconnell to 2029.

Section 9.3 of the LAP sets out the policies in relation to Flood Risk Management in Castleconnell. The LAP acknowledges that a flood relief scheme is required in the town, with the LAP seeking to ensure that flood risk is avoided where possible and mitigation will be required in some instances. With regard to this the LAP sets out the following objective:

Objective IU 05: Flood Risk Management:

It is an objective of the Council to:

a) *Manage flood risk in accordance with the requirements of "The Planning System and Flood Risk Management Guidelines for Planning Authorities", DECLG and OPW (2009) and any revisions thereof and consider the potential impacts of climate change in the application of these guidelines.*
b) *Ensure development proposals within the areas outlined as being at risk of flooding are subject to Site Specific Flood Risk Assessment as outlined in "The Planning System and Flood Risk Management Guidelines", DECLG and OPW (2009). These Flood Risk Assessments shall consider climate change impacts and adaptation measures, including details of structural and non-structural flood risk management measures, such as those relating to floor levels, internal layout, flood-resistant construction, flood-resilient construction, emergency response planning and access and egress during flood events. Reference shall be made to Section 5.8 requirements of the Flood Risk Assessment in the SFRA of the Limerick Development Plan 2022-2028.*
c) *Support and co-operate with the OPW in delivering the Castleconnell Flood Relief Scheme.*
d) *Ensure that future developments in flood prone areas is generally limited to minor developments in line with the Circular PL 2/2014 and the Flood Risk Management Guidelines for Planning Authorities.*
e) *Developments on lands benefitting from Arterial Drainage Schemes shall preserve the maintenance and access to these drainage channels. Land identified as benefitting from these systems may be prone to flooding, as such site specific flood risk assessments will be required as appropriate, at planning application stage. Ensure future development of lands within Flood Risk Zone A/B, is in accordance with the plan-making Justification Tests in the SFRA.*

The LAP outlines the extents of the Town which are at risk to the potential flood risk. See Figure 2-1 below.

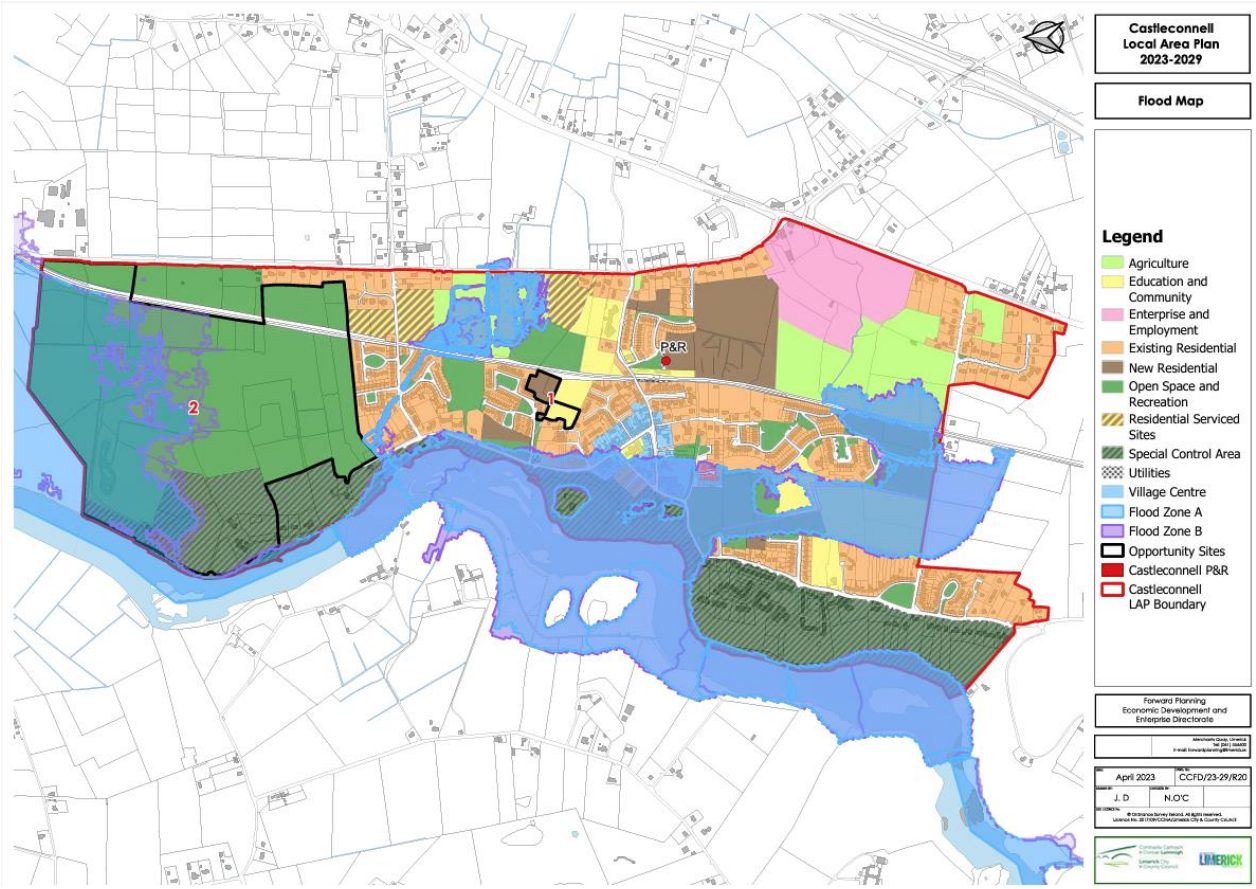

Figure 2-1: Flood Risk Extents

As outlined Objective IU 05 of the LAP seeks to ensure that future flood risk in the town is mitigated in addition to supporting the development of a flood relief scheme in collaboration with the OPW. The proposed works are in keeping with this objective of the LAP.

Given the nature of the proposed works, the works are contained within lands which have a number of land use zoning objectives as identified within the Castleconnell LAP. These land use zonings are as follows:

Table 2-1: Scheme Land Use Zoning Objectives

Area		Zoning
C_02261	Rivergrove	Open Space and Recreation Special Control Area
C_02262	The Elvers	Special Control Area Existing Residential
C_02263	The Elvers / The Mall Junction	Special Control Area Existing Residential Open Space and Recreation
C_02264	The Mall	Special Control Area Existing Residential Village Centre
C_02265 / C_02266	Coolbane / Meadowbrook Estate	Special Control Area Existing Residential Village Centre
C_02267	Coolbane Wood	Special Control Area Existing Residential Village Centre Open Space and Recreation
C_02268	Cedarwood Stream	Existing Residential

As outlined in Table 2-1 above, there are a number of land use zoning objectives on the lands of the proposed scheme as well as the lands adjacent. The most common land use zoning objective on the sites of proposed works is Special Control Area. The objective of this land use zoning is to *'To protect the natural habitat of the river and its designation as part of the Lower River Shannon Special Area of Conservation. Limit future development within Flood Risk Zone A/B to water compatible development'.*

The LAP sets out the following objective for the development of areas which are zoned as Special Control Areas:

Objective CH 04 Special Control Area: *It is an objective of the Council to:*

a) *Protect and maintain the integrity of the Special Control Area and protect the watercourses in Castleconnell providing a buffer zone, in accordance with the Special Control Area zoning designation on the Land Use Zoning Map;*
b) *Ensure that development including holiday homes and holiday apartments shall not be permitted on land zoned Special Control Area. Ancillary leisure/tourism development that are water compatible may be permitted, where it can be satisfactorily demonstrated that there will be no impact on the integrity of this Special Control Area or on the natural habitat of the River and its designation as part of Lower River Shannon Special Area of Conservation.*

The objectives of the remaining land use objectives are as follows:

Open Space and Recreation:

To protect, provide for and improve open space, active and passive recreational amenities. Limit future development within Flood Risk Zone A/B to water compatible development.

Existing Residential:

To provide for residential development, protect and improve existing residential amenity.

Village Centre:

To protect, consolidate and facilitate the development of Castleconnell's commercial, retail, educational, leisure, residential, social and community uses and facilities.

A manner of different development types are permitted under these land use zonings. The proposed works, which are the subject of this EIAR will allow for Limerick City and County Council to meet the objectives of these land use zonings in accordance with the objectives set out in the Limerick City and County Development Plan 2022-2028, and the Castleconnell Local Area Plan 2023-2029.

As outlined within the Castleconnell LAP, there are 37 structures in the town which are recorded on the Record of Protected Structures. These structures include:

- RPS Reg No. 1075: Grange House, Country House built 1828;
- RPS Reg No. 5059: Spa House, detached five-bay two-storey former assembly room, built c. 1771;
- RPS Reg No. 5057: Post Box, Wall-mounted cast-iron post box, c. 1890;
- RPS Reg No. 5056: Bridge, Single-arch sandstone road bridge across the River Shannon, built c. 1815;
- RPS Reg No. 1084: Church, Medieval structure – church (in ruins);
- RPS Reg No. 1085: Island House, country house, built c. 1840;
- RPS Reg No. 1099: Castle Connell, Medieval site – castle (in ruins); and
- RPS Reg No. 1102: Castleconnell School, urban structure – institutional, built in 1867.

In addition to this, there are a number of structures which are listed on the National Inventory of Architectural Heritage (NIAH), this includes:

- 21807037: The Grange, country house;
- 21807036: Spa House;
- 21807035: post box;
- 21807034: Mall House;
- 21807010: Island House, bridge; and
- 21807009: Island House.

There are a number of National Monuments Service (NMS) sites adjacent to the proposed works, this includes:

- LI001-004005: Cross;
- LI001-004003: Cross-slab;
- LI001-004002: Cross-inscribed stone;
- LI001-004003: Cross-slab;
- LI001-004004: Ritual site - holy well; and
- LI001-003: Castle.

With regard to the location, scale and nature of the proposed works, the works will not negatively impact on the architectural/historic and cultural integrity of the heritage assets identified.

In addition to this, there are 3no. Architectural Conservation Areas (ACA) within Castleconnell. The proposed works fall within areas of the Northern ACA and Central Core ACA, the impact of the proposed works on these ACAs will be assessed in the Cultural Heritage Chapter of this EIAR.

Areas of the River Shannon which the scheme traverses are designated as a Special Area of Conservation (SAC) and from part of the Lower Shannon SAC. The location of the proposed works is also situated upstream of the River Shannon and River Fergus Special Protection Area (SPA). These sites are protected under the EU Habitats Directive and are of international importance for their wetland, intertidal and estuarine habitats as well as wader and wildfowl populations.

In this respect, a Natura Impact Statement (NIS) has been prepared. It concludes that provided that the mitigation measures outlined are strictly adhered to, there will be no adverse impacts from the works involved with the proposed Flood Relief Scheme in Castleconnell; either alone or in-combination with other projects and plans on the screened-in Natura 2000 sites.

2.4 Planning History

There are a number of historical planning applications abutting the proposed works. The table below sets out the recent planning history associated with the locations of works in Castleconnell.

Table 2-2: Planning History

Planning Ref. No.	Development Description	Location	Decision Date	Status
13460	the construction of a two-storey detached dwelling, new site entrance and all associated site works	The Fishery Yard'	04/11/2013	Grant by ABP
19943	The construction of a driveway and entrance to parochial house 2 and alter existing entrance to parochial house 1 and erect a fence/concrete block wall between houses 1 and 2 and carry out associated site works	The Parochial House, The Mall	27/05/2020	Grant
1848	replacing the original natural slate roof. Remove the existing single storey annex and replace with a new two storey extension, consisting of 2 no. ground floor bedrooms and en suites, together with a tv room and playroom on the first floor.	Stormont House, Castleconnell	03/07/2018	Grant
12642	Retention of a flat roofed single storey extension and elevational changes to the rear of existing dwelling house	4 Meadow Brook, Castleconnell	26/01/2013	Grant
17423	change of use of 6 No. ground floor retail units to 6 no. ground floor own access apartments and all associated site works	Castlecentre, Shanacloon	31/08/2017	Grant

2.5 Conclusion

Having regard to the provisions of:

- EU ‘Floods’ Directive 2007;
- The National Planning Framework;
- The Regional Spatial and Economic Strategy for the Southern Region;
- The Planning System and Flood Risk Management 2009;
- Climate Change Sectoral Adaptation Plan for Flood Risk Management, 2015;
- Our Sustainable Future: Framework for Sustainable Development;
- National Climate Action Plan;
- Mid-West Area Strategic Plan (MWASP) 2012-2030;
- Shannon Catchment Flood Risk Assessment and Management Study (CFRAM);
- Limerick City and County Council Development Plan 2022-2028; and
- Castleconnell Local Area Plan 2023-2029.

It is concluded that the proposed development would be in compliance with national, regional and local planning policy provisions and would not seriously injure the amenities of the area or significantly impact the current land use objectives in Castleconnell and would, therefore, be in accordance with the proper planning and sustainable development of the area.

3 Examination of Alternatives

This chapter of the EIAR provides an overview of the alternative approaches, locations, designs and concepts that have been considered prior to the selection of the Preferred Option for the FRS. It describes the process of selecting the Preferred Option based on the engineering, design and environmental criteria. The aim of this Flood Relief Scheme is to reduce the risk of flooding in Castleconnell. Alternatives are selected to comply with the aim, providing feasible engineering and design with the lowest impact in the environment.

3.1 Alternatives Considered

In order to arrive at a suitable flood relief scheme, multiple assessments have been carried out at different stages.

At the outset of the project, a Constraints Report was prepared which identified the key environmental sensitivities and constraints in the area, which could affect the design of potential flood relief options. A topographical survey and river survey were also carried out, in order to gain a detailed understanding of the existing conditions on-site.

A Hydrology Report was prepared to understand the design flood flows for the scheme, while a Hydraulics Report was prepared to understand the river system and simulate predicted flood flows for different return periods. The hydraulic models can be used to test different flood defence measures and estimate economic damages arising from flooding.

Following this, multiple Flood Risk Management approaches were screened to see which are suitable or unsuitable for the proposed development. Suitable or viable measures were taken forward for further assessment. A number of potential options are then developed based on a viable measure or combination of several viable measures.

The potential options are then subject to Options Assessment in the form of Multi-Criteria Analysis (MCA), which considers each option in terms of its Social, Economic, Environmental, and Technical performance. The preferred option emerging from MCA is then taken forward for further refinement and assessment through the planning process, including in this EIAR.

Table 3-1 below shows a succinct summary of the option assessment process. This process is described in detail in the following sections.

Table 3-1: Options assessment process summary

First stage: Initial screening		Second stage: Development of Flood Risk Management (FRM) Approaches and Technical Assessment of Options in Study area		Third Stage: MCA and Selection of Preferred Option
Flood Risk Management Approaches (8 Approaches and NbS)	**Screening of Flood Risk Management (FRM) Approaches**	**Development of FRM Approaches and Technical Assessment of Feasible Options (4 approaches): FRM4-Diversion, FRM5 Improved conveyance, FRM 7 Containment and FRM8 Flood Resilience and Emergency Response**	**Env Assess of Options (Containment)**	**MCA technical, economic, social, and environmental**
FRM Approach 1: Re-purpose of existing non-flood management infrastructure	Scale of assets is more than the anticipated flood risk benefits. Considered for future flood risk management and monitoring. **Not Taken Forward**			
FRM Approach 2: Catchment scale and disperse actions to reduce flow downstream	Implementing will be complex and costs significant. Not viable but considered for future catchment scale restoration. **Not Taken Forward**			
FRM Approach 3: Inline storage on main watercourses or tributaries to reduce flow downstream	Requires complex changes to third-party assets outside of control of the scheme. Considered for future flood risk management and monitoring. **Not Taken Forward**			
FRM Approach 4: Diversion of flow around and away from risk areas	Could benefit other downstream flood receptors if a diversion can extend to bypass other risk areas. **Taken Forward for further analysis**	- Widening of the existing western channel would not provide any meaningful reduction in flood level - Extensive lowering of existing ground levels not significant enough and new hard flood defences would still be required. - To avoid hydromorphology effects the right bank would need to be at a 1 in 10-year flood flows level. Provision of storage, not possible. **Screened out and Not taken forward**		
FRM Approach 5: Improved conveyance of flow	Improving conveyance is a potentially viable approach. Key limitations of this approach are the potential environmental and visual impacts associated with such works. **Taken Forward for further analysis**	- General maintenance of the riverbed and island vegetation. Reduces flood levels within the Village but increases downstream levels. Alone would not reduce flood levels, needs hard defences. - Removal of the instream weirs from the northern properties to Cloon Island. Reduces flood levels within the Village but increases downstream levels. Alone would not reduce flood levels, needs hard defences. - Removal of the weirs and islands from the northern properties to Stormont House. Reduces flood levels within the Village but increases downstream levels. Alone would not reduce flood levels, needs hard defences. - Softening of the bends at either side of the River Shannon. Reduces flood levels within the Village but increases downstream levels. Alone would not reduce flood levels, needs hard defences. - Widening of the channel at Doonass Bridge and replacement of the existing bridge with a wider one. Alone would not reduce flood levels, needs hard defences. No measures individually or in combination resulted in a meaningful reduction in flood levels. **Screened out and Not Taken Forward**		
FRM Approach 6: Refurbish or enhance defences to achieve standard of protection	There are no existing formal flood defences in Castleconnell and so this approach is not applicable. **Not Taken Forward**			
FRM Approach 7: Containment of flood level	This approach is considered potentially viable. The key limitation is the wall heights (visual impact above 1.5m not typically considered acceptable in public areas.) **Taken Forward for further analysis**	- Walls suited to the northern parts of Village, where there is insufficient space for embankment between the northern properties/ the Mall Road/Maher's Pub and the SAC - Embankments suited to southern parts of the Village where space exists west of Meadowbrook estate and west and south of Coolbane Woods - Road raising to the north, at the Scanlon Park junction and to the south, at the Coolbane Woods junction on Chapel Hill - Demountable barriers or flood gates can also be used where space is constrained, and access is still required. **Taken Forward for Option Assessment**	**3 Flood Relief Scheme Options (1, 2 and 3)** comprising structural defences are described in cells (Northern, Central and Southern). Options vary only in Central section. Environmental Assessment concluded that Option 1 was least preferred, impacts predicted for Hydromorphology, Ecology and Cultural Heritage. **Option 2 and 3 were equally preferred**	The outcome of the MCA Analysis shows that **Option 2** provides the highest score in terms of technical, environmental, and economic criteria and is the Preferred Option. It achieves the objective of the project to achieve the reduced flood risk to properties, is technically feasible and has the lowest impact from an environmental perspective. **Option 2 taken forward for Environmental Impact Assessment, AA Screening and Preliminary Design**
FRM Approach 8: Flood resilience, preparedness, and emergency response	The slow response of the downstream sections mean that a forecasting is particularly suitable for this scheme. **Taken Forward for further analysis**	Because of the risks associated with the appropriate maintenance, timely erection of, and dependency on the homeowner to be present to install the flood gates, measures involving individual property protection (IPP) have been screened out as being non-technically viable. Flood resilience would have limited benefit in the Village centre due to the depth of flooding predicted and would not be deemed practical or effective. There is significant risk to this approach for Castleconnell. in the Village centre. Screened out and **Not taken forward**		
Alternative: Nature Based Solution (NBS) Opportunities and Benefits	NBS would have limited benefits in Castleconnell due to significant flows and the spatial scale of the catchment. Potential solutions such as creation of wetlands and woodlands would require a catchment-scale approach to result in any meaningful reduction in flood levels, which is outside the scope of the scheme and would be complex in terms of land acquisition. Also, Not viable. **Not Taken Forward**			

3.1.1 Directive 2014/52/EU

The EIA Directive 2014/52/EU requires that the main alternatives of a proposed FRS be considered and presented in the EIAR, and the reasons for selecting the emerging Preferred Option to be justified accordingly. This requirement is outlined in the following statement:

"A description of the reasonable alternatives (for example in terms of project design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects".

Alternatives were considered for this development early in the Options Development phase, and their viability assessed regarding applicability to the areas, economic impacts/benefits, environmental impacts/benefits, social impacts and acceptability, and cultural benefits/impacts. The process employed at the early phase is described further below.

3.1.2 First stage: Initial screening

A review of alternative Flood Risk Management (FRM) approaches has been undertaken to consider the different FRM methods that could potentially be viable and which relate to the study area. Options were screened based on the following criteria:

- Applicability to the area;
- Economic (potential benefits, impacts, likely costs etc.);
- Environmental (potential impacts and benefits);
- Social (impacts on people, society and the likely acceptability of the measure); and
- Cultural (potential benefits and impacts upon heritage sites and resources).

During the screening process, eight FRM approaches were screened, as well as consideration of nature-based solutions. These approaches are provided in the "Castleconnell Flood Relief Scheme Options Assessment Report"[1] completed by JBA and JB Barry in 2024 and summarised below.

FRM Approach 1: Repurposing of existing non-flood management infrastructure

This FRM approach considered structural changes to the embankments at Parteen Basin and the headrace canal, and operational changes to the Ardnacrusha power station turbines, turbine operation, spillway to modify the flow regime through the power station and down the Old River Shannon could all potentially offer flood risk protection to the current and future climate change design standards. All of these are third party assets outside of the control of the project and so this approach can be considered highly complex. This would also likely require changes to Parteen Basin and Parteen Weir. The potential effect of these measures is highly uncertain and would require detailed routing modelling and impact assessment.

The scale of these assets suggests that the costs of changes, including the environmental, hydraulic and social impact assessments required would likely be well in excess of the flood risk benefits available. It is possible that additional benefits outside of the flood risk management scheme may be available, but these would be highly dependent the nature of any change by the asset owner or operator. These additional benefits could reduce flood risk to other receptors along the Old River Shannon and non-flood risk benefits such as ecosystem services or recreation.

[1] JB Barry JBA (2024) *Castleconnell Flood Relief Scheme Options Assessment Report*. Unpublished

FRM Approach 2: Catchment scale and disperse actions to reduce flow downstream

The Parteen Basin and Parteen Weir present a notable break in connectivity of the hydrological and hydraulic regime of the Lower Shannon. Lough Derg provides additional and more substantial attenuation of upstream Shannon flows. The scale of catchment measures upstream of the Parteen Basin required will be disproportionate in order to provide a negligible reduction in flood flows on the Old River Shannon through Castleconnell. The operation of Parteen Weir and Basin could diminish the impact of any upstream measures. Implementing upstream catchment management measures requires negotiation and management of the complex interaction between stakeholders, landowners and organisations. This approach would be complex, the scale of the measures required would require significant works to third party lands along the length of the River Shannon, the effectiveness of the results would be subject to operational and structural conditions at Parteen Basin, and the cumulative costs would be significant and largely disproportionate to the monetary benefits available in Castleconnell. For this approach to be viable, it would need to be considered in the context of a Flood Relief Scheme for all benefitting areas along the River Shannon.

There is the potential for significant benefits to environmental and cultural heritage criteria, however the economic and social effects are highly uncertain. There is also a risk that any modifications to Parteen Weir could increase flood risk upstream and may not be viable.

FRM Approach 3: Inline storage on main watercourses or tributaries to reduce flow downstream

For Castleconnell, this approach is subtly different to Approach 1, in that changes to the operating rules for Parteen Weir and Parteen Basin could be optimised to offer flood risk benefits to receptors along the Old River Shannon. Any change in operating rules would need careful review in terms of the safe operation and management of the Ardnacrusha power station and associated embankments along the headrace, tailrace and the Parteen Basin. There are also a range of factors that affect the extent by which the current regime can be modified. These include maximum rate of drop in water level in Parteen Basin to ensure the stability of the surrounding embankments, the capacity of the headrace canal, the effect of upstream winds and the necessary head of water to maximise the pass-through flow at the Ardnacrusha turbines. Similar to Approach 1, this approach requires changes to the operation of third-party assets outside of control of the flood risk scheme. The approach is highly complex with very uncertain effects. The estimated costs are projected to be lower than those associated with undertaking major works on the Ardnacrusha turbines and spillway.

Measures associated with the above ***FRM Approaches 1, 2 and 3***, were not taken forward for further assessment due to the complexity, scale of works required on third party lands, and the uncertainty surrounding their effectiveness. However, in the future they may be considered and reviewed for future flood risk management within the climate adaptation plan and may form part of a wider catchment-scale restoration project.

Nature Based Solution Opportunities and Benefits were also considered. Nature Based Solutions (NBS) are typically measures that include planting and are implemented at ground level. They are designed to accommodate overland flow in a way that mimics natural processes, such as retention, storage and treatment. They aim to delay the rate at which surface water is conveyed, store excess volumes of water prior to releasing at a slower rate or infiltrating back to ground and filtering any potential debris or pollutants from the water. NBS can include amenity, biodiversity, water quantity and water quality benefits. However, due to the fact that most NBS are at ground level, their incorporation often requires large land take which can have a significant impact, particularly in urbanised areas. The local topography also has an impact on the effectiveness and suitability of NBS to manage overland flow across an area.

Nature Based Solutions can be implemented at different scales:

- International Scale – Generally relates to international policies which aim to prevent future increase in flood hazard.
- Catchment Scale – An approach to reduce runoff of manage sediment regime to protect downstream areas at risk. Typically expensive and uncertain approach to reducing flood levels or time to peak.

- Reach Scale – Measures local to a flood defence structure to reduce its scale, size or height. These are usually less expensive than catchment scale measures and have a greater degree of certainty regarding their effectiveness.
- Local Scale – Typically additions to engineering solutions such as maintenance regimes, wildflower meadow and tree planting etc. They can have significant local benefits but will have minimal benefits on a larger scale.
- Individual Scale – Measures that individuals can implement at their own property, such as green roofs, wildflower strips and community activities. These measures can be effective for small scale flooding of individual properties but often have negligible impact to the wider area.

Due to the large catchment of the Old River Shannon through Castleconnell, NBS would need to be considered at a catchment scale, reach scale or local scale. Catchment scale solutions could include upland afforestation, creation of floodplain and riparian woodland, upland/peatland restoration, riparian corridor restoration, barrier removal, online storage and wetland creation. Each of these measures would require large areas of land and in order to have a measurable impact on flood levels in Castleconnell would need to be implemented throughout the catchment, which is outside the control of the flood relief scheme.

Reach scale measures may include many of the same measures as outlined in the above paragraph, but on a smaller scale and aimed only at the reach of the Old River Shannon that has a direct impact on Castleconnell. Similarly, most of these measures would need to be implemented on lands that are outside the control of the flood relief scheme. Furthermore, they would not remove the need for hard defences but be required in addition to hard defences.

Local scale measures may include river restoration and maintenance, removal of barriers, introduction of SuDS measures within the village, floodplain restoration and detention areas.

Due to the characteristics of the Old River Shannon, the surrounding topography, the proximity of development within the village and the large upstream catchment influenced by Parteen Weir, there are limited Nature Based Solutions applicable to the area. Any potential changes to the operation of Parteen Weir and Ardnacrusha, or to the storage capacity in Lough Derg, as discussed in the paragraphs above, could form part of a Nature Based Solution. However, as previously mentioned these are third party assets and are outside the control of the flood relief scheme.

FRM Approach 4: Diversion of flow around and away from risk areas

The use of the partially unsettled land to the west of Castleconnell (along the right bank of the Old Shannon) for flood relief or a diversion channel was considered. This would require significant land purchase and the social, cultural, and environmental effects are highly uncertain. Economic effects, however, are less uncertain than other criteria as economic activity in this area is limited to mainly agriculture. Overall, this could be a highly complex and costly approach, which could provide benefits to other downstream flood receptors considering that the diversion can extend to bypass these risk areas. Any diversion channel would need to consider severance of landholdings and access issues, which may present significant challenges to implement. Potential impacts on flood levels downstream would also need to be carefully assessed.

FRM Approach 5: Improved conveyance of flow

In-stream river features such as weirs and islands in the River Shannon through Castleconnell result in increased water levels and increased sediment on the riverbed. Opportunities to improve conveyance centred on these features were considered under this approach. Key limitations of this approach are the potential environmental and visual impacts associated with such works.

FRM Approach 6: Refurbish or enhance defences to achieve standard of protection

This approach was not applicable as there are no existing formal flood defences (e.g. flood walls, embankments) in Castleconnell.

FRM Approach 7: Containment of flood level

The potential of containing flows within banks or limiting the extent of the floodplain to protect risk receptors was deemed viable at the individual settlement level. However, defence heights and their visual impacts, particularly in public areas, were identified as key limitations.

FRM Approach 8: Flood resilience, preparedness, and emergency response

Flood forecasting and warning systems can deliver benefits to other communities between Parteen and Limerick. Forecasting is particularly suitable for this scheme considering the slow response of the downstream sections of the Shannon combined with the influence of the operation of Parteen Basin and Parteen Weir. This approach would not reduce flood risk to properties but rather aims to increase resilience of the local community and businesses to respond to and recover from flooding in the most appropriate way.

Measures associated with FRM Approaches 4, 5, 7 and 8, were progressed further for technical analysis either as standalone or combined measures.

3.1.3 Second stage: Technical assessment of feasible options

Following the initial screening of the FRM approaches, the following flood risk management measures were identified as potentially feasible measures for Castleconnell and were taken forward for further technical assessment. The potentially feasible measures were then considered on an area-by-area basis in the Options Assessment, taking into account the constraints faced in different parts of Castleconnell. The potentially feasible measures consisted of:

- Do nothing;
- Do minimum;
- Structural Measures:
    - Direct defences including:
        - Reinforced Concrete (RC) Walls
        - Sheet Piles
        - Engineered Earth Embankments
        - Road Raising
        - Demountable Barriers
    - Individual Property Protection
- Non-Structural Measures:
    - Diversion Channel
    - River Restoration Works

Do Nothing

The ‘Do Nothing’ scenario is defined as the option involving no future expenditure on flood defences or maintenance of existing defences/channels. The implication is that the existing risk of flooding persists in the study area and possibly worsens over time, due to existing opes, the reduction in structural integrity of the existing walls with age, and climate change impacts are felt.

This is not a sustainable option; therefore, it has not been considered further.

Do Minimum

The “Do Minimum” measure would involve ongoing maintenance works or implementing additional minimal measures to reduce risk to specific areas with no strategy in place. This is to maintain the existing standard of protection in the current scenario and would likely lead to worsening impacts due to climate change. The existing masonry and stone walls throughout Castleconnell are not considered formal flood defence walls and cannot be relied upon to provide effective flood relief. Do minimum would generally involve repairing and reinforcing these existing non-formal flood defence walls now and as repairs are needed in the future together with the provision of non-return valves on existing outfalls and demountable barriers in fisherman access opes.

The walls in Castleconnell are not formal defences and do not currently provide effective flood relief. Given the existing flood pathways in Maher's Pub car park and via the Island House causeway, as well as the extensive emergency response operation required by LCCC on a recurring basis, this option was not considered further.

Structural Measures

Direct flood defences

The construction of direct defences along the banks of the existing river would contain flood volumes and flows within the river channel and may take the form of embankments, reinforced concrete walls or sheet-piling.

A Multi-Criteria Analysis (MCA) was conducted to evaluate different construction techniques across various areas. The final choice of defence, whether embankments or reinforced concrete/sheet piled walls, also considered buildability and health and safety aspects. Stakeholder consultation and assessment of likely environmental impacts further informed this process.

In general, it was considered that walls would be more suited to the northern part of Castleconnell, where there is insufficient space to accommodate an embankment between the Mall and the SAC. Towards the south, there are opportunities to provide an earth embankment where sufficient space exists, namely to the west of Meadowbrook estate and to the west and south of Coolbane Woods. Road raising could be used as a defence both to the north, at the Scanlon Park junction and to the south, at the Coolbane Woods junction. Demountable barriers or flood gates can also be used where space is constrained, and access is still required.

Individual property protection (IPP)

This measure involves property protection on an individual basis to protect from the full impact of flooding and speed up both recovery and reoccupation. This would typically consist of flood gates on private property, air brick covers, and non-return valves to drains. Flood gates installed in doorways are typically effective to approximately 0.6m flood depth. Above this depth, the water pressure on the walls of typical domestic properties could cause structural damage. IPP would also include measures to seal or otherwise secure windows and vents and may involve tanking buildings above and below ground to resist the ingress of water.

Individual property protection measures were not considered feasible as standalone measures due to the large number of properties at risk, the excessive predicted flood depths, the difficulty in retrofitting IPP measures to older and protected buildings and more importantly, the dependency on the homeowner to be present to install the units ahead of a flood event. It is also important that the flood barriers are stored securely and maintained correctly so that the units and seals remain in good condition allowing them to work effectively when needed. It is not easy to ensure that this will be achieved when the units are located on private property and managed by members of the public.

It is important that a continuous and passive response to flood management is provided where possible. Because of the risks associated with the appropriate maintenance and timely erection of flood gates on private property, any measure involving IPP which places a significant number of people or properties behind these gates has been screened out as being non-technically viable. It should be noted that limited use of demountable flood barriers elsewhere, subject to formal operational protocol, is considered distinct from IPP. Demountable flood barriers in use at driveways or roads are proposed at publicly accessible areas and will be stored, maintained, installed and replaced by the Local Authority or appointed sub-contractors as required.

Non-Structural Measures

Diversion Channel

The combination of high flow rates and a confined river cross section with heavy vegetation contributes to raised flood levels with resultant flooding within Castleconnell.

There is an existing western channel (approx. 800m long on the western bank, beginning opposite the Mall Road and re-joining the Old River Shannon c. 150m upstream of Doonass Bridge) on the right bank of the Shannon along Castleconnell. Hydraulic modelling showed that local widening of this channel would not significantly reduce flood levels in the northern part of Castleconnell, nor would it reduce flood levels in the southern part of the village.

Therefore, a much greater diversion and/or diversion channel would need to be provided to convey flood flows downstream, thus by-passing Doonass Bridge and a narrowing of the River Shannon at this location. An extensive lowering of existing ground levels to the 1 in 5-year flood level, over a significant area along the right bank of the Old River Shannon was also tested. This reduced flood levels throughout the village by up to 480mm. However, the reduction was not significant enough and new hard flood defences would still be required. Furthermore, the increased conveyance capacity within the river increased flood levels downstream of the village.

The right bank would need to be at a level to contain the 1 in 10-year flood flows with flows of greater magnitude breaking out into the diversion channel. There is already considerable upstream storage provided through the ESB managed Ardnacrusha Power Station and Parteen Weir, with extensive tracts of floodplain submerged during extreme floods. Provision of sufficient additional storage, that does not impact on existing development is not possible. This would also require significant works within the Lower River Shannon SAC, which would be a significant ecological constraint.

For all these reasons, this measure was screened out at this stage.

River Restoration Works

As a result of the modified flow regime down the Old River Shannon due to Parteen Weir, the geomorphic characteristics of the river have changed significantly over time. Increased riverbed levels due to siltation along with a number of man-made weirs and heavy vegetation growth has affected the conveyance capacity of the river through Castleconnell.

A range of river restoration works was tested within the model. These included:

- General maintenance of the riverbed and island vegetation to prevent silt and vegetation build up within the channel. This would result in a reduction in flood levels of c. 280mm-450mm from Rivergrove B&B to Chapel Hill. However, the flood levels downstream would increase slightly. This measure alone would not reduce flood levels enough to avoid the need for hard defences.
- Removal of the instream weirs from the northern properties to Cloon Island, which are believed to trap sediment and debris. Hard defences were included to the centre and south of the village to test whether these river restoration works would remove the need for hard defences to the northern properties. This measure would reduce flood levels by approximately 65mm-195mm, which is less than what general maintenance provides and would slightly increase flood levels downstream. Therefore, this measure alone does not sufficiently reduce flood levels to eliminate the need for hard defences to the northern properties.
- Removal of the weirs and islands from the northern properties to Stormont House, which are believed to trap sediment and debris. Hard defences were included to the centre and south of the village to test whether these river restoration works would remove the need for hard defences to the northern properties. This would result in a reduction in flood levels of up to 490mm from Rivergrove B&B to Cloon Island. However, the flood levels downstream would increase slightly. This measure alone does not reduce flood levels enough to avoid the need for hard defences.
- Softening of the bends at either side of the River Shannon. This would result in a reduction in flood levels of up to 240mm from Rivergrove B&B to Chapel Hill. However, the flood levels downstream would increase slightly. This measure alone does not reduce flood levels enough to avoid the need for hard defences.

- Widening of the channel at Doonass Bridge and replacement of the existing bridge with a wider one. This measure did not provide any meaningful reduction in upstream flood levels, indicating that hard defences would still be required.

While results varied, none of these measures resulted in a meaningful reduction in flood levels and all combinations tested resulted in increased flood levels downstream due to the increased conveyance through the village. Because of this, and the significant environmental impacts, such as associated works within the Lower River Shannon SAC, this measure was screened out.

3.2 Options Assessment

The Options Assessment Report[1] presents the various structural and non-structural defences in the wider context through the screening of all available alternatives considered (as described above in Section 3.1). From the technical assessment of the feasible measures, three Options were developed. Each of the Options considered how the scheme may need to be altered in the future to allow for adaptation in terms of alignment and height of defences from the impact of climate change on flows.

Table 3-2 shows the measures summarised under each Option and their location reference related to flood cells and section (North, Central, South). The Options are a combination of the measures that were determined to be the most appropriate for Castleconnell Village.

Table 3-2: Summary of the three Options measures and their locations

Measure location Reference (Flood cell/section)	Option 1	Option 2	Option 3
A/North section **B/North section**	Flood walls to the rear of the northern properties adjacent to the river. Culverting of the Cedarwood Stream through Grange House, from the downstream end of the open section at the Mill Building to its outfall to the River Shannon. Proposed pumped foul connection from Grange House to the public foul sewer to the north. Ramp within the property of Dunkineely House, from the flood wall on the northern boundary of Mall House to the corner of Dunkineely House.		
C/Central section **D/Central section** **E1/Central section** **E2/Central section**	Flood wall around the entire perimeter of Mall House. Demountable barrier to the vehicular entrance at the front of the property. Ramped access required to the pedestrian entrance to provide pedestrian access only during a flood event.	Flood wall to the rear of Mall House. No defences required to the front of the property and full access during flood event.	Flood wall around the entire perimeter of Mall House. Demountable barrier to the vehicular entrance at the front of the property. Ramped access required to the pedestrian entrance to provide pedestrian access only during a flood event.
	No defences to Mall Road Section A.	Set-back flood wall along Mall Road Section A.	No defences to Mall Road. Section A.
	Road raising of entire Scanlon Park Junction. Demountable barrier across the Mall Road. Re-construction of the Island House causeway to the MRFS level to allow access to the properties at all times. Sluice gates to be fitted to the culverts through the bridge, which will be closed during flood events to isolate the Cloon Stream. No defences required between Island House and Maher's Pub.	Road raising and demountable flood barrier across the Island House entrance. No demountable across the Mall Road.	Road raising of entire Scanlon Park Junction. Demountable barrier across the Mall Road Demountable flood barrier across the Island House entrance.
	Embankment across Cloon Stream from Maher's Pub to Cloon Island. Provision of culverts through this embankment with sluice gate/penstock arrangement to cut flows off during a flood event.	Set-back flood wall along Mall Road Section B. Flood wall alongside Maher's Pub car park to the Meadowbrook cul-de-sac.	

F1/South section **F2/South section** **F3/South section**	Embankment from Meadowbrook Estate to Stormont House. Low-level flood wall adjacent to existing wall. Road raising along entrance road. Road raising and demountable barrier across Chapel Hill Road. Embankment to the rear of Coolbane Woods.
G/South section	Removal of overgrown vegetation from the Cedarwood Stream, from its interface with the railway crossing to property Coole House, as part of the construction works. Annual inspection and maintenance thereafter to manage future vegetation that may impact conveyance. Replacement of the existing circular culvert at property Coole House with a larger rectangular culvert. Widening of the existing channel for a distance of c. 15m immediately upstream of this culvert.

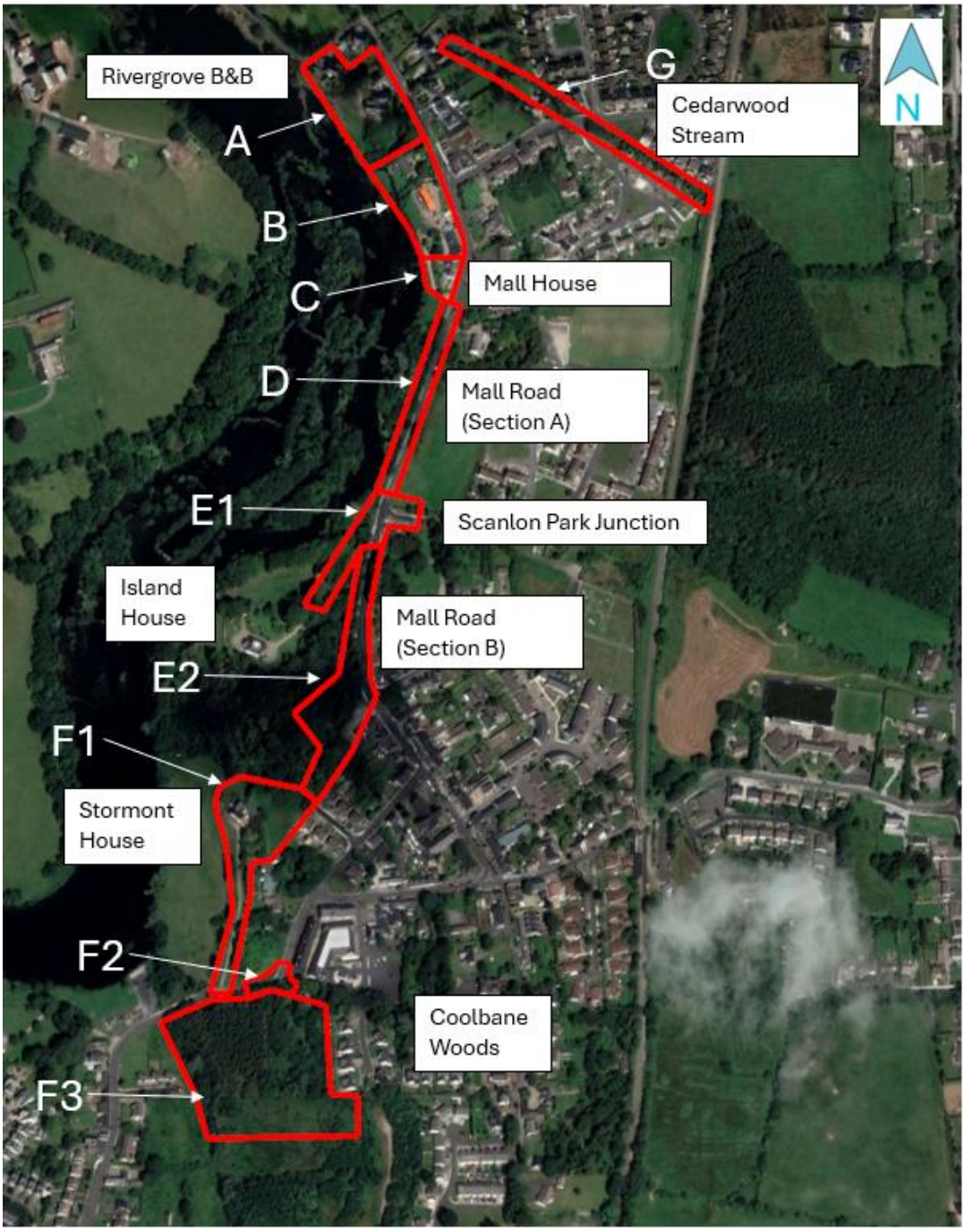

Figure 3-1: Flood cells used during optioneering.

As shown in the Table 3-2, the measures in the northern and southern sections are common to all three options. The central section differs in measures for each option. Options 2 and 3 share common measures

in the central section, including a set-back flood wall along Mall Road and a flood wall alongside Maher's Pub car park.

A detailed description of each measure is provided in the Castleconnell Flood Relief Scheme Options Report[1]. For reference overview figures are shown overleaf.

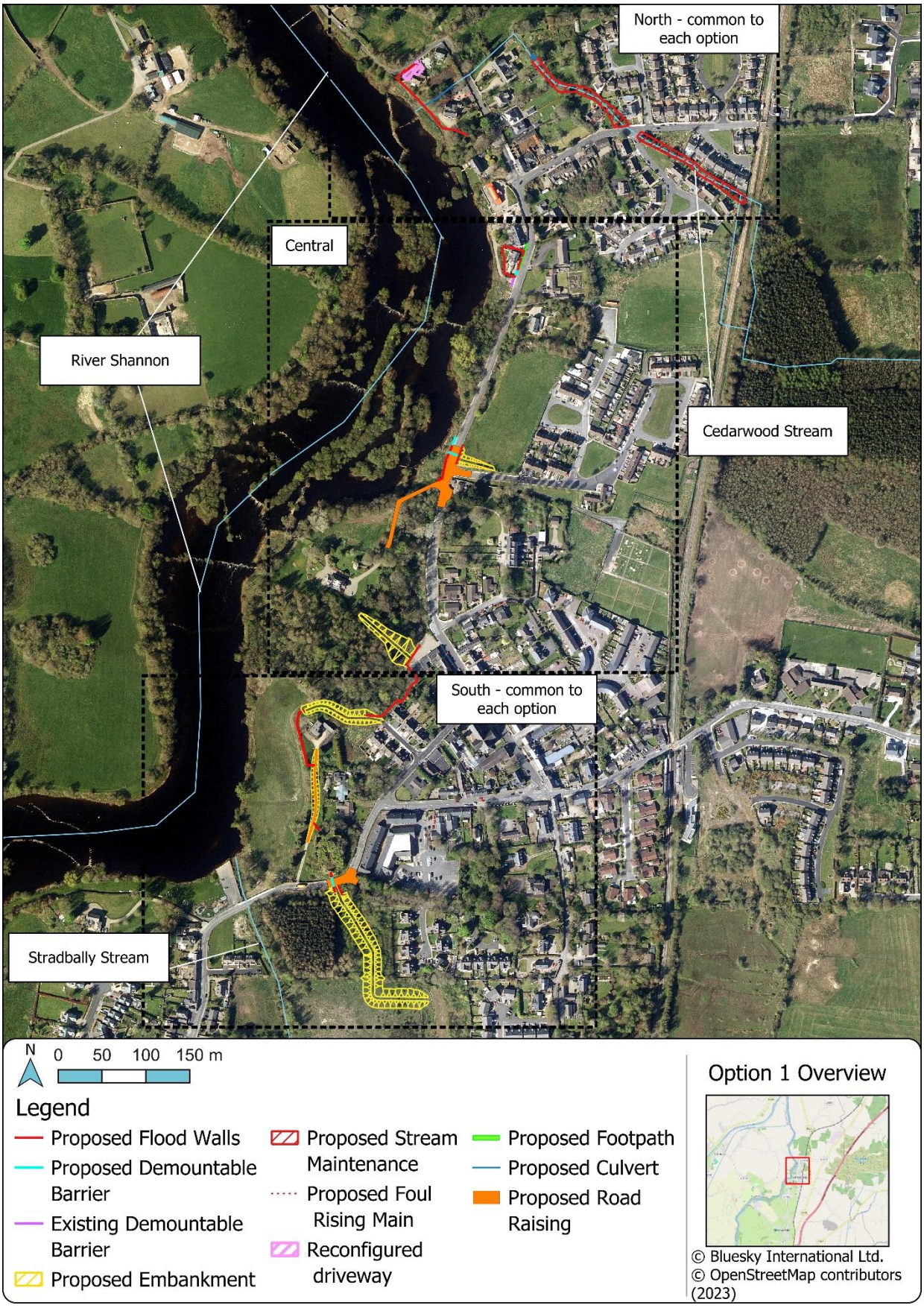

Figure 3-2: Option 1 overview

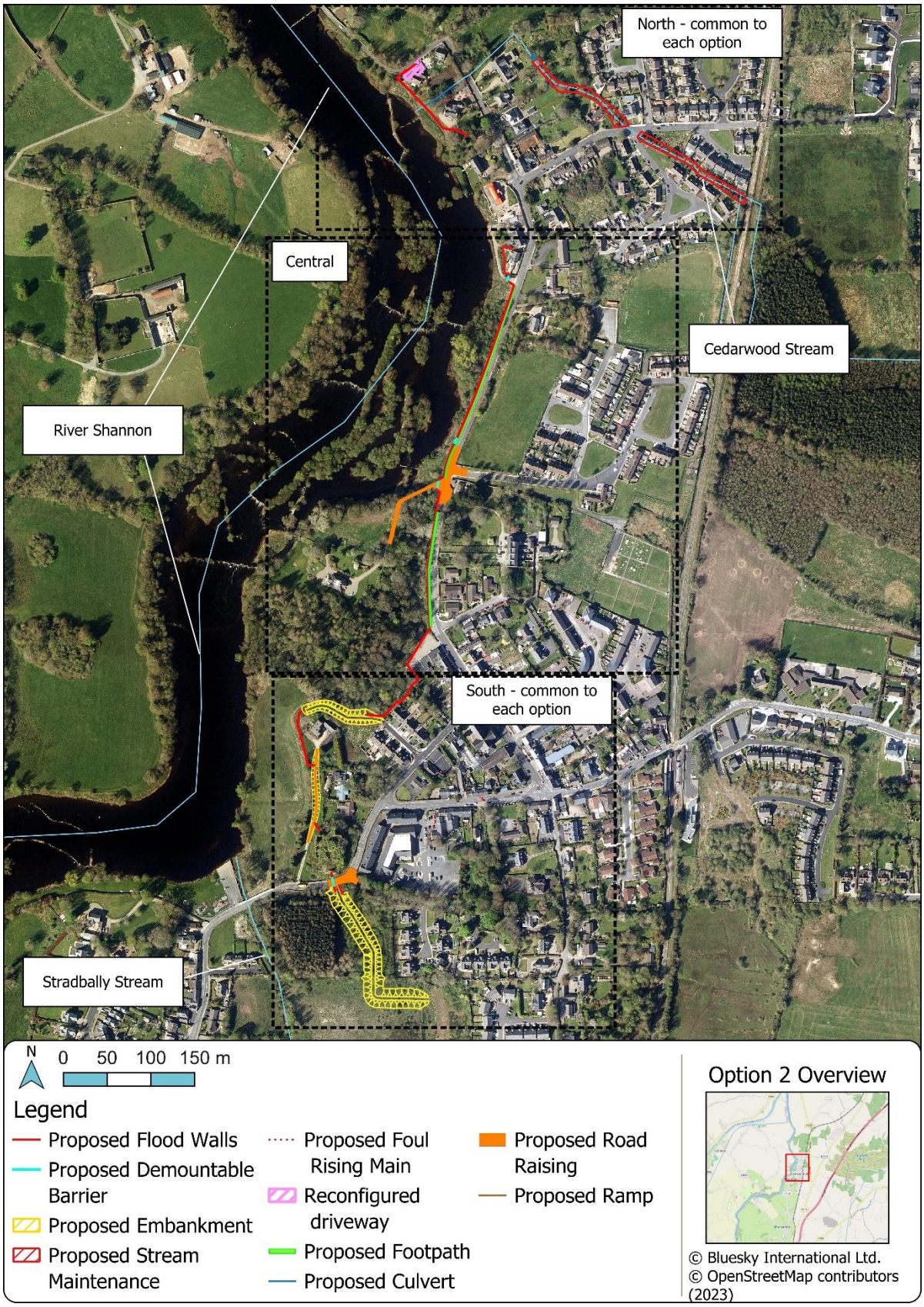

Figure 3-3: Option 2 overview

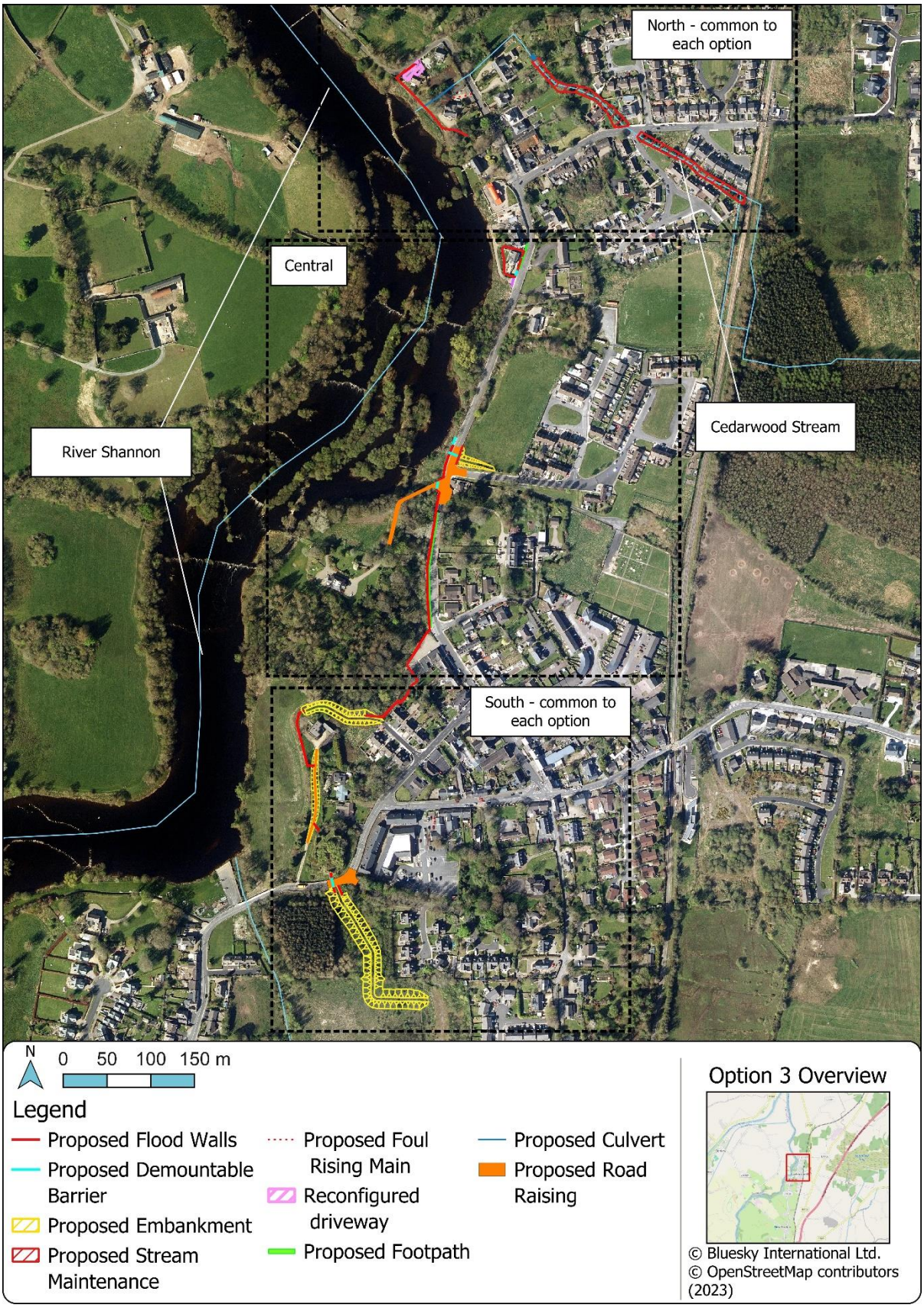

Figure 3-4: Option 3 overview

3.2.1 Environmental Comparison of Options

The potential environmental impacts associated with all Options are summarised below. As the three Options are identical in the northern and southern sections, the expected impacts in these areas are also

identical. The main focus of the summary is therefore on the central section of the scheme and comparison of the impacts of measures in this section.

Option 1

Hydrology, Hydrogeology and Hydromorphology

The highest adverse effects on water would be in the central section as a result of the construction of the causeway and embankment at Island House crossing over the Cloon Stream. Due to the direct changes to the Cloon Stream, there would likely be a high negative effect. Temporary impacts to water quality would be likely during construction, and permanent impacts to the hydromorphology of the stream would occur once operational.

Impacts on the water environment in the northern and southern sections would be largely temporary and moderate, limited mostly to the construction stage. Once operational, the proposed pumped foul connection at Grange House, which currently discharges raw sewage directly to the Cedarwood Stream, to the public foul sewer to the north is expected to have positive impacts on water quality. This positive impact is the same in all three Options.

Biodiversity

Impacts on biodiversity are likely to occur due to the scheme's proximity to the Lower River Shannon SAC and requirements for vegetation removal in places. While in the northern and southern sections the impacts would be slight to moderate and largely limited to the construction phase, such as the use of machinery or construction of a haul road for movement of a piling rig, operational impacts would be likely in the central section. Potential risk for high negative effects on the biodiversity of this area would be due to the construction of the raised causeway and embankments within the heavily wooded area around Island House, which is within the Lower River Shannon SAC. A slight negative impact is also likely in the operational phase in the northern section at Grange House, due to the introduction of a culvert.

Most impacts on biodiversity in the northern and southern sections would be during construction. Embankment construction at Coolbane Woods and Stormont House in the southern section would require vegetation removal which could lead to moderate negative impacts.

Cultural Heritage

Impacts in the northern section would be moderate negative, due to its location in an Architectural Conservation Area (ACA) and proposed alterations to the curtilage of a building on the Record of Protected Structures (RPS).

In the central section, works on the boundary walls of Island House (listed on the RPS) and changes to the curtilage of other protected structures such as Mall House (listed on the National Inventory of Architectural Heritage) would cause moderate negative impacts. The highest potential impact would be high negative due to the alteration of the bridge to Cloon Island (RPS 5056). This Option proposes replacement of the Island House causeway to the MRFS level and raising of the entrance road to Island House to provide unimpeded access during flood events. These would lead to significant alterations to the stone bridge, causing a significant negative impact.

Construction works and the introduction of flood walls in the vicinity of Castleconnell Castle (LI001-003) will have a slight permanent impact on its setting but would not affect the Castle itself. Construction work will take place in the Zone of Notification of the Castle however, so mitigation measures will be required. This impact will not be significant. In other cultural heritage receptors impacts would be slight negative to no impacts.

Positive impacts on various cultural heritage features are likely as they will provide an improved standard of flood protection as a result of the scheme.

Landscape and Visual Amenity

Flood walls along Rivergrove B&B and Grange House in the northern section would cause temporary visual impacts during the construction phase, and permanent moderate negative effects on visual amenity once operational. Mitigation in the form of glass panels in the proposed flood walls at these properties to maintain views of the river, are feasible to reduce these impacts.

In the central section flood walls would be built around one house, resulting in permanent moderate negative effects on visual amenity. Provision of flood walls at Maher's Pub would also lead to a slight negative effect. There are no permanent effects on visual amenity and landscape from road raising or embankment at Scanlon Park.

Impacts in the southern section would be similar to those in the northern section and would likely not be significant.

Construction and access impacts

Across the scheme, temporary negative impacts are likely during construction, due to temporary disruption to access or from construction noise and vibration. These are likely to be slight negative and would be typical of construction projects.

Once operational, during flood events access to Castleconnell from the north would be restricted by the demountable flood barrier across Mall Road at the Scanlon Park entrance. Access would also be restricted from the south by the demountable flood barrier across Chapel Hill. These impacts would be moderate but intermittent, with alternative routes to and from the village available. Access will be required to private property during the operational stage for inspection of defences and repair if necessary. Vehicular access to one property will be restricted during flood events.

These impacts are discussed in further detail within the Construction Environmental Management Plan (CEMP).

Option 2

Hydrology, hydrogeology and hydromorphology

The highest impact on water from this Option would be temporary moderate negative in the central section. Construction of flood walls along the length of the Mall Road and rebuilding of the boundary wall along Island House would have the potential to increase sedimentation and runoff entering the nearby waterways through the SAC habitat along the walls. The total length of works is greater than in Options 1 or 3, leading to a greater impact than those Options.

Once operational, the flood wall along the length of the Mall Road would provide protection for a long section of road, reducing the potential for pollution and sedimentation during flood events. Furthermore, as the design has detailed the construction of the wall approximately 1m back from the existing wall it would enable a 1m wide strip to be naturally reinstated. These are positive impacts compared to Options 1 and 3.

Impacts on the water environment in the northern and southern sections would be largely temporary and moderate, limited mostly to the construction stage. Once operational, the proposed pumped foul connection at Grange House, which currently discharges raw sewage directly to the Cedarwood Stream, to the public foul sewer to the north is expected to have positive impacts on water quality. This positive impact is the same in all three Options.

Biodiversity

Impacts on biodiversity are likely to occur due to the scheme's proximity to the Lower River Shannon SAC and requirements for vegetation removal in places. During construction the haul road for the piling rig will also have temporary impacts in all three Options. While construction will occur close to or within vegetated areas in various places, there are fewer defences proposed in wooded areas than in Option 1. Removal of the sluice gates on the Island House causeway structure will result in a long-term positive impact. This would result in fewer direct impacts on biodiversity than Option 1.

Greater levels of construction are required in Option 2 compared to Option 3, where there is less construction along the Mall Road. However, the setback of the wall in Option 2 would lead to long-term positive impacts in the operational stage, as it would provide an extension of the existing riparian zone which would be naturally reinstated over time. The immediate area along the wall will be kept free of vegetation, to allow for regular visual and scheduled maintenance. With these positive impacts the overall impact on biodiversity would be moderate.

Potential impacts during construction and operation phases in the northern and southern sections would be the same as Options 1 and 3.

Cultural heritage

Impacts on cultural heritage in the north and south of the scheme are the same as for Options 1 and 3.

In the central section, works on the boundary walls of Island House (listed on the RPS) and changes to the curtilage of other protected structures such as Mall House would cause moderate negative impacts, as in Options 1 and 3. Potential impacts are lower than Option 1 as measures to the Island House causeway are different. In Option 2, it is proposed to raise the driveway and level of the road, with no significant alteration to the causeway, unlike in Option 1. The proposals will include repair of stonework where required and fixing of a handrail to some castellations, which would be aligned to the cultural heritage consultants' advice.

Positive impacts on various cultural heritage features are likely as they will have an improved standard of flood protection as a result of the proposed scheme.

Landscape and visual amenity

Flood walls along Rivergrove B&B and Grange House in the northern section would cause temporary visual impacts during the construction phase, and permanent moderate negative effects on visual amenity once operational. Mitigation measures, such as installing glass panels in the proposed flood walls at these properties to maintain river views, are feasible to reduce these impacts.

Impacts in the southern section would be similar to those in the northern section and would likely not be significant.

In the central section, flood walls would be built around three sides of one house, resulting in permanent moderate negative effects on visual amenity. Provision of flood walls at Maher's Pub and along the length of Mall Road would also lead to a slight negative effect.

Construction and access impacts

Across the scheme, temporary negative impacts are likely during construction, due to temporary disruption to access or from construction noise and vibration. These are not likely to be significant and would be typical of construction projects.

Once operational, no impacts on access to Castleconnell from the north would be expected for members of the public as the flood walls remove any need for a demountable flood barrier at this point. Intermittent access issues would still occur due to the demountable flood barrier at Coolbane Woods. Access will be required to private property during the operational stage for inspection of defences and repair if necessary. Vehicular access to two properties will be restricted during flood events

These impacts are discussed in further detail within the Construction Environmental Management Plan (CEMP).

Option 3

Hydrology, Hydrogeology and Hydromorphology

The highest impact on water from this Option would be temporary moderate negative in the central section. Construction of flood walls along part of the Mall Road and rebuilding of the boundary wall along Island House would have the potential to increase sedimentation and runoff entering the nearby waterways through the SAC habitat along the walls.

Operational impacts are not likely to be significant. The reduction in length of the flood wall along the Mall Road would provide less protection from potential pollutants than with Option 2.

Impacts on the water environment in the northern and southern sections would be largely temporary and moderate, limited mostly to the construction stage. Once operational, the proposed pumped foul connection at Grange House, which diverts the existing foul line from the Cedarwood Stream to the public foul sewer to the north, is expected to positively impact water quality. This positive impact is the same in all three Options.

Biodiversity

Impacts on biodiversity are likely to occur due to the scheme's proximity to the Lower River Shannon SAC and requirements for vegetation removal in places. During construction the haul road for the piling rig will also have temporary impacts in all three Options. While construction will occur close to or within vegetated areas in various places, there are fewer defences proposed in wooded areas than in Option 1. This would result in fewer direct impacts on biodiversity than Option 1.

Greater levels of construction are required in Option 2 compared to Option 3, where there is less construction along the Mall Road. However, the setback of the wall in Option 2 would lead to long-term positive impacts in the operational stage, as it would provide an extension of the existing riparian zone which would be naturally reinstated over time. Option 3 does not benefit from this increase in riparian area.

Potential impacts during construction and operation in the northern and southern sections would be the same as Options 1 and 2.

Cultural Heritage

Impacts on cultural heritage in the north and south of the scheme are the same as for Options 1 and 2.

In the central section, works on the boundary walls of Island House (listed on the RPS) and changes to the curtilage of other protected structures such as Mall House would cause moderate negative impacts, as in Options 1 and 2. Potential impacts are lower than Option 1 as alterations to the Cloon Island bridge are not required.

Positive impacts on various cultural heritage features are likely as they will have an improved standard of flood protection from the scheme.

Landscape and Visual Amenity

Flood walls along Rivergrove B&B and Grange House in the northern section would cause temporary visual impacts during the construction phase, and permanent moderate negative effects on visual amenity once operational. Mitigation measures, such as installing glass panels in the proposed flood walls at these properties to maintain river views, are feasible to reduce these impacts.

Impacts in the southern section would be similar to those in the northern section, and would likely not be significant.

In the central section flood walls would be built around one house, resulting in permanent moderate negative effects on visual amenity. Provision of flood walls at Maher's Pub and along part of the Mall Road would also lead to a slight negative effect.

Construction and access impacts

Across the scheme, temporary negative impacts are likely during construction, due to temporary disruption to access or from construction noise and vibration. These are not likely to be significant and would be typical of construction projects.

Once operational, during flood events access to Castleconnell from the north would be restricted by the demountable flood barrier across Mall Road at the Scanlon Park entrance. Access would also be restricted from the south by the demountable flood barrier across Chapel Hill. These impacts would be moderate but intermittent, with alternative routes to and from the village, available. Access will be required to private property during the operational stage for inspection of defences and repair if necessary. Vehicular access to two properties will be restricted during flood events.

These impacts are discussed in further detail within the Construction Environmental Management Plan (CEMP).

The environmental impacts discussed above are summarised in Table 3-4. It provides a clear comparison between impacts on each Option. The weight of the effect is displayed by different symbols: the blue circle represents High potential effects; orange represents Moderate potential effects and green is a Slight or Neutral effect. These symbols are shown below:

High potential effect	
Moderate potential effect	
Slight/no potential effect	

3.2.2 Cost

A full break-down of costs for the three Options is provided in the Options Report[1].

3.2.3 Multi Criteria Analysis Outcomes

The effectiveness of each of the feasible Options can be measured in terms of how it achieves a set of flood risk management objectives. This section summarises the detailed multi-criteria analysis (MCA) of the shortlisted Options, which was carried out to evaluate the performance of each Option in terms of predefined objectives. It follows the OPW Guidance Note adopted for the Flood Risk Management Plans, which was applied to the detailed scheme appraisal. Each of the MCA objectives has also been weighted both globally and locally to reflect the importance of each. These weightings are in accordance with the OPW Technical Methodology Note (TMN) – Option Appraisal and the Multi-Criteria Analysis (MCA) Framework.

Criteria Scores: The MCA produces a weighted score for each objective and the sum of these within each of the criteria classifications is the Criteria Score, as summarised in:

- **MCA Benefit Score**: The sum of the scores for the economic, social and environmental criteria. It excludes the technical criteria score. This score represents the net benefits of the Option.
- **Option Selection MCA Score:** The sum of the scores for all four of the criteria. This score compliments the MCA Benefit Score with the Technical Criteria Score, and hence includes all of the aspects that should be taken into account in considering the Preferred Option for a given location.

Table 3-3: Summary of MCA score for each Option

Criteria	Option 1	Option 2	Option 3
Technical	550	700	450
Economic	354	396	354
Social	151	151	151
Environmental	-975	-164	-316
MCA Benefit Score	-470	383	189
Options Selection Score	**80**	**1083**	**639**

The MCA score table shows that Option 2 provides the highest score in terms of technical, environmental and economic criteria.

The negative value in the environmental criteria indicates negative impacts. Positive or no impacts would be represented by positive values. Option 2 has the highest value (-164) in the environmental criteria which means that environmental impacts are lower for this Option. Furthermore, this result is attributed also to the positive impact that measures in Option 2 provide to biodiversity. It also scores higher on technical and economic criteria.

Table 3-4: Summary of environmental impacts

	North			Central			South		
Option	1	2	3	1	2	3	1	2	3
Hydrology hydrogeology hydromorphology									
Biodiversity									
Cultural Heritage									
Landscape and visual amenity									
Construction impacts									
Operational access									
Comments	The northern section is identical in all 3 Options. Moderate negative effects are possible to hydrology due to construction works in close proximity to the River Shannon. Impacts to biodiversity are also expected to be moderate in the northern section, due to disturbance and habitat loss during construction.			Alterations to the Cloon Island bridge will lead to high negative impacts on cultural heritage. This structure is listed on the Limerick Record of Protected Structures (RPS) and the proposed alterations will negatively affect the structure. Construction within the wooded area could lead to high negative effects during construction on both biodiversity and hydrology and hydromorphology. The construction of the embankment at Island House would directly impact the Cloon Stream during construction and operation.	Potential negative impacts to hydrology and hydromorphology and biodiversity are present in this area as in Options 1 and 3. Due to the extended length of wall and greater construction needs, this impact will be greater than in Option 3 However, the long-term positive from increasing the riparian area adjacent to the wall partially offsets the negatives of construction.	No high negative impacts are expected in this area. The reduction in wall length along the Mall will reduce potential impacts on hydrology and hydromorphology compared to Option 2, while impacts to biodiversity will be less than in Option 1, as embankments and road raising are not required within the woodland around Island House.	The southern section is identical in all 3 Options. Impacts to hydrology in this section will be less significant than in the central and northern sections as the measures are set back further from the Shannon. Construction adjacent to the Lower River Shannon SAC and in the wooded area west of Coolbane Woods could lead to moderate negative impacts. During flooding, the demountable barrier at the entrance to Coolbane Woods will impact access into and out of Castleconnell, however alternative routes are available.		

3.3 Preferred Option selection

Following the Options Assessment outlined in the above sections, a Preferred Option emerged. The three Options considered provide the same level of protection to existing properties in Castleconnell and they have common elements among them. These include the northern section (the area to the north of the Mall Wall) and the southern section (the area to the south of Maher's pub). Feedback from each of the Public Participation Days (PPD) and liaison with the local community and affected landowners, was essential in choosing the Preferred Option. One of the key desires identified at the PPDs was to maintain access along the Mall Road. This was taken into consideration during the Option Selection process.

The differences in the Options occur in the central section. All three Options included local protection to Mall House and Dunkineely House, but this takes slightly different forms in Option 2.

At the entrance to Island House, Option 1 proposed significant works to the existing causeway. To prevent flood waters passing the causeway and entering the Village, the Option proposed to replace the existing causeway structure and the provision of penstocks to close off the openings that extend through the causeway, allowing it to act as a flood defence structure. Barriers to this Option included the fact that the causeway is listed on the Record of Protected Structures and is located within the SAC. This would make implementation challenging, which is reflected in its low environmental score. Option 1 also proposed no protection to the Mall Road and proposed a demountable barrier crossing the Mall Road near the junction with Scanlon Park. There would also be local raising of the road level at this junction and an earth embankment constructed along the north side of Scanlon Park to tie into higher ground. Option 1 would result in The Mall Road being closed to all traffic during flood events.

Option 1 also proposed the construction of an earth embankment across Cloon Stream, extending from the car park to Maher's pub into the higher ground towards Island House to prevent flood flows entering the village via the south side. Culverts would be provided through this embankment to allow flow through Cloon Stream under normal flow conditions however, penstocks or non-return valves would be installed on these to prevent backing up of flows during flood events. The advantage in this measure would be the removal of the need to provide a flood wall along The Mall between the entrance to Island House to Maher's pub but would mean the embankment would be constructed within the SAC.

Option 3 would remove the need to significantly amend the causeway to Island House and for the embankment extending across Cloon Stream within the SAC from Maher's pub towards Island House. It does this through the provision of a flood wall along The Mall from the entrance to Island House and the car park at Maher's pub. This has the advantage of limiting the impact on both the SAC and the listed structure. This Option would still rely on the provision of localised raising of the road at the entrance to Island House, approximately 300mm higher than in Option 1, an embankment extending parallel to Scanlon Park and a demountable barrier crossing The Mall Road. It also means that, as with Option 1, The Mall Road would be closed to all traffic during a flood event.

Option 2 has been developed to prevent the flood water from entering The Mall Road through the construction of a new flood wall to replace the Mall Wall from the entrance to Island House, to Mall House. The presence of the SAC and in particular the alluvial woodland has been considered. To mitigate impacts on these, would be constructed outside the boundary of the SAC. This Option would result in a slight reduction in the width available for the highway and footpath along this length of The Mall Road. Therefore, to provide a passive element to the flood defence at the entrance to Island House, it was proposed to raise the entrance road level by c. 250mm and provide a demountable barrier at the entrance to the causeway.

Feedback received from the local community at the Public Participation Days (detailed in Chapter 5 Consultation) strongly favoured maintaining the access along the Mall Road once the flood relief scheme is operational. This was taken into consideration during the selection of the preferred option. Maintaining access along Mall Road offers significant health and safety benefits. It ensures that a safe access route remains open during flood events, preventing the public from attempting to use flooded roads. Further

feedback from the PPDs highlighted the importance of retaining the heritage of the village and minimising effects on the environment as much as possible, which informed the construction techniques, alignments and materials proposed.

When considering benefit cost ratio (BCR), it should be noted that none of the Options provide a BCR greater than 1. Details are given in Chapter 8 “Economic Appraisal of Shortlisted Options” of the Castleconnell Flood Relief Scheme Options Report[1]. Option 3 provides the highest BCR (0.82) and the additional cost of the new Mall Wall results in Option 2 having the lowest BCR (0.69) of the three Options. However, BCR does not account for intangible benefits such as improvement of ecology and landscape, maintaining access along the Mall Road (which was requested by the local community), increasing the footprint of the SAC by c. 1 m along the Mall Road and enhancing the woodland at the Coolbane Woods. The Steering Group recommended that the scheme progress with Option 2 despite providing a low BCR.

3.3.1 Summary of Preferred Option (Option 2)

From the screening of alternative measures and assessment of options, Option 2 emerged as the Preferred Option. This decision considered the project’s objectives to reduce flood risk to village properties, be technically feasible, perform better in terms of economic criteria and have the lowest negative environmental and social impacts.

The measures included in Option 2 will have the lowest environmental impact of the three options. Its minimal impact on the SAC makes this option preferable for protecting an internationally designated site. Additionally, it will enable the continuity of riparian vegetation and the natural reinstatement of land along the Mall over time, which is a positive impact. Option 2 also provides better access during flood events compared to Options 1 and 3, as it maintains full access to Mall Road during these events. Replacing the Mall Wall also removes the risk of collapse of the existing wall under hydrostatic pressure during a flood event.

4 Description of Proposed Development

4.1 Introduction

This section of the EIAR outlines the proposed FRS for Castleconnell as shown in Figure 4-2. The proposed FRS has been previously described in the project Options Assessment Report as the Emerging Preferred Option. Generally described, it comprises a series of flood defences positioned along the left (eastern) bank of the River Shannon as it flows past Castleconnell, comprising new flood walls, earth embankments, road raising, and demountable flood barriers, and works to the Cedarwood Stream. Details are provided in the sections below. In addition to this, reference is made in the EIAR to engineering drawings produced as part of the FRS application, and Photomontages have been prepared as part of Chapter 13.

The engineering drawings accompanying the application are as follows:

- List of drawing names to be added

4.2 Site Location and Context

The study area for the proposed Flood Relief Scheme, as assessed in the FRS Options Report[1], is outlined in red in Figure 4-1.

The River Shannon is the largest river in Ireland, with a total catchment area covering approximately 15,700 km^2. The river rises in the Cuilcagh Mountains, at Shannon Pot, in Co. Cavan. The river flows in a southerly direction, discharging in the Shannon Estuary. Approximately 10,824km^2 of the Shannon catchment and associated flood flow is drained via Castleconnell Village.

Flood flows at Castleconnell are heavily influenced by Parteen Weir and Lough Derg which is approximately 6.5km upstream of Castleconnell Village.

There is a topographical fall in a southerly direction with road levels adjacent to Rivergrove B&B on the Lacka Road of c.24mOD falling to 22.7mOD on Chapel Hill fronting the public carpark

Castleconnell is served by the M7 motorway, R445 regional road, and the Limerick-Ballybrophy railway line.

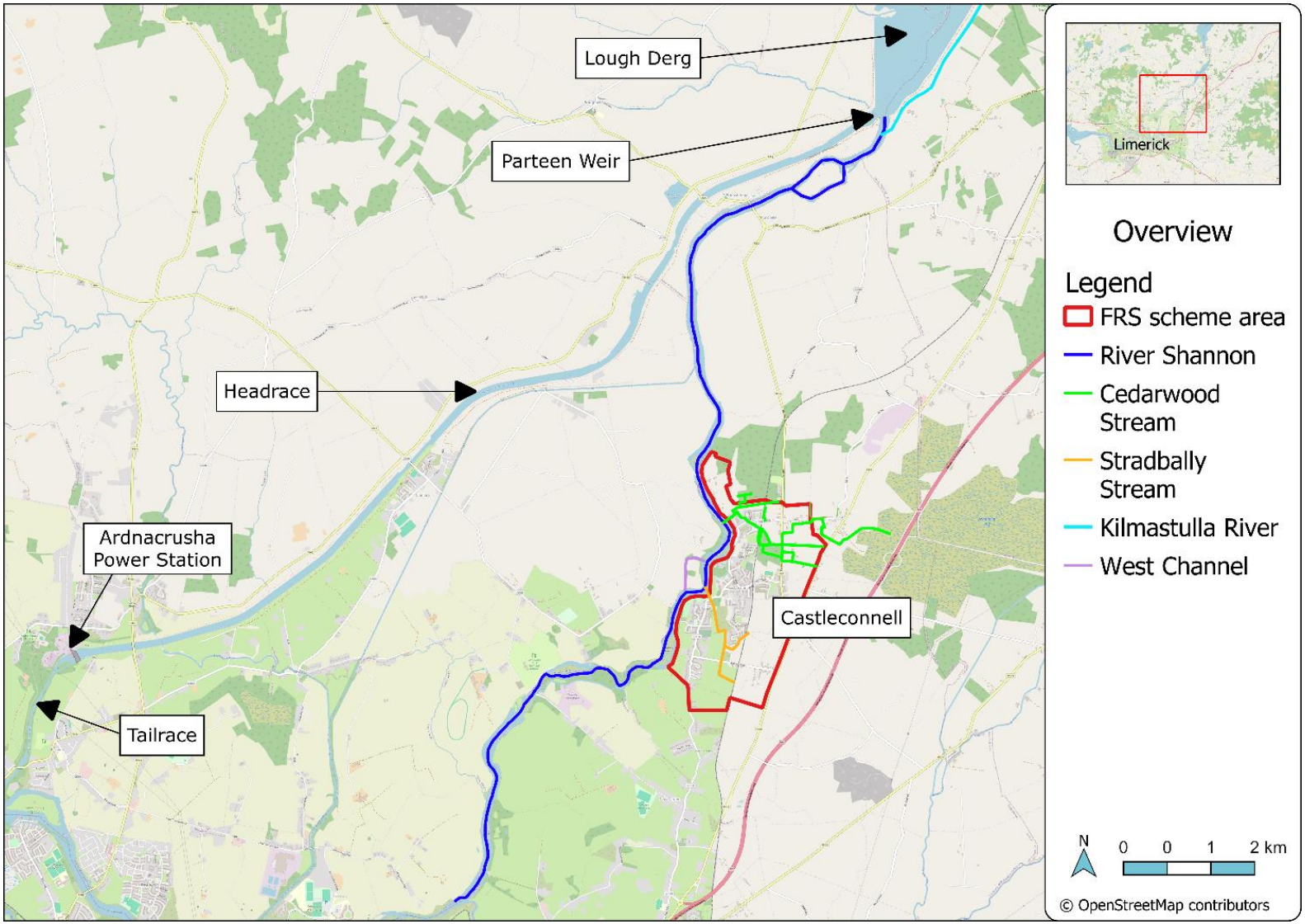

Figure 4-1: Castleconnell FRS Catchment Overview

4.3 Description of Proposed Development

The proposed development comprises the following. Numbers refer to references shown in Figure 4-2:

4.3.1 Rivergrove B&B and Grange House

Rivergrove B&B and Grange House are located at the northern end of Castleconnell Village on Elvers Road. Both are detached buildings with private gardens, with high stone walls separating them from the road, which is a narrow single-lane road lined with stone walls and trees or hedgerows. Rivergrove B&B is adjacent to the River Shannon, with views over the river and the riparian vegetation along its banks. Grange House is south of Rivergrove and also looks onto the River Shannon. Both houses have driveways which open onto Elvers Road.

The proposed development will require replacement of the existing wall to the west of Rivergrove B&B with a new flood wall (Figure 4-2, No. 1). The new flood wall extends across the existing entrance and a new entrance will be provided at higher ground further to the East. Provision of a new low-level plinth inside the existing front boundary wall to the north of the B&B will avoid the need to replace the existing high stone wall. The proposed flood walls at this location will have a sheet piled foundation with a reinforced concrete plinth supporting a reinforced concrete flood wall which will be clad in stone similar to the existing wall. A short length of glass panels will be provided within the flood wall to maintain key views of the river from the conservatory.

The existing wall to the west of Grange House (Figure 4-2, No. 2) will also be replaced with a new flood wall that will continue along the southern side of the driveway until it ties in with high ground. Glass panels will be provided in sections, as agreed with the homeowner, to maintain key views of the river from key areas of the house. The proposed flood wall at this location will have a sheet piled foundation with a reinforced concrete plinth supporting a reinforced concrete flood wall which will be clad in stone similar to the existing wall. The open section of the Cedarwood Stream adjacent to the Mill Building will remain in place as a visual point of interest, but will be disconnected from the watercourse. A new diverted culvert will be constructed just north of the open feature, which will carry the watercourse to its outfall into the River Shannon. A new pumped foul connection will be provided to the public foul sewer to replace the existing free outfall from the house to the Cedarwood Stream open feature.

In this location tree removal would be required to facilitate construction on the new flood wall and to accommodate the driveway reconfiguration at Rivergrove B&B. Most of the trees to be removed are small garden trees. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.2 Mall House

Mall House is a two-storey detached house at the northern end of the Mall Road. The house is overlooking the River Shannon. A private access lane runs along the western edge of Mall House to Dunkineely House, directly north of Mall House. The access lane separates Mall House from the River Shannon.

The walls to the north, west and south of Mall House will be replaced with a new flood wall that will be clad in stone similar to the existing wall (Figure 4.2, No. 3). Where the northern face of the house is constructed against the boundary wall, a ramp will be constructed in the property of Dunkineely House to cut off flows from this side. The northern wing wall and hedge to the main entrance of Dunkineely House will be removed and demountable barriers will be provided in the gateway (one existing vehicular entrance plus one proposed pedestrian entrance). No protection is required to the front because the Mall Road is protected. (Figure 4.2, No. 4).

In this location tree removal would be required to facilitate construction on the new flood wall, most of which are small garden trees. This removal is needed to facilitate the construction of the new flood wall. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.3 Mall Road

Mall Road is a single-lane road connecting Castleconnell Village centre with the residential areas to the north, including Mall House, Grange House, and Rivergrove B&B. Works will take place along a stretch of Mall Road from Maher's Pub in the south, north past the junction with Island House and Scanlon Park, to Mall House (approx. 450m in total). A low stone wall runs along its entire length on its western side, except for the entrance to Island House, and several small openings which act as fishermen's access to the river (known as opes).

The northern end of Mall Road, from the Island House/Scanlon Park junction to Mall House, has good views of the River Shannon to the west, with sections of trees or other vegetation. On its eastern side is a large green field, with several detached houses at the northern end, across from Mall House.

The southern end of Mall Road, from the junction down to Maher's Pub, is more enclosed due to tall trees on Cloon Island and Island House.

The existing wall to the west of the Mall Road will be demolished, with a new flood wall constructed which will be set back by c. 1m and constructed outside the SAC and alluvial woodland (Figure 4-2, No. 5). The existing footpath along the Mall Road will similarly be moved back in line with the new wall. However, c. 55m immediately south of the entrance to Island House, the existing wall will be replaced along its existing alignment due to the narrowness of the road (Figure 4-2, No. 8).

A demountable barrier will be constructed in the main fisherman access point through the Mall wall, known locally as Broderick's slip (Figure 4-2, No. 6).

In this location tree removals will be required, outlined in the standalone Arboricultural Impact Assessment Report. Most of the trees are on the southern part of the road along its border with Cloon Island. These are the trees immediately adjacent to the existing stone wall, with more existing trees west of these which will remain in place. The impact of this is assessed in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.4 Island House and Scanlon Park Junction

The Island House and Scanlon Park junction approximately splits Mall Road into northern and southern halves. It is an uncontrolled junction, with no pedestrian crossing markings, and a stop sign from the Scanlon Park side. Immediately south of the junction on the Scanlon Park (eastern) side of Mall Road is a pumping station owned and operated by Uisce Éireann.

Island House itself sits on Cloon Island, and is accessed from Mall Road by a causeway and long driveway. Several trees along the driveway will require pruning to facilitate the works, but will all be retained.

A ramp will be constructed at the entrance to Island House (Figure 4.2, No. 7), to the '504 event' 1% AEP flood level (23.70m). A flood gate will be provided on top of this to defend up to the 'Baseline design event (limitations in operational conditions)' (24.24m). Nominal raising of the Scanlon Park junction, approx. 100mm, will be required to accommodate this. The driveway to Island House will also be raised by c. 250mm and a handrail will be provided along either side of the causeway. The sluice gates on the causeway structure will be removed to allow flow through Cloon Stream.

4.3.5 Maher's Pub

Maher's Pub is at the southern end of Mall Road, with a large car park which backs onto the trees associated with Cloon Island.

A new flood wall alongside Maher's Pub car park will be provided (Figure 4-2, No. 9). It is proposed to set back the wall along the rear (western) boundary by c. 6m to remain outside of the root protection zone of the Cedar tree, which is used by herons for nesting. This flood wall extends along the northern boundary of nr. 7 Meadowbrook Estate, terminating at the end of the cul-de-sac. A section of the existing boundary wall

will be removed, and a gate will be provided through the wall for emergency access to Stormont House and for maintenance of the embankment in the Stormont House grounds only. There will be no access for members of the public through the gate.

In this location trees removal will be required to facilitate the construction of the new flood wall. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.6 Meadowbrook Estate

Meadowbrook Estate is a cul-de-sac residential estate of 12 no. houses, with an entrance of New St. The houses are semi-detached with small front and rear gardens. To the west and northwest of Meadowbrook is a green area and wooded area associated with Cloon Island and Stormont House.

A flood embankment will be constructed along the rear of Meadowbrook Estate, from nr. 7 Meadowbrook Estate and north of Stormont House (Figure 4.2, No. 10). This will tie in with the new flood wall along nr. 7 Meadowbrook Estate, with a gate provided through the wall between the estate and the new embankment.

In this location trees removal will be required to facilitate the construction of the new embankment and new flood wall. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.7 Stormont House

Stormont House is a detached house on a large plot of land which is adjacent to the River Shannon, west of the centre of Castleconnell. The house has wide views of the river, with a low stone wall along its western side. The house is accessed by a long driveway from Chapel Hill to the south, which passes by Castleconnell Castle and two other houses to the east.

A low-level flood wall will be constructed along the west of Stormont House (Figure 4-2, No. 11), inside the existing castellated boundary wall. The ground levels along the Stormont House entrance road will also be raised, and a short length of low-level flood wall to tie in with rock at the Castle in two locations, one to the east of the entrance to Stormont House and the second adjacent to the road raising at the Coolbane Woods junction will also be constructed. These walls will be concealed by earth at either side.

In this location trees removal will be required to facilitate the construction of the new embankment and new flood wall. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.8 Coolbane Woods

Coolbane Woods is a small residential estate to the south of Castleconnell, accessed from Chapel Hill. The estate is bound to the west by a wooded area, with trees also lining the entrance road to the houses.

At the junction, road raising to the ‘504 event’ 1% AEP level will occur adjacent to the castle (Figure 4-2, No. 14). A demountable flood barrier to the west of the junction will be constructed, to defend up to the ‘Baseline Design Event (limitations in operational conditions)’.

A flood embankment will be constructed along the southern boundary of the Coolbane Woods entrance road and along the rear of house no.’s 1-4, to tie into higher ground to the south (Figure 4-2, No. 15).

In this location trees removal will be required to facilitate the construction of the new embankment. Details are provided in the Arboricultural Impact Assessment (AIA) and Chapter 8.

4.3.9 Cedarwood Stream

The Cedarwood Stream is a tributary of the River Shannon which flows in a westerly and north-westerly direction between the residential areas of Cedarwood Grove and The Commons, under The Commons Road, along the back of gardens of houses in Castle Court and on Elvers Road, before outflowing to the River Shannon near Grange House (Figure 4-2, No. 16). The stream has a narrow riparian strip and is heavily overgrown.

Overgrown vegetation will be removed from the Cedarwood Stream, from its interface with the railway adjacent to a property known as ‘Coole’ (V94 PY9X), as part of the construction works. As outlined in the standalone Arboricultural Impact Assessment Report, 1 no. will be removed. Annual inspection and maintenance will take place thereafter to manage future vegetation that may impact conveyance. An existing 1.2m diameter circular culvert at Coole House will be replaced with a larger rectangular culvert (2m wide x 1.3m high) to ensure improved conveyance. The impact of this is assessed in the Arboricultural Impact Assessment (AIA) and Chapter 8.

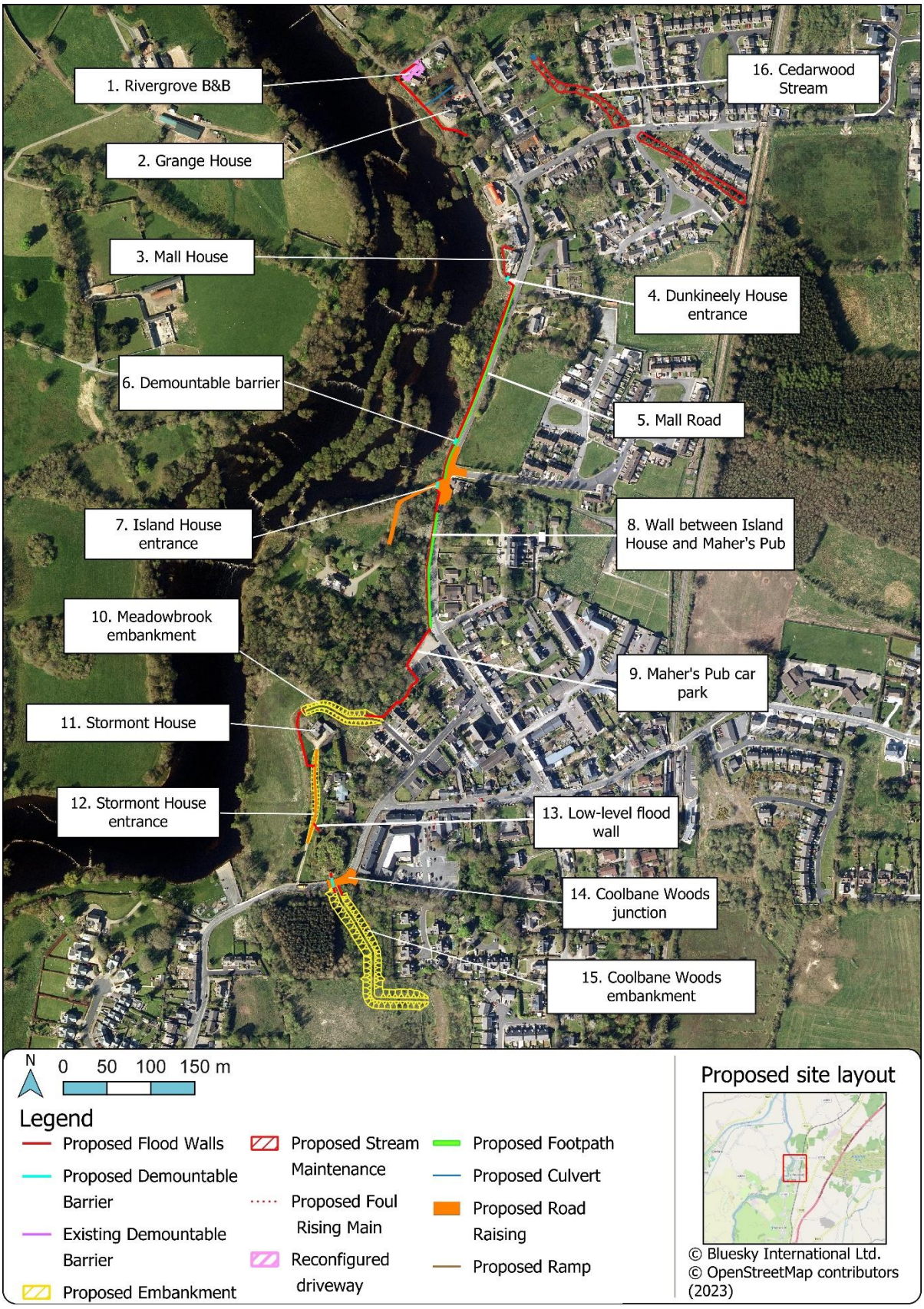

Figure 4-2: Proposed Flood Relief Scheme layout

4.4 Construction Activities

It is expected that the construction phase will take place over c. 18-24 months. A Construction Environmental Management Plan (CEMP) has been prepared which will be used by the appointed contractor throughout construction. The CEMP includes details below and mitigation measures as outlined in further sections of this EIAR.

The proposed works will be constructed in a general north to south sequence. Depending on seasonal conditions works proposed within the Stormont House property and Coolbane Woods can be constructed in parallel with the works to the north. It is estimated that the works will take approximately 18-24 months to complete. Vegetation clearance works, where required, will need to take place outside the bird breeding season (March to August inclusive).

Area of works	Estimated Construction Time in Months
Northern properties	4
Cedarwood Stream	1
Mall House	1
Mall Road North	3
Island House	1
Scanlon Park Junction	0.5
Mall Road South	3
Maher's Pub	1
Meadowbrook Estate Wall	1
Stormont House Embankment	2
Stormont House	1
Coolbane Woods Junction	0.5
Coolbane Woods Embankment	5
Total	**24**

A Community Liaison Officer will be appointed for the construction stage of the FRS. This person will be responsible for communicating with the residents of Castleconnell and keeping them informed of construction progress, phasing, utilities diversions or disruptions, and other relevant information.

4.4.1 Construction Compounds

Several compound areas will be established during the construction phase, for use in different geographical areas of the scheme. Establishment of these areas will include the following:

- Site offices;
- Site facilities (canteen, toilets, drying rooms, etc.);
- Secure compound for the storage of all on-site machinery and materials;
- Temporary car parking facilities;
- Temporary fencing;
- Site Security to restrict unauthorized entry;
- Bunded storage of fuels and refuelling area.
- A separate container will be located in the Contractors compound to store absorbents used to contain spillages of hazardous materials. The container will be clearly labelled, and the contents of the container will be disposed of by a licenced waste contractor at a licenced site. Records will be maintained of material taken off site for disposal;
- Drainage collection system for washing area to prevent run-off into surface water system.

4.4.2 Construction Traffic Route

HGV's will travel to and from the site via the R525, R445, and M7. Further construction traffic details and the associated impacts are described in Chapter 11 Material Assets of this EIAR. The proposed construction route is shown in Figure 4-3.

4.4.3 Excavation and Infilling

Excavation and import of soil will be required for construction of the embankments. The Design Team has calculated that approx. 33,130m^3 of material will be excavated, with approx. 11,815m^3 of this volume backfilled, and the remaining 21,315m^3 removed from site. In addition to this, approx. 24,068m^3 of clay will be imported for the proposed embankments, and 4,248m^3 of material for proposed roadworks.

4.4.4 Tree Removal and Seasonal Constraints

Some tree removal is required in order to facilitate the proposed construction activities. The impact of this tree removal is detailed in Chapter 8. The engineering drawings accompanying the application show the extent of proposed tree removal. The removal of trees is also referenced above in Section 4.3.

All instream works should be conducted between July and September inclusive as per IFI recommendations. Tree and vegetation removal will be carried out from 1st September to 28th February only.

4.4.5 Surface Water Runoff and Groundwater Pumping

Groundwater pumping will be required where the water table is encountered during excavations, most likely around Rivergrove B&B, the Mall Road, and at Coolbane Woods, where groundwater levels were recorded between 0.25 and 2.1mbgl. Mitigation has been recommended in Chapter 10 of this EIAR to ensure that groundwater discharged via pumping is not contaminated with suspended solids.

4.4.6 Instream Works and Works Near Water

There will be some instream works in the Cedarwood Stream, however no other instream works are required as part of the proposed FRS. All instream works should be conducted between July and September inclusive as per IFI recommendations. Minor works will be required to install flap valves to surface water outfalls however, these are not expected to cause any disturbance.

Works will take place near water at several locations throughout the scheme. Mitigation measures for these works are outlined in Chapter 10 of this EIAR.

Figure 4-3: Proposed haul route

4.5 Climate Change Adaptability

Climate change is an important consideration in any FRS to ensure it remains operational into the future. Predicted increases in rainfall and flows will put pressure on the FRS performance. Climate change analysis has been carried out on the proposed development to examine the necessary changes required to ensure it remains operational into the future when considering the mid-range future scenario (MRFS).

The baseline flood model was run for the MRFS, and the overall impacts were assessed. Any changes or additional areas at risk of flooding in the future were identified. Following this, potential adaptations to the proposed development were tested.

For Castleconnell there are two main avenues that can be considered – extending and raising defences and/or a regional climate change approach to managing the River Shannon at a catchment scale. The increase in flood level from the present day to the MRFS is approximately 0.5m and the increase in flood level from MRFS to the high-end future scenario (HEFS) is approximately a further 0.2m.

4.5.1 Design Constraints

The key design constraint for the MRFS scheme is the ability to adapt the current scheme defences to allow for raising and increased storage. These aspects have therefore been considered as resilience measures that are to be built into the scheme in the form of foundations and groundwork designs such that future changes can be made with limited cost and difficulty. Alignments of the proposed defences have also taken this into consideration to prevent the need to further realign defences in the future.

Data analytics and predictive modelling will continue to be used to understand flood risks better and to inform decision making. This can include the use of sensors and remote monitoring to gather real-time data on water levels and flow rates. It is proposed to install a water level gauge in Castleconnell as part of the proposed scheme. This will be used during flood events as additional information to inform the timely erection of demountable barriers and to calibrate any future hydraulic model with actual measured water levels. Consideration will be given to installation of a flow gauge if an appropriate location can be determined.

4.5.2 Scale of Defences

Defence heights and lengths will increase in the MRFS due to the increased levels simulated in the model. The extent by which defences will have to be raised will vary depending on location. Landscaping and ecological impacts of raised defences will have to be considered in the future to ensure the defences not only provide the necessary protection but also do not result in any conflicts with environmental and landscape aspects.

The defence heights to the northern properties in the present-day scenario are driven by flood levels, ranging up to 1m high at Rivergrove B&B and Mall House and up to 2m at Grange House. These heights are all higher than the existing walls at the properties and will create an obstruction to the view of the river. Further raising of these walls by up to 0.5m for the MRFS or 0.7m for the HEFS is unlikely to be considered acceptable to the residents and therefore considered not viable.

The relocated entrance at Rivergrove B&B will provide some element of passive protection against the MRFS but does not include any allowance for freeboard. Therefore, a demountable barrier will be required across the entrance in larger climate change flood events to provide protection against the design event.

The open section of the Cedarwood Stream adjacent to the old Mill Building on the grounds of Grange House does not experience out of bank flows in the present-day scenario however, the MRFS scheme would require closure of this channel. This may have significant impacts on the Mill Building which is a protected structure.

There are three properties to the North of the Village that do not require protection in the present-day scenario however, two of these will require protection in the MRFS and the third will require protection in the HEFS. It is expected that protection would be provided through a new flood wall, similar to the present-day solution for the neighbouring properties.

The defence height of the flood wall along the Mall Road from Mall House to Maher's Pub and adjacent to the Maher's Pub car park, in the present-day scenario is driven by guarding height meaning that the increase from present-day to MRFS is just 0.2m. Therefore, raising of defences is considered a viable solution at these locations.

The life expectancy of a typical demountable barrier or flood gate is approx. 25 years. A review of flood levels should take place ahead of replacement of the demountable barriers at Dunkineely House, the fisherman's access through the Mall wall, Island House and at Chapel Hill to determine whether higher flood barriers are required.

The height of the flood wall from the rear of Maher's Pub along the northern boundary of No. 7 Meadowbrook is driven by the flood levels, resulting in a height of up to 1.8m adjacent to the house. Therefore, raising the wall here is unlikely to be considered acceptable to the residents and is not considered viable.

There is sufficient space to raise the proposed high-level embankment from Meadowbrook to Stormont House to cater for the MRFS and HEFS however, raising of the low-level embankment would result in a land take of the majority of the remaining garden to the northwest of Stormont House. All embankments will be constructed with the base width associated with the MRFS heights, and side slopes of 1 in 3. This means that the width of the top of the embankment will be greater in the current scenario, to allow for an appropriate crest width of 4m (as per OPW and LCCC maintenance requirements) once they have been raised to the MRFS height.

The proposed low-level flood wall to the west of Stormont House is driven by flood levels in the present-day scenario, resulting in an approx. 0.7m high wall. While raising this is unlikely to impede views of the river from the house, it will entirely conceal the existing castellated boundary wall.

Raising of the embankment to the west and south of Coolbane Woods is not expected to impact the adjacent properties. As per the Meadowbrook embankment, the base widths have been designed for the MRFS height for ease of adaption.

4.5.3 Climate Change Adaption Summary

The potential adaptations for the climate change scenario look to enhance the current scheme design to protect into the future. The need for larger foundations and adaptable construction details (e.g., embankment widths and the extent of glass panels provided) are the key measures needed to allow adaptation of the scheme in the future. The construction costs associated with construction of defences to the MRFS level for the present-day scheme are not cost beneficial at present day and so are proposed as future adaptation works instead when they are required.

Relatively simple adaptation of the proposed development is possible to provide protection up to the HEFS flood level through walls or demountable structures to raise the proposed defence crest levels where required. Foundations for the current defences will be constructed so that this raising is possible without rebuilding the walls and embankments.

Defence heights become excessive in areas such as the northern properties and at Meadowbrook Estate. Whether the flood scheme can be adapted to protect vulnerable properties and features under future climate change conditions or only extend the lifetime up to a point when flooding becomes inevitable can only be answered with sufficient confidence with ongoing monitoring of flood and river flow changes, river morphology and form changes, and condition of the defence structures and scheme as a whole. The resilience of key utilities currently located under the Mall Road and the substation/pumping station will also influence the viability of various properties in the future.

Possible changes in policies (e.g., upstream Shannon level and operation of Ardnacrusha and/or Parteen Weir for power supply policy) were not analysed as these are outside the control of the project. To provide protection to the HEFS or beyond additional measures to reduce peak flow and/or increase flow conveyance will be required. However, initial model runs suggest that this alone is unlikely to provide adequate protection against the expected rise in flood levels. If these are not viable then policy measures will be required (e.g., resilient re-development, relocation, flood warning and property resilience (note. Property resilience is not effective beyond certain flood depths).

4.6 Maintenance and Operational Activities

Following construction, each proposed measure will have its own bespoke management plan.

Regular inspections of the embankments will take place, together with investigations of their performance after each flood event.

Responsibility for erection of the demountable flood barriers ahead of a flood event will remain with Limerick City & County Council and/or nominated contractors. Flood trigger levels have been devised for each demountable flood barrier, based on detailed modelling of water levels in the River Shannon and flood scenarios in Castleconnell. When the relevant trigger level is reached, the nominated crew will install the demountable barriers and put road diversion signs in place.

A routine inspection and maintenance plan will be developed whereby Limerick City & County Council and/or nominated maintenance contractors will inspect and install the demountable barriers once per year to examine them for any defects and to ensure that staff are trained and familiar with the installation process. The Cedarwood Stream will be regularly inspected from the railway to the culvert replacement any maintenance to manage overgrowth that may affect conveyance in the channel will be carried.

4.7 Decommissioning

Decommissioning of the proposed development is not expected to occur. Regular maintenance of structures will take place to identify any damage or deterioration. The proposed development has been designed to be adaptable to changing conditions as a result of climate change. This will allow it to remain in use in the future and be adapted when necessary.

5 Consultation

5.1 Introduction

Consultation is an on-going part of the EIA process. There are two elements of consultation which take place prior to the submission of an EIAR. The first avenue for consultation is to seek opinions and input from statutory bodies that have an interest or who may be affected by parts of the development, including government bodies and regulatory bodies. Non-governmental organisations and other relevant organisations were also contacted as part of this consultation process. These consultees were identified in the Scoping stage of the EIAR and were contacted as specified below. The second avenue is to consult with local residents, business owners, and locals who may be impacted by the development or any member of the public who has an interest in the proposed FRS. This was undertaken through public consultation events held throughout the scheme process.

5.2 Consultation on Scoping Stage

In accordance with the EIA Directive (85/337/EEC) as amended in 2011 Directive (2011/92/EU) and 2014 Directive (2014/52/EU) under Article 6 and the Aarhus Convention, statutory and non-statutory bodies, local authorities, and relevant stakeholders must be consulted on the specific characteristics of the project and its likely impacts on the environment.

The EIAR requirements for consultation are defined in the EIA Directive (85/337/EEC) as amended in 2011 Directive 2011/92/EU and 2014 Directive 2014/52/EU under Article 6.

Article 6 (1)

Member States shall take the measures necessary to ensure that the authorities likely to be concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the information supplied by the developer and on the request for development consent.

Statutory and non-statutory consultees were issued the EIAR Scoping Report via email and were asked to submit any comments, observations, or submissions in relation to the proposed scope and level of information to be included in the EIAR.

The list of consultees who were sent a copy of the Scoping Report are:

- An Taisce - The National Trust for Ireland;
- Bat Conservation Ireland;
- Birdwatch Ireland;
- Coillte;
- Dept. of Agriculture, Food, and Marine;
- Dept. of Environment, Climate and Communications;
- Dept. of Housing, Planning, and Local Government;
- Dept. of Transport, Tourism, and Sport (DTTAS);
- Environmental Protection Agency (EPA);
- Electricity Supply Board (ESB);
- Failte Ireland;
- Geological Survey Ireland (GSI);
- Health Service Executive (HSE);
- Inland Fisheries Ireland (IFI);
- Irish Environmental Network;
- Irish Heritage Trust;
- Irish Wildlife Trust;
- Local Authorities Water Programme (LAWPRO);

- National Monuments Service;
- National Parks and Wildlife Service;
- National Transport Authority;
- Office of Emergency Planning;
- Office of Public Works (OPW);
- Sustainable Water Network Ireland (SWAN);
- Teagasc;
- The Heritage Council;
- Transport Infrastructure Ireland:
- Uisce Éireann.

5.2.1 Consultation Responses

Of the consultees contacted, the following responses were submitted (Table 5-1).

Table 5-1: List of responses received from EIAR Scoping Consultation

Consultee	Response	Response Date
An Taisce	Email acknowledgement. No comment.	11/10/2023
Department of Environment, Climate and Communications	Email acknowledgement. No comment.	11/10/2023
Department of Housing, Local Government and Heritage – Development Applications Unit (DAU)	Email with letter detailing recommendations related to heritage assessment within the EIAR. Appendix 5.1 of Volume III	07/11/2023
Irish Water/Uisce Éireann	Email with attached recommendations with regard to water infrastructure for EIARs, and an attached letter detailing initial consultation with Irish Water carried out on 14th November 2022. Appendix 5.2 of Volume III	26/10/2023
Office of Emergency Planning	Email acknowledgement. No comment.	20/10/2023
Transport Infrastructure Ireland	Email with general guidance for the preparation of an EIAR, which may affect the national road network. Appendix 5.3 of Volume III	03/11/2023
National Environmental Health Service Environment and Climate Change Network Support Unit	Email with recommendations for Population and Human Health assessment. Appendix 5.4 of Volume III	06/12/2023

Responses are further summarised and addressed in Table 5-2.

Table 5-2: Detailed summary of EIAR Scoping Responses

Consultee	Summary of issues raised	How the issue is addressed in the EIAR
Development Applications Unit (DAU)	It is advised that the Office of Public Works Project Archaeologist (PA) team is engaged with by the design team to advise on all aspects of this scheme from design, through EIAR compilation to construction.	The OPW Project Archaeologist team was engaged with and provided comment on the Cultural Heritage chapter of the EIAR (Chapter 12).
	It is vital that the entirety of what constitutes underwater and terrestrial archaeological and cultural heritage is reflected in the EIAR scope. A detailed assessment of the existing environment, including archaeological and underwater cultural heritage, should be undertaken by suitably qualified specialists. The purpose of such assessments is (at the earliest opportunity) to identify, describe and assess the likely significant effects on archaeological heritage resulting from, inter alia, the construction and operation of a project. This is to ensure that significant adverse effects can be avoided, reduced or offset, and that mitigation measures can be embedded into the design, wherever possible. The assessment should address direct and indirect effects, and should include issues such as SIs, enabling works, vibration, hydrological change, and any cumulative effects.	The Cultural Heritage chapter of the EIAR (Chapter 12) includes a detailed assessment of the existing environment, undertaken by Courtney Deery Heritage Consultancy Ltd. The assessment addresses direct and indirect effects, and includes the issues as outlined.
	The risk of unforeseen or unplanned effects needs to be addressed, including the potential for a project to cause risks to archaeology due to its vulnerability to external accidents or disasters (for example, the flooding of a site due to a burst dam). Consideration should be given, as far as reasonably practical, to down- and up-river effects, including on archaeological heritage outside a given study area, e.g., will the proposed scheme increase flooding elsewhere?	The potential for upstream and downstream effects outside the study area has been considered in the Cultural Heritage chapter of the EIAR (Chapter 12).
	Hydrological assessment should take place – consideration should be given to potential for dredging of riverbeds or tidal zones and subsequent lowering of water levels or dewatering.	Hydrological assessment has taken place throughout the design process. No dredging or dewatering is expected to occur as a result of the proposed development. This has been included in the assessment in the Cultural Heritage chapter of the EIAR (Chapter 12).
	The impact of vibrations on upstanding archaeological monuments or built heritage during FRS works would also need to be considered and mitigated in advance, particularly regarding upstanding structures such as town walls.	The Cultural Heritage chapter of the EIAR (Chapter 12) considers potential for vibrations.
	Impacts on the setting of archaeological monuments and on views of and from monuments arising from new or upgraded FRS infrastructure also need to be assessed and mitigated, where necessary. This is particularly important where there is the potential for the setting of a National Monument or significant views within and of a historic town to be affected by an FRS project. Any interactions between impacts on archaeological heritage and other environmental factors should also be documented for each asset and captured in a matrix of interactions.	Potential for visual impacts on cultural heritage features has been assessed as part of the LVIA chapter of the EIAR (Chapter 13). Similarly, other interactions between environmental factors are assessed in Chapter 12 and Chapter 14.
	It is essential that the description of effects is precise and concise and focuses on effects that are probable or likely to occur, including the reasonably foreseeable worst-case scenario. Discussion of negligible effects should be avoided. Further information on describing effects is given in the Environmental Protection Agency (EPA's) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022).1 Assessment should also include a description of proposed mitigation measures for a given programme of works, consideration of a do-nothing scenario, and alternatives to avoid or reduce significant adverse effects.	The description of effects has followed the EPA's 2022 Guidelines. The assessments in this EIAR also include a description of proposed mitigation measures, consideration of a do-nothing scenario, and alternatives.

	There is a potential for all FRS works to impact upon terrestrial and underwater archaeological heritage. An historic town or the frequency of certain types of monuments within a given landscape can be strong indicators of previously unknown sites and artefacts. Assessment of archaeological potential must also include the landscape within which monuments are located, including watercourses. A range of archaeological, built, and cultural heritage can typically occur in riverine environments and should be considered.	The Cultural Heritage chapter of the EIAR (Chapter 12) fully considers the wide range of archaeological, built, and cultural heritage in the wider FRS study area. This included assessment of archaeological potential within the landscape through archaeological investigation and wade surveys where instream works are proposed.
	It is essential that archaeologists look beyond standard sources such as the SMR/RMP/NIAH when conducting baseline inventories. Field surveys, historical cartographic sources, primary research, and local knowledge should all also be consulted.	The Cultural Heritage chapter of the EIAR (Chapter 12) included a wide range of primary and secondary sources in its baseline review, including those named in the DAU response.
	Section 3.3.6 of the above Guidelines (EPA 2022, 32) states that EIAR cultural heritage chapters should contain the following: • Cultural Heritage • Archaeology • Known archaeological monuments • Areas of archaeological potential (including unknown archaeology) • Underwater archaeology • Architectural heritage • Designated architectural heritage • Other significant architectural heritage • Folklore and history • Designations or sensitivities • The Landscape • Landscape Appearance and Character • Landscape Context • Views & Prospects • Historical Landscapes." Furthermore, Section 3.6.4 of Frameworks and Principles for the Protection of the Archaeological Heritage (Government of Ireland 1999) states, in relation to the scope of archaeological assessments, that they: "may, as appropriate, include documentary research, field-walking, examination of upstanding or visible features or structures, examination of existing or new aerial photographs or satellite or other remote sensing imagery, geophysical survey, topographical assessment, general consideration of the archaeological potential of the area or areas effected by a development based on their environmental characteristics, or archaeological testing."	The Cultural Heritage chapter of the EIAR (Chapter 12) followed the 2022 EPA Guidelines, as outlined in the DAU response.
	Section 1.1 of the same document specifically notes that the: "… date is not in itself a determinant of archaeological significance or interest. Any material remains which can contribute to understanding past societies may be considered to have an element of archaeological significance." Therefore, all assessments need to include all elements of archaeological, built and cultural heritage, including post-c. 1700 receptors, to be sufficiently accurate in providing a reliable reference against	The Cultural Heritage chapter of the EIAR (Chapter 12) included post-c. 1700 receptors in the broad categories named in the DAU response.

	which the effects of a project can be assessed. The following types of archaeological, architectural, and cultural heritage receptor broad categories should be considered in the assessment: • Water power • Canals and navigations • Crossings • Boats and boating infrastructure • Fishing built heritage • Designed landscapes • Historic floodplain management • Extraction in and along river channels • Woodland and vegetation management • Waste disposal • Agricultural built heritage • Intangible heritage and collective memory	
	The EIAR should include consideration of wrecks, through use of the Department's Wreck Viewer and other methodologies.	The Cultural Heritage chapter of the EIAR (Chapter 12) considered potential for wrecks in the study area.

	The Cultural Heritage EIAR methodology should follow the steps as outlined in the DAU response. In summary these are:
	• Desk-based assessment
	• Archaeological investigations
	• Underwater archaeological impact assessment
	• Other types of investigation, including but not limited to:
	  ○ Geophysical surveys (both land-based and water-based)
	  ○ Test excavations
	  ○ Metal detection surveys
	  ○ Archaeological building/structural surveys
	  ○ Photogrammetric surveys
	  ○ Specialist historical research
	  ○ LiDAR assessments
	  ○ Assessment and monitoring of SI works (such as geotechnical investigations)
	  ○ Monitoring of groundworks (may follow on from some of the recommendations made in an EIAR/UAIA)
	  ○ Digital Elevation Models/Digital Surface Models/Digital Terrain Models data collection and assessment
	  ○ Visual impact assessment and assessment of impact on setting.
	The EIAR chapter on Cultural Heritage should include a description of the full gamut of terrestrial and underwater cultural heritage (as described above), a synthesis of all prior investigations and assessments and a detailed impact statement and mitigation recommendations. Detailed final reports
		The Cultural Heritage chapter of the EIAR (Chapter 12) follows the prescribed methodology as outlined in the DAU response.

	on all prior investigations should be included as appendices. The chapter should include, as a minimum, the following: A synthesis of desktop study to include historical and cartographic research, research on primary and secondary archival sources, and the results of a review of the Wreck Inventory of Ireland Database, Record of Monuments and Places/ Sites and Monuments Record, National Inventory of Architectural Heritage and the Record of Protected Structures. A synthesis of all underwater surveys, intertidal surveys and any other assessments undertaken. An inventory of all underwater cultural heritage assets, including archaeological monuments, architectural heritage sites and areas, wrecks, submerged palaeolandscapes, archaeological features/deposits, sites/monuments, or objects and marine built heritage. All sites should be accompanied by mapping with associated geospatial data; where possible, the full (known/predicted) extent of archaeology identified should be mapped using polygons. For ease of use each item, regardless of designation, should be numbered using a sequential system of identifiers. A detailed Impact Statement, which includes drawings/mapping that clearly show impacts/ effects, and recommendations for appropriate mitigation of any adverse impacts and effects to known or potential archaeological heritage	
	It is national policy, as set out in the Frameworks and Principles for the Protection of the Archaeological Heritage that 'there should always be a presumption in favour of avoiding developmental impacts on the archaeological heritage' and it is essential that this overarching, core principle is proactively embedded within the design process. Assessment and an attendant mitigation strategy should therefore aim to avoid or reduce effects on the underwater cultural heritage and inform the design of a given scheme with reasonable alternatives that achieve the maximum amount of preservation in situ. The risk of adverse effects on archaeological heritage, and attendant cost and delay implications for an FRS project progression, can be reduced through carrying out mitigation as early as possible and ideally in the design stage.	Cultural Heritage has been considered throughout the early design and Options Selection stages of the proposed FRS. This allowed certain options which would have led to detrimental effects on cultural heritage to be identified early. The Cultural Heritage EIAR chapter also includes specific mitigation measures which aim to avoid or reduce effects.
	EIARs will include a Schedule of Environmental Commitments detailing specific measures to be undertaken to mitigate any adverse effects on underwater cultural heritage. The archaeological elements of the Schedule of Environmental Commitments should be reviewed in advance of EIAR submission to the planning authority by the Department as part of the consultative process. The Schedule of Environmental Commitments should comprise of a list of relevant measures that the FRS developer is obligated to undertake to mitigate adverse effects.	The specific mitigation measures to be undertaken, including those to mitigate any effects on underwater cultural heritage, are included in the preliminary CEMP submitted with this application. The preliminary CEMP will be taken by the appointed contractor and put into practice on site in the form of a site-specific CEMP.
	The report should make recommendations for further archaeological mitigation, which in summary may include some or all the following: • Mitigation by avoidance (preservation in situ) • Mitigation by remedy/offsetting (Preservation by Record', Archaeological Monitoring) • Archaeological excavation (preservation by record) • Archaeological monitoring • Follow-up inspections	Archaeological mitigation is included in the Cultural Heritage chapter of the EIAR (Chapter 12).
Irish Water/Uisce Éireann – Response to EIAR Scoping	Flood Relief Schemes would generally protect key infrastructure such as Wastewater Pumping Stations and ESB cabinets.	These features have been protected as part of the design of the proposed scheme, where relevant.
	There is an existing UÉ abstraction asset (Clareville – Water Supply Project) in proximity to the proposed works and as such the FRS Environmental Impact Assessment Report (EIAR) should	Clareville Water Works, Castleconnell Pumping Station No. 1, and other public water and wastewater networks

	consider any indirect/ cumulative effects. This is the intake for the Limerick Water Resource Zone. There is also public water and wastewater networks infrastructure in Castleconnell, including a strategic rising main from Castleconnell Pumping Station No.1 to Castletroy WWTP, which may be impacted by the scheme. Of note, the proposed solutions include works in the vicinity of Castleconnell Pumping Station No.1 and overflow. All necessary measures to protect and maintain access to Irish Water infrastructure and water sources shall be undertaken and incorporated into the design. Where an Irish Water asset is altered or diverted a Diversion Agreement is required. Details on this process can be found at https://www.water.ie/connections/developer-services/diversions/. Any design proposal to divert an Irish Water asset must be completed in accordance with IW Standard Details and Codes of Practice which are available on the Irish Water website.	in Castleconnell are discussed in full in the Material Assets chapter of the EIAR (Chapter 11).
	Road drainage must also be considered, i.e., storm pumps to cater for river flood level. The current river peak flow level should be identified as well as the identification of what the peak river flows will be after the Flood Relief Scheme works are in place.	Current and proposed peak river flows have been modelled extensively as part of the design of the proposed scheme. These have taken into account road drainage.
	The potential impacts to Uisce Éireann assets as result of flood level rise should be considered as well as identifying proposed mitigation measures that will protect Uisce Éireann assets.	Potential impacts to Uisce Éireann assets are discussed in the Material Assets chapter of the EIAR (Chapter 11). The proposed defences will protect the Uisce Éireann foul pumping station at Scanlon Park. There is a second Uisce Éireann pumping station on the Belmont Road, which is shown to be at risk of flooding however, this is outside of the scope of the flood relief scheme.
	Where the development proposal has the potential to impact an Uisce Éireann Drinking Water Source(s), the applicant shall provide details of measures to be taken to ensure that there will be no negative impact to Uisce Éireann's Drinking Water Source(s) during the construction and operational phases of the development. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified as part of the report.	The Clareville Water Works, which is the intake for the Limerick Water Resource Zone, is downstream of the proposed development via the River Shannon. Potential for impacts on the water source is assessed in the Material Assets chapter of the EIAR (Chapter 11).
	Where the development proposes the backfilling of materials, the applicant is required to include a waste sampling strategy to ensure the material is inert.	Material import has been assessed in Chapter 9. The mitigation measures in this chapter include testing of this material to ensure it is inert, prior to its delivery to the site.
	Mitigations should be proposed for any potential negative impacts on any water source(s) which may be in proximity and included in the environmental management plan and incident response.	The water environment has been assessed in Chapter 10. This chapter outlines mitigation measures for the protection of water, including water sources.
	Any and all potential impacts on the nearby reservoir as public water supply water source(s) are assessed, including any impact on hydrogeology and any groundwater/ surface water interactions.	The water environment, including groundwater, has been assessed in Chapter 10. This chapter outlines mitigation measures for the protection of surface and groundwater, including water sources.
	Impacts of the development on the capacity of water services (i.e., do existing water services have the capacity to cater for the new development). This is confirmed by Uisce Éireann in the form of a	Foul flows from Grange House are currently discharged to the Cedarwood Stream without

	Confirmation of Feasibility (COF). If a development requires a connection to either a public water supply or sewage collection system, the developer is advised to submit a Pre-Connection Enquiry (PCE) enquiry to Uisce Éireann to determine the feasibility of connection to the Irish Water network. All pre-connection enquiry forms are available from https://www.water.ie/connections/connection-steps/.	treatment. As part of the flood relief scheme it is proposed to provide a pumped connection from this property to the public foul sewer to the north of the property. This will prevent untreated sewage from being discharged directly to the Cedarwood Stream at this property and prevent backing up of foul flows during a flood event. This is discussed in the Material Assets chapter of the EIAR (Chapter 11).
	The applicant shall identify any upgrading of water services infrastructure that would be required to accommodate the proposed development.	As part of the proposed development the foul sewer along Mall Road will be realigned c. 1-2m to the East, to facilitate construction of the proposed flood walls.
	In relation to a development that would discharge trade effluent – any upstream treatment or attenuation of discharges required prior to discharging to an Uisce Éireann collection network.	No discharge of trade effluent is required.
	In relation to the management of surface water; the potential impact of surface water discharges to combined sewer networks and potential measures to minimise and or / stop surface waters from combined sewers.	No surface water discharges to combined sewers are required.
	Any physical impact on Uisce Éireann assets – reservoir, drinking water source, treatment works, pipes, pumping stations, discharges outfalls etc. including any relocation of assets. When considering a development proposal, the applicant is advised to determine the location of public water services assets, possible connection points from the applicant's site / lands to the public network and any drinking water abstraction catchments to ensure these are included and fully assessed in any pre-planning proposals. Other indicators or methodologies for identifying infrastructure located within the applicant's lands are the presence of registered wayleave agreements, visible manholes, vent stacks, valve chambers, marker posts etc. within the proposed site.	Relocation of UÉ drainage infrastructure (foul sewer) along Mall Road is required, as detailed above. This has been assessed in the Material Assets chapter of the EIAR (Chapter 11). No other physical impact on UÉ assets is expected.
	Any potential impacts on the assimilative capacity of receiving waters in relation to Uisce Éireann discharge outfalls including changes in dispersion / circulation characterises. Hydrological / hydrogeological pathways between the applicant's site and receiving waters should be identified within the report.	The water environment including hydrological and hydrogeological pathways has been assessed in Chapter 10. This chapter outlines mitigation measures for the protection of water.
	Any potential impact on the contributing catchment of water sources either in terms of water abstraction for the development (and resultant potential impact on the capacity of the source) or the potential of the development to influence / present a risk to the quality of the water abstracted by Uisce Éireann for public supply should be identified within the report.	The water environment including water abstraction has been assessed in Chapter 10. This chapter outlines mitigation measures for the protection of water, including water sources. No water abstraction is required for the proposed development.
	Where a development proposes to connect to an Uisce Éireann network and that network either abstracts water from or discharges wastewater to a "protected"/ sensitive area, consideration as to whether the integrity of the site / conservation objectives of the site would be compromised should be identified within the report.	No connection from the Uisce Éireann network to a protected or sensitive area is proposed. The proposed works at Grange House will introduce foul flows from one property to the public foul network however, this will have the positive impact of removing untreated foul flows from the Cedarwood Stream, which discharges to the River Shannon c. 12m downstream of this discharge point.

		The Uisce Éireann foul network is pumped from Castleconnell to the WWTP in Castletroy to the southeast.
	Mitigation measures in relation to any of the above ensuring a zero risk to any Uisce Éireann drinking water sources (Surface and Ground water).	Mitigation measures are included in relation to the above in Chapter 10 and Chapter 11.
Irish Water/Uisce Éireann – Further considerations to be addressed as part of the Formal Planning Application	**Build Over/Diversions** There is an overlap of approximately 0.5km of the proposed FRS scheme with existing UÉ infrastructure of various sizes and material. Where building near / building over / diversions of existing UÉ assets are proposed, the associated designs need to be agreed with the Diversions team in UÉ and where appropriate an associated Build Over Agreement / Diversion Agreement executed between the applicant and UÉ Further details on the process to be followed are outlined on the UÉ website at https://www.water.ie/connections/developer-services/diversions/. An associated application form can be downloaded from this location, and it should be submitted, along with associated design drawings, to diversions@water.ie. Design proposals are required to be in accordance with UÉ Standard Details and Codes of Practice.	The proposed development has been designed in accordance with the requirements as outlined. Where required, consultation will take place with Uisce Éireann prior to works proceeding.
	Storm Drainage Proposals In Castleconnell, the FRS work proposals do protect the main Pumping Station site. However, evidence of any storm drainage proposals generally do not seem to have been provided. The roads in the town currently drain to the river via a separate storm system. The FRS project needs to ensure that is still the case during river flood events via storm pumps and possibly storm drainage upgrades. The current Castleconnell FRS maps suggests three storm outfalls to the Shannon river and three storm outfalls to three tributaries. All of these will need to be protected/upgraded to avoid surface flooding. The Castleconnell Waste Water Pumping Station (WWPS) Storm Water Overflow (SWO) may also be linked to the road storm system, and drainage design should take account of all contributing flows.	Three locations have been identified where pump sump chambers will be required to pump surface water over the defences. These will be connected to the surface water network. Non-return valves will be fitted to any overflows from the foul network to the surface water network. Non-return valves will also be fitted to each of the surface water outfalls to the River Shannon and surrounding streams.
Transport Infrastructure Ireland	Consultations should be had with the relevant Local Authority/National Roads Design Office with regard to the locations of existing and future national road schemes in the area.	Consultation has taken place with LCCC Roads Department throughout the scheme development
	Potential significant impacts the development would have on the national road network (and junctions with national roads) in the proximity of the proposed development should be assessed.	Potential impacts on the road network have been assessed in the Material Assets chapter of the EIAR (Chapter 11).
	Potential visual impacts from existing national roads should be assessed.	Potential visual impacts from nearby receptors including the road network are assessed in the LVIA chapter of the EIAR (Chapter 13).
	The developer should have regard to any Environmental Impact Assessment Report/Statement and all conditions and/or modifications imposed by An Bord Pleanála regarding road schemes in the area. The developer should, in particular, have regard to any potential cumulative impacts.	Potential cumulative effects have been assessed in each chapter by the relevant chapter author, and are collated in Chapter 15. In particular, this included an assessment of potential cumulative effects of the proposed development with the nearby Killaloe Bypass.
	The developer, in conducting Environmental Impact Assessment, should have regard to TII Publications (formerly DMRB and the Manual of Contract Documents for Road Works).	There are no national primary or national secondary roads within Castleconnell Village.

		The proposals include reducing the width of the Mall Road (local road) to a minimum of 5.5m. This complies with the requirements of DMURS and Limerick City & County Council requirements. Road raising and ramps have also been proposed and have been designed in accordance with Limerick City & County Council Roads Department requirements.
	The developer, in conducting Environmental Impact Assessment, should have regard to TII's Environmental Assessment and Construction Guidelines, including the 'Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes' (National Road Authority (NRA), 2006).	Air Quality has been assessed in Chapter 6, Construction Impacts. The methodologies used in the assessment of air quality are up to date best practices.
	The EIAR should consider the 'Environmental Noise Regulations 2006 (SI 140 of 2006)' and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes' (1st Rev., NRA, 2004)).	Noise Impacts have been assessed in Chapter 6, Construction Impacts. The methodologies used in the assessment of noise are up to date best practices.
	Where new structures may be proposed on national roads, the developer is reminded of the requirements of TII Standard: 'Technical Acceptance of Road Structures on Motorways and Other National Roads'. This Standard specifies the procedures to be followed in order to obtain Technical Acceptance for structures on motorway and other national road schemes and for the submission of as built records. The procedures cover the design of all road structures, including bridges, tunnels, subways, culverts, buried corrugated steel structures, retaining walls, reinforced earth structures, gantries, environmental noise barriers and temporary structures under or over motorways or other roads carrying public traffic.	There are no national primary or national secondary roads within the scheme area or Castleconnell Village.
	The developer should also be aware that there are Technical Acceptance requirements relating to the assessment, alteration, modification, strengthening and repair of all existing road structures (national roads) and same shall be agreed with the Bridge Management Section of TII. In that regard, although TII has not identified any national road structures within the Scheme Area, however, there are a number of structures on the nearby M7 Motorway: • Structure ID: LC-M07-017.00 (Ballynacourty Culvert) • Structure ID: LC-M07-018.00 (Sallymount Bridge) • Structure ID: LC-M07-019.00 (Woodpark Bridge) • Structure ID: LC-M07-020.00 (Coolreiry Bridge)	The Design Team has been made aware of these guidelines and these structures. Any potential for impacts on these structures has been assessed in Chapter 11.

	A hydraulic analysis should be undertaken to identify the impact of proposed flood alleviation works on the hydraulic capacity of any TII Structures impacted and the potential for scour at the structure. An assessment of scour and other hydraulic actions on national road structures in accordance with UK BD 97/12 should be undertaken where necessary. Scour prevention measures will be required if the assessment illustrates the potential for scour beneath the foundations.	Hydraulic analysis and scour potential has been carried out and assessed throughout the design phase of the scheme. Scour prevention measures were not found to be required as part of the design of the scheme.
	It would be important that, where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site, with reference to impacts on the national road network and junctions of lower category roads with national roads. TII's 'Traffic and Transport Assessment Guidelines' (2014) should be referred to in relation to proposed development with potential impacts on the national road network. The scheme promoter is also advised to have regard to Section 2.2 of TII's TTA Guidelines, which addresses requirements for sub-threshold TTA.	TII's 'Traffic and Transport Assessment Guidelines' (2014) have been assessed as part of Chapter 11 Material Assets. It has been concluded that the proposed development does not meet the appropriate thresholds and criteria, and so a TTA has not been prepared. Potential impacts related to traffic are included in Chapter 11.
	The designers are asked to consult TII Publications to determine whether a Road Safety Audit is required.	Chapter 11 addresses the construction-related traffic and the routes affected. This comment has been forwarded for inclusion in the site-specific Construction Management Plan (CMP).
	In the interests of maintaining the safety and standard of the national road network, the EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network.	Chapter 11 addresses the construction-related traffic and the routes affected.
	In relation to haul route identification, the applicant/developer should clearly identify haul routes proposed and fully assess the network to be traversed. Where abnormal loads are a feature of the proposed development, separate structure approvals/permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load.	The proposed haul routes have been assessed as part of Chapter 11. No abnormal loads are required as part of the proposed development.
National Environmental Health Service Environment and Climate Change Network Support Unit	The Environmental Service recommends a dedicated website is set up that details the project and includes all the environmental assessment documentation and the outcomes of public consultation. Documents uploaded to planning websites are often difficult to navigate and scroll through text for members of the public.	A dedicated website has been set up, to which all published documents are uploaded. The website can be reached at https://www.castleconnellfrs.ie/
	The EHS has received correspondence from Uisce Éireann with regard to the extraction of water to supply Dublin from Parteen in the lower Shannon basin. The EIA for this project is currently being scoped. Any potential implications of this project and/or cumulative effects of construction should be considered as part of the EIA.	Relevant permitted or existing developments are included in Chapter 15 Cumulative Effects, and have been assessed as part of the cumulative effects section of each chapter. Projects which have not entered the planning system at the time of submission of this EIAR are not included.
	The following documents should be taken into consideration when preparing the Environmental Impact Assessment Report: • Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment https://www.housing.gov.ie/sites/default/files/publications/files/guidelines_for_planning_a	Recommended documents have been taken into consideration and referenced in the EIAR.

	uthorities_and_an_bord_pleanála_on_carrying_out_eia_-_august_2018.pdf • EU publication: Environmental Impact Assessment of Projects Guidance on the preparation of the Environmental Impact Assessment Report, EU, 2017 http://ec.europa.eu/environment/eia/pdf/EIA_guidance_EIA_report_final.pdf • Adoption of the Directive (2014/52/EU) in April 2014 initiated a review of the National Guidance for EIA and the EIAR accompanying a planning application. New guidelines can be seen at: https://www.epa.ie/publications/monitoring--assessment/assessment/guidelines-on-the-information-to-be-contained-in-environmental-impact-assessment.php • The introduction of the new Guidance is supported by a Webinar produced by the EPA and can be found at: https://www.youtube.com/embed/ejKVFUztxBY	
	Generally the Environmental Impact Assessment should examine all likely significant impacts and provide the following information for each: a) Description of the receiving environment; b) The nature and scale of the impact; c) An assessment of the significance of the impact; d) Proposed mitigation measures; e) Residual impacts	Each chapter of the EIAR examines all likely significant impacts and provides the information as listed.
	Directive 2014/52/EU has an enhanced requirement to assess likely significant impacts on Population and Human Health. It is the experience of the Environmental Health Service (EHS) that impacts on human health are often inadequately assessed in EIAs in Ireland. It is recommended that the wider determinants of health and wellbeing are considered in a proportionate manner when considering the EIA. Guidance on wider determinants of health can be found at www.publichealth.ie	This point is noted and was considered as part of the preparation of the EIAR. Population and human health are considered in Chapter 7 of the EIAR.
	Any opportunities for health gain from the project should be considered. For example: • Improving pedestrian or cycling connectivity and infrastructure • Improving access to green areas • In addition to any likely significant negative impacts from the proposed development, any positive likely significant impacts should also be assessed.	Any opportunities for health gain were considered in the EIAR. Due to the nature of the scheme (primarily composed of flood walls and embankments), opportunities to improve pedestrian or cycling connectivity, or access to green areas, were limited. However, the proposals along Mall Road include a narrowing of road width and a wider footpath, improving infrastructure for pedestrians at that location. Other positive impacts have been noted where relevant.

	The HSE will consider the final EIAR accompanying the Planning application and will make comments to the Local Planning Authority on the methodology used for assessing the likely significant impacts and the evaluation criteria used in assessing the significance of the impact. The EHS recommends that the following matters are included and assessed in the EIAR: • Public Consultation – outcomes and methodology • Decommissioning phase • Noise & Vibration • Air Quality • Surface and Groundwater Quality • Geological Impacts • Ancillary facilities • Cumulative impacts	The items listed have been assessed in the EIAR.
	Public Consultation It is recommended that early and meaningful public consultation with the local community is undertaken to ensure all potentially significant impacts of the proposed development have been adequately addressed. Sensitive receptors and other stakeholders should be identified to ensure all necessary and appropriate mitigation measures are put in place to reduce the likelihood of any complaints about the proposed development in the future. The Environmental Health Service expects that meaningful public consultation, where the local community is fully informed of the proposed development, will be undertaken. The Environmental Impact Assessment Report (EIAR) should clearly demonstrate the link between public consultations and how those consultations have influenced the decision-making process in the EIA. To assist with the consultation and planning process it is recommended that the applicant develops a dedicated website for the proposed development. All correspondence, maps, project updates and documentation including the EIAR should be uploaded to the website. The EIAR should state the period of planning permission sought, the length of time construction is estimated to take and if it is anticipated that the development will be decommissioned and removed or will continue to operate (following any further planning consent) at the end of this period of planning permission (should permission be granted)	Early and meaningful public consultation has taken place throughout the proposed development process. The outcomes of this are discussed in Section 5.3 and the Options Report.
	Assessment of Consideration of Alternatives The EIAR should consider an assessment of alternatives.	An assessment of alternatives is included in Chapter 3 of the EIAR.
	Noise & Vibration The potential significant impacts for noise and vibration from the proposed development on all noise sensitive locations must be clearly identified in the EIAR. The EIAR must also consider the appropriateness and effectiveness of all proposed mitigation measures to minimise noise and vibration. Noise from construction should be controlled by the limiting of construction times. The proposed times should be specified in the EIAR.	An assessment of noise and vibration is included in Chapter 6 of the EIAR.
	Air Quality	An assessment of air quality is included in Chapter 6 of

	Due to the nature of the proposed construction works generation of airborne dust has the potential to have significant impacts on sensitive receptors. A Construction Environmental Management Plan (CEMP) should be included in the EIAR which details dust control and mitigation measures. Measures should include: • Sweeping of hard road surfaces • Provision of a water bowser on site, regular spraying of haul roads • Wheel washing facilities at site exit • Restrict speed on site • Provide covers to all delivery trucks to minimise dust generation • Inspect and clean public roads in the vicinity if necessary • Material stockpiling provided with adequate protection from the wind • Dust monitoring at the site boundary • Truck inspection and maintenance plan • Details of a road maintenance agreement between the developer and the Local Roads Authority to clarify responsibility for the upkeep and repair of access roads during the construction phase of the project	the EIAR. Mitigation measures developed in that chapter relating to dust control and air quality are included in the Preliminary CEMP submitted as part of this application.
	Surface and Ground Water Quality The proposed development has the potential to have a significant impact on the quality of both surface and ground water. All drinking water sources that are likely to be impacted, both surface and ground water, must be identified. Public and Group Water Scheme sources and supplies should be identified in addition to any private wells supplying potable water to houses in the vicinity of the proposed development. Measures to ensure that all sources and supplies are protected should be described. The Environmental Health Service recommends that a walk over survey of the site is undertaken in addition to a desktop analysis of Geological Survey of Ireland data in order to identify the location of private wells used for drinking water purposes. Any potential significant impacts to drinking water sources should be assessed. Any likely significant impacts on surface water as a result of the construction should be identified and any mitigation required identified in the EIAR.	Surface and groundwater quality are considered in Chapter 10 of the EIAR. This includes an assessment of potential impacts to drinking water sources.
	Ancillary Facilities The EIAR should include details of the location of all site office, construction compound, fuel storage depot, sanitary accommodation and canteen, First Aid facilities, disposal of wastewater and the provision of a potable water supply to the site canteen.	Ancillary construction facilities are included as part of the assessment throughout the EIAR, and are described in the preliminary CEMP submitted along with the EIAR.
	Cumulative Impacts The EIAR should include a detailed assessment of any likely significant cumulative impacts of the proposed development with existing or proposed development.	Cumulative impacts are considered in each individual chapter, and in Chapter 15 of the EIAR.
	Climate The EIA should assess the vulnerability of the proposed development against the predicted impacts of a warming climate. The applicant should outline proactive adaption measures to ensure the long-term resilience of the proposed infrastructure to the impacts climate change.	The potential for climate-related impacts during the construction phase is included in Chapter 6. The proposed development has been developed with climate adaptability in mind, as outlined in Chapter 4.

5.3 Public Consultation

Consultation has taken place throughout the development of the FRS. This included formal consultation (as detailed below), site meetings, virtual meetings and email liaison with affected landowners, as well as the sharing of information and updates through the scheme's dedicated website. Newsletters were issued throughout the project to provide an update on project progress, and these were posted to the scheme website.

5.3.1 Initial Public Consultation Event

A Public Consultation Event was held in June 2020, during the Covid-19 pandemic. Due to the pandemic restrictions, the event took place online, with information brochures and questionnaires circulated to the public. Fliers and posters were also distributed for display in local businesses. Residents and community groups were asked to return their completed questionnaires with feedback regarding previous flood events and the importance of various aspects relating to any potential scheme.

5.3.2 Emerging Options Public Participation Day

The second PPD was held on 21st of September 2022, in Castle Oaks House Hotel, Castleconnell. The purpose of the event was to present:

- the work carried out to that date in developing flood maps;
- the surveys carried out to date;
- the measures that were considered;
- how the measures were grouped into options;
- the measures that had been discounted; and
- the options which were progressing forward

The main aim was to seek feedback from the public and other interested parties in relation to the emerging scheme options. This included feedback on constraints to their implementation and suggestions for changes or alternatives. The environmental issues and constraints of the various options were also presented, and public feedback on them sought. Nine representatives from the project steering group were present throughout the day, and 63 attendees were recorded on the sign-in sheet.

5.3.3 Preferred Option Public Participation Day

The third Public Participation Day (PPD) for the Castleconnell Flood Relief Scheme was held on 6th of September 2023.

The purpose of the Preferred Option PPD was to present:

- the identified preferred flood relief option for the scheme;
- the areas benefitting from the scheme;
- how the preferred option was decided on;
- how feedback from the previous Public Participation Day (PPD) was incorporated into the preferred option; and
- the indicative planning roadmap and estimated construction timeline

Public opinion on the preferred option was sought and how this would be implemented in reality. Nine representatives from the project team were present throughout the day, and 33 attendees were recorded on the sign-in sheet

The purpose of this consultation was to get further engagement in advance of planning and incorporate any final concerns before the submission.

5.3.4 Landowner liaison

In advance of submitting the scheme for planning, there has been continued liaison between the landowners directly impacted by the scheme (both in a temporary or permanent capacity) and the local authority and the Design Team. This provided a direct contact line for residents of those affected properties to input to the scheme. This liaison will continue through the planning and detailed design processes.

5.4 Additional Consultation with DAU and NPWS

A meeting with National Parks and Wildlife Services' Regional Ecologist Jervis Good took place on the 20 July 2022 where the project's ecological sensitivities and survey efforts were discussed at length, as well as the proposed FRS design. Following the meeting additional baseline and update surveys were conducted as requested to ensure full coverage of sensitive ecological features, including QI species, within the ZoI of the proposed development. Consultation took place with NPWS regarding Annex I alluvial woodland extent within the River Shannon.

Later consultation with Jervis Good, NPWS regional ecologist, also took place at the public participation day on 6th September 2023. JBA Ecologist was present to discuss the findings of surveys and progress of the proposed Scheme, particularly interactions with the Lower River Shannon Special Area of Conservation (SAC).

The NPWS grassland specialist was consulted in relation to the latest definition of Annex I habitat Hydrophilous tall herb fen [6430] in Ireland which was recorded near to the scheme. A national survey is currently being undertaken of this habitat and it is likely that the definition and positive indicator species list will be updated in the future.

A letter dated 2nd February 2024 (ref G Pre00155/2022, Appendix 5) was sent to JBA regarding the heritage-related observations and recommendations made by the Development Applications Unit (DAU) and the National Parks and Wildlife Service (NPWS). A summary of this correspondence is provided below with JBA commentary.

5.4.1 Wall replacement on the Elvers Road (NIS)

The boundary of the Lower River Shannon Special Area of Conservation (SAC no. 21652) is directly adjacent to the existing wall of the Elvers Road. As outlined in the key ecological features map, the habitat on the riverside of this existing road wall is alluvial woodland, a priority habitat for which it is a conservation objective of the SAC to protect.

It is proposed to demolish the existing wall, and reconstruct the new flood wall offset inwards, without impacting the SAC. A detailed description of how these works are to be carried out without damaging the alluvial woodland soil or local hydrology, especially with regard to the foundations of the wall, will be required in order to fully assess the effects of the proposal. While it is recognised that a gap exists for the placement of scaffolding, debris trays and terram, for instance, and to allow equipment and personnel access, nevertheless any localised impacts need to be avoided by careful mitigation.

Also, it is recommended, as an aftercare measure, that monitoring is carried out both for alluvial woodland ground vegetation, as well as for any inadvertent establishment of invasive plant species, in the first and second year after completion of the works.

JBA response: The mitigation measures included in the Biodiversity chapter of the EIAR and NIS, and the mitigation measures in the NIS, outline in detail how these works are to be carried out, with no impact resulting on the alluvial woodland soil or local hydrology or any loss or change of this QI habitat.

The recommendation for post-construction monitoring is included in Section 8.4.2.4 of the Biodiversity chapter, and in the NIS.

5.4.2 Embankment south of Island House (NIS)

There is a slight overlap between the proposed embankment and the SAC. Although the habitat where the embankment overlaps the boundary appear to be not related to habitats or species to which the conservation objectives of the SAC apply, nevertheless this needs to be clearly detailed in the Natura Impact Statement. Also, any potential impacts of increased public access into the alluvial woodland mapped in the key ecological features map, needs to be assessed. The same recommendation relating to invasive plant species above, is made for this location.

JBA response: The habitats and species in the area of the embankment are described in the NIS. The proposed embankment has been designed to avoid the SAC and there is a natural delineation from protected habitat by a 1-2m bank into the riparian zone. There will be no public access to this embankment. The recommendation relating to invasive species monitoring is noted and also included in the NIS and Biodiversity chapter of the EIAR.

5.4.3 Otter survey (NIS and EIAR)

In addition to there being a conservation objective of the SAC to protect the habitat of this species, the otter is also a strictly protected species listed in Annex IV of the EU Habitats Directive. A thorough survey, following up-to-date best practice, for breeding and resting places of otters throughout the length of the wetland adjacent and close to the proposed flood relief works, will be necessary. Also, any potential indirect effects of the proposed scheme layout, on increasing otter mortality due to road traffic, needs to be assessed in the EIAR. A pre-construction otter survey is also recommended, as there may be changes in habitat use in the period between the initial survey and construction.

JBA response: Several otter surveys have taken place throughout the EIAR and NIS process. These are detailed in Appendix 8.4 of the EIAR, and Appendix D of the NIS.

The recommendation for a pre-construction otter survey has been noted, and recommended in the EIAR and NIS.

5.4.4 Heron nests and timing of embankment works (EIAR)

As mapped in the key ecological features map, there are nesting herons in trees very close to the proposed embankment south of Island House. Mitigation proposals should be considered which avoid disturbance to this species during the breeding season (e.g., seasonal restriction on construction works in the area). Also, any potential impacts of increased public access into the area under the trees should be assessed in the EIAR.

JBA response: A seasonal restriction on works in that area, for the protection of nesting herons, is included in Section 8.4.1.5 of the Biodiversity chapter.

5.4.5 Coolbane Woods (EIAR)

The history of the area where the embankment is proposed appears to be afforested rather than being natural Shannon floodplain woodland, despite the recolonization of willows, etc. It would be useful to obtain documentation on this (note that this is not considered regularly hydrologically linked to the SAC alluvial woodland in the sense that it is regularly flooded by the River Shannon).

JBA response: This woodland was characterised to be of local importance Wet woodland habitat, with links to Annex I Alluvial Woodland. It is not considered regularly hydrologically linked to the SAC alluvial woodland and the historical context is that it was conifer plantation that was clearfelled approximately

15-20 years ago. Currently no documentation on this area or the history of the clearfelling has been obtained. The construction of the embankment will require the entire removal of this wet woodland and options for compensation planting from the removal of this woodland have been proposed in the mitigation section.

5.4.6 Hydrological impacts of restricting river floodplain during floods (NIS and EIAR)

Any indirect hydrological impacts within the SAC, such as greater erosion due to faster flows, or changes in floodplain duration of flooding (upstream and downstream), should be considered, which may result from restricting the extent of the floodplain as a result of the scheme. Advice should be sought from Inland Fisheries Ireland (IFI) in relation to potential impacts of salmon redds and other fish species, in particular lamprey and eel.

JBA response: Operational impacts to the hydrological regime are not expected to be significant, as assessed in the Water chapter of the EIAR. This is due to the large catchment size, and limited length of flood walls and embankments meaning that the River Shannon will maintain its connection to its floodplain. Similarly, expected velocities pre- and post-scheme are not expected to be significantly different, as outlined in the Water chapter. Potential for indirect hydrological impacts within the SAC was considered in the NIS.

Consultation has taken place with IFI (Section 5.6). Impacts on fish species due to changes to hydrology are not expected.

5.4.7 Old beech trees and repointing of causeway (EIAR)

If any mature or overmature trees, in particular beech, are to be felled and removed, a survey for bats must be carried out according to best practice. Similarly, a survey of the causeway to Island House, which is proposed for repointing, should be carried out according to best practice. Where bat roosts are found in such trees and/or the causeway, contact should be made with the NPWS.

JBA response: Bat surveys have been carried out as detailed in Table 8-7 of the Biodiversity chapter. The results of these surveys are discussed in Section 8.2.6.4 of the Biodiversity chapter. Prior to felling (if required), these trees will be surveyed for bats as outlined in the Mitigation Section of the Biodiversity chapter. The old beech trees at Grange House will be retained in the proposed development.

5.5 Additional Consultation with DAU/National Monuments Service

5.5.1 DAU meeting 16th January 2024

A meeting took place on 16/01/2024 between members of the Design Team, Courtney Deery Heritage Consultancy Ltd, and the Department of Housing, Local Government and Heritage National Monuments Service and Built Heritage Policy Team.

In this meeting, the Cultural Heritage assessment of the proposed development was outlined in full, and the proposed mitigation measures discussed. It was noted that archaeological mitigation has and will incorporate the following:

- Underwater Archaeological Impact Assessment - In-stream works are limited to short sections of the Cedarwood Stream, with no instream works within the River Shannon. At the time of the meeting, a wade survey was scheduled to take place. This took place in March 2024, and the results were incorporated into the EIAR to inform the appropriate mitigation measures.
- Geophysical Survey - Restricted space in the vicinity of flood relief measures prohibits geophysical surveys for much of the proposed FRS. Additional challenges including the wet conditions of alluvial soils and peat, mean that this method of investigation is unsuitable for the proposed FRS.

- Archaeological Testing - As the majority of the proposed flood relief measures will comprise flood relief walls along existing alignments and are quite close to the riverbank and the SAC, archaeological testing will not be suitable for much of the proposed scheme, owing to restricted space, ecological impacts and the obstacle of the existing walls. Instead, it is proposed that a robust programme of archaeological monitoring of proposed geotechnical site investigations be undertaken.
- Monitoring - All earth-moving activities will be subject to archaeological monitoring under license from the National Monuments Service of the Department of Housing, Local Government and Heritage.

Architectural mitigation has and will incorporate the following:

- Consultation - Limerick County Council Conservation Officer Tom Cassidy was consulted throughout the project. He requested a modern-style handrail along the Island House causeway (RPS 5056) and existing stone be reused as much as possible as part of the scheme.
- Cladding to reduce impact on the visual amenity of the ACAs - Where possible, the stone from existing walls to be demolished will be used for cladding flood walls. Otherwise, local stone will be used. This measure will reduce the impact on the setting and character of the ACAs, protected structures and built heritage of Castleconnell. Every effort will be made to ensure the cladding appears consistent with the roughly coursed or uncoursed character of the existing walls.
- Retain views of the river - It is proposed to install glass panels in the proposed flood wall at Rivergrove B&B and Grange House (RPS 1075) to maintain views of the river from these properties. This will mitigate the impact on the setting, particularly in the case of Grange House, a protected structure.
- A public realm plan - devised in advance of the construction phase to ensure effective integration of the flood relief works into the historic townscape and river setting in a manner that seeks to contribute positively to the riverfront, taking into consideration the historic and riverine heritage of the scheme area.

DAU response

Archaeology

The DAU noted that the work carried out to the time of the meeting was very comprehensive.

While there were acknowledged constraints to carrying out geophysical surveys on-site, test excavations at several locations were identified as opportunities for strengthening the cultural heritage assessment in the EIAR. A minimum of three locations were identified to inform the baseline further and to avoid risks to the project at the construction stage.

The DAU asked whether any sediment removal was required, particularly at culverts or during undergrowth removal at the Cedarwood Stream. The project team confirmed no sediment removal is required, and that the wade/dive survey would review the culvert area.

It was recommended that any historic masonry walls proposed for demolition be surveyed for reuse of carved stone walls, and that any monitoring recommended as mitigation include for the retrieval of any such stones.

DAU noted that sheet piling was generally to a depth of 8m and if any alternative had been considered due to the potential damage to underground heritage assets. The design team stated that due to the permeability of soils in the north of the scheme that sheet piles are needed to avoid water seepage, however it was unlikely that the piling would be to a depth of 8m.

Built Heritage

The key recommendation in terms of built heritage was for the input of a Grade 1 Conservation Architect with urban design skills to assist opportunities for mitigation, upgrading, and to guide the overall design-led new infrastructure.

It was suggested that a walkover of the site with the DAU, design team members, and the Cultural Heritage chapter authors would be beneficial.

The DAU asked for clarification from the structural engineer on the design of each section of wall and why the existing walls cannot be consolidated/adapted as a flood defence as opposed to construction of a new structure. In particular this relates to walls/proposed flood defences at Cloon and Commons and Grange House where the setting would be most affected by altering the heritage walls.

5.5.2 DAU Site Walkover 6th February 2024

Following the meeting between members of the project team and the DAU, a site walkover took place. The purpose of the site walkover was the further discuss Cultural Heritage matters which came up in the earlier meeting.

Rivergrove B&B

- It was noted that the riverside front wall is not the original wall, and the entrance wing walls are block walls that do not have any cultural significance. As much as possible of the stone wall at the northern boundary of the property will be retained, however some will be removed to create the new entrance.

Grange House

- DAU recommended a considered methodology for the dismantling and reinstatement of the entrance gate piers is developed by a conservation architect.
- DAU requested that the Steering Group consider retaining the old stone wall and instead constructing a new flood wall immediately beside it (on the property side). Due to space constraints and lack of structural integrity of the existing wall it was decided that this was not practical. The proposal at this location is just the proposed wall along the alignment of the existing wall.
- DAU suggested consolidation works to the existing wall to strengthen it and then raise it, similar to other schemes such as Lifford FRS.
- DAU advised that until the existing wall construction is known, including foundation details, using the existing wall should not be ruled out.
- DAU queried whether any of the weirs within the Old River Shannon extend to the riverbank, risking damage during the construction of the scheme.
- DAU advised that a box culvert would not be favourable for the replacement of the open feature. The feature is a mill race associated with the upstanding mill within the property. Project team assured that a stone feature would be designed in agreement with the landowner at detailed design.
- DAU noted that the scheme drawings in relation to the historic walls, in general, are engineering drawings and that they will need design input from a conservation architect with an urban background. The project team has engaged Southgate Associates, heritage conservation specialists to advise on engineering aspects.
- DAU queried the removal of the beech trees and asked what their current lifespan is and whether they can be retained. It is not possible to retain the trees as the proposals will pass through the tree roots protection area causing the trees to become unstable. Replacement with native trees will be agreed with the landowner and indicated in the design drawing. NOTE: following further design iteration, the proposed culvert at Grange House will be diverted slightly to the north from its original proposed route, meaning that the beech trees will be retained.

Dunkineely House and Mall House

- DAU queried why the scheme proposes to replace the boundary wall of Mall House instead of the low level boundary wall between the driveway to Dunkineely House and the Old River Shannon. Project team explained that Dunkineely House is not shown to flood in the design flood event and construction of a new wall between the driveway and river would result in a much longer and higher wall.

Mall Road

- DAU queried why the existing wall cannot be strengthened considering the height increase is minimal. Project team explained that a structural engineering assessment had been undertaken which determined that the existing walls cannot be relied upon to provide the necessary design standard. Furthermore, as details of the existing foundations are not clear they cannot be relied upon to withstand pressure from flood waters.
- DAU requested a Teams call with the Structural Engineers to discuss. A site meeting will take place to explain the constraints and confirm the design.

Island House

- DAU suggested that a railing fixed to the causeway castellations may be preferable over a standalone handrail with rail posts to prevent difficulties maintaining the castellations. The exact handrail detail will be agreed with the homeowners at detailed design stage, taking into account the recommendation from DAU.

Maher's Pub

- DAU recommended that an archaeology test trench is undertaken along the alignment of the flood wall at the rear of the car park. Project team noted that a trial pit had been undertaken at this approximate location in 2020 however the depth may not be sufficient for archaeology. This was resolved and is reported in the Cultural Heritage Chapter of this report.

Meadowbrook Estate

- No issues or concerns raised.

Stormont House

- DAU recommended 2 no. archaeology test trenches to the rear of Stormont House. One in the lawn where the low-level embankment is proposed and a second near Meadowbrook Estate where the high-level embankment is proposed. Access to the rear of Meadowbrook may be difficult due to limited space between the existing sheds and a telegraph/ESB pole. This was resolved and is reported in the Cultural Heritage Chapter of this report.

Coolbane Woods

- DAU recommended 1 no. archaeological test trench along the alignment of the proposed embankment given its proximity to the castle ruin. The test trench was carried out in the site to the south of Coolbane Woods. This was resolved and is reported in the Cultural Heritage Chapter of this report.
- The location of the large, displaced piece of castle masonry located across the road from the castle site was pointed out. Project team noted that the embankment avoids this.
- DAU queried whether the rear boundary wall to houses 4-7 in Coolbane Woods would perform as a flood wall. Project team explained that it is a standard block wall with gaps in places and would not perform as a flood wall.

5.6 Additional Consultation with Inland Fisheries Ireland

An informal consultation with Inland Fisheries Ireland (IFI) was conducted on 4th December 2023 with JBA Ecologists on the proposed scheme design. Measures for protection and enhancement for fish included in this Chapter, in particular the overall design and construction mitigation, were considered acceptable by IFI.

6 Construction Impacts – Air Quality and Dust, Noise and Vibration, and Climate

The Scoping Report identified that the proposed development would affect the following environmental aspects only during construction and that it would result in no operational impacts. The preliminary engineering details provided construction related data for use in assessing the potential environmental impacts. This chapter will assess the potential for impacts in the following environmental factors:

- Air Quality and Dust;
- Noise and Vibration;
- Climate;

As these environmental factors are not expected to lead to effects in the operational phase, they have been combined into a single Construction Impacts chapter. Construction impacts in other environmental factors are assessed in the relevant chapters.

6.1 Air Quality and Dust

This Chapter of the EIAR assesses the air quality and dust impact of the proposed development during construction and operational phases.

6.1.1 Assessment Methodology

Dust Deposition Guidelines

Dust particles can be classified into those that are easily deposited and those that remain suspended in the air for long periods. This division is useful as deposited dust is usually the coarse fraction of particulates that causes dust annoyance, whereas suspended particulate matter is implicated more in exposure impacts. Airborne particles have a large range of diameters, from nano-particles and ultrafine particles (diameters less than 0.1µm) to the very large particles with diameters up towards 100µm. There is no clear dividing line between the sizes of suspended particulates and deposited particulates, although particles with diameters >50 µm tend to be deposited quickly and particles of diameter <10 µm (PM_{10}) have an extremely low deposition rate in comparison. Therefore, the size of suspended and deposited dust particles affects their distribution and as such requires two very different approaches to sampling these fractions. PM_{10} is the fraction of airborne (suspended) particulates which contains particles of diameter less than 10µm. $PM_{2.5}$ is the fraction of airborne (suspended) particulates which contains particles of diameter less than 2.5µm. PM_{10} and $PM_{2.5}$ particles can penetrate deep into the respiratory system increasing the risk of respiratory and cardiovascular disorders. Total Suspended Particles (TSP) is the term used when referring to larger particles which do not have a specified size limit. It is common for TSP to be measured alongside PM_{10} and $PM_{2.5}$ particularly at industrial sites when dust monitoring is undertaken.

Particulate matter can emanate from natural and anthropogenic sources. Natural sources include sea salt, forest fires, pollen and moulds. Natural sources are unregulated and harder to control. Anthropogenic sources can be regulated and understanding the sources of particulate matter is very important. PM_{10} is most commonly associated with road dust and construction activities. Wear and tear of brakes and tyres on vehicles and crushing activities at construction sites can all contribute to a rise in PM_{10}. $PM_{2.5}$ is associated with fuel burning, industrial combustion processes and vehicle emissions. Larger particles (100µm diameter) are likely to settle within 5-10m of their source under a typical mean wind speed of 4-5 m/s, and particles between 30-100 µm diameter are likely to settle within 100m of the source. Smaller particles, particularly those <10 µm in diameter, i.e., PM_{10}, have a greater potential to have their settling rate impeded by atmospheric turbulence and to be transported further from their

source. Dust emissions are exacerbated by dry weather and high wind speeds. The impact of dust therefore also depends on the wind direction and the relative location of the dust source and receiver.

Currently no Irish statutory standards or limits exist for the assessment of dust deposition and its tendency for causing nuisance. Similarly, no official air quality criterion has been set at a European or World Health Organisation (WHO) level, although a range of national 'yardstick' criteria from other countries is found in literature.

The Quarries and Ancillary Activities, Guidelines for Planning Authorities states that following with regard to the control of dust;

"There are currently no Irish statutory standards or EPA guidelines relating specifically to dust deposition thresholds for inert mineral/aggregate dust. (See, however, the Air Quality Standards Regulations 2011 for measurement standards). There are a number of methods to measure dust deposition (such as the Frisbee method) but only the German TA Luft Air Quality Standard relates a specific method (i.e., Bergerhoff) of measuring dust deposition with dust nuisance. On this basis it is recommended that the following TA Luft dust deposition limit value be adopted at site boundaries near quarry developments:

Total dust deposition (soluble and insoluble): 350 milligram per square metre per day (when averaged over a 30-day period).

Best practice dust control measures should be proposed by the applicant".

In England and Wales, a *'custom and practice'* limit of 200 mg/m^2/day is sometimes referenced using Frisbee-type Deposition Gauges. This value was derived by multiplying a historical, typical UK median background by 3.5 (which was the ratio of the 95th percentile to the median). It should be noted that because background dust levels can vary significantly from place to place and with season, the authors Vallack & Shillito were clear that the preferred approach is to calculate a bespoke site-specific "complaints likely" dust guideline, where sufficient local baseline monitoring data is available (at least 12-months) based on 3.5 times the median background level. However, such bespoke local baseline data is often not available and in such cases the authors recommended using as a fall-back the 95th percentile of typical UK background data. It is important that the limitations of the 200 mg/m^2/day benchmark are appreciated: firstly, it is simply a custom and practice yardstick and was never based on actual dose-response data; secondly, in deriving this default "complaints likely" guideline, the authors used a dataset that was quite old and not necessarily indicative of today's background levels.

The German TA Luft Regulations, "Technical Instructions on Air Quality Control" state that total dust deposition (soluble and insoluble, measured using Bergerhoff type dust deposit gauges as per German Standard Method for determination of dust deposition rate, VDI 2119) should not exceed a dust deposition rate of 350 mg/m^2/day (when averaged over a 30+/-2 day period). The use of this limit value is appropriate to minimise the impact of airborne dust levels on the receiving environment beyond the site boundary. The German TA Luft criteria for '*possible nuisance'* and *'very likely nuisance'* are 350 mg/m^2/day and 650 mg/m^2/day, respectively.

Criteria from other countries that can be referred to include;

- In the USA, Washington has set a state standard of 187 mg/m^2/day for residential areas.
- Western Australia also sets a two-stage standard, with '*loss of amenity first perceived'* at 133 mg/m^2/day and '*unacceptable reduction in air quality*' at 333 mg/m^2/day.
- The Swedish limits promoted by the Stockholm Environment Institute, and used regularly in Scotland, range from 140 mg/m^2/day for rural areas to 260 mg/m^2/day for town centres.

These go some way to addressing the view that the annoyance impact (and hence potential for complaints) depends on the worsening of dust levels above existing background levels.

In 2005, the UK Highways Agency released an Interim Advice Note 61/05 '*Guidance for Undertaking Environmental Assessment of Air Quality for Sensitive Ecosystems in Internationally Designated Nature Conservation Sites and SSSIs*' as a supplement to the Design Manual for Roads and Bridges (DMRB) Guidelines. This interim guidance states that dust or particles falling onto plants can physically smother the leaves affecting photosynthesis, respiration and transpiration. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels above 1,000 mg/m^2/day which is considerably greater than the level at which most dust deposition may start to cause a perceptible nuisance to humans. As such, once dust deposition rates are maintained within the guidelines for human nuisance the impact of dust deposition on sensitive ecosystems is considered negligible. Therefore, the following dust deposition limits are typically recommended;

- Dust Deposition Rate limit = 350 mg/m^2/day (averaged over a 30+/-2 day period using Bergerhoff Gauge Method).
- Dust Deposition Rate limit affecting sensitive ecological receivers = 1,000 mg/m^2/day
- PM_{10} 24 Hour Mean concentration limit = 50 µg/m^3 not to be exceeded more than 35 times a calendar year
- PM_{10} Annual Mean concentration limit = 40 µg/m^3
- $PM_{2.5}$ Annual Mean concentration limit = 25 µg/m^3

Guidance on the assessment of dust from demolition and construction

As prescribed within Environmental Protection UK and the Institute of Air Quality Management, Land-use Planning & Development Control: Planning For Air Quality (January 2017) the proposed Castleconnell Flood Relief Scheme has been assessed in accordance with the "Guidance on the Assessment of Dust from Demolition and Construction (IAQM) January 2024 (Version 2.2). This guidance has been referenced to assess the potential impact of the vehicle movements and the earthworks phase of the proposed works. Good practice construction mitigation measures are recommended to be implemented to minimise emission quantities during construction.

6.1.2 Receiving Environment

Baseline Air Quality

No baseline air quality or dust deposition survey has been undertaken. Reference has been made to EPA data to quantify the existing air quality in proximity to the proposed development site.

The EPA has divided the country into zones for the assessment and management of air quality. The zones adopted in Ireland are Zone A, the Dublin conurbation; Zone B, the Cork conurbation; Zone C, comprising 21 large towns in Ireland with a population >15,000; and Zone D, the remaining area of Ireland. The background air quality in the area of the development is of good quality and the site is located in 'Zone D' as denoted by the EPA.

Nitrogen Dioxide (NO_2), Ozone (O_3) and Particulate Matter (PM_{10} and $PM_{2.5}$) background concentrations from two EPA Air Quality monitoring stations in Limerick City, specifically Station 39: Peoples Park and Station 85: Henry Street have been referenced. These stations are both located 10.32 Km south-west of the proposed Castleconnell FRS.

The CAFE (Clean Air for Europe) Directive sets air quality standards for member states in Europe and has been transposed into Irish legislation by the Air Quality Standards Regulations 2011. Table 6-1 shows the most recent full year of data (June 2023 – June 2024). Results show that there were no exceedances of these EU CAFÉ directive annual mean limits for NO_2, O_3, PM_{10}. or $PM_{2.5}$.

Table 6-1: Annual Average Nitrogen Dioxide (NO2), Ozone (O3) and Particulate Matter (PM_{10} and $PM_{2.5}$) concentrations at People's Park Limerick and Henry Street Limerick (June 2023 – June 2024)

Station	Period	Measured Concentration (µg/m³)			
		NO_2	O_3	PM_{10}	$PM_{2.5}$
Peoples Park, Limerick	June 2023 – June 2024	8.42 µg/m³	56.01 µg/m³	12.26 µg/m³	7.82 µg/m³
Henry Street, Limerick	June 2023 – June 2024	14.04 µg/m³	47.20 µg/m³	12.15 µg/m³	6.81 µg/m³
Annual Mean Limit Value		40 µg/m³	-	40 µg/m³	20 µg/m³
Maximum Daily 8 hr Mean Limit		-	120 µg/m³	-	

The Environmental Protection Agency's Air Quality Index for Health (AQIH) is a number from one to 10 that identifies the current air quality currently in a region and whether or not this might affect human health. A reading of 10 means the air quality is very poor and a reading of one to three inclusive means that the air quality is good. The AQIH readings are based on five air pollutants which can harm human health: Ozone gas, nitrogen dioxide gas, sulphur dioxide gas, $PM_{2.5}$ particles and PM_{10} particles. The AQIH at both stations; Peoples Park, and Henry Street, Limerick is currently 1 - Good [index calculated at 9.00 AM, Thursday, November 2nd, 2023] (EPA, 2023).

The World Health Organization (WHO) guidelines on outdoor (ambient) air pollution levels, which are widely used as reference tools by policymakers across the world to set standards and goals for air quality management, were updated in September 2021. Across nearly all pollutants, the new recommended limits for concentrations and exposures are lower than the previous guidelines. The 2021 update reflects far-reaching evidence that shows how air pollution affects many aspects of health, even at low levels.

6.1.3 Predicted Impact

Do Nothing Scenario

The Do-Nothing scenario is defined as the option involving no future expenditure on flood defences or maintenance of existing defences/channels. There is no air quality and dust impact from the 'Do Nothing scenario'

Construction Phase

Construction Dust Impact Assessment:

As stated above, there will be no operational air quality and/or dust impact from the operation of the proposed development. Therefore, this chapter further summarises and assesses the nature of only proposed construction works in each area.

The Dust Impact Assessment has been undertaken in accordance with Guidance on the Assessment of Dust from Demolition and Construction (IAQM) January 2024 (Version 2.2) to predict the risk of dust impacts and the level of mitigation that is required to control the residual effects to a level that is "not significant".

Activities on construction sites have been divided into four types to reflect their:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

The potential for dust emissions is assessed for each activity that is likely to take place. Obviously, if an activity is not taking place, e.g., demolition, then it does not need to be assessed. The risk assessment categories assume that the most basic project controls are applied to every project.

The assessment methodology considers three separate dust impacts:

- Annoyance due to dust soiling;
- The risk of health effects due to an increase in exposure to PM10; and
- Harm to ecological receptors with account being taken of the sensitivity of the area that may experience these effects.

The assessment is used to define appropriate mitigation measures to ensure that there will be no significant effect.

The assessment steps are:

STEP 1: Screening the Need for a Detailed Assessment

An assessment will normally be required where there is:

A 'human receptor' within:

- 250 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 250 m from the site entrance(s)

an 'ecological receptor' within:

- 50 m of the boundary of the site; or
- 50 m of the route(s) used by construction vehicles on the public highway, up to 250m from the site entrance(s)

STEP 2: Assess the Risk of Dust Impacts

The risk of dust arising in sufficient quantities to cause annoyance and/or health and/or ecological impacts should be determined using four risk categories: negligible, low, medium and high risk. A site is allocated to a risk category based on two factors:

- the scale and nature of the works, which determines the potential dust emission magnitude as small, medium or large (STEP 2A); and
- the sensitivity of the area to dust impacts (STEP 2B), which is defined as low, medium or high sensitivity.

These two factors are combined in STEP 2C to determine the risk of dust impacts with no mitigation applied. The risk category assigned to the site can be different for each of the four potential activities (demolition, earthworks, construction and trackout). More than one of these activities may occur on a site at any one time. Where appropriate, the site can be divided into 'zones' for the dust risk assessment.

<u>Step 2A: Define the Potential Dust Emission Magnitude</u>

Earthworks, construction and trackout will occur during the construction phase. Table 6-2 describes the potential dust emission class criteria for each outlined construction activity.

Table 6-2: Criteria Used in the Determination of Dust Emission Class

Activity	Criteria used to Determine Dust Emission Class		
	Small	**Medium**	**Large**
Demolition	• Total building volume <12,000 m^3 • Construction material with low potential for dust release (e.g., metal cladding or timber • Demolition activities <6 m above ground level • Demolition during wetter months	• Total building volume 12,000 m^3 – 75,000m^3 • Potentially dusty construction material. • Demolition activities 6-12 m above ground level	• Total building volume >75,000m^3 • Potentially dusty construction material (e.g., concrete) • On-site crushing and screening, • Demolition activities >12 m above ground level
Earthworks	• Total site area <18,000m^2 • Soil type with large grain size (e.g., sand), • <5 heavy moving earth vehicles active at any one time • formation of bunds <3 m in height	• Total site area 18,000 – 110,000m^2 • Moderately dusty soil type (e.g., silt) • 5-10 heavy moving earth moving vehicles active at any one time. • formation of bunds 3m - 6 m in height,	• Total site area >110,000m^2 • potentially dusty soil type (e.g., clay) • >10 heavy earth moving vehicles active at any one time. • formation of bunds >6 m in height
Construction	• Total building volume <12,000m^3 • Construction material with low potential for dust release	• Total building volume 12,000 – 75,000m^3 • Potentially dusty construction material (e.g., concrete) • On-site concrete batching	• Total building volume >75,000m^3 • On-site concrete batching • Sandblasting
Trackout	• <20 outward HDV trips in any one day • surface material with low potential for dust release, • Unpaved road length <50m	• 20 - 50 outward HDV trips in any one day • moderately dusty surface material (e.g., high clay content), • Unpaved road length 50-100m	• >50 outward HDV trips in any one day • potentially dusty surface material (e.g., high clay content • Unpaved road length >100m

The potential dust emission magnitudes for the proposed development were estimated using information provided by JB Barry Engineers, outlined in Table 6-1, and determined using the criteria detailed in Table 6-2 as follows;

Demolition:

Demolition includes any activity involved with the removal of an existing structure (or structures). Demolition incudes:

Table 6-3: Volume of demolition works as calculated by the Design Team

Area of works	Stone walls	Concrete	Paving / Road works	Total Volume (m^3)
Northern properties	159	27	33	**219**
Cedarwood Culvert	0	5	0	**5**
Mall House	115	4	0	**119**
Mall Road North	304	46	152	**502**
Island House	0		20	**20**
Scanlon Park Junction	0	5	0	**5**
Mall Road South	212	32	106	**350**
Maher's Pub	106	0	53	**159**

Meadowbrook Estate	93	0	0	**93**
Stormont House	0	0	47	**47**
Coolbane Woods Junction	0	10	0	**10**
Coolbane Woods Embankment	0	0	0	**0**
Ancillary Works (Pipe diversion etc.)	0	0	120	**120**
Total Volume (m3)	**989**	**129**	**531**	**1649**

Therefore:

- Total building volume <12,000 m^3
- The general height of the existing walls that will be demolished is 1- 1.5m above ground level, and it is anticipated the footings will 0.5m – 1m below ground level. Hence demolition activities <6 m above ground level
- The existing walls to be taken down are predominantly comprised of stone, with low dust emissions as the stone will be re-used.

Therefore, the dust emission magnitude for Demolition is defined as Small.

Earthworks:

Earthworks covers the processes of soil-stripping, ground-levelling, excavation, and landscaping. Excavated material will be generated from the stripping of surface and excavation of subsoil layers for the construction of the proposed foundations and channel works. Earthwork's material will be placed to form embankments. Excess material will be disposed offsite.

Area of Earthworks includes:

Table 6-4: Areas of earthworks as calculated by the Design Team

Area of works	Total Area (m^2)
Northern properties	**2200**
Cedarwood Culvert	**110**
Cedarwood Stream	**1595**
Mall House	**693**
Mall Road North	**1644.5**
Island House	**660**
Scanlon Park Junction	**0**
Mall Road South	**1144**
Maher's Pub	**528**
Meadowbrook Estate	**462**
Stormont House	**4356**
Coolbane Woods Junction	**0**
Coolbane Woods Embankment	**6512**
Ancillary Works (Utility diversion etc.)	**2450**
Total Area (m^2)	**22354.5**

Therefore:

- Total site area of works is 22,354.5 m^2

- The site itself contains moderately dusty soil types. Site investigation identified sandy and clayey gravel prevalent up to approximately 8m depth below existing ground level, which is underlain by dense gravel.
- There will be 8 vehicles active at any one time

Therefore, the dust emission magnitude for Earthworks is defined as **Medium**.

Construction:

Construction covers any activity involved with the provision of a new structure (or structures), its modification or refurbishment. See Chapter 4 above. Works include:

Table 6-5: Total building volume as calculated by the Design Team

Area of works	Concrete	Steel Sheet Piles	Stone Cladding	Paving	Backfilling	Layer works for roadworks	Asphalt Road Surfacing	Imported Clay for Embankments	Total Volume (m^3)
Northern properties	208	17	80	22	885	66	0	0	**1278**
Cedarwood Culvert	15				28	9			**52**
Cedarwood Stream	0	0	0	0	0	0	0	0	**0**
Mall House	187	0	44	0	528	0	0	0	**759**
Mall Road North	624	0	141	0	506	1265	98	0	**2634**
Island House	99	0	0	0	0	137	0	0	**236**
Scanlon Park Junction	5	0	0	0	0	0	75	0	**80**
Mall Road South	434	0	32	0	352	880	68	0	**1766**
Maher's Pub	193	0	16	36	599	106	0	0	**950**
Medowbrook Estate	193	2	24	0	616	0	0	0	**835**
Stormont House	149	0	22	0	360	924	0	3584	**5039**
Coolbane Woods Junction	13	0	0	0	0	0	42	0	**55**
Coolbane Woods Embankment	0	0	0	0	2849	0	0	15670	**18519**
Ancillary Works (Diversions etc.)	24	0	4	0	37	1994	172	0	**2231**
Total Volume (m^3)	**2144**	**19**	**363**	**58**	**6760**	**5381**	**455**	**19254**	**34434**

Therefore:

- Total building volume 34,434m^3
- Potentially dusty construction material (e.g., concrete).

Therefore, the dust emission magnitude for Construction is defined as **Medium.**

Trackout:

Trackout covers the transport of dust and dirt from the construction site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles (HDVs) leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when HDVs transfer dust and dirt onto the road having travelled over muddy ground on site.

- Significant bulk excavation works and clay importation is anticipated at Coolbane Woods embankment, as well as the Stormont house embankment. This will generate the most HGV movements during the anticipated dig and replace works and be the busiest construction period. Based on general construction rate assumptions for excavator work rates it is recommended to allow that 8 – 12 HGV movements per hour. Should the contractor's approach be to commence with the embankment works and the structural works for the walls in parallel, these HGV single trip movements can potentially increase to 12 -19 per hour. Therefore, there will be > 50 outward HDV trips in any one day.
- Potentially dusty surface material
- Unpaved road length, some elements are >100m

Therefore, the dust emission magnitude for Trackout is defined as **Large**

Step 2B: Define the Sensitivity of the Area

The sensitivity of the area takes account of a number of factors:

- the specific sensitivities of receptors in the area;
- the proximity and number of those receptors;
- in the case of PM_{10}, the local background concentration; and
- site-specific factors, such as whether there are natural shelters, such as trees, to reduce the risk of wind-blown dust.

The criteria for determining the sensitivity of receptors are detailed in Table 6-6 for dust soiling effects and health effects of PM_{10}.

Table 6-6: Criteria for Determining Sensitivity of Receivers

Sensitivity of Receiver	Criteria for Determining Sensitivity	
	Dust Soiling Effects	**Health Effects of PM_{10}**
High	Dwellings, museums and other culturally important collections, medium and long-term car parks and car showrooms	Residential properties, hospitals, schools and residential care homes
Medium	Parks, places of work	Office and shop workers not occupationally exposed to PM_{10}
Low	Playing fields, farmland, footpaths, short-term car parks and roads	Public footpaths, playing fields, parks and shopping streets

The criteria detailed in Table 6.7 and Table 6-8 were used to determine the sensitivity of the area to dust soiling effects and human health impacts.

Table 6-7: Sensitivity of the Area to Dust Soiling Effects on People and Property.

Receiver Sensitivity	Number of Receivers	Distance from Source (m)			
		<20m	<50m	<100m	<250m
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

Table 6-8: Sensitivity of the Area to Human Health Impacts.

Receiver Sensitivity		Annual Mean PM_{10} Conc	Number of Receivers	Distance from Source (m)		
			<20m	<50m	<100m	<250m
High	>32 µg/m^3	>100	High	High	High	Medium
		10-100	High	High	Medium	Low
		1-10	High	Medium	Low	Low
	28-32 µg/m^3	>100	High	High	Medium	Low
		10-100	High	Medium	Low	Low
		1-10	High	Medium	Low	Low
	24-28 µg/m^3	>100	High	Medium	Low	Low
		10-100	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	<24 µg/m^3	>100	Medium	Low	Low	Low
		10-100	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Medium	>32 µg/m^3	>10	High	Medium	Low	Low
		1-10	Medium	Low	Low	Low
	28-32 µg/m^3	>10	Medium	Low	Low	Low
		1-10	Low	Low	Low	Low
	24-28 µg/m^3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
	<24 µg/m^3	>10	Low	Low	Low	Low
		1-10	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low

Table 6-9: Sensitivity of the Area to Ecological Impacts

Receiver Sensitivity	Distance from Source (m)	
	<20	<50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Sensitivity of Receivers

A population of Castleconnell was reported as 2,488 in the Census of Ireland 2022. Table 6.10 outlines the range of numbers of properties within specific distance bands from the proposed construction activities to determine the receptor sensitivity of the area to Dust Soiling Effects on People and Property.

Table 6-10: Cumulative number of sensitive receivers within 20m, 50m, 100m, 200m and 350m of the site.

Parameter	Number of Receivers within Distance from Site (m)			
	<20m	<50m	<100m	<200m
No. of receivers in proximity to Site	~40-45	~80	>100	>100
Receiver Sensitivity	High	Medium	Medium	Low

Sensitivity of People to Dust Soiling

Demolition, Earthworks and Construction: There are approx. 41 sensitive residential properties within 20m of the proposed construction activities on the site, including, properties at Coolbane Woods, properties at Coolbawn Meadows, properties at The Mall, properties at The Elvers, Rivergrove House and Grange B&B. There are approx. an additional 35 sensitive residential properties within 50m of the proposed works.

Therefore, the sensitivity of the Area to Dust Soiling Effects on People and Property is **High**; in terms of potential demolition, earthworks and construction dust impacts.

Trackout: As general guidance, without site-specific mitigation, trackout may occur from roads up to 500 m from large sites (as determined in Step 2A). The impact declines with distance from the site, and it is only necessary to consider trackout impacts up to 50 m from the edge of the road, As shown in Table 6-10, there are ~80 sensitive receptors within 50 m of the site.

Therefore, as shown in Table 6-7 the sensitivity of the area to dust soiling effects is **Medium.**

Sensitivity of the Area to Human Health Impacts

Section 6.1.2 outlines baseline air quality in the study area. The PM_{10} concentrations recorded at EPA monitoring stations in Limerick; station 39: Peoples Park and station 85: Henry Street, which are both 10.32 Km south-west of the Castleconnell FRS have been referenced for a year from June 2023 – June 2024. These concentration values are 12.26 µg/m^3 and 12.15 µg/m^3 respectively, which are well below the Air Quality Standard annual limit value of 40µg/m^3 and below the recent 2021 WHO air quality guideline value of 15 µg/m^3. There are ~40-45 sensitive receptors within 20m of the site. As shown in Table 6-8, the sensitivity of the area to Human Health Impacts is **Low**; in terms of potential demolition, earthworks, construction and trackout dust impacts.

Sensitivity of the Area to Ecological Impacts

Dust deposition due to demolition, earthworks, construction and trackout has the potential to affect sensitive habitats and plant communities. Dust can have two types of effect on vegetation: physical and chemical. Direct physical effects include reduced photosynthesis, respiration and transpiration through smothering. Chemical changes to soils or watercourses may lead to a loss of plants or animals for example via changes in acidity. Indirect effects can include increased susceptibility to stresses such as pathogens and air pollution. These changes are likely to occur only as a result of long-term demolition and construction works adjacent to a sensitive habitat.

A portion of the development site is within the boundary of Lower River Shannon SAC (Site code: 002165). This area extends southwest of the proposed development site. Works will take place c. 1m from the SAC boundary along Mall Road and elsewhere the proposed works are in close proximity to the SAC boundary. Although Lower River Shannon is mostly designated for its aquatic habitats and species which won't be impacted by dust soiling, there are terrestrial habitats within the SAC which may be affected by dust soiling in which proposed demolition, earthworks, construction and trackout are all <20m from.

Table 6-9 outlines Sensitivity of the Area to Ecological Impacts. A high receiver sensitivity is those receivers with an international or national designation, therefore, the sensitivity of the Area to Ecological Impacts is **High**; in terms of potential demolition, earthworks, construction and track out dust impacts.

The sensitivity of the area to dust soiling, human health impacts and ecological impacts for each activity is summarised in Table 6-11.

Table 6-11: Outcome of Defining the Sensitivity of the Area

Potential Impact	Sensitivity of the Surrounding Area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	Medium
Human Health	Low	Low	Low	Low
Ecological Impacts	High	High	High	High

Step 2C: Define the Risk of Impacts

In accordance with the IAQM Guidance, the dust emission magnitude (Step 2A) and sensitivity of the area (Step 2B) have been combined and the risk of impacts from demolition, construction, earthworks and trackout determined (before mitigation is applied). The risk of dust soiling, impact on human health and ecological impact before mitigation, is summarised in Table 6-12.

Table 6-12: Summary Dust Risk to Define Site-specific Mitigation

Potential Impact	Dust Emission Magnitude			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium Risk	Medium Risk	Medium Risk	Medium Risk
Human Health	Negligible	Low Risk	Low Risk	Low Risk
Ecological Impacts	Medium Risk	Medium Risk	Medium Risk	High Risk

STEP 3: SITE-SPECIFIC MITIGATION

In accordance with the IAQM Guidance, for proposed mitigation measures, the highest risk category should be applied. Therefore, the mitigation measures applicable to a High-Risk site should be applied as outlined in Section 6.1.4.

Operational Stage

There will be no air quality and/or dust deposition impact from the 'Operation Phase'.

6.1.4 Mitigation Measures

Do Nothing Scenario

There will be no air quality and dust mitigation measures required for the 'Do Nothing scenario'.

Construction Phase Mitigation

The following mitigation measures are to be implemented during the construction phase:

Step 3: Site-Specific Mitigation

In accordance with the IAQM Guidance, the highest risk category should be applied when determining proposed mitigation measures. Therefore, the mitigation measures applicable to a **High-Risk site** will be applied. The proposed mitigation measures in the IAQM guidance are as follows:

General Measures

Communications

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Display the head or regional office contact information.
- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority. The DMP may include monitoring of dust deposition, dust flux, real-time PM_{10} continuous monitoring and/or visual inspections.

Site Management

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the logbook.
- If applicable, hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.

Monitoring

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100 m of site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the recommended mitigation measures, record inspection results, and make an inspection log available to the local authority when asked.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

Preparing and maintaining the site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.
- Cover, seed or fence stockpiles to prevent wind whipping.

Operating vehicle/machinery and sustainable travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.

- Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 15 mph on surfaced and 10 mph on unsurfaced haul roads and work areas.
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g., suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste Management

- Waste Material to be disposed of at an appropriately licensed facility

Measures specific to demolition

- Ensure effective water suppression is used during demolition operations. Handheld sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.
- Avoid explosive blasting, using appropriate manual or mechanical alternatives.
- Bag and remove any biological debris or damp down such material before demolition.

Measures specific to earthworks

- Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.
- Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

Measures specific to construction

- Avoid scabbling (roughening of concrete surfaces) if possible
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.
- Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.
- For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust.

Measures specific to trackout

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.

- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site logbook.
- Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).
- Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Access gates to be located at least 10 m from receptors where possible.
- If a programme of air quality monitoring shall be implemented at the site boundaries for the duration of construction phase activities to ensure that the air quality standards relating to dust deposition and PM_{10} are not exceeded, the following limits are recommended;
- Dust Deposition Rate limit = 350 mg/m^2/day (averaged over a 30+/-2 day period using Bergerhoff Gauge Method).
- Dust Deposition Rate limit affecting sensitive ecological receivers = 1,000 mg/m^2/day
- PM_{10} 24 Hour Mean concentration limit = 50 µg/m^3 not to be exceeded more than 35 times a calendar year
- PM_{10} Annual Mean concentration limit = 40 µg/m^3
- $PM_{2.5}$ Annual Mean concentration limit = 25 µg/m^3
- Where levels exceed specified air quality limit values, dust generating activities shall immediately cease and alternative working methods shall be implemented. A complaints log shall be maintained by the construction site manager and in the event of a complaint relating to dust nuisance, an investigation shall be initiated.

Operational Phase Mitigation

There are no air quality and dust mitigation measures required for the 'Operational Stage'.

6.1.5 Residual Impacts

Construction Phase

Construction site dust control measures and good construction site management and practice is capable of effectively mitigating the potential for significant impact of fugitive dust emissions. Therefore, the potential for fugitive dust emission effects at the nearest residential properties and ecological receptors will be controlled to ensure impacts are of negligible significance.

The IAQM Guidance recommends that significance is only assigned to the effect after considering the construction activity with mitigation. Therefore, the detailed mitigation measures have been defined in a form suitable for implementation by way of inclusion within the EIAR which makes up part of the planning consent.

Approximately 41 sensitive receptors have been noted within 20m of the proposed construction works. Works are proposed c.1m from Lower River Shannon SAC boundary along Mall Road. Using the IAQM methodology for the assessment of impacts from construction activities, the following is indicated in Table 6-13;

- the risk of dust soiling impacts are medium for demolition, earthworks, construction and trackout;
- the impacts on human health are negligible for demolition, and low for earthworks, construction and trackout; and
- the ecological impacts are medium for demolition, earthworks and construction and are high for trackout.

In accordance with the IAQM Guidance, the highest risk category measures have been applied in the determination of appropriate mitigation measures. The significance of impacts arising from the risks identified together with the proposed mitigation measures are summarised in Table 6-13.

Together with the proposed mitigation measures and the existing low background particulate (PM_{10}) concentrations, the construction phase activities on the proposed site will not cause an exceedance of the air quality objectives at receptor locations.

Table 6-13: Summary of Significance of Impact including Site-specific Mitigation.

Potential Impact	Significance			
	Demolition	Construction	Earthworks	Trackout
Dust Soiling	Negligible	Negligible	Negligible	Negligible
Human Health	Negligible	Negligible	Negligible	Negligible
Ecological	Negligible	Negligible	Negligible	Negligible

Operation Stage

There will be no air quality and dust impact from the 'Operation Stage'.

6.1.6 Monitoring

Construction Stage

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority if and when requested. This should include regular dust soiling checks of surfaces such as street furniture, cars and windowsills within 100m of site boundary, with cleaning to be provided if necessary.
- Carry out regular site inspections to monitor compliance with the dust management measures, record inspection results, and make an inspection log available to the local authority if and when requested.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.
- Agree dust deposition and/or real-time PM_{10} continuous monitoring locations with the Local Authority. Where possible commence baseline monitoring at least three months before work commences on site. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.

6.1.7 Interactions

Impacts on air quality are interlinked with the environmental effects on:

Population and Human Health, discussed in Chapter 7**.** Significant quantities of dust or impacts on air quality could lead to negative effects for population and human health.

Biodiversity, discussed in Chapter 8. Significant quantities of dust or impacts on air quality could lead to negative effects for the species in the area.

Water, discussed in Chapter 10. Dust generated from construction activities can settle on the surface of water bodies and impact physical chemical parameter by increasing turbidity.

Landscape and Visual Amenity, discussed in Chapter 13. Dust generated can settle in the landscape, including buildings and vegetation impacting their visual amenity. Dust suspended in the air reduces also visibility.

Appropriate construction phase mitigation measures have been outlined to ensure that the potential impact on the SAC will be negligible. Therefore, the impact of dust deposition in combination with other environmental effects e.g., direct loss of habitat, pollution etc will result in a negligible effect on the SAC and any other habitats of significance.

The removal of soils, overburden and rocks during the construction phase has the potential to give rise to dust impacts, potentially giving rise to water pollution and impacts on flora and fauna and the visual landscape. Potential interactive negative impacts have been identified in Chapter 14, and a full suite of appropriate mitigation measures have been included in the relevant sections of the EIAR.

6.1.8 Potential Cumulative Impacts

In relation to the in-combination construction and/or operational impact of the proposed Castleconnell Flood Relief Scheme, with other proposed schemes planned in the area, the list of schemes noted from the planning chapter have been reviewed. None of these schemes will result in any significant additional construction and/or operational Air Quality & Dust impact.

6.2 Noise and Vibration

This Chapter of the EIAR assesses the noise and vibration impact of the proposed development during the Construction and Operational Phases.

This noise and vibration impact assessment has been prepared to assess the potential noise and vibration impact of the proposed flood relief scheme on the nearest residential properties. It can be expected that the future operation of the proposed flood relief scheme will not have a significant noise impact. Therefore, the construction activities of the proposed flood relief scheme have been examined to identify those that have the potential to give rise to a short-term noise and vibration impact and a suitable construction impact assessment has been undertaken. As appropriate, construction phase mitigation measures have been outlined.

The assessment and evaluation of the potential noise and vibration impact arising from the proposed flood relief scheme involved the following:

- Baseline Noise Survey – noise monitoring survey representative of the daytime period to determine the existing noise climate in proximity to the residential receivers in the vicinity of the proposed flood relief scheme.
- Identification and assessment of potential noise and vibration sources from the construction of the proposed flood relief scheme.
- Construction noise impact prediction using the methodology outlined in BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Part 1: Noise.
- An assessment of the predicted noise levels and the noise impact on the nearest residential receivers against relevant guidelines and standards.
- A recommendation of appropriate construction and operational noise and vibration mitigation measures.

6.2.1 Assessment Methodology

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures

ISO 1996-1:2016 Acoustics — Description, measurement and assessment of environmental noise — Part 1: Basic quantities and assessment procedures defines the basic quantities to be used for the description of noise in community environments and describes assessment procedures. It also specifies methods to assess environmental noise and gives guidance on predicting the potential annoyance response of a community to long-term exposure from various types of environmental noises.

Application of the method to predict annoyance response is limited to areas where people reside and to related long-term land uses. ISO 1996: 2016 describes adjustments for sounds that have different characteristics. The term rating level is used to describe physical sound predictions or measurements to which one or more adjustments have been added. Based on these rating levels, the long-term community response can be estimated. The potential noise is assessed either singly or in combination, allowing for consideration, when deemed necessary by responsible authorities, of the special characteristics of their impulsiveness, tonality and low-frequency content, and for the different characteristics of road traffic noise, other forms of transportation noise (such as aircraft noise) and industrial noise.

BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise

BS5228 gives recommendations for methods of noise control relating to construction sites, including sites where demolition, remediation, ground treatment or related civil engineering works are being carried out, and open sites, where work activities/operations generate significant noise levels, including industry-specific guidance. The legislative background to noise control is described and recommendations are given regarding procedures for the establishment of effective liaison between developers, site operators and local authorities. This part of BS5228 provides guidance concerning methods of predicting and measuring noise and assessing its impact on those exposed to it.

Annex E of BS5228-1:2009+A1:2014 *Code of practice for noise and vibration control on construction and open sites – Part 1: Noise*, provides guidance on assessing the potential significance of noise effects from construction activities. In relation to construction noise limits, BS 5228-1:2009+A1: 2014 *Noise and Vibration Control on Construction and Open Sites Part 1: Noise* details the 'ABC method', which recommends a construction noise limit based on the existing ambient noise level. General and short-term construction noise impacts that are deemed typical of any construction site noise sources, including activities such as ground preparation, site clearance, foundation earthworks, erection of new buildings, etc. are assessed in accordance with the 'ABC method' defined in BS 5228.

For the proposed flood relief scheme, the ambient noise levels have been determined through the baseline noise survey and then rounded to the nearest 5dB to determine the appropriate category (A, B or C) and subsequent threshold value. A potential significant effect is indicated if the construction noise level exceeds the appropriate category threshold value. If the existing ambient level exceeds the threshold category values, then a potential significant impact is indicated if the total noise level, including both the ambient noise and the various contributions of construction noise, is greater than the ambient noise level by more than 3dB. Table 6-14, reproduced from BS5228, demonstrates the criteria for selection of a noise limit for a specific receiver location.

Table 6-14: Construction noise threshold levels based on the BS 5228 'ABC' method

Assessment Category and Threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A (A)	Category B (B)	Category C (C)
Nighttime (23.00 to 07.00)	45	50	55
Evening and weekends (D)	55	60	65
Daytime (07.00 – 19.00) and Saturdays (07.00 - 13.00)	65	70	75

Notes:
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values.
Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as category A values.
Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than category A values.
19.00–23.00 weekdays, 13.00–23.00 Saturdays and 07.00–23.00 Sundays.

TII Construction Noise Guidelines

There are no national construction noise limit guidelines. Instead, there are indicative levels of acceptability for construction noise, as contained in the National Roads Authority (now Transport Infrastructure Ireland or TII) *"Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes"* (March 2014) and outlined in Table 6-15.

Table 6-15: Maximum permissible noise levels at the façade of dwellings during construction

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{AMax} dB
Monday to Friday - 07.00 to 19.00	70	80*
Monday to Friday - 19.00 to 22.00	60*	65*
Saturday - 08.00 to 16.30	65	75

** Construction activity at these times, other than that required in respect of emergency works, will normally require the explicit permission of the relevant local authority. (Ref. TII Guidelines)*

Construction Vibration Guidelines

The relevant guidelines for vibration limits are the following:

- British Standards Institution. British Standard 7385: Evaluation and measurement for vibration in buildings. Part 1: Guide for measurement of vibration and evaluation of their effects on buildings. 1990.
- British Standards Institution. British Standard 7385: Evaluation and measurement for vibration in buildings. Part 2: Guide for damage levels from ground borne vibration. 1993.
- British Standards Institution. British Standard 6472: Guide to evaluation of human exposure to vibration in buildings. Part 1: Vibration sources other than blasting. 2008.
- National Roads Authority (now TII), Good Practice Guidance for the Treatment of Noise during the Planning of National Road Schemes, March 2014.

Relevant vibration limits and guidelines can be divided into two categories, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. Higher levels of vibration are typically tolerated for single events or events of short duration such as during construction projects compared to permanent vibration from operational industrial sources. For example, blasting (an instantaneous activity) and piling (a repetitive/continuous activity), two of the primary sources of vibration during construction projects, are typically tolerated at vibration levels up to 12mm/s and 2.5mm/s, respectively.

The TII Guidelines (March 2014) identify limits for protection against cosmetic damage as a function of vibration frequency, and are:

- 8 mm/s (vibration frequency <10Hz)
- 12.5 mm/s (vibration frequency 10 to 50Hz)
- 20 mm/s (vibration frequency >50 Hz).

Guidance relevant to acceptable vibration at the foundation of buildings is contained within BS 7385 (1993): *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration.* This guidance states that there should typically be no cosmetic damage to buildings if transient vibration does not exceed 15mm/s at low frequencies rising to 20mm/s at 15Hz and 50mm/s at 40Hz and above. These guidelines refer to relatively modern buildings.

6.2.2 Receiving Environment

Baseline Noise Survey

A daytime baseline noise monitoring survey was undertaken in proximity to the residential properties close to the alignment of the River Shannon through Castleconnell on 29th September 2023. The noise survey was undertaken in accordance with the methodologies outlined in ISO 1996 Description, measurement and assessment of environmental noise and BS 4142. A Norsonic Nor140 Sound Level Meter (Serial No. 1402988 – Calibration Date – 13/04/2023) was used during the noise monitoring survey. A wind shield was used on the microphone throughout the survey and the sound level meter was calibrated before and after the survey period. The sound level meter was placed at a height of approximately 1.25m at the selected monitoring locations. The noise monitoring survey durations in proximity to the nearest noise sensitive receiver locations were undertaken over consecutive 30-minute periods. The meteorological conditions during the noise survey periods were noted as ideal with no periods of rainfall or higher wind speeds. The weather conditions during the noise survey were noted to be calm with little to no breeze, a temperature of approximately 16°C and no rainfall.

The purpose of the noise survey was to determine a typical daytime background noise level in the area and the measurement parameters recorded and reported during the baseline noise survey are defined as follows:

- A-weighted Decibel (dBA): Decibels measured on a sound level meter incorporating a frequency weighting (A Weighting) which differentiates between sound of different frequency (pitch) in a similar way to the human ear. This takes account of the fact that the human ear has different sensitivities to sound at different frequencies.
- L_{Aeq} is the A-weighted equivalent continuous steady sound level during the sample period.
- L_{A10} is the A-weighted sound level that is exceeded for 10% of the sample period and is generally used to quantify traffic noise.
- L_{A90} is the A-weighted sound level that is exceeded for 90% of the sample period and is generally used to quantify background noise.
- L_{Amin} is the minimum A-weighted sound level measured during the sample period.
- L_{Amax} is the maximum A-weighted sound level measured during the sample period.

Baseline noise measurements were undertaken in proximity to the representative residential receivers in accordance with ISO 1996: 2016 as shown in Figure 6-1. All noise measurement data was downloaded at the company office, exported from the manufacturer's software and stored as Microsoft Excel spreadsheet files.

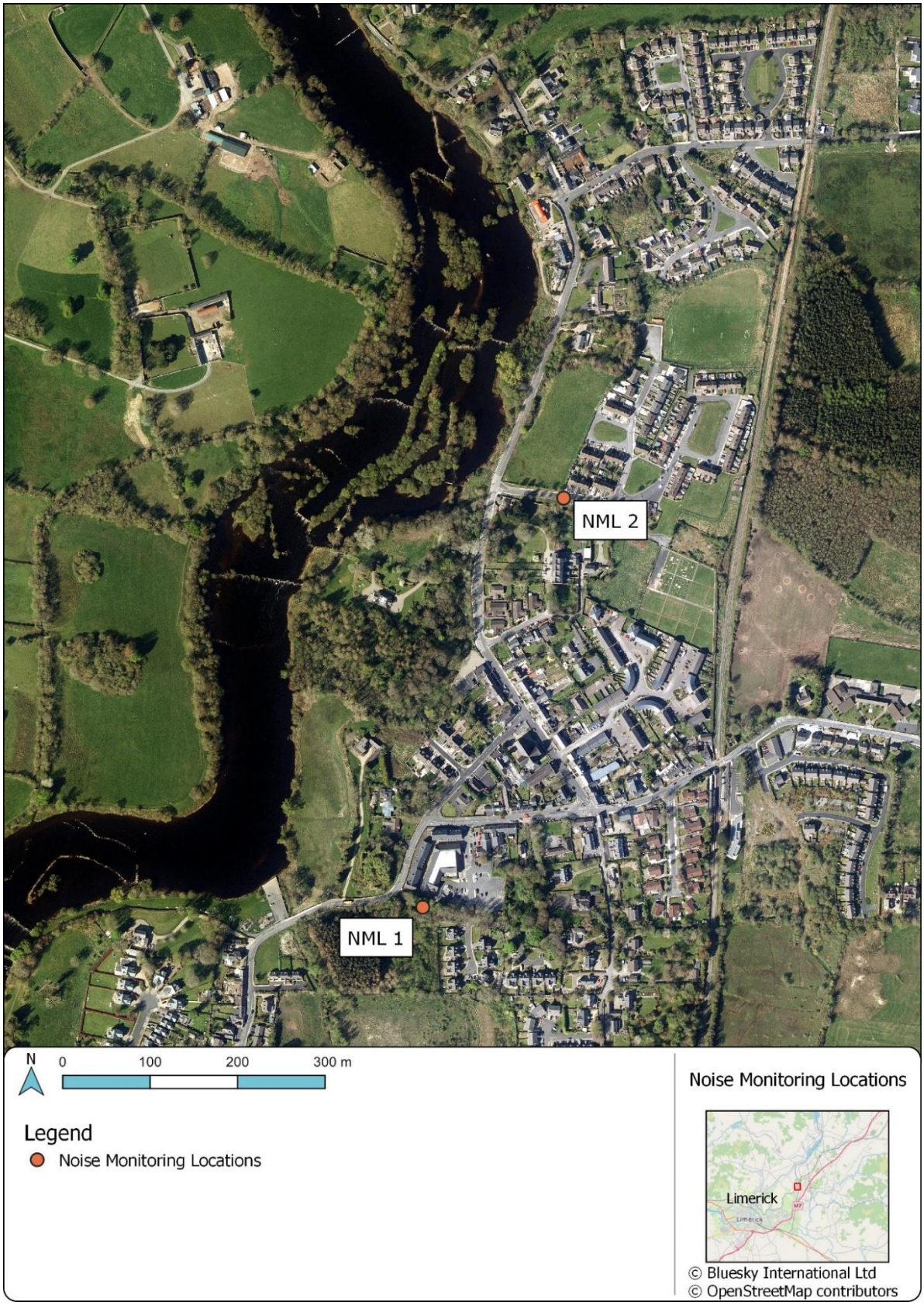

Figure 6-1: Noise Monitoring Locations (NML)

Table 6-16: Baseline Noise Levels

Location	Time	L_{Aeq}	L_{AMax}	L_{AMin}	L_{A10}	L_{A90}	Sources
NML 1	11:28	51.1	62.1	41.5	55	42.4	Passing traffic on Chapel Hill. Construction noise from Coolbane Wood area.
	11:58	51.8	66.9	40.1	54.7	41.8	
NML 2	12:41	56.8	72.6	44.7	60.8	45.3	Passing traffic on The Mall road and access to Scanlon Park
	13:11	54.7	71.3	44.6	56.3	47.2	

The baseline noise measurement data indicates that Castleconnell is a quiet village with passing traffic on the surrounding road network the dominant noise source.

6.2.3 Characteristics of the Proposed Development

A full description of all of the proposed works can be found in the EIAR Chapter 4, The Proposed Development. The main areas and works which are predicted to give rise to noise and vibration during construction of the Castleconnell Flood Relief Scheme are described below. The nature of proposed construction works in each area and the approximate distance to the nearest noise sensitive receivers are also summarised and assessed. It is expected that there will be no significant vibration impact during the construction of the proposed Castleconnell Flood Relief Scheme. However, there is sheet piling proposed at the flood walls at Rivergrove B&B and Grange House, and at the flood wall adjacent to No. 7 Meadowbrook Estate. Piling works are frequently one of the noisier aspects of construction.

As stated above, there will be no operational noise and/or vibration impact from the operation of the proposed Castleconnell Flood Relief Scheme.

6.2.4 Predicted Impact

Construction Phase

Noise impact as a result of the construction phase of the proposed flood relief scheme will be perceptible at nearby properties but this will be intermittent and temporary. Construction activities will not take place during night-time hours. The following construction practices have the potential to produce intermittent and temporary noise impacts:

- Site Clearance & Excavation - dozers, tracked excavators & dump trucks;
- Infilling / Levelling - Excavators, wheeled loaders, and rollers;
- Wall removal & construction - Concrete mixer trucks & delivery vehicles;
- General Construction - Masonry wall construction, etc.
- Road and pathway construction – Asphalt spreader, vibratory roller, etc.
- Information provided by JB Barry Engineers displayed in 6.1 section, Table 6-3, Table 6-4, and Table 6-5 have been used to determine the potential construction phase noise as follows:

- Total site area of works is 19,904.5 m^2
- The volume of excavated, backfilled and imported material is estimated to be 95,676 m^3 (Appendix 11.3)
- Total building volume 34,434m^3 (Appendix 11.4)
- During embankment works there will be a minimum of 8-10 HGVs active per hour
- During embankment and structural works there will be a minimum of 12-19 HGVs active per hour
- It is expected that HGV vehicle movements may be in the region of 12-19 vehicles per hour during the busiest period of construction works. Significant bulk excavation works and clay importation is anticipated at Coolbane Woods embankment, as well as the Stormont house embankment. This will generate the most HGV movements during the anticipated dig and replace works and be the busiest construction period. Therefore, there will be > 50 outward HDV trips in any one day.

Construction noise can be assessed in terms of the equivalent continuous sound level and/or in terms of the maximum level. The level of sound in the neighbourhood that arises from a construction site depends on a number of factors and the estimation procedures need to take into account the following significant factors;

- the sound power outputs of processes and plant;
- the periods of operation of processes and plant;
- the distances from sources to receiver;
- the presence of screening by barriers;
- the reflection of sound;
- ground attenuation;
- meteorological conditions (particularly wind speed and direction), and
- atmospheric absorption.

Typical noise levels from construction works likely to take place during construction phase of proposed flood relief scheme are outlined in Table 6-17.

Table 6-17: Typical Noise Levels from Construction Works likely to take place during the construction of proposed development

Ref No.	Equipment	A-weighted sound pressure level, L_{Aeq}, dB @ 10m
Table C.2 Sound level data on site preparation		
Clearing Site & Ground excavation/earthworks		
1	Dozer ж (142 kW, 20T)	75 ж
3	Tracked excavator (102 kW, 22T)	78
12	Dozer (142 kW, 20T)	80
14	Tracked excavator (226 kW, 40T)	79
Loading lorries		
27	Wheeled loader (493 kW)	80
Distribution of material		
30	Dump truck (tipping fill) (306 kW, 29T)	79
31	Dump truck (empty) (306 kW, 29T)	87
Rolling and compaction		
37	Roller (rolling fill) ж	79 ж
Table C.3 Sound level data on piling and ancillary operations		
Sheet steel piling - vibratory		
8	Vibratory Piling Rig	88
Table C.4 Sound level data on general site activities		
Distribution of materials		
1	Articulated dump truck ж	81 ж
Mixing & Pumping concrete		
20	Concrete mixer truck	80
Trenching		
63	Tracked excavator	77
Power for site cabins		
84	Diesel generator	74
Pumping water		
88	Water pump (diesel) (10 kW, 100Kg)	68
Sweeping and dust suppression		
90	Road sweeper (70 kW)	76
91	Dust suppression unit trailer	78
Table C.5 Sound level data on road construction works		
Breaking road surface & concrete		
1	Backhoe mounted hydraulic breaker	88
6	Hand-held pneumatic breaker	95

ж Drive-by maximum sound pressure level in L_{Amax} (overall level)

(Ref: BS 5228 Noise on Construction and Open sites)

It is most likely that the above outlined construction activities will occur separately throughout periods of construction at each works location. The proposed construction works will not be continuous over the construction period at any one location. By its nature, construction phases of such a proposed development are transient in terms of locations of precise activities on site from time to time. Therefore, the predicted worst-case $L_{Aeq,1\ hour}$ noise levels at specific locations have been outlined to present a worst-case range of noise levels that have the potential to occur at various stages throughout the construction period.

The predicted worst-case construction noise levels at specific locations in proximity to potential future construction works are summarised in Table 6-18.

Table 6-18: Predicted worst-case 1-hour construction noise levels at selected noise sensitive locations in proximity to short-term construction works.

Reference	Description	Likely Equipment / Plant expected to be required	Proximity of works to nearest receiver	Predicted Worst-case 1 Hour Noise Level $L_{Aeq/1\ hour}$
NSR 1	Works near to properties at Coolbane Woods. Embankment Construction to a height of ~2.5m.	1 No. Excavator, 1 No. Dump Truck (tipping fill), 1 No. Dozer	~20m (NSR 1)	79 dB(A) $L_{eq, 1\ Hr}$
NSR 2	Works near to properties at Coolbawn Meadows. Proposed low level wall and demountable barrier across Chapel Hill Road.	1 No. Excavator, Concrete wall construction	~20m (NSR 2)	75 dB(A) $L_{eq, 1\ Hr}$
NSR 3	Works near to properties at Meadowbrook Estate and single residential property. Embankment Construction to a height of ~2.5m.	1 No. Excavator, 1 No. Dump Truck (tipping fill), 1 No. Dozer	~20m (NSR 3)	79 dB(A) $L_{eq, 1\ Hr}$
		Sheet Steel Piling	~20m (NSR 3)	85 dB(A) $L_{eq, 1\ Hr}$
NSR 4	Works near to properties at The Mall. Proposed flood wall and new footpath.	1 No. Excavator, 1 No. Dump Truck (tipping fill), 1 No. Concrete Mixer Truck, Concrete wall construction, 1 No. Asphalt Spreader	~20m (NSR 4)	78 dB(A) Leq, 1 Hr
NSR 5	Works near to properties at The Elvers. Proposed flood wall.	1 No. Excavator, 1 No. Dump Truck (tipping fill), 1 No. Concrete Mixer Truck, Concrete wall construction,	~20m (NSR 5)	76 dB(A) Leq, 1 Hr
NSR 6	Works near to properties at The Rivergrove B&B. Proposed flood wall.	1 No. Excavator, 1 No. Dump Truck (tipping fill), 1 No. Concrete Mixer Truck, Concrete wall construction	~20m (NSR 6)	76 dB(A) Leq, 1 Hr
		Sheet Steel Piling	~20m (NSR 6)	85 dB(A) $L_{eq, 1\ Hr}$

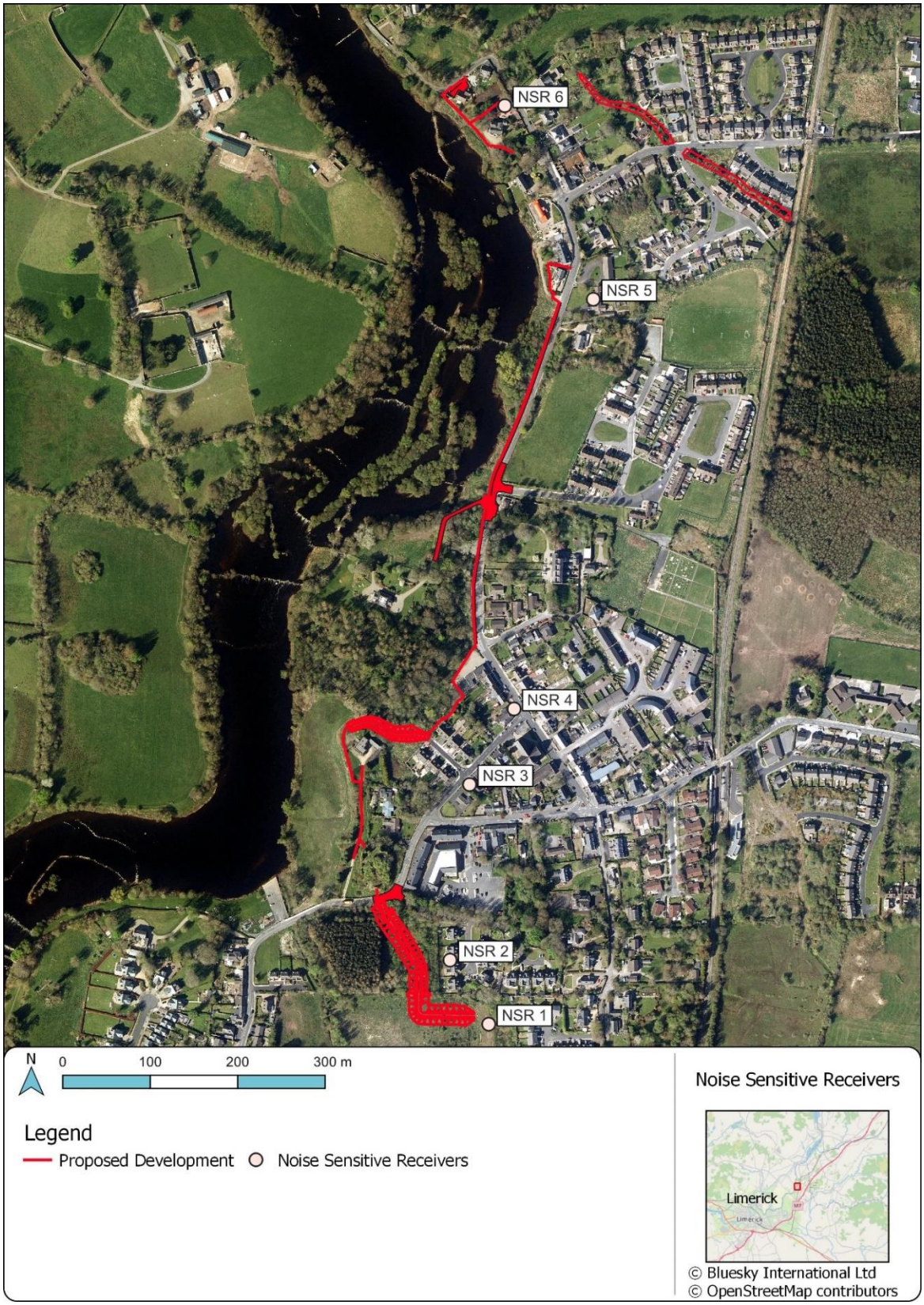

Figure 6-2: Selected noise sensitive receivers in proximity to proposed works.

Construction Noise Impact Significance

In accordance with the BS 5228-1:2009+A1: 2014 Noise and Vibration Control on Construction and Open Sites Part 1: Noise 'ABC method', the ambient noise levels (rounded to the nearest 5 dB) in the area of the proposed construction works range from 45 - 60 dB $L_{Aeq,T}$ during daytime. As a result, the noise sensitive receivers fall into Category A of the 'ABC' assessment methodology.

It is important to note that construction noise impacts will occur during daytime hours only and will be short-term at each area of construction along the proposed flood relief scheme. Not all construction noise sources will operate at once and construction noise levels are likely to vary throughout the typical working day.

A pragmatic approach needs to be taken when assessing the significance of noise effects of any construction project. The significance of the construction noise from the project has been determined by considering the change in the ambient noise level with the construction noise on-going. BS5228 states that noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient noise level plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB $L_{Aeq, Period}$, from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact. BS5228 also states that for public open space, impact might be deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise ($L_{Aeq, Period}$) by 5 dB or more for a period of one month or more.

Based on the BS5228 'ABC' assessment methodology, the contractor should aim to limit daytime construction noise to 65 dB $L_{Aeq,12\ Hour}$ at all works areas with the application of appropriate mitigation measures.

Based on the expected short-term duration of works at each location there will be a short-term noise impact at the nearest sensitive receivers to the proposed works. In some of the works areas, the predicted worst-case 1-hour construction noise levels may briefly be in excess of the recommended maximum noise level of 70 dB L_{Aeq} / 80 dB L_{AMax} at the nearest residential properties as outlined by the TII Guidelines (March 2014).

Noise from construction works will fluctuate throughout the course of a typical working day as well as over the course of the construction works being undertaken in any one location. Therefore, the daytime construction noise limit of 65 dB $L_{Aeq,12\ Hour}$ should be achieved at the nearest residential properties. The construction noise impacts will be short-term and will not be significant, as the works are most likely to occur in one area for less than 1 month.

Appropriate construction mitigation measures outlined below will be implemented as part of the Construction Environmental Management Plan (CEMP).

Construction Vibration at Sensitive Receivers

Construction vibration impacts have the potential to occur if piling works are undertaken in very close proximity to sensitive receivers. Piling works are proposed at the flood walls at Rivergrove B&B and Grange House, and at the flood wall adjacent to No. 7 Meadowbrook Estate. The 'press in' technique is a common method of sheet piling on sensitive sites as it produces less noise and vibration that traditional dynamic systems. The steel U sections are loaded onto the piling system and these sheets are gripped by a plier with varying pressure applied to the sheet pile to insert it into the ground. During piling, a vibration monitor with triaxial geophone shall be placed 3 - 5 meters from the piling location. The piling process takes several minutes for each sheet, dependent on ground type and conditions. Relevant vibration limits and guidelines can be divided into two categories, those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. Higher levels of vibration are typically tolerated for single events or events of short duration such as during construction projects

compared to permanent vibration from operational industrial sources. For example, blasting (an instantaneous activity) and piling (a repetitive/continuous activity), two of the primary sources of vibration during construction projects, are typically tolerated at vibration levels up to 12mm/s and 2.5mm/s, respectively. Accurate vibration level prediction is extremely difficult due to a significant number of variables that apply to such calculations, e.g., piling methods, ground conditions, etc. Therefore, the contractor should ensure that the guidelines which identify limits for protection against cosmetic damage as a function of vibration frequency are not exceeded through the use of the selected low vibration piling method and continuous monitoring of vibration levels during any piling that may have the potential to result in a vibration impact at nearby properties.

Operational Stage

There are a number of demountable flood defences, for which vehicles will be required to deploy these demountables and which may involve JCB or teleporter vehicles to transport pallets or erect defences. Similar applies to mobilising temporary sump pumps, road closure signage, etc. However, potential noise impacts from the short-term and infrequent use of such vehicles and pumps during periodic flood events is not possible to predict or quantify accurately. Therefore, the potential noise impacts during operational phase have not been considered for the proposed Castleconnell Flood Relief Scheme and can be expected to be short-term and insignificant. Therefore, there will be no operational noise impact.

6.2.5 Mitigation Measures

Construction Mitigation

Appropriate mitigation measures have been identified to ensure the Construction Phase target noise limits are not exceeded. The contractor will be required to implement the control measures recommended in BS 5228 and apply the appropriate measures where applicable. Other measures will include:

- Working hours during site construction operations will be restricted to daytime hours from 07:30 hours to 16:30 hours (Monday to Friday) and, as may be required, from 08.00 hours to 13.00 hours (Saturdays). Evening and night-time work is not expected to take place although it is possible that limited 24 hours working may be required to take place on occasion. This will only take place with the prior agreement of Limerick County Council.
- An on-site speed limit will be enforced for all traffic. Drivers of vehicles will be advised of the speed limits through the erection of signs *i.e*., a typically recommended on site speed limit is 10 km/hr.
- Where practicable, the use of quiet working methods and the most suitable plant will be selected for each activity having due regard to the need for noise control.
- Best practicable means will be employed to minimise noise emissions and will comply with the general recommendations of BS 5228. To this end operators will use "*noise reduced"* plant and/or will modify their construction methods so that noisy plant is unnecessary.
- By positioning potentially noisy plant as far as possible from noise sensitive receivers the transmission of sound can be minimised. Earth mounds and/or stockpiles of material or perimeter hoarding on site can be used as a physical barrier between the source and the receiver.
- Mechanical plant used on site will be fitted with effective exhaust silencers. Vehicle reverse alarms will be silenced appropriately in order to minimise noise breakout from the site while still maintaining their effectiveness.
- All plant will be maintained in good working order. Where practicable, machines will be operated at low speeds and will be shut down when not in use.
- Compressors will be of the "noise reduced" variety and fitted with properly lined and sealed acoustic covers.
- In all cases engine and/or machinery covers will be closed whenever the machines or engines are in use.
- All pneumatic percussive tools will be fitted with mufflers or silencers as recommended by the equipment manufactures. Where practicable, all mechanical static plant will be enclosed by acoustic sheds or screens.

- Employees working on the site will be informed about the requirement to minimise noise and will undergo training on the following aspects:
  - The proper use and maintenance of tools and equipment.
  - The positioning of machinery on-site to reduce the emission of noise to the noise sensitive receivers.
  - Avoidance of unnecessary noise when carrying out manual operations and when operating plant and equipment.
  - The use and maintenance of sound reduction equipment fitted to power pressure tools and machines.
- Cognisance will also be taken of the *Environmental good practice site guide* 2005 compiled by CIRIA and the UK Environment Agency. This guide provides useful and practical information regarding the control of noise at construction sites.
- Where excessive noise levels are recorded, further mitigation measures will be employed which may include temporary wooden hoarding / acoustic screening to be installed to a height of no less than 2m around areas of construction where loud noise levels occur.
- The contractor will ensure that the TII Guidelines which identify limits for protection against cosmetic damage as a function of vibration frequency are not exceeded through the use of the selected low vibration piling method.
- Responsible Person – The Contractor will appoint a responsible and trained person who will be present on site and who will be willing to answer and act upon complaints and queries from the local public.
- Night-time Working - If there are items of plant (*e.g.*, dewatering pumps and similar) in use during night-time hours they will be chosen, sited and enclosed such that levels at the nearest properties do not exceed the measured background noise levels.

Monitoring

Where deemed necessary due to excessive impact or complaints received, noise monitoring will be undertaken during construction works to determine noise levels at noise sensitive receivers. On the basis of the findings of such noise monitoring, appropriate noise mitigation measures will be implemented to reduce noise impacts.

The contractor will conduct continuous monitoring of vibration levels during any piling that may have the potential to result in a vibration impact at nearby properties.

Operational Mitigation

The proposed flood relief scheme will not result in a significant operational noise impact. Therefore, no operational mitigation measures are deemed necessary.

6.2.6 Residual Impacts

The assessment of construction noise impacts from the proposed flood relief scheme has indicated that construction noise limit criteria may be exceeded at the nearest residential properties for short periods during daytime. This may occur on occasions when heavy construction activity occurs in close proximity to noise sensitive receivers. Noise from construction works will fluctuate throughout the course of a typical working day as well as over the course of the construction works being undertaken in any one location. Therefore, the daytime construction noise limit of 65 dB $L_{Aeq,12\ Hour}$ should be achieved at the nearest residential properties. The construction noise impacts will be short-term and will not be significant. Also, while the overall construction activities for the proposed flood relief scheme will occur over several months, the nature of the proposed works and its duration at any one location will mean that noise sensitive receivers will not be exposed to continuous construction noise impact during the construction period.

Once the above mitigation measures have been implemented, the residual impacts from the development will not be significant.

6.2.7 Interactions with Other Environmental effects

The environmental effects of noise and vibration are interlinked with environmental impacts of

Population and Human Health, discussed in Chapter 7. Noise and vibration may create disruption to human physiological effects to human health. Vibration may also cause damage to building which can affect safety and wellbeing.

Appropriate construction phase mitigation measures have been outlined to ensure that the potential impact on the human receivers and the SAC will be negligible. Therefore, the noise and vibration impact in combination with other environmental effects e.g., direct loss of habitat, pollution, etc will result in a negligible effect on the SAC and any other habitats of significance.

6.2.8 Cumulative Effects

The proposed vehicular movements, construction machinery and piling during the construction phase has the potential to give rise to noise and vibration impacts, potentially giving rise to impacts on humans and fauna. Potential interactive negative impacts have been identified in Chapter 15, and a full suite of appropriate mitigation measures have been included in the relevant sections of the EIAR.

In relation to the in-combination construction and/or operational impact of the proposed Castleconnell Flood Relief Scheme, with other proposed schemes planned in the area, the list of schemes noted from the planning chapter have been reviewed. None of these schemes will result in any significant additional construction and/or operational noise and vibration impacts.

6.2.9 Difficulties Encountered in Assessment

No significant difficulties were encountered when preparing the Noise and Vibration impact assessment.

6.3 Climate

6.3.1 Assessment Methodology

This Chapter of the EIAR assesses the climate impact of the proposed development during Construction and Operational Phases.

This climate impact assessment has been prepared to assess the potential climate impact of the proposed flood relief scheme. It can be expected that the future operation of the proposed flood relief scheme will not have a significant climate impact. Therefore, the construction activities of the proposed flood relief scheme have been examined to identify those that have the potential to give rise to a short-term climate impact in terms of ‘embodied carbon’ and ‘construction activities’ carbon emissions.

The assessment and evaluation of the potential climate impact arising from the proposed flood relief scheme was based on reference to the relevant Transport Infrastructure Ireland (TII) Publications and TII Carbon Tool, for use in the assessment of climate effects for national road schemes and these are described in the SD and OTD for climate, as follows:

- Climate Assessment of Proposed National Roads, December 2022. This Standard Document (SD), PE-ENV-01105 sets out the required approach for Climate Practitioners to identify significant climate effects; in terms of both Greenhouse Gas (GHG) emissions and climate resilience, associated with all stages of proposed national road developments: the design, construction, and operation of national roads in accordance with TII’s project planning and national planning requirements.

- The methodology outlined in this SD and the theory of climate assessment are presented in an "Overarching Technical Document" (OTD), PE-ENV-01104. The OTD should be read in conjunction with this SD. The OTD provides best practice methodology and processes for climate assessment for proposed national road developments, as well as light railway and rural cycleways (offline & greenways) projects.
- Transport Infrastructure Ireland Carbon Tool for Road and Light Rail Projects: User Guidance Document, GE-ENV-01106.

In accordance with the TII Guidelines outlined above, the climate impact assessment has included a Greenhouse Gas (GHG) Assessment Process as follows;

- Using Table 3.21 Phase 2, Stage 2 GHG Assessment Instructions, it is a requirement to quantify available GHG data using the TII Carbon Assessment Tool. This process should include available major sources of GHGs provided to the climate practitioner by the project engineers including:
  - Cut and fill balance, etc.
  - Main materials for construction – these include pavement, earthworks, concrete, and steel, etc.

A Climate Change Risk (CCR) Assessment Process has been undertaken elsewhere in the EIAR in the form of detailed flood risk assessment, etc.

6.3.2 Assessment Methodology

Greenhouse Gas (GHG) Assessment

The GHG impact assessment for the proposed Castleconnell Flood Relief Scheme has been assessed using the TII Carbon Assessment Tool. The Carbon Assessment Tool has been used for the calculation of emissions arising from the construction of the proposed Castleconnell Flood Relief Scheme. The Carbon Assessment Tool aligns with TII's project phases as well as (PAS) 2080 Carbon Management in Construction (BSI, 2016). [2]The tool includes an emission factors library using factors developed by relevant industry bodies. The outputs from the Carbon Assessment Tool allow for comparison and evaluation of the lifecycle carbon impacts for any given national road project.

Using the Transport Infrastructure Ireland (TII) Carbon Tool for Road and Light Rail Projects[3]: Guidance, the lifecycle carbon emissions for the flood relief scheme have been calculated. The calculation tool for lifecycle carbon emissions assesses various stages of the project as follows;

- "**Pre-Construction"** stage considers activities that will take place at the pre-construction stage of a project, specifically clearance and demolition works.
- **"Embodied Carbon"** stage considers the product stage, including materials that will be used during the construction process, their lifetime (to determine replacement cycles) and details of material transportation.
- **"Construction Activities"** stage considers construction activities that will take place during infrastructure development, including excavation activities, energy use of construction activities, water use and landscaping and vegetation.

[2] British Standards Institution (BSI). (2016) *PAS 2080: Carbon Management in Infrastructure*. Available at: https://www.bsigroup.com/siteassets/pdf/en/insights-and-media/insights/brochures/pas_2080.pdf

[3] GE-ENV01106 (2024) *Transport Infrastructure Ireland Carbon Tool for Road, Greenway and Light Rail Projects: User Guidance Document. Available online: https://www.tii.ie/media/muioiouu/ge-env-01106-02.pdf*

- The **"Operational Use Carbon"** stage considers emissions associated with the operation of the infrastructure scheme such as energy, water and waste
- The **"Operational Carbon Emissions"** of a project considers emissions associated with the use of the scheme.
- The **"Maintenance Carbon"** stage of a project considers emissions associated with the fuel used for the maintenance of the infrastructure scheme during its use.
- "**End of Life Carbon**" stage considers the decommissioning of the scheme, including deconstruction and demolition activities and waste disposal.

During the construction phase of the proposed Castleconnell Flood Relief Scheme, GHG emissions will potentially be generated by site preparation works, excavation, infilling works, construction activities, energy usage, etc.

During the operational phase for the proposed Castleconnell Flood Relief Scheme, no significant climate impacts will result from carbon emissions. There are a number of demountable flood defences, for which vehicles will be required to deploy these demountables and which may involve JCB or teleporter vehicles to transport pallets or erect defences. Similar applies to mobilising temporary sump pumps, road closure signage etc. However, the emissions from the short-term and infrequent use of such vehicles and pumps is not possible to quantify accurately. Therefore, the potential climate impacts in terms of carbon emissions (tCO_{2e}) during operational phase have not been considered for the proposed Castleconnell Flood Relief Scheme and can be expected to be insignificant.

6.3.3 Baseline Environment

Baseline Climate Survey

'Ireland, National Inventory Report 2023' as published by the EPA in March 2023[4], indicates that in 2021, total emissions of greenhouse gases including indirect emissions from solvent use (without LULUCF) in Ireland were 62,109.9 kt CO_2 equivalent and the total with LULUCF 69,448.1 kt CO_2 equivalent. This value is 11.6% higher than emissions in 1990 but the total for 2021 is 13.5% lower than the peak of 71,814.5 kt CO_2 equivalent in 2001 when emissions reached a maximum following a period of unprecedented economic growth.

[4] Environmental Protection Agency (EPA). (2023) *Ireland's National Inventory Report 2023*. Available at: https://www.epa.ie/publications/monitoring--assessment/climate-change/air-emissions/2023-EPA-Provisional-GHG-Report_Final_v3.pdf

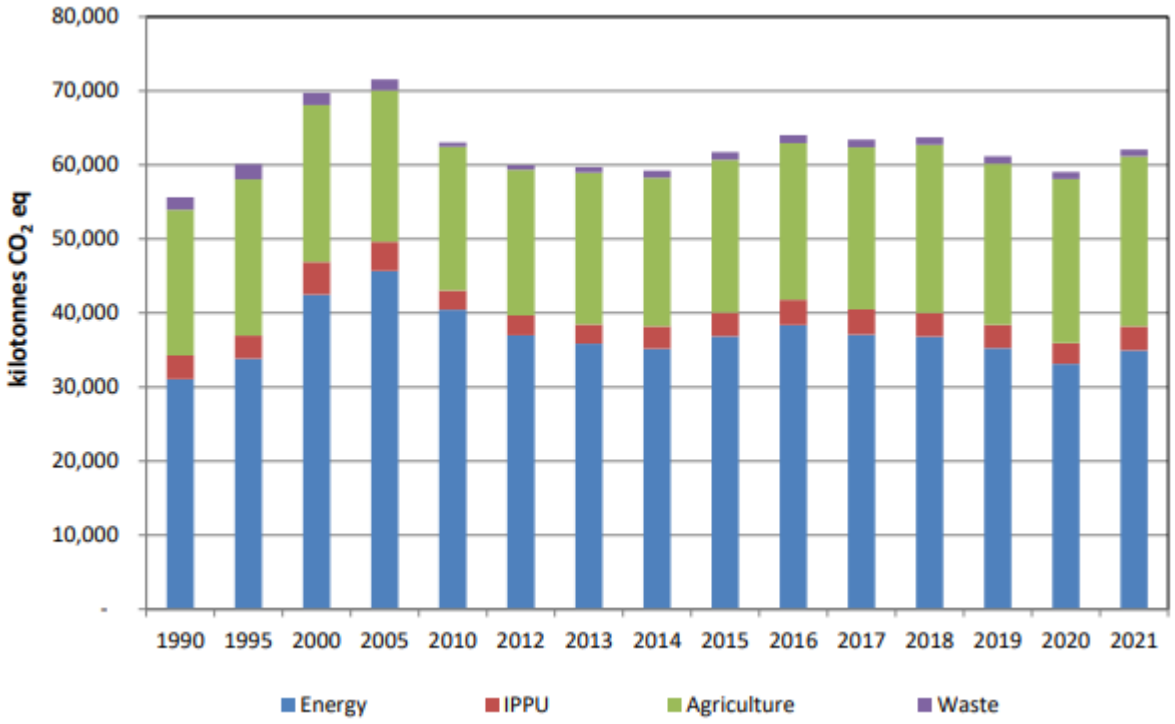

Figure 6-3: National Total GHG emissions (excl. LULUCF) 1990-2021 (EPA 2023)

The Governments Climate Action Plan 2023 (CAP23) is the second annual update to Ireland's Climate Action Plan 2019. This plan is the first to be prepared under the Climate Action and Low Carbon Development (Amendment) Act 2021, and following the introduction, in 2022, of economy-wide carbon budgets and sectoral emissions ceilings. The plan implements the carbon budgets and sectoral emissions ceilings and sets a roadmap for taking decisive action to halve our emissions by 2030 and reach net zero no later than 2050, as we committed to in the Programme for Government.

CAP 23 outlines that Flood Risk Management is the responsibility of the Office of Public Works and Chapter 22. Adaptation outlines the following actions in Section 22.6 Actions. The detailed implementation maps for actions, including timelines and responsible organisations, are set out in the accompanying Annex.

Action Number	Action
AD/23/2	Produce guidance on the assessment of adaptation measures and the development of Climate Change Adaptation Plans for past and new flood relief schemes.
AD/23/3	Update the existing Minor Works Programme to ensure applications consider the potential impacts of climate change and, where necessary, that any measures proposed provide for, or are adaptable to, possible future changes in flood risk

6.3.4 Characteristics of the Proposed Development

A full description of all the proposed works can be found in the EIAR Chapter 4, The Proposed Development. The main areas and works which are predicted to give rise to climate emissions during construction of the Castleconnell Flood Relief Scheme are described below. The nature of proposed construction works and quantity of materials to be used has been assessed.

As stated above, there will be no significant operational climate impact from the operation of the proposed Castleconnell Flood Relief Scheme.

6.3.5 Predicted Impacts

Construction Stage

The quantification of carbon emissions and the associated climate impact as a result of the construction phase of the proposed flood relief scheme has been based on the following construction quantity information provided by JB Barry Engineers provided in Table 6-3, Table 6-4 and Table 6-5.

As provided in the sections 6.1 and 6.2 above the assessment of the impacts is done based on the summarized construction activity below:

- Total site area of works is 19,904.5 m^2
- The volume of excavated, backfilled and imported material is estimated to be 95,676 m^3 (~64,000 tonnes, i.e. a material density of ~1500 kg/m^3 for clay materials.)
- Total building volume 34,434m^3
- During embankment works there will be a minimum of 8-10 HGVs active per hour
- During embankment and structural works there will be a minimum of 12-19 HGVs active per hour
- It is expected that HGV vehicle movements may be in the region of 12-19 vehicles per hour during the busiest period of construction works. Significant bulk excavation works and clay importation is anticipated at Coolbane Woods embankment, as well as the Stormont house embankment. This will generate the most HGV movements during the anticipated dig and replace works and be the busiest construction period. Therefore, there will be > 50 outward HDV trips in any one day. In terms of carbon emissions, this has been assessed assuming 20 litres of fuel usage per hour, for 10 hours per day and for 90 days of continuous operations.

Construction Phase

Table 6-19 outlines the Total Greenhouse Gas Emissions predicted from the construction phase of the proposed development assessed by using the TII Carbon Tool. This includes material embodied carbon calculation and emissions coming from the construction activities (including machinery operation, and energy use and waste management during construction).

Table 6-19: Total Greenhouse Gas Emissions (tonnes CO2 equivalent) due to the construction phase

Name	Pre-Construction	Embodied Carbon	Construction Activities	Construction Waste	Operational Use	Total (t CO_2 equivalent)
Castleconnell FRS	0	711.9425	117.9527	0	0	829.8952

Therefore, as a percentage of 2021 Annual Carbon Emissions of 69,448.1 kt CO_2 equivalent, the proposed Castleconnell Flood Relief Scheme will account for 0.00119% of annual CO_2 emissions. This represents a **negligible** impact.

Operation Phase

There will be no operational climate impact from the operation of the proposed Castleconnell Flood Relief Scheme. The proposed development will provide tangible benefits in terms of reduced flood impacts, and a reduction in financial loss and disruption. Potential emissions from the short-term and infrequent use of vehicles and pumps during periodic flood events is not possible to quantify accurately and will be miniscule. Therefore, the potential climate impacts in terms of carbon emissions (tCO_{2e}) during operational phase of the FRS are considered to be insignificant and therefore their assessment is not considered and excluded.

6.3.6 Mitigation Measures

Construction Mitigation

As no significant adverse effects are predicted to occur during the construction phase, no specific construction phase mitigation measures are required.

Operational Mitigation

The proposed flood relief scheme will not result in a significant operational climate impact. Therefore, no operational mitigation measures are deemed necessary. No specific construction or operation phase mitigation measures have been outlined for the proposed flood relief scheme. A Climate Change Risk (CCR) Assessment Process has been undertaken elsewhere in the application in the form of detailed flood risk assessment in the Options Report.

6.3.7 Residual Impacts

As no significant adverse effects are predicted to occur during the construction or operation phase, no specific climate effects are predicted.

6.3.8 Interactions with Other Environmental effects

Land and soil, discussed in chapter 9. Interaction of land and soil effects are interlinked with climate due to sequestered carbon released from excavation. Based on the above assessment these

6.3.9 In Combination Effects

The construction machinery and processes may generate GHG emissions during the construction phase of the proposed development. These emissions have been assessed using the TII Carbon Tool. Regarding the combined construction and operational impacts of the proposed FRS and other planned schemes in the area, a review of the schemes listed in Chapter 15 was conducted. This review concluded that none of these schemes will result in significant additional GHG emissions

6.4 Difficulties Encountered in Assessment

No significant difficulties were encountered when preparing the Construction Impacts chapter.

7 Population and Human Health

7.1 Introduction

This chapter describes the likely impacts of the proposed FRS on the human environment including the potential effects on human health and disruptions to the population of Castleconnell and the surrounding area. This chapter primarily addresses the potential effects of the proposed scheme on human health, demographics, receptors such as schools and existing community facilities, and recreation and tourism. Other sections of the EIAR, such as Construction Impacts (Chapter 6), are closely linked to effects on population and human health. All these sections should be read to gain a full understanding of the impacts on human health.

7.2 Assessment Methodology

This chapter has been prepared having regard to the EIA Directive 2014/52/EU and the associated Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA, 2022), as well as the Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment, 2018. It is noted that Article 3 of the 2014 Directive effectively defines the EIA process as identifying, describing and assessing in an appropriate manner, in the light of each individual case, the direct and indirect significant effects of a project on a series of specified environmental factors. The first of these is “population and human health” which replaces “human beings” in the 2011 Directive. The term “human health” is not defined in the 2014 Directive.

Consideration of human health effects resulting from the construction and operation of a project should focus on health issues arising in the context of the other environmental factors listed in Article 3 of the Directive/ Section 171A of the Act, namely:

- Population;
- Biodiversity, with particular attention to protected species and habitats;
- Land, soil, water, air and climate;
- Material assets, cultural heritage and the landscape; and
- Interaction between the above factors.

European Commission guidance relating to the implementation of the 2014 Directive, in reference to “human health” states “*Human health is a very broad factor that would be highly Project dependent. The notion of human health should be considered in the context of other factors in Article 3(1) of the EIA Directive and thus environmentally related health issues (such as health effects caused by the release of toxic substances to the environment, health risks arising from major hazards associated with the Project, effects caused by changes in disease vectors caused by the Project, changes in living conditions, effects on vulnerable groups, exposure to traffic noise or air pollutants) are obvious aspects to study. In addition, these would concern the commissioning, operation, and decommissioning of a Project in relation to workers on the Project and surrounding population*”.

A desktop study has been carried out to establish the baseline associated with economic activity, employment opportunities, settlement and social patterns. Noise and dust generation during construction has been assessed in the Construction Impacts chapter.

The proposed development site is located within the Castleconnell Electoral Division. Baseline information with respect to the demographic and employment characteristics of the resident population within the area was sourced from the 2022 Census from the Central Statistics Office. The data included information on population, structure, age profile, and household size, number of persons at work and employment profile. Information was also sourced from the Limerick Development Plan 2022-2028.

7.3 Receiving Environment

7.3.1 Site Description

Castleconnell is situated approximately 10 kilometres northeast of Limerick City, between the M7 motorway and the River Shannon. Its hinterlands are the rural area between it and Limerick City's suburbs. The Village centre is approximately 1 kilometre from the R445, the former national Limerick-to-Dublin route. County Limerick and County Clare are separated by the River Shannon, which flows through the Village. Along the banks of the River Shannon, the Village has developed linearly roughly north to south, with the main street running parallel to the river.

Castleconnell is regarded as one of the critical areas for tourism and for related activities such as fishing, boating, sailing, and riverside walks. According to the Limerick Development Plan 2022-2028, the population of the Castleconnell area is projected to increase by 28% by 2028, from the Census 2016 base of 2,107. There is sufficient land zoned for residential use in Castleconnell to accommodate this increase.

The areas around Castleconnell Village are primarily in use as agricultural pasture.

7.3.2 Demographics

The smallest geographical units distinguished by the Central Statistics Office (CSO) are Electoral Districts (EDs) and Small Areas (SAPS).

Table 7-1 outlines the population change between 2016 and 2022 in the State, in Limerick, and Castleconnell. This Table demonstrates the population increases are largely consistent across all regions, with Castleconnell experiencing the same percentage increase in population as across the State, while Limerick slightly lower.

Table 7-1: Population Trends between 2016 and 2022

District	2016	2022	Change from 2016-2022 (%)
State	4,761,865	5,149,139	+8.1
Limerick City and County	194,899	209,536	+7.5
Castleconnell	3,332	3,607	+8.25

The majority of the population of Castleconnell are in the age 20-64 age group, with 2,011 of the 3,607 people in that group (55.75%).

Age cohort	Population No.
Pre-school children (0 to 4 years)	196 (5.43%)
School children (5 to 19 years)	835 (23.15%)
Adults (20 to 64 years)	2,011 (55.75%)
Adults over 65	565 (15.66%)

Households

Table 7-2 below outlines the average household size in each of the geographical areas assessed. The statistics illustrate that Castleconnell has followed the State-wide trend of a very slight decrease in household size, with Limerick increasing over the same period.

Table 7-2: Average Household Size (persons per household)

District	2016	2022
State	2.75	2.74
Limerick	2.47	2.70
Castleconnell	2.78	2.75

There were 1,298 households in Castleconnell Electoral Division in 2022.

Employment

Recent trends in employment were evaluated using CSO information generated from the 2011 and 2016 Census statistics. The information was compiled on the basis that:

- The labour force is defined as the sum of people aged 15 years and over who are at work or who are employed; and
- The participation rate is the proportion of persons in the labour force aged 15 years and over expressed as a percentage of all persons in that age group.

Statistics shown in Table 7-3 below outlines the employment figures for Limerick City and County Council, and Castleconnell.

Table 7-3: Employment Figures for Limerick and Castleconnell

Area	At Work		Unemployed (ex 1st time job seekers)		% Rates of Participation in Labour Force	
	2016	2022	2016	2022	2016	2022
Limerick	89,862	101,594	63,962	67,117	57.9	59.8
Castleconnell	1,575	1,763	941	1,047	62.3	62.2

This indicates that the number at work in Castleconnell increased during that period, though at lower rates than the county-wide trend.

Table 7-4: Distribution of employment by broad industrial group in Limerick and Castleconnell (Number of persons aged 15 and over) 2022

Industry	Limerick	Castleconnell
Administrative and Secretarial Occupations	8,189	143
Associate Professional and Technical Occupations	9,929	211
Caring, Leisure and Other Service Occupations	7,213	144
Elementary Occupations	7,777	122
Managers, Directors and Senior Officials	6,350	153
Process, Plant and Machine Operatives	7,118	120
Professional Occupations	19,108	395
Sales and Customer Service Occupations	6,077	88
Skilled Trades Occupations	12,604	173
Not stated	13,469	138
Total	97,834	1,687

The majority of employment in Castleconnell in 2022 is in professional occupations and technical occupations.

General Health

The population was surveyed in the 2022 Census and asked if they considered their health to be bad or very bad. 63 people in Castleconnell answered bad or very bad, or 1.75% of the population.

7.3.3 Principal Potential Receptors

An assessment of the principal potential receptors within the environs of the proposed development including homes, schools, tourism, agriculture and commercial and industrial premises was conducted in detail below.

Homes

According to the most recent 2022 census, Castleconnell contains 1,298 dwellings, the vast majority (1,251) being houses or bungalows. There are a small number of flats or apartments (45), and 1 bed-sit and 1 caravan/mobile home.

The following housing estates and houses will be affected by the flood relief scheme;

- Meadowbrook – 12 properties will have restricted access during the works, access through Meadowbrook will be necessary for the construction phase of the embankment and floodwall.
- Coolbane Wood – 11 properties will be affected by a Stop-And-Go traffic management system implemented at the junction of Coolbane Wood and Chapel Hill.
- Scanlon Park – 85 properties will be affected by a Stop-And-Go traffic management system at the junction of Scanlon Park and the Mall Road during the construction phase.
- Properties off The Mall Road – there are 11 properties located at the northern section of the proposed development.
- Cedarwood Grove, The Commons, and Castle Court – approximately 35 properties in these areas are close to the proposed works located along the Cedarwood Stream.

Along with these groups of properties, homes in other parts of Castleconnell will also potentially be affected during the construction and/or operation of the scheme.

Schools

There is one school located 461m from the proposed development. This is shown in Table 7-5.

Table 7-5: Educational facilities in the area

School type	Name
Primary school	Castleconnell National School

Childcare Facilities

There are three childcare facilities within Castleconnell, all located within 360m of the proposed development:

- Castle Creche, Coolbawn Meadows, off Station Road
- ACM Kids, 14-15 Castle Street
- Sunny Lane Creche, Main Street

Health, Social, Community, and Recreational Facilities

There are several health, social, community and recreational facilities in Castleconnell. These are outlined in the table below.

Table 7-6: Health, Social, and Community Facilities in Castleconnell

Name	Address
Medical Facilities	
Castleconnell Medical Practice	Main Street, Castleconnell
Social Facilities	

Enable Ireland, Adult Services Hub	Coolreiry, Railway Rd
Riverbrook Nursing & Respite Care	Stradbally North, Castleconnell
Churches	
St. Joseph's Catholic Church	Main Street **Castleconnell**
Community Facilities	
Lisnagry FC	66 Scanlon Park Castleconnell
River Leisure	Stradbally North**,** Castleconnell
Castleconnell Boat Club	World's End, Lacka
Rivergrove House B&B	Lacka, Castleconnell
Castle Oaks House Hotel	Stradbally, Castleconnell

The River Shannon itself is an amenity in Castleconnell, with the footpath along the Mall and the open space at The Ferry Playground, just south of Chapel Hill, providing opportunities for walking and scenic views of the River Shannon. The Ferry car park also offers an access point to the River Shannon for watersports groups. The road from Charcos Pub to Castleconnell Boat Club to the north, known locally as "Worlds End" is a popular walking route among locals.

7.4 Predicted Impacts

7.4.1 Do Nothing Scenario

Under the Do-Nothing Scenario, it is likely that flooding will continue to occur in Castleconnell. Flooding has the potential to affect up to 50 homes, as well as the identified businesses, health, social and community facilities, as well as recreational facilities.

Flooding is likely to compromise human health directly through destruction of property, and indirectly through social and economic damages.

Impacts to population and human health under the do-nothing scenario, through continued flooding in Castleconnell, would be **significant to profoundly negative, long-term.**

7.4.2 Construction Phase

The potential construction phase impacts on local residences and businesses associated with the proposed development will relate mainly to traffic, noise, air emissions and visual impacts, all of which are outlined in Chapter 6 (Construction Impacts), Chapter 11 (Material Assets), and Chapter 13 (LVIA) of this EIAR.

During construction there is a risk to the health and safety of workers on the development, as with any construction project. There is also potential for negative impacts and disturbance to the community from construction.

Impacts on Economic Activity

During the construction phase, construction workers will be employed at the site and their potential use, both personal and business-related, of local retail, leisure and accommodation services will potentially stimulate economic activity for local businesses. In addition to direct construction employment, it is anticipated that the proposed project will lead to indirect employment via related services during the construction phase.

The impact on economic activity during construction will be **temporary positive.**

Impacts on Human Health and Safety

As with any construction site there will be potential risks to the health and safety of construction personnel on-site due to the use of large, mobile machinery and heavy equipment and materials. However, health and safety procedures will be put in place as part of the construction management plan with the appointed contractor. There will be no significant offsite health and safety risks, and the proposed development site will be securely fenced from the public during the construction phase.

The impact on human health and safety during construction will be **temporary, imperceptible, negative.**

Impacts on Residential, Recreational, Commercial, and Community Amenity

The construction phase of the development will impact on residential, recreational, commercial, and community amenity in Castleconnell as outlined above and through construction-specific impacts outlined in Chapter 6. Procedures will be put in place to address local concerns as part of the construction management plan with the appointed contractor. Impacts to access and roads and traffic will also occur, as outlined in Chapter 11 Material Assets.

This impact will be **temporary slight negative.**

7.4.3 Operational Phase

Once operational, the proposed development will not result in significant negative impacts for population and human health. **Long-term positive impacts** are likely from the operation of the scheme as it will increase the level of flood protection for people's homes and businesses.

The proposed relief scheme will introduce new infrastructure to the Castleconnell area, in the form of; embankments, road raising, demountable and flood barriers. The works on the Mall Road will also result in a slightly narrower road width and slightly wider footpath width, a positive for pedestrians and general human health for locals in the area as it will improve safety along the road. Temporary and intermittent impacts are expected during periods of flooding where demountable flood barriers will be in place resulting in disruption and road diversions. The operation of these barriers will result in an **intermittent slight negative** impact however this will be outweighed by the **positive impact** they will have by providing flood protection.

7.5 Mitigation Measures

7.5.1 Construction Phase

While under construction, there will be potential risks to the health and safety of construction personnel. A comprehensive Health and Safety Programme will be put in place on the site prior to commencement of construction to minimise any risks to site personnel and visitors. The requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013) will be complied with at all times. A Construction Stage Traffic Management Plan will be developed and agreed with Limerick City & County Council and the relevant property owners prior to commencement of the works.

The following mitigation measures are proposed during the construction phase:

- During pre-construction and construction phases safety will be managed in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013). A Project Supervisor Construction Stage (PSCS) will be appointed as part of the proposed project;
- Safety will be a primary concern during the construction phase of the proposed FRS. A contractor safety management program will be implemented identifying potential hazards associated with the proposed work including a permit to work system;

- The design of the final proposal will be subject to safety design reviews at each stage with all relevant risk summarised in the Design Risk Assessment. A Project Supervisor for the Design Process (PSDP) has been appointed as part of this process;
- Temporary contractor facilities and areas under construction will be enclosed and fenced off from the public with adequate warning signs of the risks associated with entry to these facilities. Entry to these areas will be restricted and will be kept secure when construction is not taking place;
- Measures to ensure public safety with respect to air quality and dust, and noise and vibration, are detailed in Chapter 6; and
- Measures to ensure public safety with respect to construction traffic are detailed in Chapter 11.

7.5.2 Operational Phase

When the scheme is operational, a maintenance and monitoring schedule will be put in place to verify that the proposed flood defences are operating to the appropriate design standard. Repairs will be made as necessary. This will ensure that there is no risk to human health as the scheme ages.

Four demountable flood barriers are required as part of the proposed development. These barriers will be put in place only when flood events require them. The frequency of these flood events has been calculated by the design team. The demountable barriers will be in operation at the following locations approximately;

- Dunkineely House – Events greater than the 1 in 2-year event
- Fisherman's Entrance – Events greater than the 1 in 2-year event
- Island House – Events greater than the 1 in 10-year event
- Chapel Hill – Events greater than the 1 in 10-year event

There will be a traffic management plan in place during the road closure at Chapel Hill and warning signage leading up to the closure. The diversion route will be signposted. The diversion route will be via Stradbally North, Belmont Road, R525 and Railway Road. The Belmont Road will begin to flood in the 1/5 year event approximately, a longer diversion route is necessary via the Hermitage before joining the R525 c. 2km further south. This route will also be signposted when relevant.

The proposed FRS has been designed so that guarding heights are at an appropriate level (1.2m), along flood defence walls (1.1m at lower points on The Mall), and that embankments are sloped gently, to ensure that there is no risk of injury arising from typical use of walls, or embankments during maintenance.

7.6 Residual Impacts

7.6.1 Do Nothing Scenario

The nature of the development is to protect homes and businesses from flooding, as floods have been known to cause significant damage in Castleconnell in the past. If the proposed development does not go ahead, flooding is likely to continue impacting Castleconnell into the future.

Under the Do-Nothing Scenario the impact on population and human health is likely to be **significant to profoundly negative**, with residual impacts lasting into the long-term.

Construction Phase

While under construction, there will be a positive benefit to employment in Castleconnell, which can have cascading effects for local businesses as a result of the increased number of workers in the area. There will be potential risks to the health and safety of construction personnel. Mitigation measures in place include adequate Health and Safety standards to ensure that no injury or accidents occur during the construction phase. The population of Castleconnell will experience disruptions to daily life and to their recreational facilities due to associated impacts on Traffic, Air, Noise, and the Visual amenity

during the construction phase. Mitigation measures are described further in associated chapters of the EIAR. These impacts will be temporary and lasting only a part of the duration of the construction phase (i.e., most locations will not be disrupted for the entire 18- 24 months of construction). The residual impact of the construction phase on population and human health is predicted to be **temporary, imperceptible, negative.**

Operational Phase

The nature of the development is to protect both homes and businesses from flooding, and to improve surface water drainage on the island. There is potential as a result of the proposed FRS for Castleconnell to become more desirable as a residential and business area due to the reduced risk of flooding. There will be a slight reduction in visual amenity for Stormont House which will experience reduced visibility to the open area of the SAC due to the new embankment. Rivergrove and Grange House at the northern end of the scheme will also experience a partial loss of view, however this will be partially mitigated by the use of glass panels in the flood walls to maintain key views, as agreed with the relevant landowners and discussed in Chapter 13. The residual impact to population and human health during the operation of the scheme is predicted to be **positive, with long term effects.**

7.7 Interactions

The environmental effects on population and human health are interlinked with the environmental effects of:

- Chapter 6 – Construction impacts
  - Significant quantities of dust or impacts to air quality could lead to negative effects for population and human health in Castleconnell. There are no significant negative interactions expected, as the effect from air quality and dust as outlined in the Construction Impacts chapter will be negligible.
  - Excessive noise or vibration during construction could interact negatively with population and human health in Castleconnell or the surrounding area. Mitigation measures outlined in the Construction Impacts chapter will ensure that the impact of noise and vibration on population and human health will not be significant.
- Chapter 10 – Surface and Groundwater
  - Impacts to water quality could negatively interact with population and human health, due to either impacts to drinking water, or the amenity value of the River Shannon at Castleconnell. Negative interactions with population and human health are not expected to occur, due to the mitigation measures to be put in place for the protection of water, and residual impacts to water being slight negative to imperceptible.
- Chapter 11 – Material Assets
  - Impacts to material assets, in particular to utilities or roads, traffic, and transport, could lead to interactions with population and human health if significant or allowed to go on for a long time. They have the potential to affect the population of Castleconnell and their daily activities during the construction phase, and during operation when the demountable flood barriers are in place.
  - During construction, there will be short disruptions to utilities which will inconvenience a small number of people in Castleconnell. These will be communicated to residents in advance and will be kept to the shortest time possible. The overall impact of these disruptions, with mitigation measures in place as outlined in Chapter 11, will be temporary and imperceptible.
  - During construction, temporary disruptions to traffic and access due to both full and partial road closures will occur. This will lead to temporary negative impacts for residents and people passing through Castleconnell, as outlined

in Chapter 11. With mitigation measures in place as outlined in Chapter 11, the overall negative impact on population and human health due to interactions with roads, traffic, and transport will be temporary, slight, negative.

- Once operational, there will be an intermittent impact on roads, traffic and transport due to the use of demountable flood barriers during flood events in Castleconnell. When the demountable flood barriers are in place, there will be a slight negative interaction with population and human health. This will be mitigated against by advance warning systems, and the availability of alternative routes.

All mitigation measures outlined in the respective chapters of this EIAR will be implemented in full to ensure the potential impact is minimised in relation to traffic, noise and vibration, air quality and water.

7.8 Potential Cumulative Impacts

Several developments are proposed or under construction in the area of Castleconnell, as outlined in Chapter 15. If the construction periods of these developments are to overlap, there is a potential to impact on population and human health through disruptions Castleconnell. These effects will be **temporary** while the construction phase progresses and will **not be significant**.

Once operational, the proposed FRS, when considered cumulatively with the above developments, will have a **positive impact** on population and human health.

8 Biodiversity

8.1 Introduction

This chapter assesses the impacts of the proposed Castleconnell Flood Relief Scheme, (hereafter referred to as 'the proposed Scheme') on biodiversity during the construction and operation phases.

This chapter provides an overview of the assessment and field methodologies; receiving ecological environment; a description of the nature and scale of any potential significant direct or indirect impacts; and any necessary mitigation and biodiversity enhancement measures recommended as part of this EIAR.

Castleconnell is located on the freshwater section of the old River Shannon. Ecological receptors within the study area can be strongly linked to the water environment and hydromorphological factors, and this chapter will give cognisance to the inter-relationships between these aspects, in particular.

This Chapter should be read in conjunction with the Natura Impact Statement (NIS)[5] that has been carried out for this Scheme.

8.1.1 Methodology

Study Area

The study area of the proposed Scheme was defined by the findings of the desk study (presence/absence of protected habitats, flora or fauna within the Zone of Influence (ZoI)) and best practice methodology for assessing effects on those ecological features. In general, surveys were conducted for each of the ecological receptors within specific geographical areas; and focussed on assessing potential impacts within the ZoI of the proposed Scheme.

This assessment has had regard to the following policy, legislation and guidance documents.

Relevant Guidelines, Policy and Legislation

The biodiversity assessment included a comprehensive review of the following documents:

- The Planning & Development Act 2000 & the Planning and Development (Amendment) Act, 2010 (as amended) hereafter referred to as the Planning Acts.
- Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).
- Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive).
- Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 as amended by Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 on the assessment of the effects of certain public and private projects on the environment.
- European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011) (as amended).
- EU Water Framework Directive (2000/60/EC) and European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003).
- OPR Practice Note PN02 Environmental Impact Assessment Screening (OPR, June 2021).

[5] JB Barry, JBA (2023). *Castleconnell Flood Relief Scheme Natura Impact Statement*. Unpublished

- Guidelines for planning authorities and An Board Pleanála on carrying out environmental impact assessment (Department of Housing, Planning and Local Governments, August 2018);
- Guidelines on the information to be contained in Environmental Impact Assessment Reports (Draft) Environmental Protection Agency (EPA, 2022);
- Guidelines for Assessment of Ecological Impacts of National Road Schemes (NRA, 2009);
- Wildlife Acts (and amendments) 1976 to 2021.
- Flora (Protection) Order, 2022 (S.I. No. 235 of 2022).
- Inland Fisheries Acts 1959 to 2017.
- Guidelines on the Protection of Fisheries during construction works in and adjacent to water. (Inland Fisheries Ireland, 2016).
- National Biodiversity Plan 2017-2021, Department of Culture, Heritage and the Gaeltacht (DCHG) 2017 (to be superseded by National Biodiversity Plan 2023-2027 should this document by published within the project's timeframe).
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (EU 2013).
- Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, (CIEEM, 2018);
- Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes (National Roads Authority, 2005)
- Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes (NRA, 2008b).
- Riparian breeding bird surveys methods (Cummins et. al, 2010).
- Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition) (Collins (ed.), Bat Conservation Trust 2016.
- Bat Mitigation Guidelines for Ireland (Marnell et al., 2022);
- Guidance Note 08/18. Bats and Artificial Lighting in the UK - Bats and the Built Environment series (ILP, 2018);
- The Bat Workers' Manual, 3rd Edition (Mitchell-Jones and McLeish), Joint Nature Conservation Committee 2004.
- Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (2008), NRA 2008.
- Guidelines on the Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads, NRA 2010.
- Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters, IFI 2016; and
- Planning for Watercourses in the Urban Environment. A Guide to the Protection of Watercourses through the use of Buffer Zones, Sustainable Drainage Systems, Instream Rehabilitation, Climate / Flood Risk and Recreational Planning, IFI 2020.

Data Collection and Collation

This ecological assessment is based on a combination of desk-based research and a number of ecological field surveys targeting select groups of protected fauna likely to be impacted by the construction and operation of the proposed Scheme. The desk-based research includes a data search for protected and notable species using the National Biodiversity Data Centre (NBDC) Mapping System[6]. A customised polygon was produced to extract all the species data from the set Zone of Influence for this scheme.

[6] NBDC (2023) NBDC Biodiversity Maps [online], available: https://maps.biodiversityireland.ie/Map/Terrestrial/Dataset/189

Data Sources

Reviewed data sources included relevant published biodiversity data; collation of existing information on the ecological environment; and consultation with relevant statutory bodies. Accessed data sources include:

- The Status of EU Protected Habitats and Species in Ireland Volume 1: Summary Overview, NPWS 2019;
- The Status of EU Protected Habitats and Species in Ireland Volume 2: Habitats Assessment, NPWS 2019;
- The Status of EU Protected Habitats and Species in Ireland Volume 3: Species Assessment, NPWS 2019;
- EPA Online databases on water quality and WFD maps (Available online at https://gis.epa.ie/EPAMaps/);
- Aerial photography available from www.osi.ie and Google Maps http://maps.google.com/;
- National Biodiversity Data Centre (NBDC) - Species Distribution Maps (Available online at www.biodiversityireland.ie);
- NBDC All Ireland Red Data lists for vascular flora, mammals, butterflies, non-marine molluscs, dragonflies & damselflies, amphibians, and fish (Available online at https://www.biodiversityireland.ie/resources/irish-red-lists/);
- International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (Available online at http://www.iucnredlist.org);
- Online data available on Natura 2000 network of sites and on Natural Heritage Areas (NHAs) or proposed Natural Heritage Areas (pNHAs) as held by the National Parks and Wildlife Service (NPWS);
- Records of rare and protected species for the study area, held by the NPWS.
- Habitat and species GIS datasets provided by the NPWS;
- Bat records from Bat Conservation Ireland's (BCI) database;
- Environmental Impact Statements or Environmental Impact Assessment Reports for any developments located along the alignment of the proposed Scheme;
- Environmental information/data for the area available from the EPA website; and
- Records from the Botanical Society of Britain & Ireland (BSBI).

Consultation

Consultation is ongoing with a number of key stakeholders in relation to EU Natura 2000 sites which includes, but is not limited to the following:

- Limerick City and County Council.
- National Parks and Wildlife Services

A meeting with National Parks and Wildlife Services' Ecologist Jervis Goode took place on the 20th of July 2022 where the project's ecological sensitivities and survey efforts were discussed at length, as well as the proposed FRS design. Following the meeting additional baseline and update surveys were conducted as requested to ensure full coverage of sensitive ecological features, including QI species, within the ZoI of the proposed development. Consultation took place with NPWS regarding Annex I alluvial woodland extent within the River Shannon.

Later consultation with Jervis Goode, NPWS Ecologist, also took place at the public participation day 6th September 2023, on findings of surveys and the proposed Scheme, particularly interactions with the Special Area of Conservation (SAC).

The observations and recommendations obtained as a result of the above consultations are included and addressed in this report.

The NPWS grassland specialist was consulted in relation to the latest definition of Annex I habitat Hydrophilous tall herb fen in Ireland. A national survey is currently being undertaken of this habitat and it is likely that the definition and positive indicator species list will be updated in the future.

An informal consultation with Inland Fisheries Ireland (IFI) was conducted on 4th December 2023. Measures for protection and enhancement for fish included in this Chapter, in particular the overall design and construction mitigation, were considered acceptable by IFI.

Methodology for the Assessment of Impacts

General Approach

The ecological features identified during the walkover surveys and from desk-based assessments were reviewed.

An informal screening process is presented at the end of the baseline environment sub-section to ensure that the assessment focuses only on features where the impact could have important consequences for biodiversity (valued ecological features). Any features which are important beyond the site level were identified for further evaluation. Ecological features with little or no value beyond the site level were screened out and a short statement explaining this is given in the screening section.

Separate Appropriate Screening[7] and Natura Impact Statement[5] reports have been produced, to assess the potential for effects on Designated Natura 2000 sites. The AA Screening Report concluded that likely significant effects were anticipated for the QIs of the Natura 2000 sites arising from the proposed Scheme, either alone or in-combination with other plans or projects. This conclusion triggered the production of the NIS report.

Valuation of Receptors

The value of designated sites, habitats and species populations is assessed with reference to:

- Their importance in terms of 'biodiversity conservation' value (which relates to the need to conserve representative areas of different habitats and the genetic diversity of species populations).
- Any social benefits that habitats and species deliver (e.g., relating to enjoyment of flora and fauna by the public); and
- Any economic benefits that they provide.

The valuation of designated sites considers different levels of statutory and non-statutory protection. Assessment of habitat depends on several factors, including the size of the habitat, its conservation status and quality. The assessment also takes account of connected off-site habitat that has the potential to increase the value of the on-site habitat through association. Valuation of species depends on a number of factors including distribution, status, rarity, vulnerability, and the population size present.

Table 8-1: Examples of criteria used to define the value of ecological features (NRA, 2009)

Level of Value	Examples of Criteria
International	An internationally important site e.g. Special Protection Area (SPA), Special Area of Conservation (SAC), Ramsar (or a site considered worthy of such designation). A regularly occurring substantial population of an internationally important species (listed on Annex IV of the Habitats Directive). Designated shellfish waters.

[7] JBA Consulting (2023) Castleconnell Flood Relief Scheme - AA Screening.

	Major fisheries area.
National	A nationally designated site e.g. Natural Heritage Area (NHA), a proposed Natural Heritage Area (pNHA), statutory Nature Reserve, or a site considered worthy of such designation. A viable area of a habitat type listed in Annex I of the Habitats Directive or of smaller areas of such habitat which are essential to maintain the viability of a larger whole. A regularly occurring substantial population of a nationally important species, e.g. listed on The Wildlife Act 1976 or The Wildlife (Amendment) Act 2000. A species included in the Irish Red Data Lists/Books. Significant populations of breeding birds.
Regional/County (Co. Dublin)	Species and habitats of special conservation significance within County Dublin, as identified in Dublin City Biodiversity Action Plan 2021-2025. An area subject to a project/initiative under the County's Biodiversity Action Plan. A regularly occurring substantial population of a nationally scarce species.
Local	Areas of internationally or nationally important habitats which are degraded and have little or no potential for restoration. A good example of a common or widespread habitat in the local area. Species of national or local importance, but which are only present very infrequently or in very low numbers within site area.
Less than local (works site and its vicinity)	Areas of heavily modified or managed vegetation of low species diversity or low value as habitat to species of nature conservation interest. Common and widespread species.

Ecological Valuation may also be considered of Local Importance (higher value) or Local Importance (lower value) (see Table 8-2).

Table 8-2: Examples of criteria used to define the value of ecological features of local importance[8]

Level of Value	Examples of Criteria
Local Importance (higher value)	Locally important populations of priority species or habitats or natural heritage features identified in the Local Biodiversity Action Plan (BAP), if this has been prepared. Resident or regularly occurring populations (assessed to be important at the Local level) of the following: *Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive. *Species of animal and plants listed in Annex II and/or IV of the Habitats Directive. *Species protected under the Wildlife Acts; and/or *Species listed on the relevant Red Data List. Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality.

[8] NRA (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes, available: https://www.tii.ie/technical-services/environment/planning/Guidelines-for-Assessment-of-Ecological-Impacts-of-National-Road-Schemes.pdf

	Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value
Local Importance (lower value)	Sites containing small areas of semi-natural habitat that are of some local importance for wildlife. Sites or features containing non-native species that are of some importance in maintaining habitat links

Guidance published by CIEEM (2018)[9] recommends breaking down the importance of ecological features in a geographic context similar to the NRA guidance shown in Table 8-1 with the following frame of reference to be adapted to local circumstances.

- International and European;
- National;
- Regional;
- Metropolitan, County, vice-county or other local authority-wide area
- River Basin District;
- Estuarine system/Coastal cell; and
- Local

The NRA (2009) guidance is congruent with this CIEEM (2018) guidance and includes a 'Less than local' level. The NRA (2008, rev. 2009) guidance on geographic criteria for ecological valuation, as described in Table 8-1 is followed in this chapter.

Descriptive Terminology

The significance of effects is assessed referring to the EPA's 2022 Guidelines, provided in Figure 1-2 which determine the significance of impacts. The table below provides the quality and significance of ecological effects.

Table 8-3: Categories of Effects (derived EPA, 2022)

Description	Categories of Effects
Quality of Effects	Positive Effects A change which improves the quality of the environment (for example, by increasing species diversity; or the improving reproductive capacity of an ecosystem, or by removing nuisances or improving amenities).
	Neutral Effects No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error.
	Negative/adverse Effects A change which reduces the quality of the environment (for example, lessening species diversity or diminishing the reproductive capacity of an ecosystem; or damaging health or property or by causing nuisance).
Describing the Significance of Effects	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

[9] CIEEM (2018) Guidelines for Ecological Impact Assessment in the United Kingdom and Ireland: Terrestrial, Freshwater, Coastal and Marine.

	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.
Describing the Extent and Context of Effects	Extent Describe the size of the area, the number of sites and the proportion of a population affected by an effect.
	Context Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?).
Describing the Probability of Effects	Likely Effects The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented.
	Unlikely Effects The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented.
Describing the Duration and Frequency of Effects	Momentary Effects Effects lasting from seconds to minutes.
	Brief Effects Effects lasting less than a day.
	Temporary Effects Effects lasting less than a year.
	Short-term Effects Effects lasting one to seven years.
	Medium-term Effects Effects lasting seven to fifteen years.
	Long-term Effects Effects lasting fifteen to sixty years.
	Permanent Effects Effects lasting over sixty years.
	Reversible Effects Effects that can be undone, for example through remediation or restoration.
	Frequency of effects Describe how often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually).
Describing the Types of Effects	Indirect Effects (a.k.a. Secondary or Off-site Effects) Effects on the environment. Which are not a direct result of the project, often produced away from the project site of because of a complex pathway
	Cumulative Effects The addition of many minor or insignificant effects, including effects of other projects, to create larger, more significant effects.
	Do-nothing Effects The environment as it would be in the future should the subject project not be carried out.

	Worst Case Effects The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable Effects The effects arising from a project in the case where mitigation measures substantially fail.
	Irreversible Effects When the character, distinctiveness, diversity or reproductive capacity of an environment is permanently lost.
	Residual Effects The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic Effects Where the resultant effect is of greater significance than the sum of its constituents (e.g. combination of SOx and NOx to produce smog).

Significance of Impacts

The overall significance of an impact can be derived from the total description of the effect compared against the sensitivity and significance (value). The context and character of the receptor must also be assessed, such as its position in relation to the effect and its connectivity to the effect, however this should be determined before assessing the significance of the impact.

The total description of the effect includes the character, magnitude, probability and consequences of the effect as described in Table 8-4 which are combined to give a general description of the effect on an ordinal scale from Negligible to High. The sensitivity and significance of the receptor is also described on an ordinal scale from Negligible to High.

The placement of the general description of the effect, and the sensitivity/significance of the receptor on this scale is determined by a Competent Person (a qualified ecologist in this case) as they interpret the qualities of the effect from the categories listed in Table 8-3 and the receptors sensitivity and significance. Level of significance, also described as value of the receptor is previously set out in sub-section 1.2.5.3 above. Sensitivity of the receptor is assessed by the Competent Person based on the receptor's characteristics and how susceptible to impact they are from the type of effect.

The overall significance of an effect is then categorised into one of the classification of Figure 1-2. The scale has been ordered into an upper and lower bound for each qualitative category, so that degrees of significance within subcategories can be interpreted by the Competent Person.

Table 8-4: Significance of impacts matrix

Magnitude of impact	**Sensitivity / Value of Receptor**			
	High	Medium	Low	Negligible
High	Profound	Very Significant	Moderate	Not significant to Slight
Medium	Significant to Very Significant	Significant	Slight to Moderate	Not significant to Slight
Low	Moderate to Significant	Slight to Moderate	Slight	Not significant
Negligible	Not significant	Not significant	Not significant	Imperceptible

Furthermore, the NRA (2009) and CIEEM (2018) guidelines were followed (in conjunction with the EIA guidelines), which requires examination of the following two key elements:

- Impact on the integrity of the ecological feature; and
- Impact on its conservation status within a given geographical area.

Ecological Integrity

Ecological integrity should be regarded as the coherence of ecological structure and function, across the entirety of a site that enables it to sustain all of the biodiversity or ecological resources for which it has been valued[10].

Ecological integrity is most often used when determining impact significance in relation to designated nature conservation areas (e.g., SACs, SPAs or pNHA/NHAs) but can often be the most appropriate method to use for non-designated areas of biodiversity value where the component habitats and/or species exist, with a defined ecosystem at a given geographic scale.

Any adverse impact on the integrity of an ecological site or ecosystem is considered to be significant if it moves the condition of the ecosystem away from a favourable condition: removing and/or changing the processes that support the sites' habitats and/or species; affects the nature, scale, structure, complexity and functioning of component habitats; and/or, affects the population size and viability of the inhabiting floral and faunal species therewithin.

Conservation Status

The definitions for conservation status given in the EU Habitats Directive 92/43/EEC, in relation to habitats and species, are also used in the CIEEM (2018) and NRA (2009) guidance:

- For natural habitats, conservation status means the sum of the influences acting on the natural habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species, at the appropriate geographical scale.
- For species, conservation status means the sum of influences acting on the species concerned that may affect the long-term distribution and abundance of its populations, at the appropriate geographical scale.

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status.

After the definitions provided in the EU Habitats Directive 92/43/EEC, the conservation status of a habitat is favourable when:

- Its natural range and areas it covers within that range are stable or increasing.
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and
- The conservation status of its typical species is favourable as defined below under species.

And the conservation status of a species is favourable when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats.

[10] NRA (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes, available: https://www.tii.ie/technical-services/environment/planning/Guidelines-for-Assessment-of-Ecological-Impacts-of-National-Road-Schemes.pdf.

- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- There is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

If it is determined that the ecological integrity and/or conservation status of a key ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e., local, county / regional, national, international). In some cases, an impact may not be significant at the geographic scale at which the ecological feature has been valued (e.g., national) but may be significant at a lower geographical level (e.g., local).

Residual Impacts

The project is assessed including some designed-in mitigation. This is done where mitigation is proven to be effective and will be implemented effectively with a high certainty. Where significant residual impacts are still identified, further mitigation measures will be proposed as part of the EIA process to avoid, reduce or minimise them. Each impact assessment section assigns a final significance level to the impact described, which considers and includes the implementation of any stated mitigation measures; these are the residual impacts.

Cumulative Impacts

Potential sources of cumulative impacts were identified based on the ecology of valued ecological features. Potential sources of cumulative impacts were sought within an area where there is the potential for a significant impact on a site or species. The plans and projects identified as potential sources of cumulative impacts are described in section 8.7.1.

8.1.2 Ecological Surveys

Ecological site surveys were carried out by JBA Ecologists, JBA Arboriculturist, and Sub-consultants Dr Joanne Denyer (Denyer Ecology) and Ecofact. Table 8-5 contains further details on survey dates and type of survey undertaken.

The ecological walkover survey recorded habitats and protected species, following the methods outlined in the documents below:

- Heritage Council (2011). Best Practice Guidance for Habitat Survey and Mapping (Smith et al. 2011).
- Fossitt, J. (2000). A Guide to Habitats in Ireland. The Heritage Council, Kilkenny (Fossitt 2000a).
- Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (NRA, 2009b).

Aerial photographs and site maps assisted the survey. Habitats have been named and described following Fossitt[11]. Nomenclature for higher plants principally follows that given in The New Flora of the

[11] Fossitt, J. (2000). A Guide to Habitats in Ireland. The Heritage Council, Kilkenny

British Isles 4th Edition[12]. Identification of Irish plants generally follows that given in Webb's An Irish Flora[13].

Details of ecological surveys undertaken within the study area are available in Table 8-5 below.

Table 8-5: Ecological surveys undertaken in the study area

Survey type	Date	Location of survey	Assessed in NIS or EIAR
Habitat surveys –survey data included in Appendix 8.2			
In-river habitats	1 August 2019	River Shannon and islands.	NIS & EIAR
Habitats and invasive species	13 August 2019	Entire scheme	NIS & EIAR
Ecological walkover on Northern section of scheme	25 June 2021	Additional area added to FRS option –At Rivergrove and Grange House	NIS & EIAR
Ecological walkover	19 July 2022	Additional habitat mapping to update information in 2022. Entire scheme	NIS & EIAR
Annex I habitats (surveyed by Sub-consultant Denyer Ecology)	21 May 2022	Annex habitats entire scheme	NIS
Alluvial Woodland extent check	20th July 2022	Annex habitats entire scheme	NIS
Alluvial woodland mapping extent in winter	10 February 2023	Woodland around Cloon Stream	NIS
Bird surveys – survey data included in Appendix 8.3			
Wintering birds	14 November 2019 17 December 2019 15 January 2020 13 February 2020 11 March 2020	Vantage point at Ferry Playground & Mall Road	QI birds assessed in NIS All other birds assessed in EIAR
Wintering Birds 2024 update surveys	16 Jan 2024 23 Feb 2024	Vantage point at Ferry Playground & Mall Road	QI birds assessed in NIS All other birds assessed in EIAR
Breeding bird survey	28 July 2022	Entire scheme	EIAR
Heronry nest check at Mahers pub - Drone	8 September 2022	Heronry in 2 trees behind Mahers pub	

[12] Stace, C. (2019) New Flora of the British Isles, 4th ed.

[13] Parnell, J. and Curtis, T. (2012) Webb's An Irish Flora [online], 8th ed, Trinity College Dublin, available: http://www.corkuniversitypress.com/product-p/9781859184783.htm

Breeding Bird survey	4th May 2023	Entire scheme	EIAR
Breeding Bird survey	1st June 2023	Entire scheme	EIAR
Mammal surveys - Survey data included in Appendix 8.4			
Winter mammals – set up Trail Camera x 2 on Cloon Stream for Otter	26 January 2023	Cloon Stream	NIS & EIAR
Trail Camera for Otter on Cloon Stream x 2 cams	19th May 2023	Cloon Stream	NIS & EIAR
Trail Camera for Otter on Cloon Stream x 2 cams	1st June 2023	Cloon Stream	NIS & EIAR
Winter mammals – set up Trail Camera x 2 on Cloon Stream for Otter	26 January 2023	Cloon Stream	NIS & EIAR
Bat surveys– survey data included in Appendix 8.5			
Bat activity	19 September 2019 20 May 2020 20 July 2020	Entire scheme	Impact assessment in EIAR
Bat static detectors	19th September – 29th September 2019 20th May – 25th May 2020 19th July – 27th July 2020 12th August- 19th August 2020	Static detectors set up at Island House, Mahers Pub & Coolbane woods	Impact assessment in EIAR
Bat activity and emergence – Beech trees at Grange House	8 September 2022	Additional area added to FRS option at Grange House	EIAR
Aquatic surveys – survey data and sub-consultant report included in Appendix 8.6 and 8.7			
Fisheries / aquatic survey (surveyed by Sub-consultant Ecofact)	August 2021	6 survey locations within River Shannon & Cloon Stream	QI species included in NIS Non-QI species in EIAR
eDNA in Cedarwood Stream	13th September 2023	Cedarwood stream	NIS & EIAR
Tree survey – Sub-consultant report included in Appendix 8. 8			
Tree surveys (surveyed by Arborist)	19 & 20 October 2022	Entire scheme	EIAR

Terrestrial and Riparian Edge Habitat Surveys

Habitat surveys of the terrestrial and riparian edge habitats were conducted on the 1st of August 2019 and 13th August 2019. Additional section was added to the scheme in 2021 and this was surveyed on 25th June 2021. Additional habitat survey was carried out on 19th July 2022 to update mapping. These habitats have been subsequently visited during other surveys in 2023 and 2024 and remain in the same condition.

Separate Annex I habitat surveys were conducted by Denyer Ecology and Aquatic Habitats were conducted by Ecofact.

All habitats located within the survey area of the proposed Scheme were mapped to level three of the Heritage Council's Fossitt (2000) habitat codes, and in accordance with Best Practice Guidance for Habitat Survey and Mapping[14]. Floral species present that were either representative of a habitat or considered to be of conservation interest were recorded. The habitat's extent was mapped onto an aerial photograph within the QField GIS Android application, with GPS points taken where any ecological features of note were observed. Any non-native invasive plant species listed on the Third Schedule of the Birds and Habitats Regulations were also recorded during the habitat surveys. Identification for higher plants principally follows that given in Webb's An Irish Flora[15]; while contemporary nomenclature is in line with The New Flora of the British Isles 4th Edition[16].

Annex I Habitats

Surveys to assess areas of potential Annex I habitats and to map their extent were undertaken by Dr Joanne Denyer (Denyer Ecology) and JBA Ecologist Hannah Mulcahy in May 2022. The full survey report is included in Appendix 8. Two habitats listed under Annex I of the E.U. Habitats Directive have been recorded within the study area (Section 8.2.4.1). These include:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) 91E0* (*Priority Habitat).
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430). This is not a QI of the Lower River Shannon and will be assessed in the EIAR.

The following guidance documents and resources were used in the assessment of these habitats.

- NPWS 2012 Lower River Shannon SAC (site code 2165) Conservation objectives supporting document woodland habitats (Version 1, 2012);
- O'Neill, F.H. & Barron, S.J. (2013). Results of monitoring survey of old sessile oak woods and alluvial forests. Irish Wildlife Manuals, No. 71. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin;
- O'Neill, F.H., Martin, J.R., Devaney, F.M. & Perrin, P.M. (2013) The Irish semi-natural grasslands survey 2007-2012. Irish Wildlife Manuals, No. 78. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Ireland;
- Perrin, P. (2016). Irish Vegetation Classification Technical Progress Reports No.1-7. Unpublished report by BEC Consultants for the National Biodiversity Data Centre;
- Perrin, P. (2016). Irish Vegetation Classification Technical Progress Report No. 2. Unpublished report by BEC Consultants for the National Biodiversity Data Centre;
- Irish Vegetation Classification (accessed online https://biodiversityireland.ie/projects/ivcclassification- explorer/); and
- Perrin, P., Martin, J., Barron, S., O'Neill, F., McNutt, K. & Delaney, A. (2008). National Survey of Native Woodlands 2003-2008. Volume I – Main Report. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.

[14] Smith, G., O'Donoghue, P., O'Hora, K., and Delaney, E. (2011) 'Best Practice Guidance for Habitat Survey and Mapping, 2011', available: http://www.heritagecouncil.ie/fileadmin/user_upload/Publications/Wildlife/Habitat_Survey_Guidance/Habitat_Survey_Guidance_Hyperlinked_2.pdf.

[15] Parnell, J. and Curtis, T. (2012) *Webb's An Irish Flora* [online], 8th ed, Trinity College Dublin, available: http://www.corkuniversitypress.com/product-p/9781859184783.htm

[16] Stace, C. (2019) *New Flora of the British Isles*, 4th ed.

Follow-up surveys to finalise the extents of these habitats and conduct ecological walkovers of the priority Annex I Alluvial woodlands, in particular, were conducted by JBA Ecologists Hannah Mulcahy, Anne Mullen and NPWS Ecologist Jervis Goode on 19 July 2022. The woodland area behind Mahers pub along the Cloon Stream was visited again on the 10 February 2023 to survey extent while vegetation had died back in winter.

The Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] is also a Qualifying Interest of the Lower River Shannon. Aquatic surveys found this to not be present in the study area in Castleconnell.

Tree survey

Tree surveys were conducted by JBA Arborist on 19 & 20 October 2022. An Arboricultural Impact Assessment was written in accordance with BS5837:2012 Trees in relation to design, demolition, and construction. The full survey report is included as a standalone report with the FRS application.

Bird surveys

Wintering bird surveys, breeding bird surveys and checks for active heron nests were conducted from 2019 to 2023. Wintering bird surveys were repeated in 2024 as four years had passed since the original surveys were conducted. The full survey report is included in Appendix 8.

Surveying techniques for the wintering bird surveys were in line with those outlined in Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (2009)[17].

The surveys conducted are included in the table below.

Table 8-6: Bird survey dates and locations

Survey type	Dates	Locations
Wintering birds	14 November 2019 17 December 2019 15 January 2020 13 February 2020 11 March 2020	Vantage point at Ferry Playground & Mall Road
Wintering Birds 2024 update surveys	16 January 2024 23 February 2024	Vantage point at Ferry Playground & Mall Road
Breeding bird survey	28 July 2022 4th May 2023 1st June 2023	Entire scheme
Heronry next check at Mahers pub - Drone	8 September 2022	Heronry in 2 trees behind Mahers pub car park
Casual records / sound records / Camera trap records	April / May 2023	Island House

[17] NRA (2009) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes, National Roads Authority, available: http://www.tii.ie/technical-services/environment/planning/Ecological-Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf

Wintering bird survey

Wintering bird surveys were carried out over winter in 2019-2020 to establish the use of migratory wetland birds of the River Shannon in the project area (Castleconnell Village). Wintering bird survey methods used included the 'look – see' method[18], whereby counts are carried out from vantage points and all birds seen are recorded. Two surveyors carried out the winter bird survey along the River Shannon from two vantage points: one at the entrance to Island House up the Mall Road, and another at the Ferry Playground.

Surveys were carried out over five months during Winter 2019/2020 and re-surveyed in 2024 by JBA Ecologists at dawn for two hours on the:

- 14th Nov 2019;
- 17th Dec 2019;
- 15th Jan 2020;
- 13th Feb 2020;
- 11th March 2020;
- 16 January 2024; and
- 23 February 2024;

Birds were identified by sight and song, and general location and activity were recorded within the QField GIS Android application. The conservation status of the bird species was later recorded as per:

- Birds of Conservation Concern in Ireland (BoCCI) lists which classify bird species into three categories: Red List – birds of high conservation concern; Amber List – birds of medium conservation concern; and Green List – birds not considered threatened[19]
- Bird species listed on Annex I of the EU Birds Directive (2009/147/EC); and
- QI species of SPAs within the ZoI of the proposed Project.

Surveying techniques were in line with those outlined in the Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes[20] / Breeding Bird Survey (BBS) methodology[21, 22].

Note on age of surveys: The wintering bird surveys were carried out in winter of 2019 to 2020 and therefore the data is three years old. However, JBA ecologists have been present at the site regularly since surveys have been undertaken and through casual observation, no differences in numbers,

[18] Lewis, L.J. and Tierney, T.D. (2014) Low Tide Waterbird Surveys: Survey Methods and Guidance Notes, Irish Wildlife Manuals 80, National Parks and Wildlife Service / Department of Arts, Heritage and Gaeltacht, available: https://www.npws.ie/sites/default/files/publications/pdf/IWM80.pdf

[19] Gilbert, G., Stanbury, A., and Lesley, L. (2021) Red and Amber Lists of Birds of Conservation Concern in Ireland 2020-2026, RSPB; BirdWatch Ireland, available: https://birdwatchireland.ie/app/uploads/2021/04/BOCCI4-leaflet-2-1.pdf

[20] NRA (2009) Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes, National Roads Authority, available: http://www.tii.ie/technical-services/environment/planning/Ecological-Surveying-Techniques-for-Protected-Flora-and-Fauna-during-the-Planning-of-National-Road-Schemes.pdf

[21] Heywood, J.J.N., Massimino, D., Balmer, D.E., kelly, L., Noble, D.G., Pearce-Higgins, J.W., Woodcock, P., Wotton, S., Gillings, S., and Harris, S.J. (2022) 'The Breeding Bird Survey 2022 incorporating the Waterways Breeding Bird Survey', BTO Research Report, 756

[22] Cummins, S., Fisher, J., McKeever, R.G., and Crowe, O. (2010) Assessment of the Distribution and Abundance of Kingfisher Alcedo Atthis and Other Riparian Birds on Six SAC River Systems in Ireland, Birdwatch Ireland / National Parks and Wildlife Service

species, or locations of birds particularly in relation to the Scheme, has been observed. Therefore, it is considered this data is current.

Breeding bird survey

A transect assessing breeding birds was carried out along the entirety of the scheme on 4 May 2023 and 1 June 2023; point counts were carried out on 28 July 2022. All suitable and accessible breeding bird habitat located along the length of the scheme works was slowly walked. Birds were identified by sight and song, and general location and activity were recorded within the QField GIS Android application. The conservation status of the bird species was later recorded as per:

- Birds of Conservation Concern in Ireland (BoCCI) lists which classify bird species into three categories: Red List – birds of high conservation concern; Amber List – birds of medium conservation concern; and Green List – birds not considered threatened
- Bird species listed on Annex I of the EU Birds Directive (2009/147/EC); and
- QI species of SPAs within the ZoI of the proposed Project.

Surveying techniques were in line with those outlined in the Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes / Breeding Bird Survey (BBS) methodology.

The watercourses that fall within the survey extent were surveyed for any breeding bird activity with a focus on riparian vegetation and woodland. Areas of scrub along the ditches were also surveyed for breeding activity where it was possible to gain access. Riparian breeding bird surveys follow the same general methodology[23, 24].

All birds observed, visually and / or by sound, were recorded on digital field maps.

Casual sound recording carried out in the grasslands and woodland areas of Island House recorded the presence of common woodland and garden birds; the proximity to the river were also noted.

[23] Bibby, C.J., Burgess, N.D., Hill, D.A., and Mustoe, S. (2000) Bird Census Techniques, Second edition. ed, London San Diego New York Boston Sydney Tokyo Toronto: Academic Press.

[24] Cummins, S., Fisher, J., McKeever, R.G., McNaghten, L., and Crowe, O. (2010) Assessment of the Distribution and Abundance of Kingfisher Alceso Atthis and Other Riparian Birds on Six SAC River Systems in Ireland, National Parks and Wildlife Service / Birdwatch Ireland.

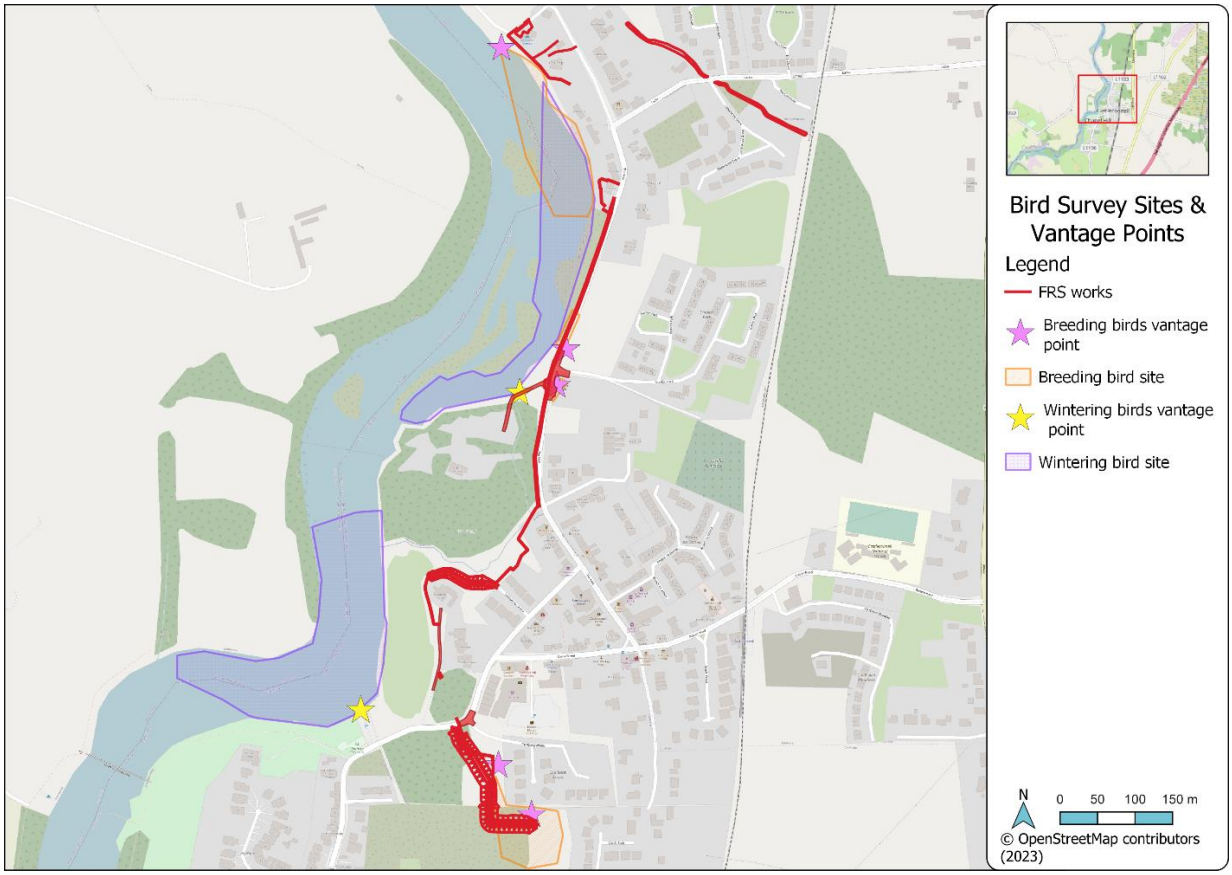

Figure 8-1: Locations and vantage points for wintering and breeding bird point count surveys

Ad-hoc records

Camera traps set out for mammal surveys were also examined for bird records and identified to the species, where possible (image clarity dependent). Further sound records gathered by local residents were compiled. These records were identified using the Merlin Bird App.

Terrestrial Mammals

During all ecological surveys and visits to Castleconnell scheme area, signs for Otter *Lutra lutra*; Badger *Meles meles*; Irish Stoat *Mustela erminea hibernica*; Irish Hare *Lepus timidus hibernicus*; Pine Marten *Martes martes*; Hedgehog *Erinaceus europaeus*; and Pygmy Shrew *Sorex minutus* within the surrounding vicinity of the proposed Scheme were noted. Field signs include scat/ droppings, setts/ dens/ holts and any mammal tracks. Surveying techniques were in line with those outlined in the Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes[25]; Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes[26]; and Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes[17].

[25] NRA (2008) Guidelines for the Treatment of Otters during the Construction of National Road Schemes, available: https://www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Otters-prior-to-the-Construction-of-National-Road-Schemes.pdf.

[26] NRA (2008) Guidelines for the Treatment of Badgers during the Construction of National Road Schemes, available: https://www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Treatment-of-Badgers-prior-to-the-Construction-of-a-National-Road-Scheme.pdf.

Survey of Cloon Stream - Trail camera surveys 2023: As the proposed Scheme will be located along the Cloon Stream, further surveys were required to determine use of the stream by Otters. This involved trail cameras set up along the stream in 6 locations in winter and spring. Trail cameras were set up for 2 weeks at the locations shown in Figure 8-2 at the following dates:

- Location 1 & 2 26 January 2023
- Location 3 & 4 19th May 2023
- Location 5 & 6 1st June 2023

This was done in combination with additional searches for field signs of otter in January 2023 while the vegetation was low in the winter, such as prints, slides, couches, dens, and spraints.

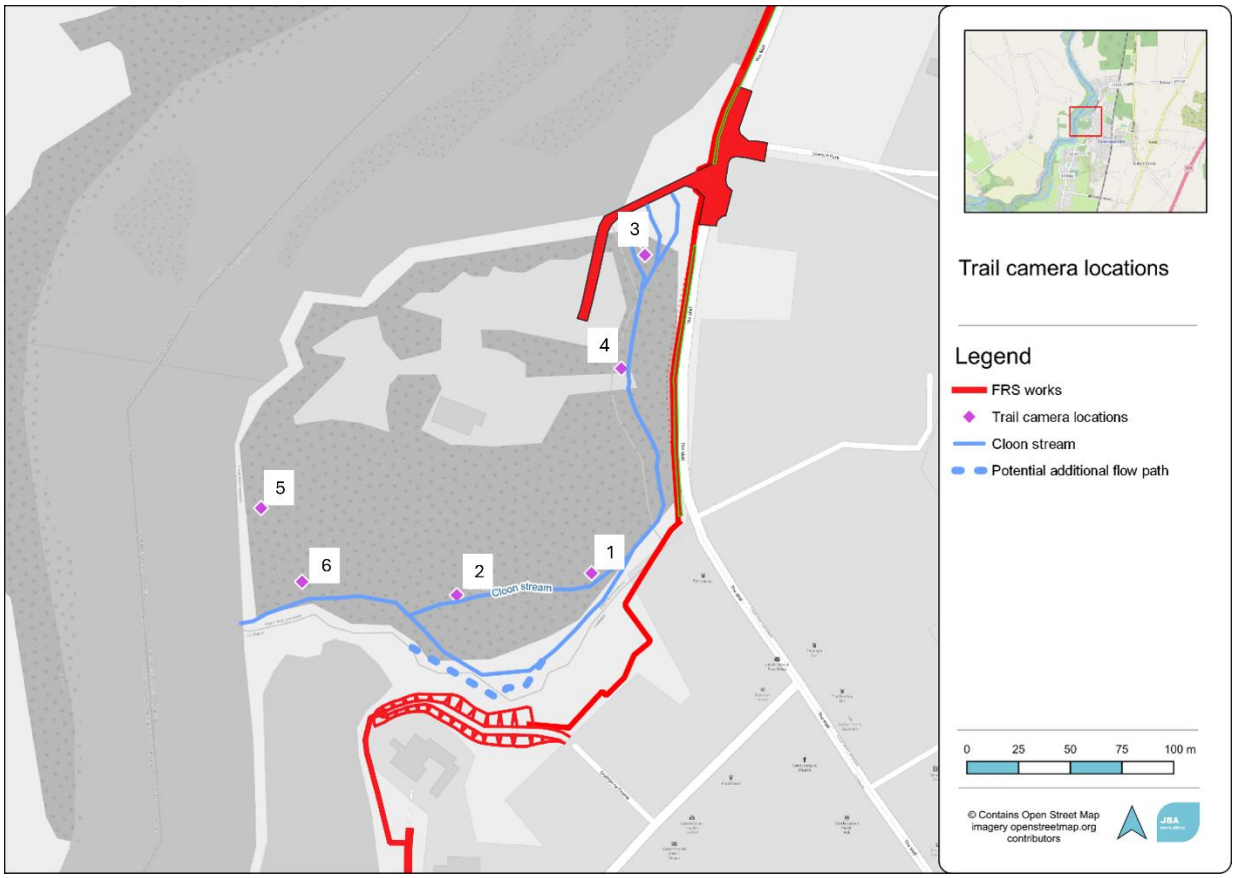

Figure 8-2: Trail camera locations on Cloon Stream

Bat surveys

The below sub-sections describe the methodologies utilised to conduct various bat surveys undertaken to inform the EIA's Biodiversity Chapter, based on guidance outlined in Bat Surveys for Professional Ecologists – Good Practice Guidelines[27].

[27] Bat Conservation Trust. (2023). *Bat surveys for professional ecologists: Good practice guidelines* (4th ed.). Retrieved from https://www.bats.org.uk/resources/guidance-for-professionals/bat-surveys-for-professional-ecologists-good-practice-guidelines-4th-edition

Bats are protected species under the Wildlife Act (1976) and Wildlife Amendment Act (2000). All bat species are protected under Annex IV of the EU Habitats Directive, the Lesser Horseshoe bat is also listed under Annex II.

Table 8-7: Bat survey dates and locations

Survey	Date	Location of survey
Preliminary Bat Roost and Habitat Suitability Surveys	19 September 2019 20 May 2020 & 20 July 2020 (and during other	Entire scheme (except Grange House and Rivergrove)
Bat activity	19 September 2019	Island House and Mall Road, and area outside of current Scheme to the south.
Bat activity	20 May 2020 & 20 July 2020	Entire Scheme (except Grange house and Rivergrove)
Bat static detectors	19th September – 29th September 2019 20th May – 25th May 2020 19th July – 27th July 2020 12th August- 19th August 2020	Static set up at Island House, Mahers Pub & Coolbane woods
Bat activity and emergence – Beech trees at Grange House	8 September 2022	Additional area added to FRS option – Flood cell A Rivergrove and Grange house

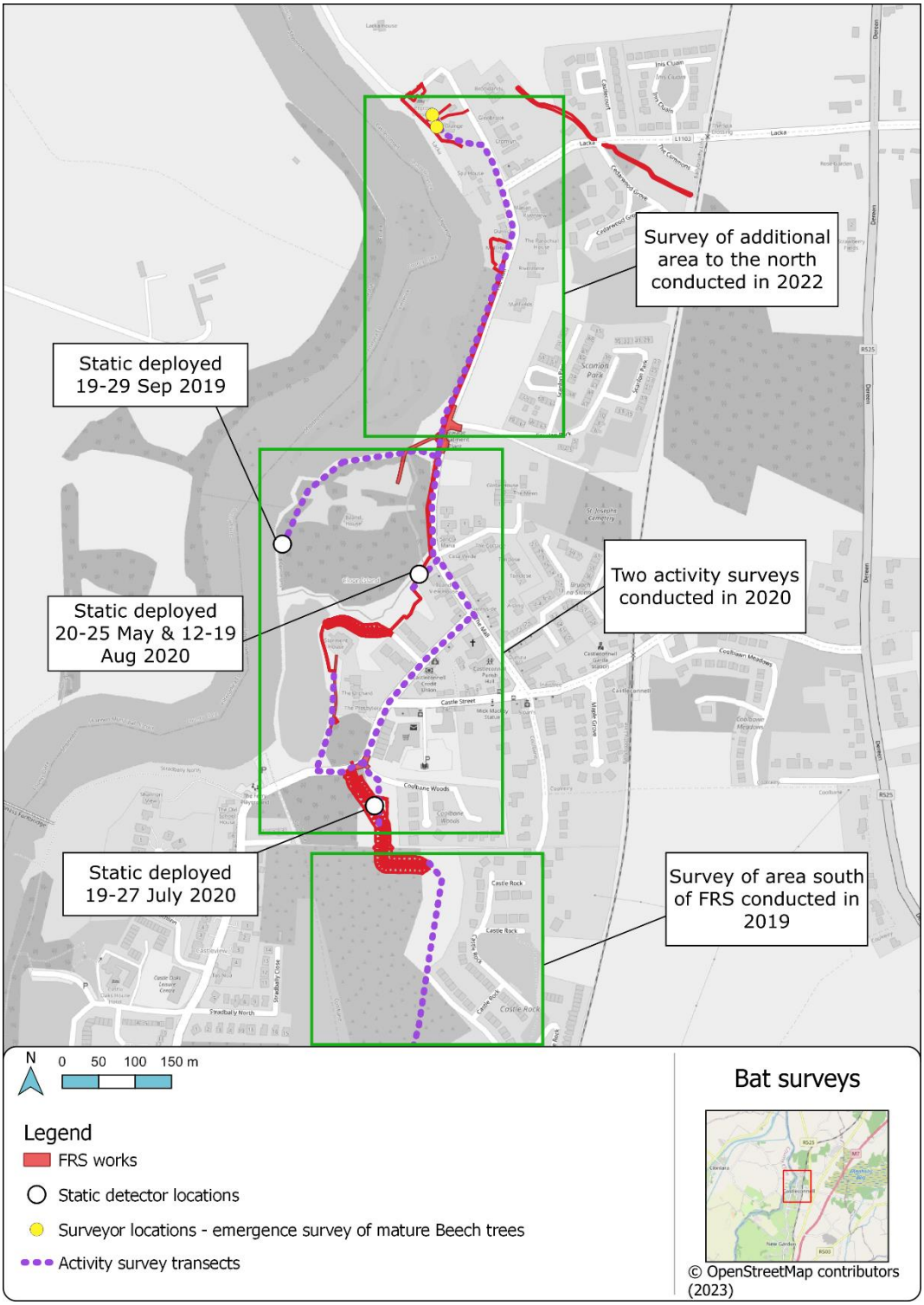

Figure 8-3: Bat survey locations carried out for this scheme

Preliminary Bat Roost and Habitat Suitability Surveys - Given the presence of a number of mature trees within the proposed Scheme boundary, there was the potential for bat roosts to be present within or adjacent to the proposed Scheme. The tree survey outlined the potential for trees to contain bat roosts. JBA Ecologists carried out a preliminary bat roost potential assessment and habitat suitability surveys were conducted during daylight hours in order to identify the location of potential roosts features (PRFs) and access points (within structures).

Transect Bat Activity Surveys – Two transect bat activity surveys were conducted between Island House and Stormant house, and including Coolbane Woods, during the months of May, June, and

August 2023. The surveys were conducted by two teams of two ecologists walking set transect routes within the targeted survey area. Surveyors used a combination of Magenta 5 and Anabat Walkabout listening devices to record the bats observed during the survey. The location of individual bats and their flight paths were recorded within the QField GIS Android application. The data collected provided information on the flight paths of local bat species within the proposed Scheme area.

Static Bat Activity Surveys – Static (in situ) bat detectors [Anabat Express & Anabat Chorus – Titley Scientific] were installed along the length of the scheme (three locations in total – Island House, Mahers Pub & Coolbane woods) between the months of May and September during 2021, 2022 and 2023 summer periods. These static detectors allowed for the collection of bat echolocation information over 5+ daytime periods. The data collected provided information on the frequency of use by individual bat species within the proposed Scheme area.

Aquatic survey (surveyed by Sub-consultant Ecofact)

Aquatic Habitat Surveys - were carried out on the entire study area on the River Shannon, with detailed investigations at a total of six survey sites. The survey was completed with reference to the Environment Agency's "River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003"[28] and "A Guide to Habitats in Ireland"[29]. River habitat types as well as flora and vegetation were characterised at each survey site. All sites were assessed in terms of:

- Stream width and depth and other physical characteristics
- Substrate type, listing substrate fractions in order of dominance, i.e., large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide, and pool in the sampling area
- Instream vegetation, and percentage coverage of the stream bottom at the sampling site (as applicable) and on the bankside
- Estimated cover by bankside vegetation, giving percentage shade of the sampling site.

Aquatic Macroinvertebrate Surveys - Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at the survey sites using kick-sampling[30]. This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the riverbed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. This procedure was undertaken at three points along/across the watercourse. Vegetation sweeps were also undertaken over a further 1-minute period to ensure a representative sample of the fauna present at the site was collected. Specific sweep netting assessments were completed to determine presence / absence of White-clawed crayfish and juvenile lamprey species.

Fish surveys - six site locations in the River Shannon and Cloon Stream were assessed for potential Lamprey and Salmon habitat. An electric fishing survey was undertaken at the six sites during August 2021. This was completed under authorisation from the Department of Environment, Climate and Communications under Section 14 of the Fisheries (Consolidation) Act (1959). Sites were surveyed following the methodology outlined in the CFB (2008) guidance "Methods for the Water Framework

[28] EA (2003) 'River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003'.

[29] Fossitt, J.A. (2000) A Guide to Habitats in Ireland, Heritage Council of Ireland series, Kilkenny: Heritage Council/Chomhairle Oidhreachta.

[30] Toner, P.F. (2005) Water Quality in Ireland 2001-2003, Wexford: E.P.A.

Directive - Electric fishing in wadable reaches"[31]. A portable electric fishing unit (Smith Root-LR 24 backpack) was used during the assessments. Fishing was carried out continuously for five minutes at each of the sites. Captured fish were collected into a container of river water using dip nets. On completion of the survey fish were then anaesthetised using a solution of 2-phenoxyethanol, identified, and measured to the nearest mm using a measuring board. Subsequent to this the fish were allowed to recover in a container of river water and were released alive and spread evenly over the sampling area. No mortalities were recorded. Strict biosecurity measures were followed during all fieldwork[32].

Juvenile Lamprey surveys generally followed the methodology for ammocoete surveys given in the manual 'Monitoring the River, Brook and Sea Lamprey, *Lampetra fluviatilis*, *L. planeri* and *Petromyzon marinus*'[33]. Electric fishing for juvenile lampreys was carried out at three 1m^2 habitat patches where available. A total of 3 x 1 m^2 enclosures were fished at each site where suitable habitat was present and where conditions allowed. Lamprey identification followed 'Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey'[34].

eDNA Sample from Cedarwood stream

An eDNA survey was conducted on the Cedarwood Stream to determine presence of the three Lamprey species, Eel and/or Smooth Newt. Twenty water samples of 50ml were collected from the Cedarwood Stream intermittently while moving upstream, mixing the samples together. These 20 samples were combined through a single dense filter to extract filtrate. This sample was sent for testing at SureScreen Scientifics for analysis.

During DNA testing, the filter is incubated to obtain any DNA within the sample. A PCR is preformed to identify the DNA of the targeted species, primers are then used to amplify target DNA, allowing it to be detected.

Amphibians – Spawn and eDNA surveys

Ecological surveyors examined the proposed Scheme area in spring for the presence of amphibian species Common Frog *Rana temporaria* and Smooth Newt *Lissotriton vulgaris*, as well as suitable waterbodies and wetlands to support breeding amphibian populations. Surveying techniques were in line with those outlined in the Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (2009)[35].

Additionally, eDNA sampling was conducted for Smooth Newt within the Cedarwood stream.

[31] CFB (2008) Methods for the Water Framework Directive - Electric fishing in wadable reaches. Central Fisheries Board.

[32] IFI (2010) Biosecurity protocols for fieldwork. Inland Fisheries Ireland. https://www.fisheriesireland.ie/documents/73-biosecurity-protocol-for-field-survey-work-1/file.html

[33] Harvey J & Cowx I (2003). Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

[34] Gardiner, (2003). Identifying Lamprey. A Field Key for Sea, River and Brook Lamprey. Conserving Natura 2000 Rivers Conservation Techniques Series No. 4 English Nature, Peterborough. http://publications.naturalengland.org.uk/publication/72035

[35] NRA (2009) Guidelines for Assessment of Ecological Impacts of National Roads Schemes, available: https://www.tii.ie/technical-services/environment/planning/Guidelines-for-Assessment-of-Ecological-Impacts-of-National-Road-Schemes.pdf.

Terrestrial Invertebrates

The surveying of terrestrial invertebrates was conducted by ecological surveyors during August 2021. Surveyors carried out walked transects along selected routes within and immediately adjacent to the boundary of the proposed Scheme. Surveying techniques were in line with those outlined in the Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (2009).

8.1.3 Zone of Influence (ZoI)

The Zone of Influence (ZoI) for the proposed Scheme is based on a judgement of the likely extent of the ecological impacts on key ecological receptors. This will vary for different ecological features, depending on their sensitivities to environmental change. The ZOI for each impact on ecological receptors is detailed in the Table below.

Table 8-8: Zone of Influence for ecological receptors

Source of impact	ZOI Distance	Reasoning for ZOI on ecological receptors
Direct impact to habitats	Footprint/ adjacent	In relation to terrestrial habitats, impacts will be limited to the lands within the boundary of the proposed Scheme, as well as the immediate surrounding environs (e.g., overshading and soil; root compaction and changes to local hydrological regimes).
Hydrological connections	Variable- up to 15km downstream	Hydrological connections (e.g., drainage ditches, wetlands, and rivers) are often the most far-reaching impacts due to their lotic or semi-lotic nature. It becomes increasingly difficult to precisely predict the likely significance of adverse water-borne pollutants as they travel downstream from the pollution point source, given potential dilution and retention factors along the course of the impacted watercourse. Under the precautionary principle any designated sites (Lower River Shannon SAC), protected habitats or species (flora and fauna) located downstream of the watercourse which pass through the footprint of the proposed Scheme, will be considered to be within the hydrological ZoI of this scheme. This ZOI is also used for this EIAR
Dust/ Air pollution	500m	In respect to ZoI for air pollution (emissions and dust), Natura 2000 sites within a 500m buffer zone of the proposed Scheme were considered as per the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction[36], including ex-situ foraging habitats utilised by QI species associated with local Natura 2000 sites. This ZOI is also used for this EIAR
Mammals- disturbance	100-150 metres	In relation to physical (vibration and clearance works); audible and visual disturbance, faunal species will be considered on a species-by-species basis. Generally, smaller mammal species (e.g., Pygmy Shrew) will be given 100m disturbance zones, which is reflective of their relatively small territories. For larger mammals, such as Otter, a 150m disturbance zone can be established in the scenario, where there is an active breeding holt.
Bats – Roosts (and lighting)	Footprint /Adjacent	The ZoI for local bats species is centred around lighting impacts within and adjacent to the footprint of the proposed Scheme, as well as the scheme's proximity to known bat roosts within the locality.
Bats – sustenance zone (foraging	3km	Impacts are likely to occur within a 3km radius sustenance zone around each known bat roost.

[36] IAQM (2014) Guidance on the Assessment of Dust from Demolition and Construction, available: https://iaqm.co.uk/text/guidance/construction-dust-2014.pdf.

area)		
Birds- habitat loss	Footprint	The ZoI for breeding bird species is generally linked with direct habitat loss within the footprint of the proposed Scheme.
Disturbance to birds	300m	Additional adverse impacts for breeding birds will likely arise from the disturbance from construction works, which can extend 300m. This is also the case for protected migrant wintering bird species (e.g., Light-bellied Brent Goose) which visit the habitats within and adjacent to the proposed Scheme.

8.2 Receiving Environment

8.2.1 Overview

This section summarises the baseline information about the environment within the footprint of the proposed Scheme. This is based on a review of the information listed in Section 0 and data collected during ecological surveys of the study area.

Details of ecological surveys undertaken within the study area are available in Section 8.1.2.

8.2.2 Designated Nature Conservation Sites

Sites of international importance including Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are collectively known as Natura 2000 sites. Designated sites, which also include Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs), which are national designations, were also identified within the proposed Scheme's Zone of Influence. The designated search area was 15km from the proposed Scheme boundary for Natura 2000, NHA and pNHA sites. This distance defines the 'Zone of Influence ' of the proposed Scheme for protected sites.

European Designated - Natura 2000 Sites (SACs / SPAs)

All European (Natura 2000) sites within a 15km buffer zone of the proposed Scheme were considered, as per Appropriate Assessment of Plans and Projects in Ireland - Guidance for Planning Authorities (Department of Environment, Heritage, and Local Government, 2010 rev.). This 15km buffer zone has also been extended to the Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs). Within this 15km buffer zone a source-pathway-receptor model was used to screen the sites which are present within the ZoI, as per OPR Practice Note PN01 Appropriate Assessment Screening for Development Management[37].

Table 8-9: Natura 2000 sites within 15km of the proposed Scheme

Natura 2000 site	Site Code	Approximate distance from site	AA Screening / NIS result
Lower River Shannon SAC	002165	0.0km (partially within site boundary	Screened In
Glenomra Wood SAC	001013	6.9 km	Out
Clare Glen SAC	00930	7.3 km	Out
Slievefelim to Silvermines Mountains SPA	004165	7.7 Km	Out
Glenstal Wood SAC	001432	9.4 km	Out
River Shannon and River Fergus	001432	10.5 Km	Screened In

[37] OPR (2021) 'OPR Practice Note PN02 Environmental Impact Assessment Screening'.

Estuaries SPA			
Lough Derg (Shannon) SPA	004058	12.4 km	Screened In
Slieve Bernagh Bog SAC	002312	9.9km	Out
Silvermines Mountains West SAC	002258	14.1km	Out
Danes Hole, Poulnalecka SAC	000030	14.7km	Out

Three of the Natura 2000 sites listed above are within the 5km zone of impact and are hydrologically linked to the scheme at Castleconnell (Figure 8-4). These include;

- Lower River Shannon SAC (002165)
- River Shannon and Fergus SPA (004077)
- Lough Derg (Shannon) SPA (004058)

These sites were screened in during the AA screening, as they may be impacted through surface water, groundwater, air, and land pathways. Impacts on these sites are assessed in detail in the Natura Impact Statement that accompanies this EIAR. All other Natura 2000 sites were screened out.

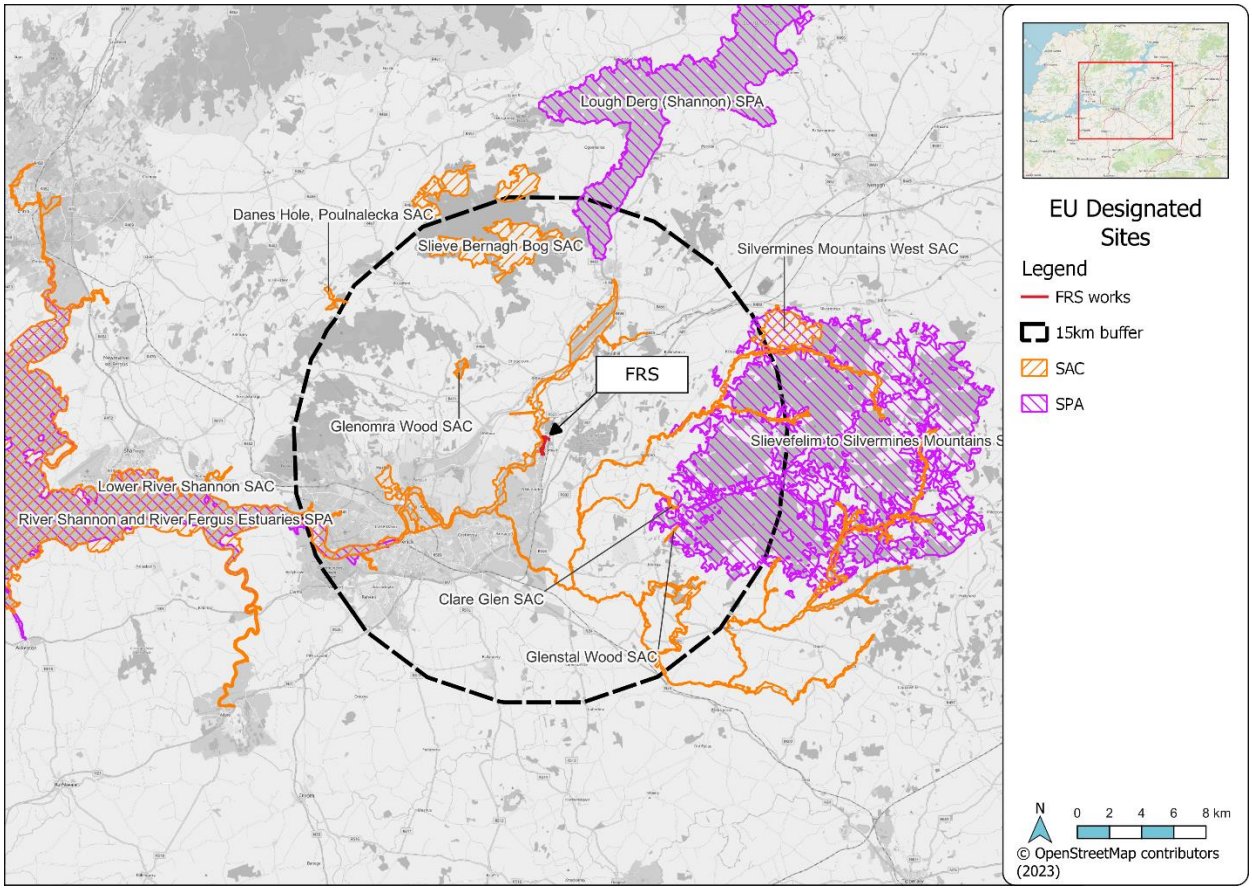

Figure 8-4: EU designated sites occurring within 15km of the proposed Scheme

Nationally Protected Sites

Designated sites, which also include Natural Heritage Areas (NHAs) and proposed Natural Heritage Areas (pNHAs), which are national designations, were also identified within the proposed Scheme's area of influence. The designated search area was 15 km from the boundary of the proposed Scheme for NHA and pNHA sites. The sites within the ZOI are discussed in the sections below.

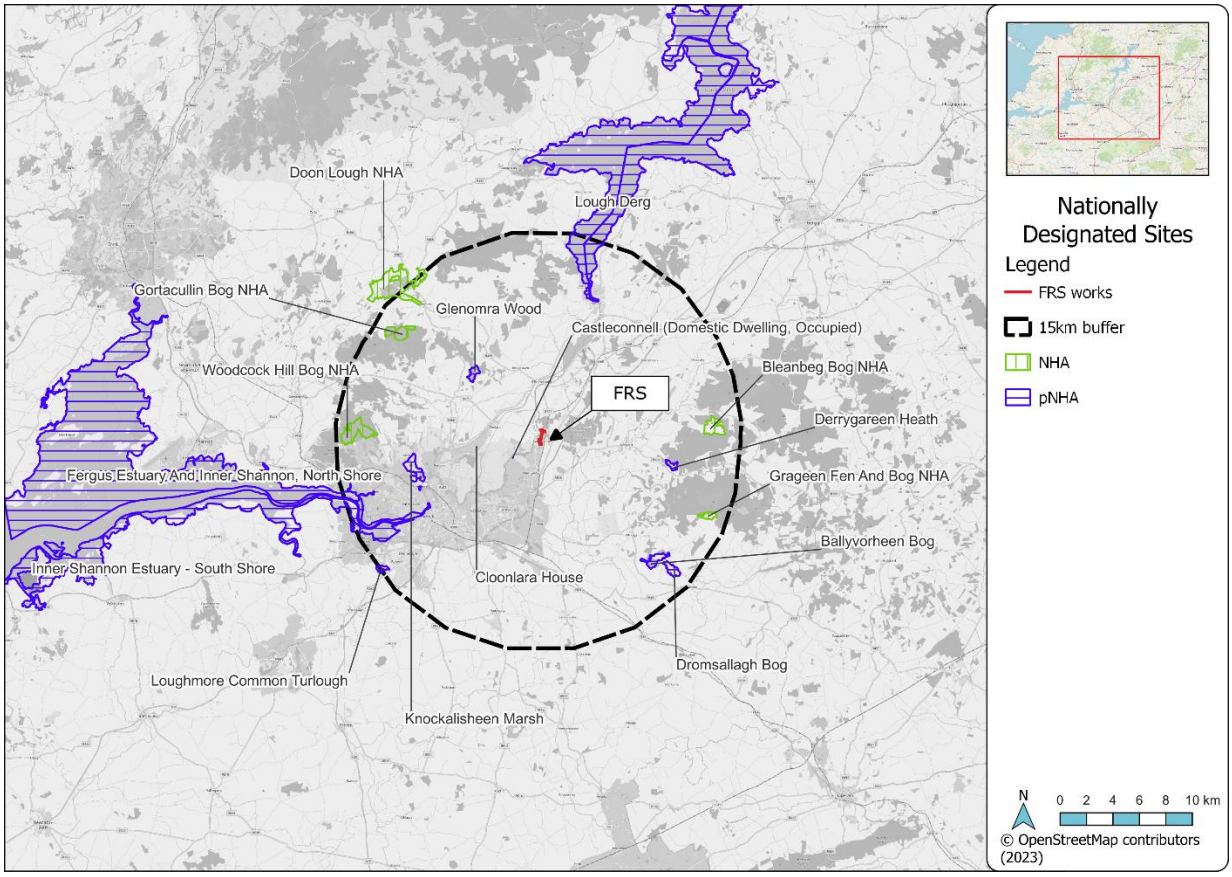

Figure 8-5**: **Nationally designated sites occurring within 15km of the proposed Scheme

Castleconnell (Domestic Dwelling, Occupied) pNHA (Site code: 000433)

This pNHA is located in the townland of Prospect, approximately 2.3km south of the proposed Scheme. Very little information is given for this site, but it is assumed this is a protected site for a roost of an unspecified bat species that may be of a particularly important roost size.

Bats roosting here may be using the River Shannon for commuting and foraging outside of the extent of the proposed Scheme and are not likely to be disturbed by construction works.

Cloonlara House pNHA

Cloonlara House lies approximately 5km from Castleconnell and is a three-storey domestic dwelling house and contains over l00 Leisler's bats *Nyctalus leisleri* during the summer months. This is one of the biggest nursery sites in Ireland and Europe with over 100 bats recorded[38].

The proposed Scheme occurs outside the 3km core sustenance zone (CSZ) of Leisler's bats[39]. Bats roosting here are not likely to be commuting or foraging within the extent of the proposed Scheme.

[38] NPWS (2009) pNHA Site Synopsis Portfolio, available: https://www.npws.ie/sites/default/files/general/pNHA_Site_Synopsis_Portfolio.pdf.

[39] Collins, J. (Ed.) (2016) Bat Surveys for Professional Ecologists: Good Practise Guidelines (3rd Edition) Bat Conservation Trust, 3rd edn. ed, The Bat Conservation Trust, London.

Glenomra Wood pNHA

This site consists of Old sessile oak woods with Ilex and Blechnum in British Isles, listed under Annex I of the EU Habitats Directive[38]38. This pNHA overlaps with the Glenomra Wood SAC, designated for the same habitats. This pNHA is situated 6.2km from Castleconnell. Given the distance of this site from the proposed scheme and lack of hydrological connections to the proposed scheme, no impacts on this pNHA are anticipated.

Knockalisheen Marsh pNHA

Knockalisheen Marsh pNHA is located mostly within County Clare but is situated just to the north of Limerick city. It consists of unimproved pasture sloping down to a wetland area which drains into the Shannon River. The site is of high ecological value in that it is a good example of unimproved pasture and wetland with good botanical diversity. This habitat type is now scarce, particularly so close to an urban environment. The site is notable for the presence of several species of orchid, including Marsh Helleborine *Epipactis palustris*. There is also a colony of Skullcap *Scutellaria galericulata*, a wetland plant which is rare in County Clare. This pNHA overlaps with the Lower River Shannon SAC. Knockalisheen Marsh lies 9km from Castleconnell. Given the distance of this site from the proposed scheme and lack of direct hydrological connections to the proposed scheme, no impacts on this pNHA are anticipated.

Derrygareen Heath pNHA

This is a rocky area of shallow peaty soils over Old Red Sandstone geology. The vegetation is that of un-reclaimed heathland, dominated by Heather *Calluna vulgaris* with Cross-leaved Heath *Erica tetralix*, and grasses such as Common Bent *Agrostis capillaris*. This pNHA overlaps with the Slievefelim to Silvermines Mountains SPA. This pNHA lies 9.3km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connections to the proposed scheme, no impacts on this pNHA are anticipated.

Fergus Estuary And Inner Shannon, North Shore pNHA

Fergus Estuary and Inner Shannon, North Shore is a large estuarine complex which comprises the River Fergus estuary from where it becomes tidal at Clarecastle, Co Clare to where it joins with the Shannon estuary and inland towards Limerick City. Habitats within the site include intertidal mudflats with fringing reedbeds, salt marsh, swamps, and wet marsh. The site is of high ornithological interest, providing a habitat for wintering and migrating wildfowl. Three of the species that are present regularly on the site – Golden Plover, Whooper Swan, and Black-Tailed Godwit – are on Annex I of the EU Birds Directive. It is also of botanical interest, with records of Triangular Club-rush *Schoenoplectus triqueter* from the shores of the Shannon Estuary. Another uncommon plant found within the site is a species of salt marsh grass *Fuccinellia* sp. This pNHA overlaps with the Lower River Shannon SAC and River Fergus and Shannon Estuaries SPA and lies 9.5km from the proposed FRS. Given the distance of this site from the proposed scheme and assessment of the overlapping SAC and SPA in the NIS prepared for the proposed scheme, this site has been screened out.

Lough Derg pNHA

Lough Derg lies within counties Tipperary, Galway and Clare and is the largest of the River Shannon Lakes, being some 40 km long. Most of the lower part of the lake is enclosed by hills on both sides, the Slieve Aughty Mountains to the west and the Arra Mountains to the east. The northern end is bordered by relatively flat, agricultural country. Lough Derg is of high ornithological importance as it supports nationally important breeding populations of Cormorant and Common Tern. In winter, it has nationally important populations of Tufted Duck and Goldeneye, as well as a range of other species including Whooper Swan. The presence of Whooper Swan, Greenland White-fronted Goose, Hen Harrier and Common Tern is of particular note as these are listed on Annex I of the E.U. Birds Directive. This pNHA overlaps with Lough Derg (Shannon) SPA and Lough Derg, North-east Shore SAC and lies 10.5km from the proposed FRS. Given the distance of this site from the proposed scheme, lack of downstream

hydrological connection to the proposed scheme and assessment of the overlapping SPA in the NIS prepared for the proposed scheme, this site has been screened out.

Inner Shannon Estuary - South Shore pNHA

This pNHA is part of the River Shannon Estuary and is comprised of extensive intertidal mudflats, fringing reedbeds, swamps, polders, salt marsh and wet marsh habitats; habitats which support many thousands of wading birds and duck. Greenland White-fronted and Greylag Geese frequent the southern shores of the estuary during the winter months. The estuary is also a stronghold for two rare plant species; triangular rush *Scirpus triqueter* and summer snowflake *Leucojum aestivum*. This pNHA overlaps with the Lower River Shannon SAC and River Fergus and Shannon Estuaries SPA and lies 11.1km from the proposed FRS. Given the distance of this site from the proposed scheme and assessment of the overlapping SAC and SPA in the NIS prepared for the proposed scheme, this site has been screened out.

Ballyvorheen Bog pNHA

Cutaway raised bog bordered by woodland with dominant Heather *Calluna vulgaris*, Purple Moor-grass *Molinia caerulea*, and many self-sown Scots Pine *Pinus sylvestris*; *Sphagnum* patches with abundant Cranberry *Vaccinium oxycoccos*. This pNHA overlaps with the Lower River Shannon SAC and lies 11.5km from the proposed Scheme. Given the distance of this site from the proposed scheme, lack of hydrological connections to the proposed scheme and assessment of the overlapping SAC in the NIS prepared for the proposed scheme, this site has been screened out.

Bleanbeg Bog NHA

Bleanbeg Bog NHA consists primarily of upland blanket bog and is located approximately 7 km east of Newport in south Tipperary. The site is situated in the townlands of Bleanbeg, Glencroe, Fiddane and Castlewaller. It incorporates a broad plateau of upland blanket bog habitat that grades into heath, upland grassland on peaty soil, and cutover bog. The western boundary of the site is defined by the transition from intact blanket bog to cutover bog, while the northern, eastern and southern sides of the site are bounded by conifer plantation. The site lies between 260 m and 368 m above sea level and is underlain by bedrock of Old Red Sandstone. Bleanbeg Bog NHA is a site of considerable conservation significance. It contains important areas of upland blanket bog together with upland grassland and heath habitats[38]. This NHA overlaps with the Slievefelim to Silvermines Mountains SPA and lies 12km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on the NHA are not expected.

Woodcock Hill Bog NHA

Ballyvorheen Bog, NW of Cappamore (R7453, R7553): Part of Lower River Shannon SAC. This site consists of upland blanket bog which is a globally scarce resource. Wet heath can also be found here. The mid-slopes of the hill feature a mosaic of upland blanket bog while the summit is covered by wet heath. The lower slopes in the south-west support blanket bog. This NHA lies 12.2km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this NHA are not expected.

Gortacullin Bog NHA

Designated for the presence of upland blanket bog and wet heath. A range of blanket bog microhabitats such as hummock/ hollow complexes, flushes and regenerating cutover with willow and birch scrub can be found here. This NHA lies 12.2km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this site are not expected.

Dromsallagh Bog pNHA

Dromsallagh Bog is a small site of cutaway raised bog with hummocks apparently regenerating well and its associated habitatsClick or tap here to enter text.. This pNHA lies 12.9km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this site are not expected.

Grageen Fen And Bog NHA

Grageen Fen and Bog NHA is an upland bog and alkaline fen located on the southern side of the Slievefelim Mountains, approximately 6 km east of Moroe and 7 km south-east of Newport, Co. Limerick. Overlaps with Slievefelim to Silvermines Mountains SPA (NPWS, 2004c). This NHA corresponds to the Slievefelim to Silvermines Mountains SPA and lies 13.1km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this site are not expected.

Doon Lough NHA

Doon Lough Bog NHA is situated approximately 3 km north-east of Broadford, Co. Clare in the townlands of Doorus, Cloonloum Beg, Teerovannan Mountallon, Killaderry, Gortnagonnella, Doon Lough and Doon. The site comprises a raised bog, which includes both areas of high bog and cutover bog, woodlands, lakes, marsh, fen and wet meadows. The site is bounded by roads to the west, south and east. The high bog is bounded by mineral ridges to the west and east and wet grassland to the south. The raised bog on the site consists of a small, relatively intact basin bog with a distinct dome. Towards the centre there is a hummock/hollow complex. Cutover bog is found all around the high bog and includes areas of regenerating cutover bog, humid grassland and Downy Birch *Betula pubescens* scrub[38] This NHA lies 13.1km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this site are not expected.

Loughmore Common Turlough pNHA

Loughmore Common (pNHA) is a turlough / seasonal lake that supports plant and bird species dependent on the shallow flooding patterns. An area of rich fen habitat occurs towards the centre of the pNHA site. This pNHA lies 14.8km from the proposed Scheme. Given the distance of this site from the proposed scheme and lack of hydrological connection to the proposed scheme, impacts on this site are not expected.

8.2.2.1 Screening of nationally designated sites

Table 8-10: Screening of nationally designated sites within ZOI of the proposed FRS

Designated site	Approx km from site	Overlap with Natura 2000 site	Screening of site
Castleconnell (Domestic Dwelling, Occupied) pNHA 000433	2.3km	Adjacent to Lower River Shannon SAC	Screen out – distance, no impact anticipated
Cloonlara House pNHA 000028	4.8km		Screen out - distance, no impact anticipated
Glenomra Wood pNHA 000011	6.2km	Glenomra Wood SAC	Screen out – SAC assessed in NIS
Knockalisheen Marsh pNHA 002001	9.0km	Lower River Shannon SAC	Screen out – SAC assessed in NIS
Derrygareen Heath pNHA 000931	9.3km	Slievefelim to Silvermines Mountains SPA	Screen out – SPA assessed in NIS
Fergus Estuary And Inner Shannon, North Shore pNHA 002048	9.5km	Lower River Shannon SAC. River Shannon and	Screen out – SAC & SPA assessed in NIS

		River Fergus Estuaries SPA	
Lough Derg pNHA 000011	10.5km	Lough Derg (Shannon) SPA. Lough Derg, North-east Shore SAC	Screen out - SPA assessed in NIS
Inner Shannon Estuary - South Shore pNHA 000435	11.1km	Lower River Shannon SAC. River Shannon and River Fergus Estuaries SPA	Screen out – SAC assessed in NIS
Ballyvorheen Bog pNHA 001849	11.5km	Lower River Shannon SAC	Screen out – SAC assessed in NIS
Bleanbeg Bog NHA 002450	12.0km	Slievefelim to Silvermines Mountains SPA	Screen out – SPA assessed in NIS
Woodcock Hill Bog NHA 002402	12.2km		Screen out – distance, lack of connections, no impact anticipated
Gortacullin Bog NHA 002401	12.2km		Screen out – distance, lack of connections, no impact anticipated
Dromsallagh Bog pNHA 001850	12.9km		Screen out – distance, lack of connections, no impact anticipated
Grageen Fen And Bog NHA 002186	13.1 km	Slievefelim to Silvermines Mountains SPA	Screen out – SPA assessed in NIS
Doon Lough NHA 000337	13.1km		Screen out – distance, lack of connections, no impact anticipated
Loughmore Common Turlough pNHA 000438	14.8km		Screen out – distance, lack of connections, no impact anticipated

8.2.2.2 Other Designated Sites

No other designated sites, such as Ramsar sites, are present within the ZoI of the proposed Scheme.

8.2.3 Habitats

Habitat types recorded within the study area are listed in Table 8-11 and shown in Figure 8-6. Habitats that have been assessed in the accompanying NIS are indicated. Alluvial Forests [91E0] is an Annex I habitat present next to the scheme and is a QI of the Lower River Shannon SAC. Any habitats present within the SAC boundary is assessed in the NIS accompanying this EIAR.

Table 8-11: Habitat types recorded in the study area

Fossitt Habitat & Code	Linked Annex Habitat & Species	Assessed in NIS?
Tall-herb swamps FS2	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels 6430	No
Wet willow-alder-ash woodland WN6	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0	Yes (if present in SAC Boundary)
Riparian woodland WN5	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0	Yes (if present in SAC Boundary)
(Mixed) broadleaved woodland WD1	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0	Yes (if present in SAC Boundary)
Reed and large sedge swamps FS1	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels 6430	No
Upland/eroding rivers FW1 – Cedarwood Stream	Pathway to SAC	Yes

Lowland/depositing rivers FW2 – River Shannon & Cloon Stream	Petromyzon marinus (Sea Lamprey) [1095] Lampetra planeri (Brook Lamprey) [1096] Lampetra fluviatilis (River Lamprey) [1099] Salmo salar (Salmon) [1106] Lutra lutra (Otter) [1355] Cormorant *Phalacrocorax carbo* [A017] Black-headed Gull *Chroicocephalus ridibundus* [A179]	Yes
Drainage ditches FW4	Pathway to SAC	Yes
Amenity grassland (improved) GA2	No link	-
Dry meadows and grassy verges GS2	No link	-
Wet grassland GS4	No link	-
Stone walls BL1	No link	-
Buildings and artificial surfaces BL3	No link	-
Conifer plantation WD4	No link	-
Hedgerows WL1	No link	-
Treelines WL2	No link	-
Scrub WS1	No link	-
Ornamental/non-native shrub WS3	No link	-

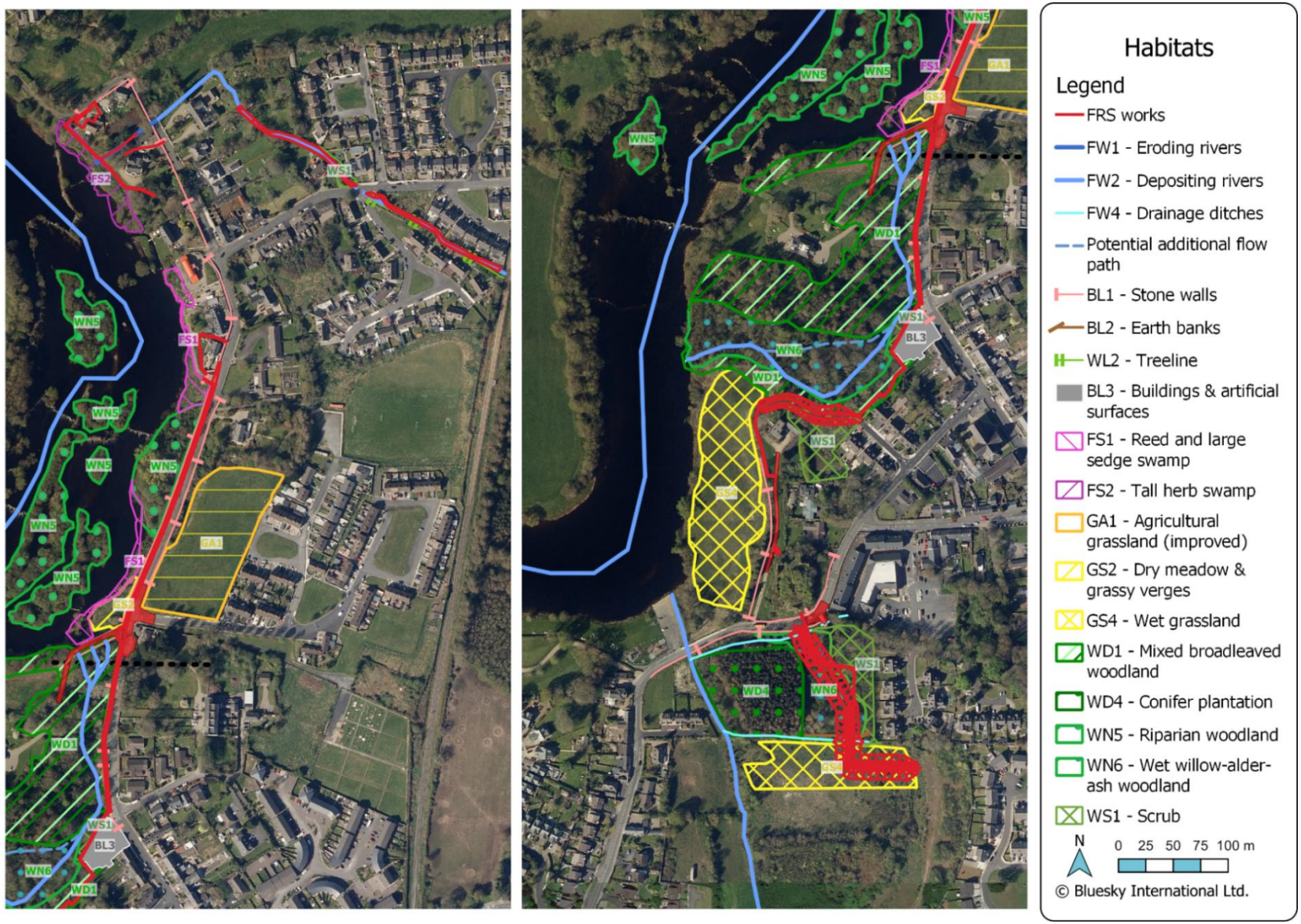

Figure 8-6: Habitats recorded within the flood cells where works will be undertaken for Castleconnell FRS

8.2.4 Riparian Habitats

8.2.4.1 Annex I Habitats

Two habitats listed under Annex I of the E.U. Habitats Directive have been recorded within the study area (full study report included in Appendix 8.2). These include:

- Alluvial forests with Alnus glutinosa and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) (91E0)* (*Priority Habitat).
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430).

Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland]

Three areas of Annex I alluvial woodland were recorded within the study area, corresponding to Fossitt habitats riparian woodland and wet willow-alder-ash woodland. One area of woodland has been described as 'Affinity to Alluvial Forests'. From north to south in relation to the woodlands mapped in Figure 8-7, the descriptions of the Annex I alluvial woodlands are further described in this section. The full survey report by Denyer Ecology is included in Appendix 8.2. These woodlands are listed as:

- Alluvial Woodland 2 – located next to the Mall Road;
- Alluvial Woodland 4- On Cloon Island, between Island House and Stormont House;
- Alluvial Woodland 3- Emerging alluvial forests at Coolbawn Woods;
- Affinity to Alluvial Woodland 1- located next to the Mall Road (between Island House and Mahers Pub);
- Instream river islands –surveyed in 2019 during initial scoping surveys. Habitat description and ground flora indicated this is Alluvial Forests 91E0;

Alluvial Woodland 2, 4 and affinity to Alluvial Woodland 1 are located within the Lower River Shannon SAC and impacts to these habitats are assessed in the Natura Impact Statement (NIS) that accompanies this report.

Woodland 3 Emerging alluvial forests at Coolbawn Woods is outside of the SAC and will be assessed in this Chapter.

Follow-up surveys to finalise the extents of these habitats and conduct ecological walkovers of the priority Annex I Alluvial woodlands in particular, were conducted by JBA Ecologists Hannah Mulcahy, Anne Mullen and NPWS Ecologist Jervis Goode on 19 July 2022. All areas of alluvial woodland, particularly the woodland area behind Maher's pub along the Cloon Stream, and the woodland beside the Mall road was visited again by JBA ecologists on the 10 February 2023 to survey extent and composition of the habitat while vegetation had died back in winter. It was checked again in summer 2023 when visiting the scheme to place trail cameras, and again in winter 2024 during wintering bird surveys. JBA ecologists are satisfied the condition and extent of this habitat is the same as the initial survey of this habitat since May 2022.

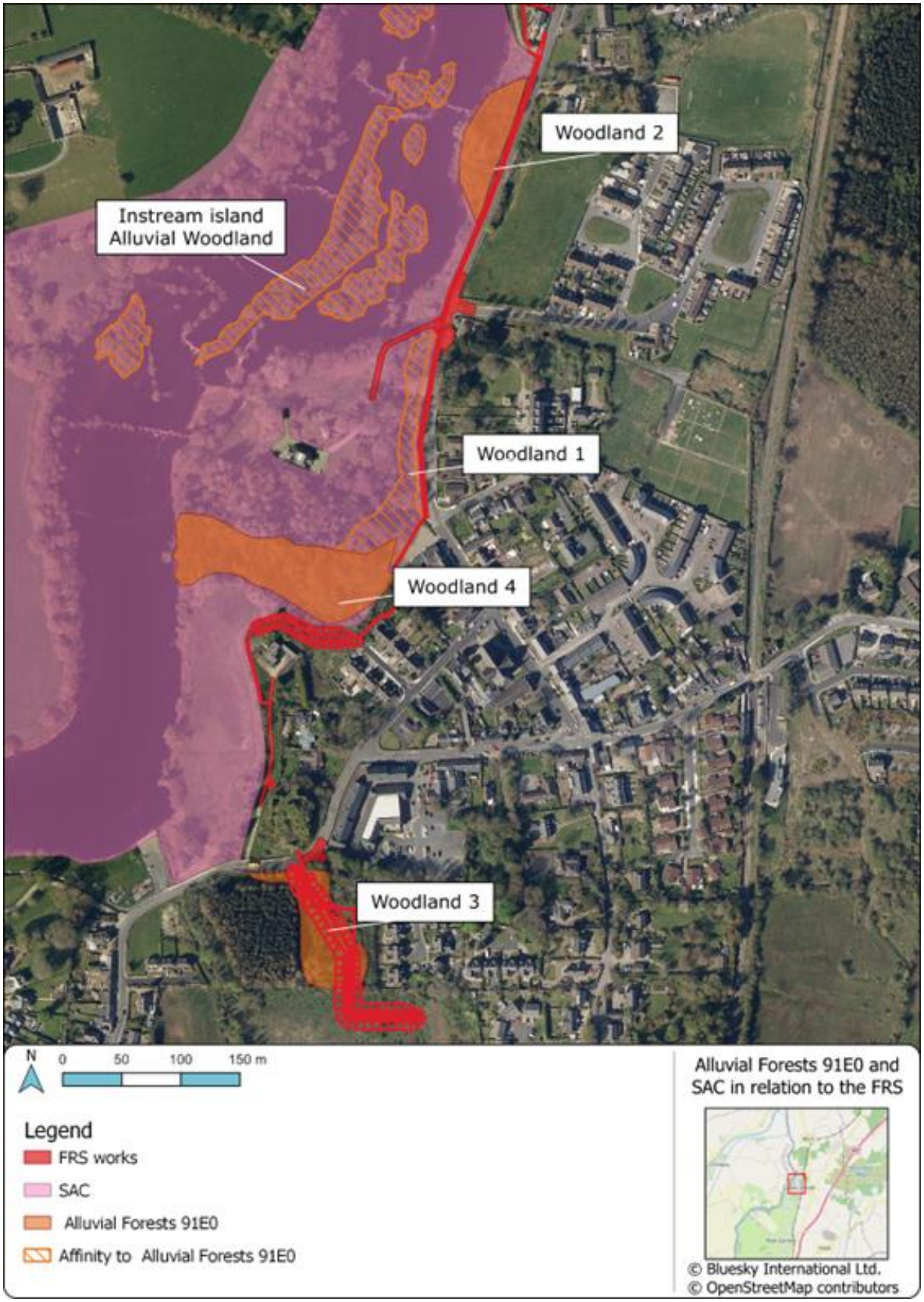

Figure 8-7: Alluvial Forest 91E0 mapped in the scheme

Alluvial woodland 3- Coolbane Woods

The southernmost area of alluvial woodland recorded also corresponds to wet willow-alder-ash woodland and occurs adjacent to a conifer plantation. This area is not adjacent to the river/ side channels (as for the other wet woodland areas) but has a typical wet woodland ground flora and is likely to be within the winter flood zone. The canopy is dominated by young Rusty Willow with Downy Birch *Betula pubescens*. The ground flora is dominated by 91E0 positive indicator species in most areas, but Pendulous Sedge is also locally frequent[40].

The area of this woodland is approximately 0.4 hectares in size. It can be considered of higher local importance. This woodland is located outside the SAC and impacts have not been assessed in the NIS. Further assessment is required for this habitat.

Figure 8-8: Alluvial woodland 3 at Coolbane Woods; corresponding to wet willow-alder-ash woodland

Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]

This Annex I habitat is present within the River Shannon adjacent to the scheme. This habitat can be classified as Tall-herb swamps FS2 and Reed and large sedge swamps FS1. It is found in patches of wetland vegetation at the edge of the River Shannon and partially submerged. Species present include Nettle, Water Horsetail, Bur-reed *Sparganium* spp. Water Mint, Hemlock Water-dropwort, Great Willowherb, Reed Canary-grass *Phalaris arundinacea*, Wild Angelica *Angelica sylvestris*, Marsh-marigold *Caltha palustris*, Meadowsweet, Water Figwort, Tufted Vetch Hemp-agrimony *Eupatorium cannabinum*, Yellow Iris (adapted from Denyer Ecology 2022b)[41].

Three additional areas of tall-herb swamps (FS2) with similar vegetation were recorded as having an affinity to tall-herb fen; these habitats lacked sufficient cover of positive indicator species. Giant Hogweed is present occasionally.

[40] Denyer Ecology (2022a) Castleconnell Flood Relief Scheme: Alluvial Woodland Habitat Survey.

[41] Denyer Ecology (2022b) Castleconnell Flood Relief Scheme: Tall-Herb Swamp Habitat Survey.

It can be considered of International Importance. This Annex I habitat is not a QI of the Lower River Shannon and therefore impacts to this habitat were not assessed in the Natura Impact Statement.

Further assessment is required in this chapter.

Figure 8-9: Tall-herb fens [6430] recorded at Rivergrove house.

Floating River vegetation [3260]

Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]' habitat is a designated QI within the Lower River Shannon SAC.

This habitat was not recorded at any of the in-stream fisheries survey sites[42].During the aquatic survey *Ranunculus, Potamogeton spp. and Fontinalis antipyretica* were identified. Whilst the species which make up this habitat were noted separately throughout the survey, due to high levels of siltation, filamentous algae, and these areas being very localized with high proportion of *Potamogeton* spp., these areas are not considered to represent this Annex I habitat. Additionally, this habitat occurs in nutrient poor fast flowing waters, however the background unsatisfactory water quality, channel modifications, and the severe river regulation has made conditions generally unsustainable for this Annex I habitat.

This Annex I habitat was recorded by AECOM ecologists in 2019 at Conway's Canal approximately 20m upstream from its confluence with the River Shannon. This Canal adjoins with the right-hand bank of the River Shannon, which is the opposite bank from the proposed scheme works. Water flowing through the canal is not hydrologically connected to water flowing past Castleconnell. This area is considered to be outside of the study area.

[42] Ecofact Environmental Consultants (2021) Baseline Aquatic Ecology Survey - Proposed Flood Relief Scheme, Castleconnell, Co. Limerick.

Therefore, due to background unsatisfactory water quality, channel modifications, and the severe river regulation has made conditions generally unsustainable for this annex habitat, this habitat is not present in the study area or downstream and is not expected to be impacted. No further assessment is required.

8.2.4.2 Surface Waterbodies within the Scheme Study Area

There are many waterbodies present in the proposed Scheme area including the River Shannon, as well as three streams: Cedarwood stream, Cloon Stream and Stradbally Stream.

Figure 8-10: Surface waterbodies recorded within the Castleconnell FRS study area

Cedarwood stream (Upland/eroding rivers FW1)

The Cedarwood Stream is located at the northern boundary of the study area. It was culverted for most of its reach, and where visible, surveyors noted the substrate consisted of sand and pebbles and the stream banks were steep. No aquatic vegetation was observed in-stream.

Results from the eDNA sampling show that European Eel is present in this river.

It can be considered of higher local importance. Impacts to this habitat are assessed in the Natura Impact Statement due to its link (pathway) with the Lower River Shannon. With the implementation of mitigation measures, as outlined in the NIS, no adverse effects will occur. Therefore, this stream can be screened out of impact assessment in this Chapter.

Figure 8-11: Cedarwood stream is culverted many times, with last culvert at Grange House near where it joins with River Shannon

River Shannon - Lowland/depositing rivers FW2

The River Shannon flows along the western boundary of the study area. The flow in the River Shannon is controlled by a Parteen regulating weir. The river is therefore not under a natural hydrological regime. There are also several fisheries modifications in the Shannon at Castleconnell such as weirs, which have changed the river levels in areas, resulting in some deeper areas and an increasingly confined channel.

The river is of International importance as it is an SAC. Impacts to this habitat are assessed in the Natura Impact Statement as it is designated as Lower River Shannon SAC. Mitigation measures applied for QI fish species Lamprey and Salmon are included in the accompanying NIS to protect these species in the River Shannon during the works. However, other non-QI fish species and habitats were recorded in the River Shannon, which are not assessed in the NIS. Therefore, further assessment is required.

Figure 8-12: River Shannon next to proposed scheme

Annex I habitats Alluvial Forests [91E0] and Tall herb fen [6430] are present on the island and edges of the River Shannon in Castleconnell and are habitats dependant on the water regime and quality of the River Shannon.

The dominant plant species recorded in the River Shannon were Water Mint *Mentha aquatica*, Branched bur-reed *Sparangium erectum*, Unbranched Bur-reed *Sparganium emersum* and Water-cress *Rorippa nasturtium-aquaticum*. Also present in high numbers mostly on the river edges were Common Reed *Phragmites australis* and Reed sweet-grass *Glyceria maxima*. Other species recorded include Water Mint *Mentha aquatica*, Yellow Iris *Iris pseudacorus*, Fool's watercress *Apium nodiflorum*, Bulrush *Typha latifolia*, Common club-rush *Schoenoplectus lacustris* and Water Hemlock *Oenanthe crocata*.

Cloon Stream - Lowland/depositing rivers FW2

The Cloon stream is a side tributary of the River Shannon, which forms Cloon Island. There is a causeway at the entrance to Island house which bridges the Cloon Stream. The bed of the Cloon stream is devoid of aquatic vegetation, however the surrounding habitat is composed of wet willow-alder-ash woodland and mixed broadleaved woodland around Island House on Cloon Island. This woodlands around the Cloon Stream have been classified as Annex I Alluvial Forests 91E0 and affinity to 91E0.

Additionally, River / Brook Lamprey (4) and Sea Lamprey (1) were recorded in the stream during the fisheries surveys, as well as 1 brown trout, Eel (3) and Three-spined stickleback (7). Non-native naturalised species recorded include Minnow (10), Roach (10) and Stone Loach (2). No salmon were recorded in the stream.

It can be considered of International importance as it is in the SAC Boundary and its connection to the River Shannon. Impacts to this habitat are assessed in the Natura Impact Statement as it is designated as Lower River Shannon SAC. Mitigation measures applied for QI fish species Lamprey and Salmon are included in the accompanying NIS to protect these species in the River Shannon during the works. However, other non-QI fish species were recorded in the Cloon Stream, which are not assessed in the NIS. Therefore, further assessment is required.

Figure 8-13: Cloon Stream - View from causeway at Island House

Figure 8-14: View of Cloon Stream from Mahers Pub Car Park in Winter in normal water conditions (above) and in flood (below)

Stradbally stream Lowland/depositing rivers FW2

The Stradbally stream lies just outside the main study area to the south and flows into the River Shannon next to the Ferry Playground. A larger drainage ditch that discharges storm water from the Supervalu car park

connects with the Stradbally stream through the Scheme area. Smaller Drainage ditches from the conifer plantation connect with this stream also.

It can be considered of higher local importance and further assessment is required.

8.2.4.3 Drainage Ditches

Drainage ditches occur within the Flood Cell F3. One ditch drains through a culverted section from the Supervalu car park, under the entrance road to Coolbane Woods housing estate, and through the Conifer plantation into the Stradbally Stream. Other small drainage ditches are located throughout the Conifer Plantation.

A large drainage ditch bordering the south of the woodland flows into the Stradbally stream. These ditches can be considered of lower local importance but are connected to the Stradbally stream of higher importance. Due to the connection/pathway further assessment is required.

Figure 8-15: Drainage ditches within Coolbane woods that drain into the Stradbally Stream

8.2.5 Other habitats

8.2.5.1 Stone walls BL1

Stone walls were recorded along the Mall Road and Chapel Hill. These limestone walls are colonised by species including Herb-Robert *Geranium robertianum*, Dandelion *Taraxacum officinale* agg., Shining Crane's-bill *Geranium lucidum*, Common Ivy *Hedera helix*, Polypody *Polypodium vulgare*, Traveller's-joy *Clematis vitalba*, Wall-rue *Asplenium ruta-muraria*, Maidenhair Spleenwort *Asplenium trichomanes*, Ivy-leaved Toadflax *Cymbalaria muralis*, Hard-fern *Blechnum spicant* and Rustyback *Asplenium ceterach*.

Figure 8-16: Mall road wall, which will be demolished and stone re-used in construction of new flood wall

In 2020, the Mall road stone wall was cleared of vegetation and pointed with cement, and therefore now does not have the above vegetation listed growing on these walls or are slowly recolonising.

Figure 8-17: River side of Mall road wall, recently re-pointed

The Stone walls will be demolished for the construction of the new flood wall; however, the stone will be re-used to clad the new flood wall. This habitat can be considered of lower local importance and no further assessment is required.

8.2.5.2 Buildings and artificial surfaces BL3

Areas of buildings and built land occur throughout the study area, often associated with unnatural or species-poor areas of amenity grassland (GA2). Much of the scheme will occur on existing built land.

Garden species are frequent, and species such as Beech *Fagus sylvatica*, Pine *Pinus* spp., Sycamore *Acer pseudoplatanus*, Holly *Ilex aquifolium*, Horse-chestnut *Aesculus hippocastanum*, Cherry *Prunus* spp., Bluebell *Hyacinthoides non-scripta*, Bramble *Rubus fruticosus* agg., Common Field-speedwell *Veronica persica*, Yorkshire-fog *Holcus lanatus*, Wilson's Honeysuckle *Lonicera nitida*, Annual Meadow-grass *Poa annua* and Daisy *Bellis perennis* were also recorded.

Non-native invasive species including Cherry Laurel *Prunus laurocerasus*, Montbretia *Crocosmia x crocosmiiflora* and Pendulous Sedge *Carex pendula* also occur.

This habitat is of lower local importance and no further assessment is required.

Figure 8-18: Mall Road on which road raising and a new flood wall will be replace the existing wall.

Figure 8-19: Mahers Pub Car Park which will have a new flood wall built a few metres in from the edge

8.2.5.3 Wet grassland GS4

Wet grassland occurs south of Coolbane Meadows adjoining Alluvial woodland beside Coolbawn Meadows. A large meadow beside Stormont House is also a wet grassland but is also cut for hay. Both of these grasslands are inundated by flood water from the River Shannon. The wet grassland south of Coolbane Meadows will partially be built on for the embankment wrap around, however the wet grassland at Stormont house will not be built on.

Species recorded in these habitats include Reed Sweet-grass *Glyceria maxima*, Creeping Buttercup, Meadowsweet *Filipendula ulmaria*, Ribwort Plantain, Jointed Rush, Common Mouse-ear *Cerastium fontanum*,

Horsetails *Equisetum* spp., Deergrass *Trichophorum* spp., Common Reed *Phragmites australis*, Common Valerian *Valeriana officinalis*, Yellow Loosestrife *Lysimachia vulgaris*, Marsh Woundwort *Stachys palustris* and Tufted Vetch *Vicia cracca*.

It can be considered of higher local importance and further assessment is required.

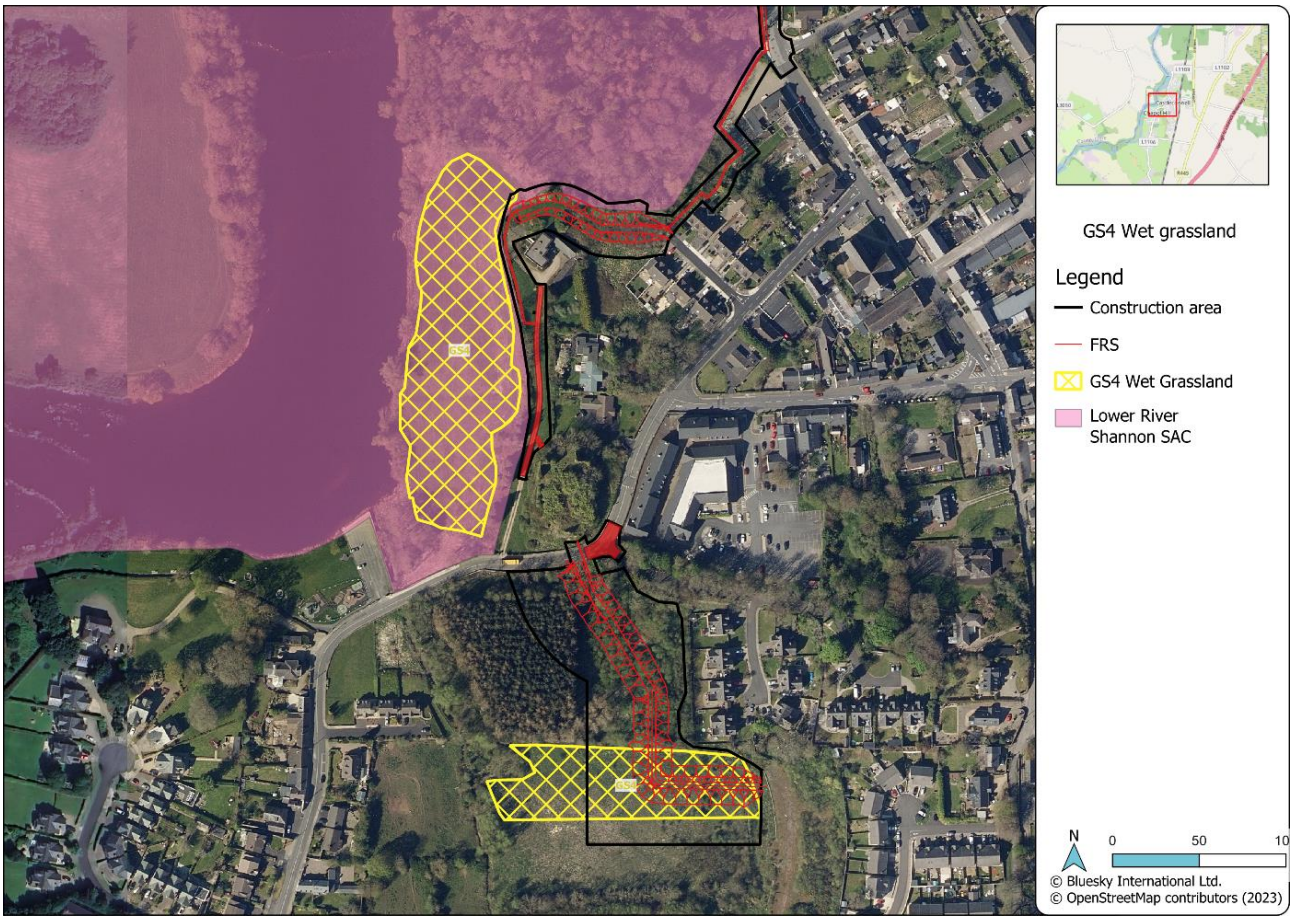

Figure 8-20: Wet grasslands affected by the proposed scheme

Figure 8-21: View of Wet Meadow and River Shannon from driveway of Stormont House

8.2.5.4 Hedgerows WL1; Treelines WL2; Scrub WS1

Treeline WL2/ Scrub WS1 mosaic A treeline of Cypress trees is located along the Cedarwood stream within an amenity area in Cedarwood Grove. This treeline then turns into a treeline of native trees such as Ash and Birch behind Cedarwood Grove houses. The Cedarwood stream has recently been cleared to facilitate a new

retaining wall has been built on the right bank of the river, but no trees have been removed for this work. On the north side of the road, the Cedarwood stream is overgrown and choked with scrub mostly composed of Snowberry, Bramble and other ornamental non-native vegetation. Mature standard trees such as Lime and Beech are found downstream in the back gardens of properties at Brooklands, Lacka. Hedges, trees and treelines can support common bird species. These habitats can be considered of local importance, although some may be of lower local to higher local importance and further assessment is required.

Figure 8-22: Example of Scrub (L) and Treelines (R) along the Cedarwood stream

Figure 8-23: Trees, scrub affected by the proposed scheme along the Cedarwood stream

Figure 8-24: Treelines at Coolbane Woods

Hedgerows WL1 / Scrub WS1 mosaic

A mosaic of hedgerow and scrub occurs directly south of Cloon Island beside Stormont House. A hedgerow separates this area of scrub from the garden of Stormont House. Species recorded in this habitat include Elder *Sambucus nigra*, Hawthorn, Pedunculate Oak *Quercus robur*, Ash, Spear Thistle *Cirsium vulgare*, Bramble Rubus fruticosus agg., Nettle, Common Knapweed, Hedge Bindweed, Lords-and-Ladies *Arum maculatum*, Hogweed, Dock, Ribwort Plantain, Greater Plantain, Cock's-foot, Perennial Rye-grass *Lolium perenne*, Creeping Bent *Agrostis stolonifera*, Greater Bird's-foot-trefoil, Red Clover, Autumn Hawkbit *Scorzoneroides autumnalis*, Jointed Rush, Common Figwort, Horsetail and Red Bartsia. Comon bird species such robins and blackbirds, or mammals such as mice and shrews may be living in this scrub area.

As of Spring 2024, scrub behind Stormont house may have been cleared by the owners. Scrub can be considered of lower local importance and no further assessment is required. However, there is an obligation to protect any breeding birds which may be nesting in this habitat during the spring and summer.

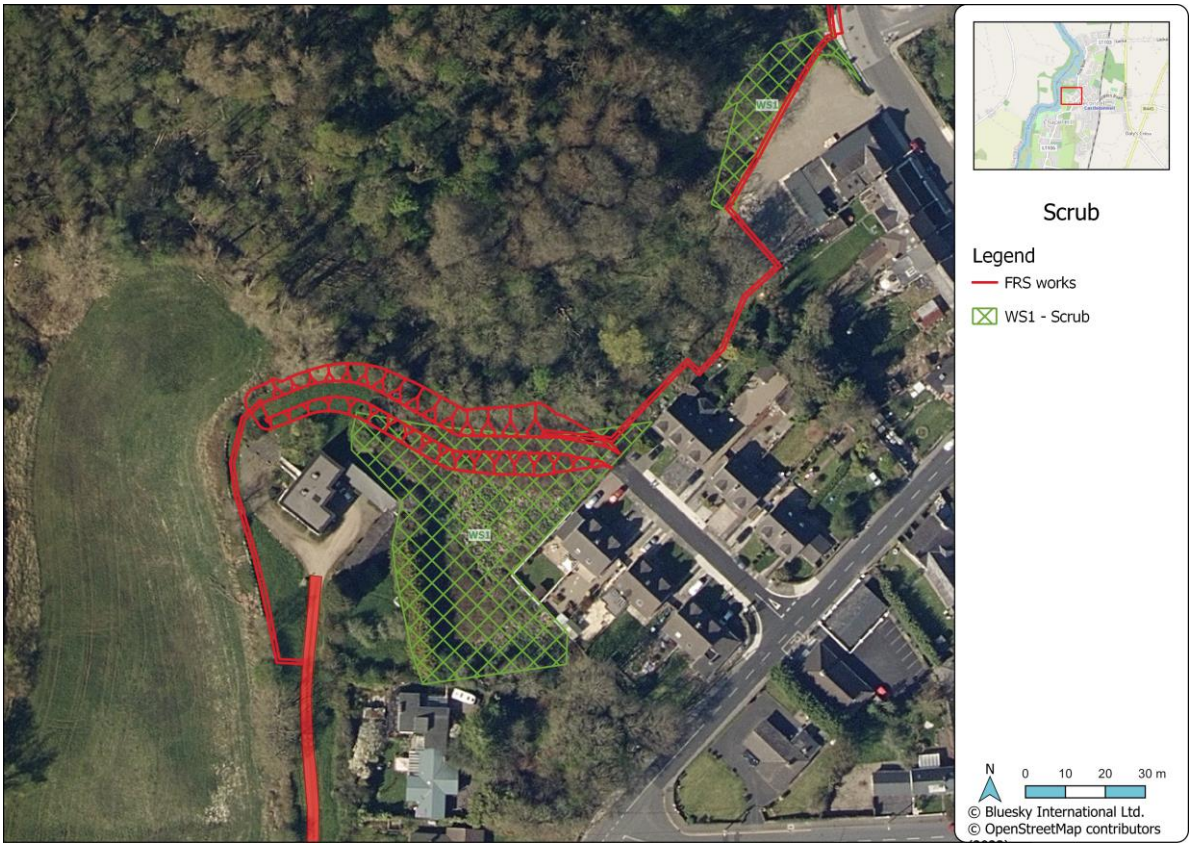

Figure 8-25**: **Scrub habitat next to Stormont House

8.2.5.5 Trees and treelines

Trees line the edge of the woodland area to the north and south of Coolbane woods. Some of these treelines will be removed to facilitate the embankment and road raising at this location. These treelines are linked to the emerging Alluvial woodland either side, and to the drainage ditches which drain into the Stradbally Stream.

As per the Tree Survey and Arboricultural Impact Assessment (included in the FRS application as a standalone report) a total of 86 individual trees, 4 tree groups, and 1 hedgerow, and 5840m² of wooded areas will be removed to facilitate the construction of the Scheme, as well as 16 trees will be pruned. (Table 8-12). These trees are generally non-native, ornamental trees which are of low ecological value or located in low value habitats (gardens, scrub etc). Any native trees, such as Ash, Alder, and Hawthorn, scheduled for removal from ecologically important habitats like Alluvial Woodland, should be considered of higher local value. Fourteen trees, marked in red in the table below, fall under this category.

Table 8-12: Trees from arborists report that will be removed to facilitate the scheme

Tree number	Tree species	Location in proposed scheme	Link with habitat
T001	Common Alder (Alnus glutinosa)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T002	Common Ash (Fraxinus excelsior)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T003	Magnolia (Magnolia sp.)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T004	Portuguese Laurel (Prunus lusitanica)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T005	Northern Japanese Magnolia (Magnolia kobus)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T006	Crab Apple (Malus sylvestris)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)

T007	Viburnum (Viburnum sp.)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T008	Japanese Pagoda (Styphnolobium japonicum)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T009	Magnolia (Magnolia sp.)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T010	Bird Cherry (Prunus padus)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T012	Common Ash (Fraxinus excelsior)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T013	Goat Willow (Salix caprea)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T016	Leyland Cypress (Cupressocyparis leylandii X)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T017	Common Beech (Fagus sylvatica)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T018	Common Beech (Fagus sylvatica)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T019	Common Ash (Fraxinus excelsior)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T020	Sycamore (Acer pseudoplatanus)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T021	Common Beech (Fagus sylvatica)	Rivergrove B&B and Grange House	Amenity grassland and built land (gardens)
T031	Cultivar Apple (Malus domestica)	Mall House	Amenity grassland and built land (gardens)
T032	Cultivar Apple (Malus domestica)	Mall House	Amenity grassland and built land (gardens)
T033	Cultivar Apple (Malus domestica)	Mall House	Amenity grassland and built land (gardens)
T034	Common Holly (Ilex aquifolium)	Mall House	Amenity grassland and built land (gardens)
T035	Sycamore (Acer pseudoplatanus)	Mall House	Amenity grassland and built land (gardens)
T036	Common Hawthorn (Crataegus monogyna)	Mall House	Amenity grassland and built land (gardens)
T091	Sycamore (Acer pseudoplatanus)	Mall House	Amenity grassland and built land (gardens)
T092	White Poplar (Populus alba)	Mall Road (phase 1)	Affinity to alluvial forest
T103	Common Ash (Fraxinus excelsior)	Mall Road (phase 2)	Affinity to alluvial forest
T104	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T105	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T106	Common Ash (Fraxinus excelsior)	Mall Road (phase 2)	Affinity to alluvial forest
T107	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T108	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T109	Common Ash (Fraxinus excelsior)	Mall Road (phase 2)	Affinity to alluvial forest
T110	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T111	Common Alder (Alnus glutinosa)	Mall Road (phase 2)	Affinity to alluvial forest

T112	Common Ash (Fraxinus excelsior)	Mall Road (phase 2)	Affinity to alluvial forest
T113	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T114	Common Beech (Fagus sylvatica)	Mall Road (phase 2)	Affinity to alluvial forest
T115	Common Beech (Fagus sylvatica)	Mall Road (phase 2)	Affinity to alluvial forest
T116	Common Hawthorn (Crataegus monogyna)	Mall Road (phase 2)	Affinity to alluvial forest
T117	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T118	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T119	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T120	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T121	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T122	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T125	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T126	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T127	Sycamore (Acer pseudoplatanus)	Mall Road (phase 2)	Affinity to alluvial forest
T136	Common Ash (Fraxinus excelsior)	Maher's Pub	Affinity to alluvial forest
T137	Common Ash (Fraxinus excelsior)	Maher's Pub	Affinity to alluvial forest
T138	Sycamore (Acer pseudoplatanus)	Maher's Pub	Affinity to alluvial forest
T139	Common Ash (Fraxinus excelsior)	Maher's Pub	Alluvial forest
T141	Sycamore (Acer pseudoplatanus)	Maher's Pub	Mixed broadleaved woodland
T142	Common Beech (Fagus sylvatica)	Maher's Pub	Mixed broadleaved woodland
T143	Common Beech (Fagus sylvatica)	Maher's Pub	Mixed broadleaved woodland
T144	Sycamore x7 (Acer pseudoplatanus)	Maher's Pub	Mixed broadleaved woodland
T145	Sycamore (Acer pseudoplatanus)	Maher's Pub	Mixed broadleaved woodland
T146	Sycamore (Acer pseudoplatanus)	Maher's Pub	Mixed broadleaved woodland
T154	Aspen (Populus tremula)	Meadowbrook Estate	Mixed broadleaved woodland
T155	Sycamore (Acer pseudoplatanus)	Meadowbrook Estate	Mixed broadleaved woodland
T156	Sycamore (Acer pseudoplatanus)	Meadowbrook Estate	Mixed broadleaved woodland
T157	Sycamore (Acer pseudoplatanus)	Meadowbrook Estate	Mixed broadleaved woodland
T159	Goat Willow x5 (Salix caprea)	Meadowbrook Estate	Mixed broadleaved woodland

T160	Aspen (Populus tremula)	Meadowbrook Estate	Scrub
T161	Japanese Cedar (Cryptomeria japonica)	Meadowbrook Estate	Scrub
T162	Aspen x12 (Populus tremula)	Meadowbrook Estate	Scrub
T174	Silver Birch (Betula pendula)	Stormont House	Amenity /garden
T175	Silver Birch (Betula pendula)	Stormont House	Amenity /garden
T180	Lawson Cypress x5 (Chamaecyparis lawsoniana)	Meadowbrook Estate	Mixed broadleaved woodland
T181	Common Ash (Fraxinus excelsior)	Meadowbrook Estate	Mixed broadleaved woodland
T194	Common Ash (Fraxinus excelsior)	Coolbane Woods	Treeline
T195	Common Ash (Fraxinus excelsior)	Coolbane Woods	Treeline
T196	Common Ash (Fraxinus excelsior)	Coolbane Woods	Treeline
T197	Common Hawthorn (Crataegus monogyna)	Coolbane Woods	Treeline
T198	Common Ash (Fraxinus excelsior)	Coolbane Woods	Treeline
T199	Common Ash (Fraxinus excelsior)	Coolbane Woods	Treeline
T201	Sycamore (Acer pseudoplatanus)	Coolbane Woods	Treeline
T202	Sycamore (Acer pseudoplatanus)	Coolbane Woods	Treeline
T214	Sycamore (Acer pseudoplatanus)	Coolbane Woods	Scrub
T215	Sycamore (Acer pseudoplatanus)	Coolbane Woods	Scrub
T216	Willow (Salix sp.)	Coolbane Woods	Scrub
T217	Common Hawthorn (Crataegus monogyna)	Coolbane Woods	Scrub
T218	Common Alder (Alnus glutinosa)	Coolbane Woods	Scrub
T219	Common Alder (Alnus glutinosa)	Coolbane Woods	Scrub
T220	Common Hawthorn (Crataegus monogyna)	Coolbane Woods	Scrub
T221	Common Hawthorn (Crataegus monogyna)	Coolbane Woods	Scrub
T222	Common Alder (Alnus glutinosa)	Coolbane Woods	Emerging alluvial forest
T223	Common Ash (Fraxinus excelsior)	Coolbane Woods	Emerging alluvial forest
T224	Common Ash (Fraxinus excelsior)	Coolbane Woods	Emerging alluvial forest
T225	Sycamore (Acer pseudoplatanus) Common Ash (Fraxinus excelsior) Horse Chestnut (Aesculus hippocastanum) Common Hawthorn (Crataegus monogyna)	Coolbane Woods	Emerging alluvial forest

	White Poplar (Populus alba)		
T226	Goat Willow (Salix caprea) Willow (Salix sp.) Common Hawthorn (Crataegus monogyna) Common Alder (Alnus glutinosa) White Poplar (Populus alba)	Coolbane Woods	Emerging alluvial forest
T228 (G)	Common ash (Fraxinus excelsior) European lime (Tilia x europaea) Sycamore (Acer pseudoplatanus) Prunus (Prunus sp.) Common beech (Fagus sylvatica)	Cedarwood stream Only Lime tree to be removed	Treeline

8.2.6 Protected Flora and Fauna

8.2.6.1 Desktop survey data

Records of protected flora and fauna including amphibians, birds, fish and mammals collated from the National Biodiversity Data Centre's biodiversity maps and databases (NBDC 2023), present within a 5km radius (approx. study area) of the proposed site and within the past 10 years are listed in Appendix 8.1. This table includes the date of the last record of these species.

These desktop results have been incorporated into the surveys for the proposed Scheme, as detailed in the sections below.

8.2.6.2 Results Bird surveys

This section summarises the results of the wintering and breeding birds. Full survey reports are included in Appendix 8.3.

Wintering bird surveys

The wintering bird surveys recorded 30 species covering a mix of common woodland and garden bird species, as well as designated species. These are provided in the Table 8-13 which outlines the species recorded for each area along the scheme as well as their designation. Amber and Red BoCCI species are colour coded accordingly. Two species listed as Qualifying Interests of the River Shannon and River Fergus Estuaries SPA, Cormorant *Phalacrocorax carbo*, and Black-headed Gull *Chroicocephalus ridibundus* were also recorded. These two species are assessed in the NIS. Wintering bird surveys were repeated in 2024 to update the original surveys carried in 2019-2020. Only one new species, Redwing, was noted during these surveys.

Breeding bird survey

Breeding bird surveys recorded the presence of 39 species, mainly common woodland and garden birds as well as migrant species. Evidence of breeding activity was recorded either by the presence of singing males, visible nests (in use, under construction, or recently fledged), evidence of feeding chicks or the presence of fledglings. This resulted in 26 species being confirmed as breeding in the area (Table 8-14).

The trees to the back of Mahers Pub, and adjacent to Island House, hold a significant rookery, as well as a heronry with at least one large Cypress and one large Beech tree being used, which is further details in the Section under ‘Heronry’.

Table 8-13: Species recorded during wintering bird surveys carried over the 2019/2020 and 2024 winter months

Latin name	Common name	Distribution	BoCCI status	Annex / QI Species
Accipiter nisus	Sparrowhawk	Island House	Green	
Anas platyrhynchos	Mallard	Predominantly recorded along the Mall Road.	Amber	ü / QI
Anser anser	Greylag Goose	Mainly recorded on the Shannon towards the Rivergrove B&B end of the scheme, On the right side of the river mainly. Feral population	Green	û
Cygnus olor	Mute swan	Using the Shannon along the entirety of the scheme	Amber	û
Chroicocephalus ridibundus	Black-headed Gull	Recorded around Ferrybank playground and in grassland by Stormont House.	Amber	QI
Alcedo atthis	Kingfisher	Observed around Rivergrove B&B	Amber	ü I
Gallinula chloropus	Eurasian moorhen	Predominantly recorded along the Mall Road.	Green	û
Aegithalos caudatus	Long-tailed tit	Recorded along the Mall Road	Green	û
Carduelis carduelis	European Goldfinch	Recorded along Meadowbrook Estate	Green	û
Certhia familiaris	Eurasian Treecreeper	Recorded in Ferry Playground park	Green	û
Cinclus cinclus	Dipper	Nest recorded under the bridge to Island House. Bird recorded on Northwestern edge of Cloon Island	Green	û
Columba palumbus	Common Wood-pigeon	Recorded throughout the scheme but with most records in forestry plantation at Coolbane woods	Green	û
Corvus cornix	Hooded crow	Recorded in flight over the River Shannon	Green	û
Corvus frugilegus	Rook	Recorded throughout the scheme; notable rookery in the trees behind Maher's Pub, and Meadowbrook estate	Green	û
Corvus monedula	Eurasian Jackdaw	Recorded in trees on Castleconnell castle.	Green	û
Cyanistes caeruleus	Eurasian Blue Tit	Recorded throughout the scheme. Locally common.	Green	û
Erithacus rubecula	European Robin	Recorded along the length of the scheme; mainly in wooded / scrub areas.	Green	û
Fringilla coelebs	Common Chaffinch	Recorded throughout the scheme. Locally common.	Green	û
Motacilla alba	Pied Wagtail	Recorded between Rivergrove B&B and Island House.	Green	û
Motacilla cinera	Grey Wagtail	Bird recorded on Northwestern edge of Cloon Island	Red	û

Latin name	Common name	Distribution	BoCCI status	Annex / QI Species
Parus major	Great tit	Recorded along the length of the scheme	Green	û
Passer montanus	Eurasian Tree sparrow	Recorded along the length of the scheme	Amber	û
Pica pica	Magpie	Recorded along the length of the scheme	Green	û
Streptopelia decaocto	Eurasian Collared-Dove	Recorded along the length of the scheme; not commonly recorded	Green	û
Troglodytes troglodytes	Eurasian Wren	Common throughout the scheme	Green	û
Turdus merula	Eurasian Blackbird	Common throughout the scheme	Green	û
Turdus philomelos	Song Thrush	Mainly in wooded area along Mall Road.	Green	û
Ardea cinerea	Grey heron	Notable heronry in tree behind Mahers pub. Locally important.	Green	û
Egretta garzetta	Little Egret	Occasional sighting, not common	Green	û
Phalacrocorax carbo	Great Cormorant	Recorded along the River Shannon.	Amber	ü / QI
Turdus iliacus	Redwing	50 birds in wintering flock at Island House	Red	û
Turdus pilaris	Fieldfare	Occasional record at Ferry playground	Green	û

Table 8-14: Species recorded during nesting bird surveys

Latin name	Common name	Breeding evidence	Distribution	BoCCI status	Annex / QI Species
Anas platyrhynchos	Mallard	Yes	Predominantly recorded along the Mall Road. Evidence of nesting activity in the soft vegetation between the wall and the river	Amber	ü QI
Anser anser	Greylag Goose	Yes	Mainly recorded on the Shannon towards the Rivergrove B&B end of the scheme, On the right side of the river mainly. Feral population	Green	û
Cygnus olor	Mute Swan	Yes	Using the Shannon along the entirety of the scheme	Amber	û
Alcedo atthis	Kingfisher	No	Recorded in proximity to Rivergrove B&B	Amber	ü Annex I
Cuculus canorus	Cuckoo	No	In trees behind Maher's Pub. Single record	Green	û
Falco peregrinus	Peregrine Falcon	No	In flight over the Shannon.	Green	ü Annex I
Falco tinnunculus	Eurasian Kestrel	No	Foraging over Scanlon Park; In flight in proximity to Rivergrove B&B	Red	û

Latin name	Common name	Breeding evidence	Distribution	BoCCI status	Annex / QI Species
Gallinula chloropus	Eurasian Moorhen	Yes	Predominantly recorded along the Mall Road. Evidence of nesting activity in the soft vegetation between the wall and the river	Green	û
Aegithalos caudatus	Long-tailed tit	Yes	Recorded along the Mall Road	Green	û
Carduelis carduelis	European Goldfinch	No	Recorded along Meadowbrook Estate	Green	û
Cinclus cinclus	Dipper	No	Nest recorded under the bridge to Island House. Bird recorded on Northwestern edge of Cloon Island	Green	û
Columba palumbus	Common Wood-pigeon	No	Recorded throughout the scheme but with most records in forestry plantation at Coolbane woods	Green	û
Corvus frugilegus	Rook	Yes	Recorded throughout the scheme; notable rookery in the trees behind Maher's Pub, and Meadowbrook estate	Green	û
Corvus monedula	Eurasian Jackdaw	Yes	Recorded in trees on Castleconnell castle.	Green	û
Cyanistes caeruleus	Eurasian Blue Tit	Yes	Recorded throughout the scheme. Locally common.	Green	û
Erithacus rubecula	European Robin	Yes	Recorded throughout the scheme.	Green	û
Fringilla coelebs	Common Chaffinch	Yes	Recorded throughout the scheme. Locally common.	Green	û
Garrulus glandarius	Eurasian Jay	No	In flight over the Shannon. Flushed from wooded area along Mall Road by passerines	Green	û
Hirundo rustica	Barn Swallow	Yes	Mainly seen forging over the River Shannon by Rivergrove B&B	Amber	û
Motacilla alba	Pied Wagtail	Yes	Recorded between Rivergrove and Cloon Island.	Green	û
Motacilla cinerea	Grey Wagtail	Yes	Bird recorded on Northwestern edge of Cloon Island	Red	û
Parus major	Great tit	Yes	Recorded along the length of the scheme	Green	û
Passer domesticus	House sparrow	Yes	Recorded around housing around Glenbrook (Northern end of the Scheme) and along Mall Road by Scanlon Park.	Amber	û
Periparus ater	Coal tit	Yes	Recorded by Castleconnell castle.	Green	û
Phylloscopus collybita	Common Chiffchaff	Yes	Recorded singing in Coolbane woods and by Castleconnell castle.	Green	û
Phylloscopus trochilus	Willow warbler	Yes	Recorded singing in vegetation along the Mall Road	Amber	û
Pica pica	Eurasian Magpie	Yes	Recorded along the length of the scheme	Green	û
Prunella modularis	Dunnock	No	Recorded next to Rivergrove B&B	Green	û
Pyrrhula pyrrhula	Bullfinch	Yes	Mainly recorded between Rivergrove B&B and Island house.	Green	û
Regulus regulus	Goldcrest	Yes	Recorded in wooded area opposite Scanlon Park, and on Cloon Island.	Amber	û
Streptopelia decaocto	Eurasian Collared-Dove	No	Recorded along the length of the scheme; not commonly recorded	Green	û

Latin name	Common name	Breeding evidence	Distribution	BoCCI status	Annex / QI Species
Sturnus vulgaris	European Starling	Yes	Recorded throughout the scheme; mainly distributed around the Rivergrove B&B, and likely nesting in out buildings in the area.	Green	û
Sylvia atricapilla	Eurasian Blackcap	Yes	Recorded throughout the scheme	Green	û
Troglodytes troglodytes	Eurasian Wren	Yes	Recorded throughout the scheme	Green	û
Turdus merula	Eurasian Blackbird	Yes	Recorded throughout the scheme. Locally common.	Green	û
Turdus philomelos	Song thrush	Yes	Evidence of nesting around the entrance to Island House. Mainly in wooded area along Mall Road.	Green	û
Turdus viscivorus	Mistle thrush	No	Mainly in wooded area along Mall Road.	Green	û
Ardea cinerea	Grey heron	Yes	Notable heronry in tree behind Mahers pub. Locally important.	Green	
Phalacrocorax carbo	Great Cormorant	No	Recorded along the River Shannon.	Amber	QI of screened-in SPAs

Heronry

Herons were recorded in every Wintering and Breeding Bird survey and are well known to the Village of Castleconnell. They have several roost and nest locations in Castleconnell, but a large number of Herons were noted to be nesting in the trees around Island House and the back of Mahers Pub. A count of heron nests was carried out from the ground using binoculars from Mahers Pub Car Park during all wintering bird survey visits, and any other survey visits carried out, particularly during the Alluvial Woodland surveys. Heron nests have been confirmed in a large conifer tree located on the left bank of Cloon Stream, behind Mahers Pub and Meadowbrook, with 5-6 nests recorded. Another large beech tree with 4-5 confirmed nests is located on the right bank on Cloon Island. Drone surveys were conducted on the 8th of September 2022 of the heronry in an area of wet woodland behind Mahers Pub. The drone was used to count the number of nests in the Conifer tree (Figure 8-28), which is next to the proposed flood wall for the Scheme, in order to identify the trees(s) being used by nesting Grey Heron. Following the tree survey[43], a 6m root protection zone (RPZ) for this large conifer has been accommodated for within the design of the Scheme (Figure 8-26), in order to protect the large conifer tree and prevent any damage to the tree, particularly as it is an important tree for nesting herons.

In 2023 a heron nesting behaviour was noted within Coolbane woods in the conifer woodland adjacent to the scheme. The nest is not visible from the road or woods but Herons it is likely it is only one nest, location is approximately shown in Figure 8-27.

Figure 8-26: Recorded heron nests; realigned scheme design to accommodate the conifer tree heronry

[43] JBA Consulting (2022) Castleconnell FRS Limerick: BS5837 - Tree Survey, Arboricultural Impact Assessment (AIA).

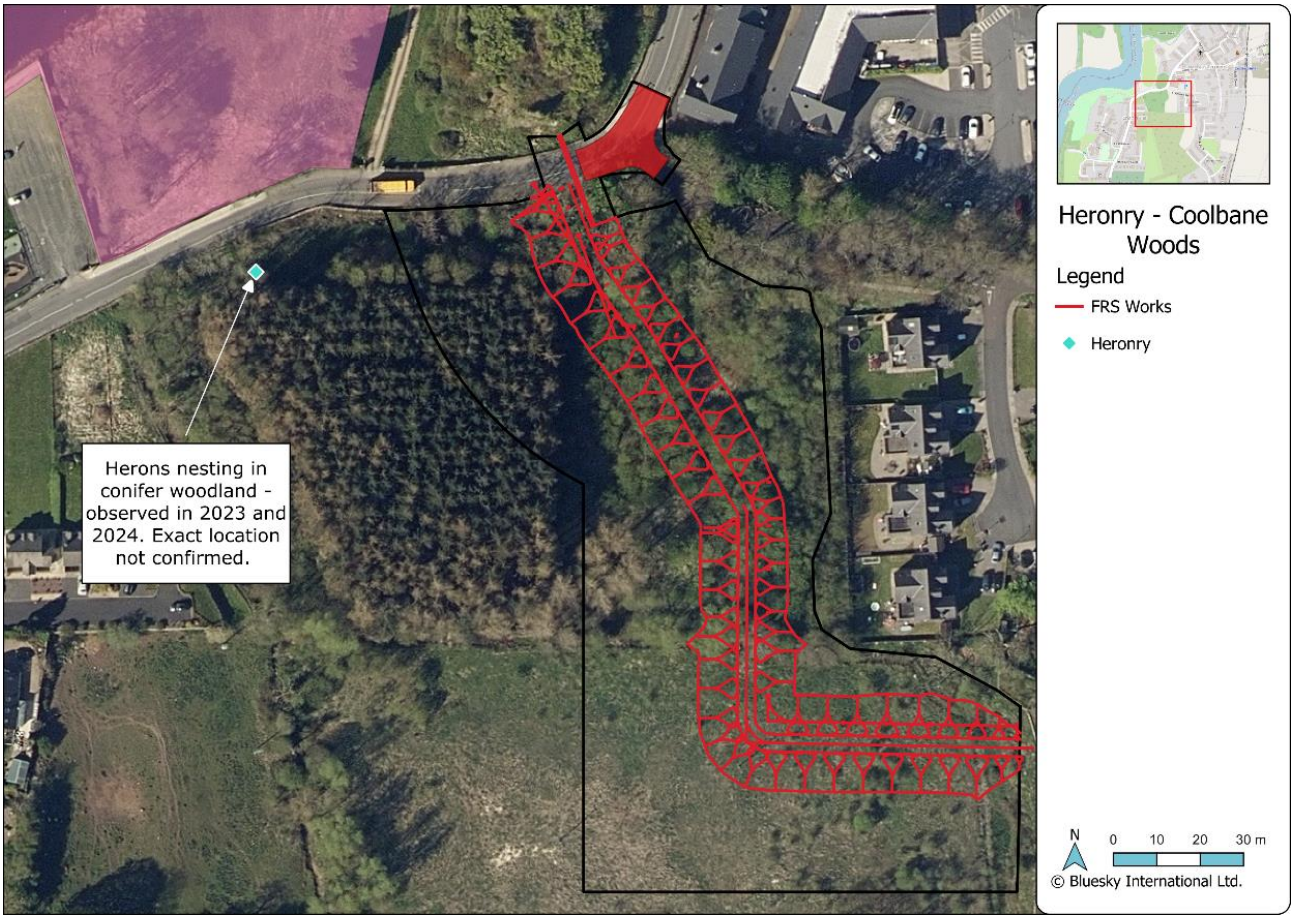

Figure 8-27: Additional heronry located in Coolbane Woods

Figure 8-28: Four Heron nests located in large conifer tree behind Mahers Pub (taken during drone survey)

Figure 8-29*: *Base of large cedar tree with herons' nest, shown in flood conditions from Cloon Stream

Protected bird species

Cormorant *Phalacrocorax carbo* and Black-headed Gull *Chroicocephalus ridibundus*

Cormorants are Amber listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. Black-headed Gull are Amber listed on the Birds of Conservation Concern in Ireland, and Red listed at an EU level. Both species are an Annex II species on the EU Birds Directive and are Qualifying Interest of the River Shannon and River Fergus Estuaries SPAs.

Cormorants were recorded both in the winter and summer months; no signs of breeding and no roost sites were recorded. Cormorant forage on the main channel of the River Shannon, and rest on exposed areas in the watercourse and along the banks. Black-headed Gull was recorded foraging along the main channel of the River Shannon. There is no suitable nesting habitat along the area of works, and no signs of nesting were recorded.

An Impact Assessment for these QI species has been carried out in the accompanying Natura Impact Statement and has found that they will not be impacted by the proposed Scheme.

Sparrowhawk *Accipiter nisus*

Sparrowhawks are Green listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. Sparrowhawk were recorded foraging in the area of woodland around Island House; they prey on small birds which are frequently recorded in the area. The wooded area may also provide roosting and breeding habitat for them; Sparrowhawk build new nests every year. They are unlikely to be affected by the works, however, some foraging habitat loss may occur, but this is not expected to affect the local population of this bird.

Kestrel *Falco tinnunculus*

Kestrels are Red listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. Kestrel was recorded foraging over the grassland area on the East of the Mall and adjacent to Scanlon Park. The grassland area is unlikely to be affected by the works carried out. The woodland area may also provide roosting and nesting opportunities. Kestrel do not build their own nests, but use hollows, abandoned nests from other

species, as well as anthropogenic structures. They are unlikely to be affected by the works, however, some foraging habitat loss may occur, but this is not expected to affect the local population of this bird.

Peregrine Falcon *Falco peregrinus*

Peregrine Falcons are Green listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. They are an Annex I species on the EU Birds directive. A Peregrine was recorded flying in a Southeast to Northwest direction. The habitat present is unlikely to provide adequate roosting or nesting opportunities but could hold prey species for them. Any works within 600m of a known nest site has the potential to disturb Peregrine Falcon. No nest sites, no young birds and no evidence of residence by Peregrine Falcon was recorded within the footprint of the scheme. Furthermore, no suitable nesting sites (suitable tower, church spire, cliff etc) were recorded within 600m of the scheme. The area does support potential prey for Peregrine Falcon, but the lack of regular sightings during surveys make it unlikely that this is a significant foraging area for them[44]. Peregrine Falcons are not expected to be impacted by the scheme and are not discussed further.

Grey Heron *Ardea cinerea*

Grey Heron are green listed on the birds of conservation concern in Ireland[45], and is classified as Secure at a European scale[46]. Long term population trends in Ireland show a slight increase but with inter annual fluctuations[47]. They are legally protected under the Birds Directive and on a local level under the Wildlife Act.

A Heronry of two mature trees at Cloon Island is estimated to hold between 8 and 10 nests, corresponding to 16 to 20 mature individuals. One nest was also observed in the conifer plantation across from Ferry Playground. There are no systematic counts of heronries in Ireland making it difficult to assess the national importance of the site. For comparison, the largest recorded heronry in the UK holds approximately 100 nests, with 9500 nests recorded across 900 sites throughout the UK[48].

The heronry in Castleconnell is of Higher Local Importance. The works will take place directly next to the Heronry and therefore Herons will be impacted by disturbance and further assessment is required.

Grey Wagtail *Motacilla cinerea*

Grey Wagtail are Red listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. Grey Wagtail were recorded along the banks of the River Shannon, on the exposed rocks and structures in the water, and along the Cloon. A disused nest was recorded under the bridge leading to Island House. The archway on the eastern side was obstructed leaving only the western side open and accessible. Works along the Cloon Stream have the potential to negatively impact local Grey Wagtail by reducing available habitat and impacting water quality.

[44] Hardey, J., Crick, H.Q.P., Wernham, C., Riley, H., Etheridge, B., and Thompson, D.B.A. (2013) 'Peregrine Falco peregrinus', in Raptors: A Field Guide for Surveys and Monitoring, Edinburgh: The Stationery Office, 187–190.

[45] Gilbert, G., Stanbury, A., and Lewis, L. (2021) 'Birds of Conservation Concern in Ireland 4: 2020–2026', Irish Birds, 45, 1–22.

[46] EEA (2023) Grey Heron - Ardea Cinerea - Linnaeus, 1758 [online], available: https://eunis.eea.europa.eu/species/900

[47] Kennedy, J., Burke, B., Fitzgerald, N., Kelly, S.B.A., Walsh, A.J., and Lewis, A.J. (2022) Irish Wetland Bird Survey: I-WeBS National and Site Trends Report 1994/95 – 2019/20. [online], available: https://birdwatchireland.ie/app/uploads/2022/04/iwebs_trends_00000_National.html#National_Summary

[48] Kelman, S. (2022) BTO Heronries Census, BTO.

Kingfisher *Alcedo atthis*

Kingfisher are Amber listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. They are an Annex I species on the EU Birds directive. Kingfisher were recorded many times along along the River Shannon, and occasionally on the Cloon Stream and Stradbally Stream. Kingfisher are a sedentary species that nest in holes in banks and use perches over water to fish. Kingfisher may be affected by loss of habitat, loss of fishing perches and by impacts on water quality reducing foraging potential. They are of regional importance and may be impacted by the works. Further assessment required.

Mute Swan *Cygnus olor*

Mute Swan is Amber listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. They are an Annex II species on the EU Birds directive. Mute Swans are frequently observed and recorded using the River Shannon along the length of the scheme. They are present year-round and breed locally, however no nests are located near the scheme or construction area. Mute Swans are present only in the River Shannon all along the length of the scheme. Both adults and juvenile birds were recorded, with some roosting recorded on the right bank of the river (opposite bank to the proposed Scheme) and resting at the Ferry Playground on the amenity grass. They were also observed in Stormont House grasslands during high flood conditions.

Mute Swans likely have nests in quieter locations in the Shannon. No nests were observed over 4 years of surveys in proximity to the scheme. It is not expected that the scheme will impact breeding swans. Any work within 150 m of the birds may cause disturbance. This means that there is a wider potential for impact from the works being carried out. Mute Swans are of Local importance and are likely to be temporarily impacted by the works.

Mallard *Anas platyrhynchos*

Mallards are Amber listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. They are an Annex II species on the EU Birds directive. Mallards were recorded along the main channel of the River Shannon all along the length of the scheme, as well as using the Cloon Stream. Both adults and juvenile birds were recorded. The vegetation along the riverbank of the River Shannon provides suitable nesting habitat for them, however no nests were observed over 4 years of surveys in proximity to the proposed scheme. It is not expected that the scheme will impact breeding Mallard.

Any work within 100m of Mallard is likely to cause disturbance, which are flightier and disturbed more easily than Swan. Mallards are of Local importance and are likely to be temporarily impacted by the works.

Greylag Goose *Anser anser*

Greylag Goose are Amber listed on the Birds of Conservation Concern in Ireland, and Green listed at an EU level. They are an Annex 2 species on the EU Birds directive. They are also considered an Invasive Species under Regulation S.I. 477 (Ireland). The Greylag Goose population are likely of feral origin and resident year-round in the area. Greylag Goose were recorded along the main channel of the River Shannon all along the length of the scheme. Both adults and juvenile birds were recorded. The vegetation along the riverbank provides suitable nesting habitat for them. The works to be carried out will be inconsequential for the wild population of Greylag Goose that winter in Ireland. Greylag Goose is not considered further.

Dipper *Cinclus cinclus*

Dippers are Green listed on the Birds of Conservation Concern in Ireland, and the population level is unknown at an EU level. Dippers are sensitive to water quality, and nest in banks, under bridges or other structures and fallen trees over watercourses. Dippers were recorded foraging along the River Shannon on the old fishing /eel weirs behind Island House, but this is not close to where the proposed works will take place. No Dippers were

recorded in proximity to the scheme either on the River Shannon or the Cloon Stream. They are unlikely to be affected by the works and no further assessment is required.

Sand Martin *Riparia riparia*

Sand Martins are Amber listed on the Birds of Conservation Concern in Ireland, and Amber listed at an EU level. They were recorded on the northern end of the scheme and there may be nesting opportunities up or downstream. They likely use the River Shannon for foraging opportunities. There is no suitable nesting habitat along the length of the scheme. They are unlikely to be affected by the works.

Passerines and other species recorded

The area covered by the scheme is widely used by a host of other species encompassing both resident and migrant birds. All bird species wintering or breeding in the area will face similar threats and interaction with the scheme. Any vegetation may be suitable cover for roosting or breeding birds, therefore scrubland, trees and vegetation that could provide cover cannot be cleared during the bird nesting season (1 March, 31 August inclusive), and caution needs to be applied out of season as birds may be breeding earlier or later depending on the climatic conditions. Vegetation (tree and scrub) removal will take place for the Scheme and therefore further assessment is required.

8.2.6.3 Results of Mammal Surveys

Signs of mammals have been noted during most ecology surveys and site visits wherever they may occur. This section summarises the results of mammal surveys. Full survey reports are included in Appendix 8.4.

Otter

As the proposed Scheme will be located along the Cloon Stream, further work to determine use of the stream by Otters was carried out. This involved trail cameras set up along the stream in 6 locations in winter and spring.

In January 2023, signs of Otter were also search from while the vegetation was low in the winter, such as prints, slides, couches, dens, and spraints. No signs of Otter such as spraints or tracks have been observed around the Cloon Stream downstream of the Island House causeway.

Table 8-15: Camera trap survey dates and results

Camera	Date range	Results
Location 1	26 January 2023 – 6 February 2023	Species recorded were Fox *Vulpes vulpes* and Grey Heron *Ardea cinerea* and House cats
Location 2	26 January 2023 – 6 February 2023	No Data – camera faulty
Location 3	19th May 2023 – 30th May 2023	No Data – no species recorded
Location 4	19th May 2023 – 30th May 2023	Species recorded were Mallard, Magpie *Pica pica* and Bullfinch *Pyrrhula pyrrhula*
Location 5	1st June 2023 – 20th June 2023	Species recorded were Blackbird *Turdus merula*, Blue Tit *Cyanistes caeruleus*, Fox, Chaffinch *Fringilla coelebs*, Great Tit *Parus major*, Brown Rat *Rattus rattus*, Song Thrush *Turdus philomelos*, Treecreeper *Certhia familiaris* and Wren *Troglodytes troglodytes*
Location 6	1st June 2023 – 20th June 2023	Species recorded were Wood Pigeon *Columba palumbus*

A potential Otter holt was observed on the right bank of the river (opposite from the Scheme) in 2019. In 2019 & 2020, Otter spraint was recorded on causeway over the Cloon stream. A live otter has been observed feeding in the Shannon during the wintering bird surveys on 13 February 2020. Therefore, Otter is present in the main

River Shannon, however no holts, couches or resting places have been found within the construction area of the Scheme.

Otter was not recorded from any of the 6 trail cameras along Cloon Stream. This does not rule out the presence of otter on the Cloon Stream, however it is unlikely that otters are regularly using the Cloon Stream, and do not appear to be using this area as a resting site, despite the dense vegetation.

Otter is a Qualifying interest of the Lower River Shannon SAC. Impacts to this species are assessed in the Natura Impact Statement (NIS) which accompanies this EIAR. It is found that disturbance impacts to Otter may occur on the Cloon stream from the Scheme, and mitigation measures are required and detailed in the NIS. It is not anticipated that otter will be disturbed over the rest of the scheme by noise impacts as the works are being undertaken along a busy Village / built environment, and screening from trees will reduce noise disturbance.

Badger

One badger scat was recorded within Cedarwood grove. Very little evidence of badger was found throughout the scheme, however. Further assessment is required.

Other mammals

Foxes were recorded many times on the trail cameras. These mammals are not protected in Ireland and no further assessment is required.

No evidence of other mammals was recorded, e.g. Pine Marten, Stoat, Hedgehog, Red Squirrel, Deer species, Pygmy Shrew. These species may be present in the area in low numbers however due to lack of evidence no further assessment is required.

8.2.6.4 Results of Bat surveys

This section summarises the results of the bat surveys. Full survey reports are included in Appendix 8.5.

Bats foraging and commuting

Bats have been recorded commuting and foraging throughout the project area, with significantly increased activity along the River Shannon riparian edges, and in wooded areas such as the woodlands around Island House, the woodland behind Mahers Pub and Coolbane woods. Species recorded include Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat, Daubenton's Bat. A Lesser Horseshoe Bat was picked up on a static detector. These areas are outside of the main works area, and bats using the area for commuting and foraging are not anticipated to be significantly adversely impacted by the proposed Scheme works.

Roosting bats

A mixed roost of approx. 30 Common and Soprano Pipistrelles was recorded in the roof of a residential building near Coolbane wood. This building is not associated with the proposed Scheme. Three Mature Beech trees at Grange House have been identified as potential Leisler's Bat roosts. The Beech trees will be removed as part of the proposed Scheme works.

Two Lesser Horseshoe roosts are present within 2km and 3km of the proposed Scheme, as identified from a database obtained from the NPWS. The former was categorised as a night roost in an occupied building near Doonass. No counts have been conducted at this roost since summer 2006, with no bats counted since 1994, with only droppings noted last in winter 2006. The latter roost is located c. 3km from the proposed scheme, also within a building, near Mountshannon. This was categorised as a hibernaculum, (i.e., an underground hibernation roost site). Counts have been conducted at this roost since 2004, with numbers of up to 26 bats; the most recent count was carried out in February 2022 with 19 bats recorded. However, the closest SAC for which Lesser Horseshoe Bat is a qualifying interest feature is >14km (Danes Hole, Poulnalecka SAC 00030) from the proposed Scheme and it is unlikely that Lesser Horseshoe Bat and roosts located nearby to Castleconnell are associated with the population at this SAC due to distance.

Summary of bat survey results

In summary, five species of bats were recorded over all surveys and static detectors, including Common Pipistrelle, Soprano Pipistrelle, Leisler's Bat, Daubenton's Bat, and Lesser Horseshoe Bat. Foraging bat activity was very high in the Castleconnell study area, particularly along the River Shannon which is likely an important feeding feature for bats. One roost was observed in a residential building at the entrance to Coolbane Woods, however the design of the scheme will not impact these roosting bats.

Approximately 87 trees will be removed to facilitate the construction of the Scheme. Although most trees were considered to have low roosting potential for bats, a dedicated tree roost survey of all trees affected by the proposed scheme was not carried out. Under the precautionary principle, it is assumed that bats may be roosting in some trees to be removed.

The value of the foraging and commuting importance of the site is determined by the commonality of the bat species, the number of bats, the presence of roosts, and the structures and features of the habitats used for foraging and commuting, extrapolated on UK guidance "Valuing Bats in Ecological Impact Assessment"[49].

Overall, the area of Castleconnell considered for the proposed Scheme works is of high local ecological value for commuting and foraging bats.

Table 8-16: Screening summary of bat features observed in proximity to the proposed scheme

Bat feature	Designation and importance	Screening
Roosts	Low local importance to all trees assessed	No roosting bats were recorded within any of the trees that will be removed to facilitate the Scheme. However, under precautionary principle, bats may be roosting in some trees to be removed and therefore are screened in. No buildings will be altered or changed which may contain roosting bats.
Commuting and foraging	Higher local	High number of Bats foraging along River Shannon and next to Scheme. In view of the nature of the species recorded, their legal protection and the numbers of the species present, the populations within this scheme are considered to be of Regional / County importance. This feature (species) is carried forward into impact assessment sections.
Lesser horseshoe bat known roosts nearby	Nationally Important	It is not anticipated that the scheme will impact these roosts, nor the foraging grounds for any of the LHB roosting due to distance, low use numbers, and use as hibernacula.

8.2.6.5 Amphibians

No signs of amphibian species Common Frog *Rana temporaria* and Smooth Newt *Lissotriton vulgaris* were observed nor suitable habitat present for their spawn. An eDNA survey was conducted on the Cedarwood Stream to determine presence Smooth Newt. This species is not present. No further assessment is required.

8.2.6.6 Aquatic Ecology Surveys

This section summarises the results of Fisheries survey carried out by Ecofact. Full survey reports are included in Appendix 8.6.

[49] CIEEM (2010) 'In Practice', available: https://cieem.net/wp-content/uploads/2019/01/InPractice70.pdf

A total of 13 species of fish were recorded within the survey reach of the River Shannon. These species included:

- Atlantic Salmon *Salmo salar*
- Brown Trout *Salmo trutta subsp. fario*
- Minnow *Phoxinus phoxinus*
- Dace *Leuciscus leuciscus*
- Stone Loach *Barbatula barbatula*
- Gudgeon *Gobio gobio*
- Eel *Anguilla anguilla*
- Flounder *Platichthys flesus*
- Perch *Perca fluviatilis*
- Pike *Esox lucius*
- River / Brook Lamprey *Lampetra fluviatilis* / *planeri*
- Sea Lamprey *Petromyzon marinus*
- Three-spined Stickleback *Gasterosteus aculeatus*

Juvenile salmon numbers were generally low but locally abundant in suitable riffle habitats. Eels were present at most of the sites in low densities. All three of the Irish Lamprey species were recorded during the survey. However, numbers were considered to be very low with juvenile Lampreys absent in many areas of suitable habitat.

Salmon *Salmo salar* and the three Lamprey species; River Lamprey *Lampetra fluviatilis*, Brook Lamprey *Lampetra planeri* and Sea Lamprey *Petromyzon marinus* are all QIs of the Lower River Shannon SAC.

Kick sampling surveys were conducted at each site area. Overall, the study reach was represented by a macroinvertebrate family richness of between 19 and 28. The Q ratings were stable across all sites at Q3-4, corresponding to WFD status ‘Moderate’. There was a paucity of group A pollutant sensitive species in the study area and Group B species were not well represented, when compared to Group C pollutant tolerant species which were the most abundant and diverse. Group D and E very pollutant tolerant species were also not well represented, which reflects this ‘Moderate’ water quality rating.

No White clawed crayfish *Austropotamobius pallipes*, Swan mussel *Anodonta cygnea* or Duck mussel *Anodonta anatina* were recorded within the survey reach, even though they were recorded in the past as part of river monitoring surveys. It is possible that there has been an outbreak of Crayfish Plague *Aphanomyces astaci* in this section of the Lower Shannon within the last ten years, considering it has been recorded further upstream within the River Shannon.

The results of these surveys are broken down for each survey area in Table 8-17 .

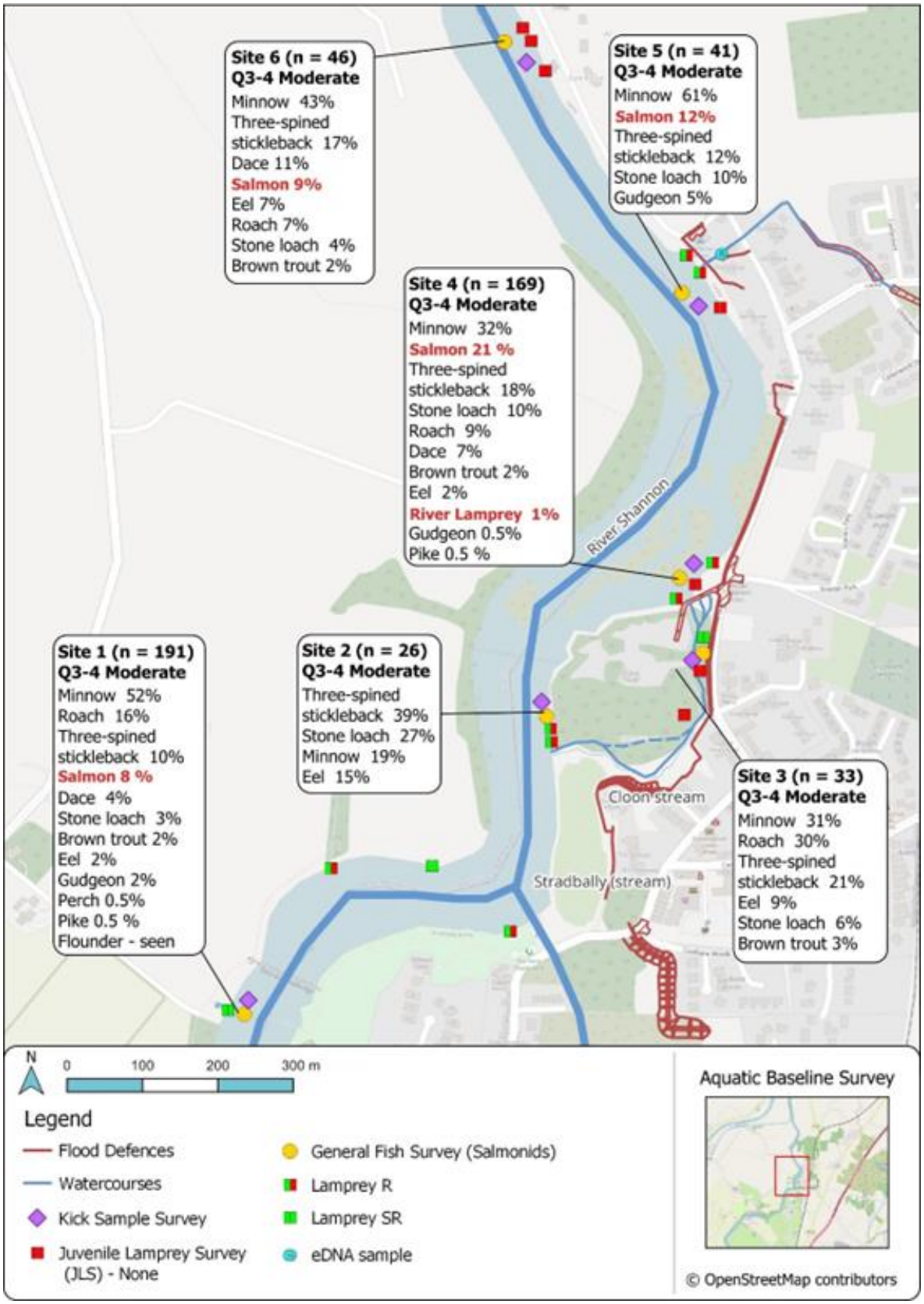

Figure 8-30: Aquatic fauna baseline surveys, with recorded QIs of the Lower River Shannon highlighted in red

Table 8-17: Results of aquatic baseline surveys at each site

Site	Location	Results of electrofishing and macroinvertebrate study
Site 1	Doonass bridge (River Shannon)	191 individual fish comprising 12 species 16 Juvenile Atlantic Salmon 35 juvenile Lamprey *Lampetra* spp 2 Sea Lamprey Brown Trout (4), Eel (3), Minnow (100), Three-spined stickleback (20), Dace (6), Stone Loach (5), Gudgeon (4), Flounder (1 - seen), Perch (1), and Pike (1) Site is rated as Q3-4 - 'Moderate' WFD status
Site 2	Castlelough / Ferry playground (River Shannon)	26 individual fish recorded at Site 2, comprising 4 species including: No salmonids 11 juvenile Lamprey *Lampetra* spp Three-spined stickleback (10), Stone Loach (7), Minnow (5), and Eel (4). Site is rated as Q3-4 - 'Moderate' WFD status
Site 3	Cloon Stream	33 individual fish recorded across 6 species No salmon 4 juvenile Lamprey *Lampetra* spp, 1 juvenile Sea Lamprey Brown trout (1) Minnow (10), Roach (10), Three-spined stickleback (7), Eel (3) and Stone Loach (2). Site is rated as Q3-4 - 'Moderate' WFD status
Site 4	In River Shannon at Elvers	169 individual fish recorded, comprising of 11 species. 35 Salmon 2 River Lamprey & 16 juvenile Lamprey *Lampetra* spp Brown trout (3), Minnow (55), Three-spined stickleback (30), Roach (15), Dace (12), Stone Loach (10), European eel (4), Perch (2), and Pike (1). Site is rated as Q3-4 - 'Moderate' WFD status
Site 5	Main River Shannon beside River Grove house	41 individual fish comprising 5 species 5 Salmon 13 juvenile Lamprey *Lampetra* spp Minnow (25), Three-spined Stickleback (5), Stone Loach (4) and Gudgeon (2) Site is rated as Q3-4 - 'Moderate' WFD status
Site 6	Pa's Gap (main River Shannon)	46 individual fish species comprising 6 species 4 Salmon No juvenile Lamprey recorded at Site 6. Brown Trout (1), Eel (3), Minnow (20), Three-spined Stickleback (8), Dace (5) and Stone Loach (2). Site is rated as Q3-4 - 'Moderate' WFD status

Summary and Conclusions of Report from Ecofact based on Baseline Aquatic Ecology Survey

The aquatic ecology of the study area is strongly influenced by the water abstraction/regulation, fisheries modifications, and background water quality within this section of the River Shannon. Biological water quality at all sites was rated as being unsatisfactory and the overall evaluation was 'Q3 -Moderately Polluted'. Water quality in this stretch of the river is affected by agricultural runoff throughout the Shannon catchment. However, during the current survey many agricultural impacts were observed –there are also untreated domestic sewage inputs and untreated discharge from the ESB salmon hatchery at Parteen Regulating Weir. There are multiple wastewater discharges in the wider study area, many of which are non-compliant. The water abstraction and regulation reduce the assimilation capacity of the river.

The fish community of the river is dominated by non-native cyprinid species, including Minnow, Dace, and Roach. Juvenile salmon numbers were generally low but locally abundant in suitable riffle habitats. Eels were present at most of the sites in low densities. All three of the Irish Lamprey species were recorded during the survey. However, numbers were considered to be very low with juvenile Lampreys absent in many areas of suitable habitat. Lampreys on this channel are also affected by the extreme water regulation. Also, Lamprey migration and habitats are impacted by the numerous fisheries structures in the channel. All migratory fish are

impacted by Parteen Regulating Weir – which blocks Lamprey migration. Salmon numbers above the Shannon dams are <5% of the Conservation Escapement Target. The overall hydromorphology has been affected by the operation of Parteen Regulation Weir which prevents sediments moving along the river also. This affects spawning and nursey habitats for both salmonids and Lampreys. Although juvenile salmon numbers were locally abundant, trout numbers in the river were surprisingly low.

Aquatic macroinvertebrates recorded showed an overall Q Rating at each site as Q3-4, which corresponds to Water Framework Directive status 'Moderate'. Family richness ranged from between 19 and 29 overall. Water quality monitoring shows that overall ecological conditions in the study area are rated as Moderate.

Overall, the Lower River Shannon in the vicinity of the proposed flood scheme is a river in ecological decline as a result of water quality pressures, instream modifications, and river regulation. This is affecting the aquatic conservation interests of the Lower River Shannon SAC. Juvenile Lamprey numbers in the channels near the proposed flood scheme features are very low. The habitats for salmon in the immediate of the proposed flood scheme are suboptimal, with no salmon recorded in the side channel that runs to the east of Island House. Lampreys were also absent from this channel. There are no protected or notable aquatic macroinvertebrates in the study area. Annex I habitat floating river vegetation is also absent[50].

eDNA Sample from Cedarwood stream

An eDNA survey was conducted on the Cedarwood Stream to determine presence of the three Lamprey species, Eel and/or Smooth Newt. The stream flows into the River Shannon from a culvert outfall at the northern extent of the proposed scheme near Grange House.

This stream is heavily modified with an existing culvert at its outfall, as well as a small weir and further culverts present upstream. Where the stream is not culverted in the last 100m before reaching the Shannon, it is confined by a two stone walls (fig). An eDNA sample was taken from an open section of the stream between two culverts, the location of which is outlined in Figure 8-31 below.

The results from the eDNA test showed only Eel present, whereas Lamprey or Newt are not present in the stream.

[50] Ecofact Environmental Consultants (2021) Baseline Aquatic Ecology Survey - Proposed Flood Relief Scheme, Castleconnell, Co. Limerick.

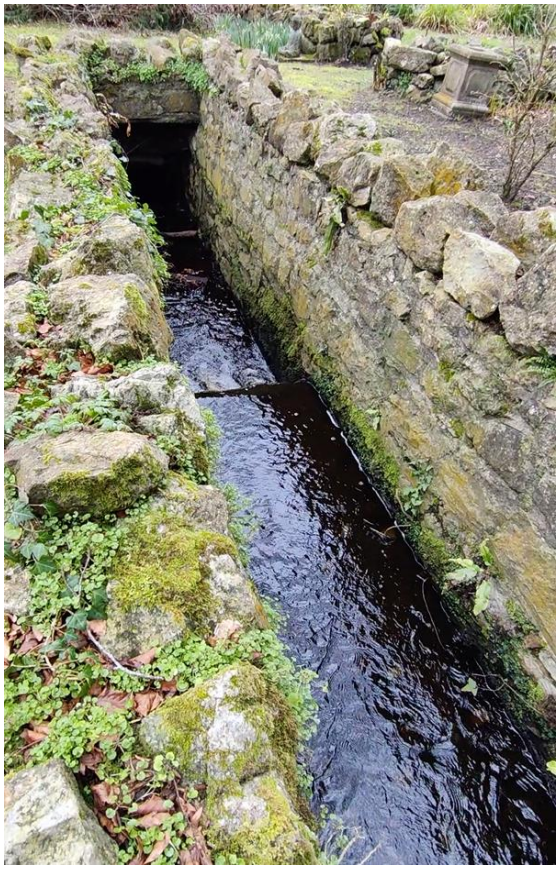

Figure 8-31: Cedarwood Stream, location of eDNA sample.

Cedarwood culvert fish passability analysis

A general desktop passability assessment has been completed for the Cedarwood stream using available engineering information. This desktop assessment has been completed using best practice guidance from SNIFFER (2012) WFD111 (2a) Coarse resolution rapid assessment methodology to assess barriers to fish migration and criteria described in the OPW (2021) Design Guidance For Fish Passage On Small Barriers.

The existing double culvert and weir system present at the downstream extent of the Cedarwood stream consists of a cylindrical culvert at bed level which runs from the outfall at the Shannon for approximately 10m (culvert A) followed by an open section with natural/rough substrate. This open section is confined by rock walls on both banks and there is a small weir with a drop height of approx. 0.4m from water level. Another cylindrical culvert (culvert B) is present for approx. 20m upstream of this open section. There is a small drop of approximately 0.05m at the downstream end of the 20m long culvert. There is no drop at the Shannon outfall, the culvert enters the main River Shannon at surface flow level, there may be a small lip at the base of the culvert under the water surface.

The stark difference in light levels present at outfalls and inflows of both culverts presents an obvious light barrier for fish, reducing potential use of the culverts.

The effective gradient across both culverts is approximately 6% This gradient is above the preferred minimum of 5% for juvenile salmonids and Lamprey passing through a culvert of 10m or higher. This means the velocity at which water passes through both culverts is likely to be slightly above the speed of the weakest swimming fish entering the stream, however a large proportion of fish may still be able to pass if the substrate conditions are optimal in both culverts.

There is a lack of a pool present under the 0.4m high weir. All fish species other than Eel require a pool to allow them to jump over drop features such as weirs. This weir poses a complete obstacle to Lamprey and would restrict movement to all but the strongest swimming salmonids. It is highly unlikely that there is viable population

of salmonids or any population of Lamprey beyond this weir. There may be a small population of Eel within the stream. This result was confirmed in the eDNA where Eel was recorded as present in the stream.

Table 8-18: Screening of aquatic species recorded in waterbodies in the scheme area

Species recorded in River Shannon surveys	Designation and importance	Screening
Atlantic Salmon *Salmo salar* River / Brook Lamprey *Lampetra fluviatilis* / *planeri* Sea Lamprey *Petromyzon marinus*	QI of Lower River Shannon SAC Internationally important	The River Shannon and its tributaries are productive rivers for Salmon and lamprey species, which are qualifying interests for the Lower River Shannon SAC. In view of their protected status the populations within this scheme are considered of International Importance. Impact assessment for these species has been carried out in the NIS with mitigation applied. Therefore, these species are screened out of assessment in this report.
Brown Trout *Salmo trutta subsp. Fario* Eel *Anguilla anguilla*	EC Regulation (1100/2007) to support the recovery of the European eel. CITES Critically endangered. Fisheries Act. Nationally Important	Suitable habitat for Brown Trout and European Eel is present in the River Shannon river and its tributaries. Considering their conservation status, populations at the proposed site are considered of national importance. These species are carried forward into the design mitigation and impact assessment sections.
Flounder *Platichthys flesus* *Pike Esox lucius* *Three-spined Stickleback Gasterosteus aculeatus*	Fisheries Act Locally important	Suitable habitat for sticklebacks and coarse fish occurs in the Shannon and smaller watercourses connected to the scheme. In view of local biodiversity these species are carried forward into the impact assessment and mitigation sections.
Other coarse fish: Minnow *Phoxinus phoxinus* Stone Loach *Barbatula barbatula* Gudgeon *Gobio gobio* Perch *Perca fluviatilis*	Non-native Locally important	Suitable habitat for coarse fish occurs in the Shannon and smaller watercourses connected to the scheme. In view of local biodiversity these species are carried forward into the impact assessment and mitigation sections.
Dace *Leuciscus leuciscus*	Non-native, invasive species Less-than-local importance	This is considered an invasive species and does not require impact assessment. The proposed Scheme will not facilitate the spread of this species. Screened out
Aquatic Invertebrates	Lower Local	The Q ratings across all sites at Q3-4, corresponding to WFD status ‘Moderate’. No important species were present. Screened out
Aquatic habitats (Watercourses of plain to montane levels with the *Ranunculion fluitantis* and. Callitricho-Batrachion vegetation (3260))	Not present	Screened out
Cedarwood stream (physical)	Higher local importance	Screened in – passability

8.2.6.7 Non-native Invasive Species

A full list of invasive species recorded in the last ten years within the site with an additional 5km buffer is in Appendix 8.1.2. These records were sourced from the National Biodiversity Data Centre's biodiversity maps and databases.

ESB (2021)[51] noted that habitat improvement and angling access works were completed throughout Castleconnell, including the spraying of Giant Hogweed which was undertaken by the Castleconnell Fishery Association (CFA). ESB also note that volunteers sprayed Himalayan Balsam later in the year, which was mainly done at the bottom of the fishery near beats 5 and 6.

3rd Schedule Invasive species recorded

The following species listed under the Third Schedule of Regulation S.I. 477/2011 have been recorded within the study area in the NBDC database: Greylag Goose *Anser anser*, Giant Hogweed *Heracleum mantegazzianum* and Zebra Mussel *Dreissena polymorpha*.

There is an informal Invasive species control by Castleconnell River Association who have been controlling Giant Hogweed around the river edges and riparian woodlands informally over the last few years. Since initial surveys, there has been a notable decrease in the presence of Giant Hogweed, as observed by Ecologists during subsequent site visits, and clear signs that this plant is being controlled through removal of flowering spikes. Giant Hogweed is a negative indicator species for Alluvial Forests and is present in this Annex I habitat adjacent to the scheme. Although being controlled over the past few years, it is still likely that GH seeds are present in the soil and therefore mitigation measures will be required to control the spread of this species during construction.

Figure 8-32: Giant Hogweed recorded in the riparian vegetation of the River Shannon

[51] ESB (2021) The 2021 Shannon Fisheries Partnership Report, available: https://cdn.esb.ie/media/docs/default-source/fisheries/123541-esb-fisheries-sfp-workplan-report-2021.pdf?sfvrsn=518410e4_3.

Figure 8-33: 3rd Schedule invasive species recorded within the study area

Zebra Mussel (and Quagga Mussel)

Zebra Mussel *Dreissena polymorpha* was recorded at two places in the River Shannon during the initial survey around the island, and later from most of the stretch of the River Shannon in low to common abundances during

the aquatic survey from all sites from Rivergrove to Doonass[52]. The freshwater invasive mussel improves water clarity and has resulted in a shifting of ecosystems here, resulting in increased light penetration in areas, meaning reduced green algae and therefore having consequences for naturally occurring wildlife, fish and aquatic species.

Zebra mussel and Quagga mussel *Dreissena rostriformis bugensis* are very similar in their appearance, however, expert knowledge is needed to distinguish these two species. Quagga mussel has been observed in Lough Derg and could be present in the river at Castleconnell (Species alert issued 9th July 2021[53]).

No instream works are required for this scheme, and it is unlikely any of the proposed works for this scheme will result in the spread of this species. However, biosecurity measures will be required during construction (detailed in section 8.4.1.9.1).

Figure 8-34: Zebra Mussel shells found in the main River Shannon

Other invasive species

Other invasive species recorded during site surveys include Butterfly-bush *Buddleja davidii*, Montbretia *Crocosmia x crocosmiiflora* and Winter Heliotrope *Petasites pyrenaicus*.

It is possible for Mink *Mustela vison* to be present within the study area, but no definite sightings or signs were recorded during the ecological surveys.

NNIS aquatic plants Curly Waterweed *Lagarosiphon major* and Nuttall's Waterweed *Elodea nuttallii* were recorded by Ecofact during the fisheries survey. Other invasive aquatic fauna recorded in the wider study area upstream include Freshwater Shrimp *Crangonyx pseudogracilis* (2004), Bloody-red Mysid *Hemimysis anomala* (2009) and the Asian Clam *Corbicula fluminea* (2011). As previously noted, the invasive Common Carp was

[52] Ecofact Environmental Consultants (2021) Baseline Aquatic Ecology Survey - Proposed Flood Relief Scheme, Castleconnell, Co. Limerick.

[53] NBDC (2021) Invasive Species Alert for Quagga Mussel [online], available: https://biodiversityireland.ie/quagga-mussel-alert/.

last recorded in 2005 from the Freshwater Fish in Irish Lakes dataset. Non-native cyprinid species, including Minnow, Dace, and Roach were also recorded by Ecofact during the fisheries survey. Dace is also considered an invasive fish species.

It is not expected that any of the above species will be further spread by the proposed works and no further assessment is required.

8.2.7 Summary of Scoping of Designated Sites & Ecological Features

The screening of designated sites and ecological features identified during the desktop study and ecological surveys is given in Table 8-19. Sites and features screened out are not considered further in this assessment for the Phase 1 element of this development. Ecological features carried forward are assessed for potential impact during construction and operation in the following sections.

Table 8-19: Summary of ecological features and the screening assessment

Designated site / Ecological feature	Value	Screening	Reasoning
Lower River Shannon SAC	International	Out	Assessed in NIS
River Shannon and River Fergus Estuaries SPA	International	Out	Assessed in NIS
Lough Derg (Shannon) SPA	International	Out	Assessed in NIS
Nationally designated sites (NHAs, pNHAs)	National	Out	No further assessment required due to distance, lack of pathway, or site linked to Natura 2000 sites.
Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] Woodland 2 & 4	International	Out	Assessed in NIS Woodland 4 is located outside the SAC Boundary and is therefore assessed in the EIAR Report
Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] Woodland 3- Coolbane Woods	Higher local	In	Further assessment required. Not assessed in NIS as this woodland is outside of the SAC Boundary.
Affinity to Alluvial Forests (91E0) [WD1 - Mixed broadleaved woodland] Woodland 1	National	Out	Assessed in NIS
Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]	National	In	Further assessment required. Not assessed in NIS as this Annex I habitat is not a QI of the SAC.
Floating River vegetation [3260]	International	Out	Not present
Stones walls	Less than local	Out	Lack of ecological value
Buildings and artificial surfaces	Less than local	Out	Lack of ecological value
Wet grassland	Higher to Lower local importance	In	Locally important habitat for various species, wet grassland in SAC boundary
Scrub	Less than local	Out	Lack of ecological value
Treelines & Mature trees	Higher to Lower local importance	In	Some trees to be removed to construct scheme
Cedarwood Stream	Higher local importance	In	Connection to Lower River Shannon SAC. Contains Eel and possibly other fish species.
Cloon Stream	International importance	In	Connection to Lower River Shannon SAC. Suitable habitat for Lamprey, Otter, Birds, and other fish species

River Shannon	International Importance	In	Lower River Shannon SAC, Suitable habitat for Lamprey, Otter, birds and other fish species
Drainage ditches & Stradbally stream	Lower (Ditch) and Higher (Stream) local importance	In	Connection to Lower River Shannon SAC
Protected flora	None present	Out	None present
QIs Birds – Cormorant and Black Headed Gull	International	Out	Assessed in NIS
Birds - Heron	Higher Local	In	Important heronry; near National level of importance
Birds of Prey	Higher Local	Out	Unlikely to be affected by the works, breeding and foraging habitat unaffected.
Waterbirds – Greylag Goose	Less than local	Out	Feral population
Riparian species - Grey Wagtail, Kingfisher	Higher Local, Regional	In	Suitable habitat present
Birds- Mute Swan, Mallard	Higher Local	In	Disturbance impacts to birds present year-round in Shannon.
Passerines	Higher Local	In	Suitable habitat present
Otter	International	Out	Assessed in NIS
Badger	National	In	Further assessment required
Bat Roosts	Higher Loca	In	No roosting bats were recorded within any of the trees that will be removed to facilitate the Scheme. However, under precautionary principle, bats may be roosting in some trees to be removed and therefore are screened in. No buildings will be altered or changed which may contain roosting bats.
Commuting and foraging Bats	High Local	In	High number of Bats foraging along River Shannon and next to Scheme. Further assessment required.
Amphibians	Less than local	Out	Lack of suitable habitat present
Atlantic Salmon *Salmo salar* River / Brook Lamprey *Lampetra fluviatilis* / *planeri* Sea Lamprey *Petromyzon marinus*	International	Out	Assessed in NIS
Brown Trout *Salmo trutta subsp. Fario* Eel *Anguilla anguilla*	National	In	Suitable habitat for Brown Trout, European Eel present in the Shannon river and streams. Considering their conservation status, populations at the proposed site are considered of national importance,
Flounder *Platichthys flesus* *Pike Esox lucius* *Three-spined Stickleback Gasterosteus aculeatus*	Higher Local	In	Suitable habitat for sticklebacks and coarse fish occurs in the Shannon and smaller watercourses connected to the scheme.
Other coarse fish: Minnow *Phoxinus phoxinus*	Higher Local	In	Suitable habitat for coarse fish occurs in the Shannon and

Stone Loach *Barbatula barbatula* Gudgeon *Gobio gobio* Perch *Perca fluviatilis*			smaller watercourses connected to the scheme.
Freshwater Invertebrates	Higher Local	In	Reliant on water quality All watercourses surveyed received 'Moderate' status,
Terrestrial Invertebrates	Less than Local	Out	No protected species recorded
Dace *Leuciscus leuciscus*	N/A	Out	This is considered an invasive species and does not require impact assessment. The proposed Scheme will not facilitate the spread of this species. Screened out
Invasives species – Giant Hogweed	N/A	In	3rd Schedule species Present along scheme.

8.3 Predicted Impacts

The potential impacts on the valued designated sites and ecological features are assessed within this section. The impact assessment considers the construction and operational phase of the proposed Scheme and the anticipated effects in the absence of any mitigation. The accompanying NIS has assessed the impacts on the screened in Natura sites and their QIs and have applied mitigation measures to protect these features and will not be assessed further in this report.

From the baseline and desktop surveys, the following designated sites, habitats and species present in the immediate surrounds of the proposed Scheme, and therefore those likely to be impacted by the works are listed below.

- Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] (Woodland 3 – Coolbane Woods) this woodland is located outside SAC Boundary and was not assessed in the NIS
- Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]
- Wet grassland
- Scrub
- Treelines and mature trees
- Birds – Heron (breeding sites /nests)
- Riparian species - Grey Wagtail, Kingfisher
- Mute Swan, Mallard
- Passerines
- Badger
- Bats – roosting in trees
- Bats- foraging and commuting
- Fish – Brown trout, Eel, Flounder, Pike, Three-spined Stickleback, Minnow, Stone Loach, Gudgeon, Perch,
- Freshwater invertebrates
- Invasive species – potential to cause spread and impact habitats and species

8.3.1 Construction phase impacts

Impacts associated with the proposed Scheme have been defined and their significance assessed in relation to their implications on ecological features, defined in terms of their geographical extent (Table 8-1). The key construction phase impacts assessed are:

- Habitat loss/disturbance.
- Disturbance to faunal species.
- Reduction in water quality.
- Release of dust (impacting habitats and water quality)
- Spread of invasive species

Potential direct and indirect impacts are discussed in detail below. Where potentially significant adverse impacts are identified, avoidance and mitigation measures are proposed to offset these impacts.

This section will assess all impacts common to the entire scheme (e.g. dust, disturbance) and further analysed by specific location of each section of the proposed Scheme. The impacts to each ecological receptor will be assessed by location of each element of the proposed Scheme as follows:

- Impacts not location specific e.g. disturbance impacts, emissions, invasive species etc.
- Impacts at Rivergrove B&B and Grange House
- Impacts at Mall House
- Impacts at Mall Road (phase 1) – Mall house to Island House
- Impacts at Mall Road (phase 2) - Scanlon Park Junction up to Maher's Pub.
- Impacts at Mahers pub
- Impacts at Meadowbrook Estate
- Impacts at Stormont Property
- Impacts at Coolbane Woods
- Impacts at Cedarwood Stream (at Cedarwood Grove)

8.3.1.1 Impacts over entire scheme

Some impacts will not be location specific and will affect certain ecological features throughout the construction phase.

This mainly is related to disturbance and noise impacts, invasive species, and release of dust and emissions during construction.

Disturbance impacts to bats

Construction works throughout the proposed Scheme area will generate noise and disturbance as a result of machinery operation and workforce movement during the c. 18-month construction duration of the project. Bats have been recorded commuting and foraging throughout the project area.

Works will not be conducted at night-time when bats are active. It is not expected that construction of the Scheme will cause any impact to bats foraging and commuting between their roosts and the River Shannon, which is the main foraging location for bats.

One confirmed roost has been recorded in proximity to the areas where works are proposed, in a building near the entrance to Coolbane Woods. This is assessed specifically in Section 8.3.1.9.

Approximately 86 individual trees, 4 tree groups, and 1 hedgerow, and 5840m² of wooded areas will be removed to facilitate the construction of the Scheme, as well as 16 trees will be pruned (as assessed in Arborists Report Appendix 8. Although most trees were considered to have low roosting potential for bats, a dedicated tree roost survey inspecting every tree for bat roosts was not carried out. Under the precautionary principle, it is assumed that bats may be roosting in some trees to be removed. Any disturbance is unlikely to impact the local population but interference to any bats and their roosts is an offence without a licence.

Disturbance impacts to Mammals

Badger scat was found in Cedarwood grove, no other signs were found. Impacts are assessed in Section 3.1.11.

No other signs of protected mammals were found during the surveys.

Disturbance Impacts to birds

The proposed scheme area was recorded as supporting 48 bird species, including wintering, passage, and resident breeding species. The key habitat features supporting these populations are the wooded habitats,

wetland habitats along the riverbank and the river channel itself. These birds can be grouped in four different general categories that may be impacted in different manners.

Herons: Grey Heron hold an important breeding site in the wooded area between Island House and Mahers Pub, using at least two trees; a large Beech tree and a large Cedar, which is located next to the proposed scheme. Impacts to these birds will be dealt with by impacts assessed by location at Mahers Pub where the Heronry is located (Section 8.3.1.6 below).

Herons were observed feeding in the Shannon and at the confluence of the Stradbally stream at the Ferry Playground. It is not expected that the Scheme will cause disturbance to breeding herons.

Mute Swan and Mallard: These birds use the river channel, islands and vegetated banks along the edge of the river. These species are resident year-round within the scheme area. They were predominately recorded on the River Shannon, rocky features in river and islands.

They are used to a background level of human presence along the River at Castleconnell, and interact with humans at the Ferry Playground, as well as Anglers and Kayakers using the rivers. Their nests are not located near the scheme.

They may be disturbed by the increase in noise associated with construction of the scheme. However, the large area of habitat available to them (River Shannon) for foraging and commuting, as well as the majority of the works will be screened by trees and instream islands, will likely mean the swans and mallard can relocate easily to other areas of the Shannon.

Riparian birds: Kingfisher and Grey Wagtail were recorded using the length of the scheme, along the river's edge and associated riparian habitats. These species were found on Cloon Stream, and along the main body of the River Shannon. Impacts to these birds will be dealt with by location at Mall Road (phase 2) - Scanlon Park Junction up to Maher's Pub. Disturbance to breeding and forging habitat is likely to be a temporary significant negative impact.

The works will require temporary clearance of herbaceous species with permanent loss of woody species. Furthermore, the works will open up passage under the bridge to Island House. No suitable breeding Kingfisher habitat was recorded during the surveys. The abundance of available habitat on the islands in the Shannon, and unaffected by the works, will provide cover for any displaced species. Habitat loss is considered to be a long-term imperceptible negative impact.

Passerines: this group includes both resident and migrant species that use the entirety of the scheme and were recorded in different habitats and using buildings, trees, scrub and herbaceous areas for nesting and / or foraging. The urban nature of the site means that they show tolerance to noise disturbance and to the presence of people. The increased noise from machinery is expected to be limited in time and space. Passerine birds are most likely to be disturbed during the breeding season. The construction phase is considered to result in a temporary imperceptible negative disturbance impact on passerines.

Impacts from habitat loss is anticipated and is discussed further in the location specific sections below.

Noise and vibrations impact on fish

A number of flood defence measures will be constructed in close proximity to the River Shannon and tributaries. Pile driving will be the most intensive construction methodology in relation to noise output. Continuous sound also has the potential to result in abandonment of spawning areas.

Pile driving has the potential to disturb fish species through intense vibrations and can even result in injury/mortality where vibration levels are high, and barotrauma occurs. There are varying degrees of sensitivity to sound in different fish species dependent on fish physiology. Fish species, such as Salmonids, other cyprinids, and Eel have swim bladders and are sensitive to barotraumatic stress. Where the swim bladder is connected to/close proximity to the inner ear, high levels of sensitivity to barotraumatic stress is observed and

a lower threshold to disturbance is observed. Popper et al., 2014[54] consider species like Salmon, Brown Trout, Eel as a medium sensitivity species to Noise. Flounder do not have a swim bladder and therefore will not be impacted by noise.

The impact of sound on fish species is summarised in a technical assessment published by AECOM[55], which reviews guidelines published by American National Standards Institute (ANSI)[54].

For impulsive sound, the injury thresholds are expressed as dual criteria including a single strike peak sound pressure level (SPL) and the cumulative energy over a period of impulses, called the sound exposure level (SELcum). The thresholds cover physical injury as mortality/mortal injury, recoverable injury and auditory injury which is called temporary threshold shift (TTS) and is an elevation in hearing threshold resulting in a temporary reduction in hearing sensitivity.

Behavioural impact criteria are provided in terms of a relative risk (high, moderate, low) at a distance from the impulsive sound source defined in relative terms as 'near' (N), 'intermediate' (I), and 'far' (F) (Table 8-20). Whilst absolute values cannot be ascribed to these categories, near can be defined to be in the range of tens of metres from the source, intermediate in the hundreds of metres, and far in the thousands of metres.

Table 8-20: Underwater sound impact thresholds for fish in relation to impulsive sound sources (AECOM, 2021)

Fish Hearing Sensitivity	Mortality/mortal injury	Recoverable Injury	Temporary Threshold Shift (TTS)	Behaviour
Low e.g. Lamprey (Assessed in NIS)	213dBpeak 219dB SELcum	213dBpeak 216dB SELcum	186dB SELcum	(N) High (I) Moderate (F) Low
Medium e.g. Atlantic Salmon, Brown Trout, Eel	207dBpeak 210dB SELcum	207dBpeak 203dB SELcum	186dB SELcum	(N) High (I) Moderate (F) Low
Eggs and Larvae	207dBpeak 210dB SELcum	-	-	(N) Moderate (I) Low (F) Low

Pile driving will occur infrequently over a short period of time where required, and sound levels are not expected to reach more than 88dB for the pile driving, and 95dB for hand-held pneumatic work and 80dB for hydraulic breaking within the construction area of the scheme (details from this EIAR Construction Impacts Chapter 6). These sound levels are not exceptionally high and will be temporary in nature. Therefore, no significant impacts on fish species are expected from noise or vibration.

Dust and emissions

A separate Air Quality report has been carried out for the EIAR (Construction Impacts Chapter 6). The volume of deposition due to demolition, earthworks, construction and track out has the potential to affect sensitive habitats and plant communities. Dust could smother Alluvial Woodland Habitat adjacent to the works. There is

[54] Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L., Halvorsen, M.B., Løkkeborg, S., Rogers, P.H., Southall, B.L., Zeddies, D.G., and Tavolga, W.N. (2014) 'Sound Exposure Guidelines', in ASA S3/SC1.4 TR-2014 Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report Prepared by ANSI-Accredited Standards Committee S3/SC1 and Registered with ANSI, SpringerBriefs in Oceanography, Cham: Springer International Publishing, 33–51, available: https://doi.org/10.1007/978-3-319-06659-2_7.

[55] AECOM (2021) Environmental Statement - Volume II Appendix 11H: Underwater Sound Effects on Fish, available: https://www.ssethermal.com/media/3qnf2kto/k3-document-6-3-19-es-appendix-11h-underwater-sound-effects-on-fish.pdf.

also a potential impact that any dust settling in the river, or watercourses could introduce pollutants which could impact Fish species.

Construction impacts for dust has been calculated medium to high risk due to the sensitive ecological receptors that are located next to the works. Therefore, mitigation measures are required. Once operational, no air quality impacts are expected for this Scheme.

Therefore, the mitigation measures applicable to a High-Risk Site should be applied. Mitigation measures are provided in the EIAR (Construction Impacts Chapter 4) Section 1.6.2 of the Air Quality and Dust, and these will be applied.

Invasive Non-native Species

Giant Hogweed has been recorded throughout the River Shannon and there is potential to spread this species during construction works across the entire scheme and impact on habitats including Annex I Alluvial forest [91E0] and Tall herb fen [6430]. Giant Hogweed is a Third Schedule species under Regulations 49 & 50 in the European Communities (Birds and Natural Habitats) Regulations 2011 (Note: Regulation 50 not yet enacted). Regulations 2011 restricts the dispersal, spread and transportation of this invasive species and due diligence must be given to work methods in the vicinity of this invasive non-native species during installation.

Sycamore *Acer pseudoplatanus* is also listed as an impactful non-native species to Alluvial forests and is present in the riparian edges. It is not expected the works will cause further spread, however removal of the trees will be beneficial to this habitat.

Therefore, mitigation measures are required to control the spread of Giant Hogweed during construction of the scheme. Biosecurity measures are required on a precautionary basis for Zebra/Quagga mussel.

8.3.1.2 Impact assessment at Rivergrove B&B and Grange House

The proposed Scheme works at the Rivergrove B&B and the Grange House consist of:

- Construction of a new reinforced concrete flood wall along the northern property boundary of the Rivergrove B&B
- Construction of a new reinforced concrete flood wall along western property boundaries of the Grange House and Rivergrove B&B.
- Steel sheet piles foundation is proposed up to a depth of approximately 8m where the soil profile changes to dense grave. A capping beam of poured concrete will provide the foundation for the flood wall for Grange House and Rivergrove.
- Cedarwood stream, which is partially culverted and partially open at Grange House will be completely culverted and diverted slightly to the north.
- Construction of a new foul rising main within the property to convey sewage from the Grange House to the gravity sewer in the Elvers Road.

Figure 8-35: Overview of FRS construction works and screened-in ecological features at Rivergrove B&B and Grange House

Direct works in River Shannon (Lower River Shannon SAC) Construction access and temporary works will be required directly adjacent to the SAC along the western property boundaries. The construction area will be 660m^2 within the riparian area of the River Shannon, this is largely outside of the SAC boundary. The riverbank will be reinstated after the construction works have been completed. This will directly impact Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430] which is present within the construction area. This impact is dealt with in the EIAR. It is anticipated that this is a temporary impact to construct the flood wall only

Annex I habitat Alluvial forests [91E0] Impacts to this habitat is assessed in the accompanying NIS. No direct impact is anticipated. Mitigation for indirect impacts from release of sediments from the excavations and building of the new flood wall is provided.

Annex I habitat Hydrophilous tall herb fen [6430] This habitat is recorded in the River Shannon next to Rivergrove B&B and Grange house. This habitat is an Annex I habitat but not a QI of the Lower River Shannon SAC. Affinity to tall herb fen habitat and mosaic of reed beds are also present here. In total this area is 1,050m^2 of which 157m^2 is Tall herb fen.

The proposed method for constructing this wall will require entering the riparian habitat and directly impacting Hydrophilous Tall Herb habitat. Mitigation will be required to protect this habitat. Jervis Goode NPWS Divisional Ecologist has been consulted on the proposed construction methodology for this section. This will likely include the following measures as discussed with NPWS:

- A stone platform can be installed in this section for machinery to enter into the riparian area, which will be underpinned by terram to ensure the stone can be completely removed after construction and keep release of dusts and small stones from entering the river.
- Seasonal constraint: works should be completed during the summer months and should be finished by the end of September ahead of any anticipated flood. Any machinery would be removed ahead of a flood if flooding is forecast during this season.
- Any concrete should be pumped from the dry side at Grange house. Rivergrove concrete will be pumped from the stone and terram platform.

- Therefore, direct impacts are anticipated from construction and will require mitigation measures to prevent permanent loss of this habitat.

Trees

Approximately 20 trees will be removed in this area of the scheme, however three mature Beech trees at Grange House, which may be potential Leisler's Bat roosts, will be retained following the decision to divert the proposed culvert slightly to the north. The majority of trees to be removed are of low quality, with 3 of moderate and 2 of high quality. Species include Alder, Ash, Magnolia spp., Portugal Laurel, Northern Japanese Magnolia, Crab-apple, Viburnum, Japanese Pagoda, Bird Cherry, Goat Willow, Beech, Leyland Cypress and Sycamore.

Bats

Bats have been recorded commuting and foraging along the extent of the River Shannon opposite Grange House. There is the potential for disturbance impacts to these bats during construction works.

Three mature beech trees will be retained along the Cedarwood Stream at Grange House. The three trees were identified as potential (but likely low) Leisler's Bat roosts. A dedicated tree roost survey of all trees was not conducted. Any bats roosting in these trees are unlikely to be impacted by the proposed works as the trees will be retained.

Mitigation measures will be required to protect bats from disturbance impacts during construction.

Cedarwood Stream

The replacement, re-design and diversion of an existing culvert of 40m on the Cedarwood Stream in the property of Grange House is expected to have a neutral impact to the stream as it will not have a negative impact on the structure of the stream from the existing baseline.

Fish

Release of sediment associated with the bankside and instream works may have an adverse impact on fish and freshwater invertebrates. Fine silt can settle on fish breeding grounds, such as coarse sands and gravels used by Brown trout. Large releases of sediment after spawning can result in sediment settling over fertilised eggs resulting in mortality. Increased turbidity and fine particulate in the water column can also result in gill irritation.

The majority of works will involve the use of precast concrete, however limited amounts of cement will be required to secure footings etc. The footprint of proposed works is also small. Cement is highly toxic to all fish species and can result in mortality in where levels are concentrated. Accidental release of hydrocarbons associated with construction machinery can also result in mortality of these fish.

Mitigation measures will be required to protect Fish from release of pollutants into the watercourse at the Cedarwood Stream.

There is an opportunity to design the replacement culvert that allows for better fish passage, such as removal of the small weir, and a natural bed type throughout the existing culvert system at the cedarwood outfall. This would result in a slight increase in habitat quality for fish on this section of the stream.

Birds

Waterbirds and Riparian Birds: The River Shannon next to Rivergrove and Grange House is likely to support breeding duck and Moorhen. Any disturbance to that habitat during the breeding season is likely to be a temporary significant negative impact on breeding birds.

Passerines: Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds.

8.3.1.3 Impact assessment at Mall House

The flood relief works at Mall House will consist of:

- Construction of new reinforced concrete flood walls along the western and northern property boundaries.
- Construction of a ramp that will tie-in with Dunkineely House located to the north of the Mall House.
- Installation of a demountable flood gate at the entrance of the access road to the Dunkineely House.

Figure 8-36: Overview of FRS construction works and screened-in ecological features at Mall House

Affinity to Hydrophilous tall herb Annex I habitat This habitat is recorded in the River Shannon next the wall and driveway beside Mall House. This habitat is an Annex I habitat but not a QI of the Lower River Shannon SAC. tIt is not anticipated that any direct impacts will occur to this habitat, although the works will be adjacent to this habitat, demolition of the existing wall and construction of the new flood wall around Mall House will be entirely outside of this habitat.

Trees

Six trees will be removed in this area of the scheme, the majority of which are of low quality, with one of moderate quality. Species include Apple, Holly, Sycamore and Hawthorn. Transplanting of Trees T007 - T009 and T031 - T033 has been considered in the Arboricultural Impact Assessment Report.

Bats

Bats have been recorded commuting and foraging along the extent of the River Shannon opposite Mall House and along the Mall Rd. There is the potential for disturbance impacts to these bats during construction works. A dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be

removed may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Fish

Fish present at this location, such as brown trout, eel etc. could be impacted, as well as freshwater invertebrates. However, the flood wall alignment and construction will not take place instream. There is potential for sediment and other pollutants (hydrocarbons, cement etc.) to be released into the river given the proximity of construction works. Increase in fine sediment load/turbidity can reduce available spawning habitat when settlement occurs and can result in direct disturbance to fish via gill irritation. High concentrations of hydrocarbons and cement can result in fish mortality. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Birds

Waterbirds, Riparian species, Passerines: The loss of six trees may reduce foraging, roosting and nesting opportunities. Any disturbance to vegetation during the breeding season is likely to be a temporary slight impact on breeding birds.

8.3.1.4 Impact assessment at Mall Road (phase 1) – Mall house to Island House

The flood relief works along the Mall Road consist of:

- Excavate along the proposed flood wall alignment up to the required foundation depth for the new flood walls.
- Construction of a new reinforced concrete flood wall along the boundary of The Mall Road and the SAC. Sheet piling may be considered at detailed design.
- Reinstatement of the Mall Road and footpath.
- Constructing a ramp at the Island property entrance from the Mall Road. This road raising will use lightweight cement.
- Installing a demountable flood gate across the Island House entrance will also be installed as part of the flood relief measures.

The new flood wall will be stepped back approximately 1m from the existing wall and SAC boundary to allow avoidance of the Alluvial woodland 2. The road excavation depth will be up to the existing ground level of the SAC, and within the road, the excavation will be stepped back deeper to the required foundation level. The works area will encroach approximately 6m from the SAC boundary towards The Mall Road. Sheet piling may be considered at detailed design.

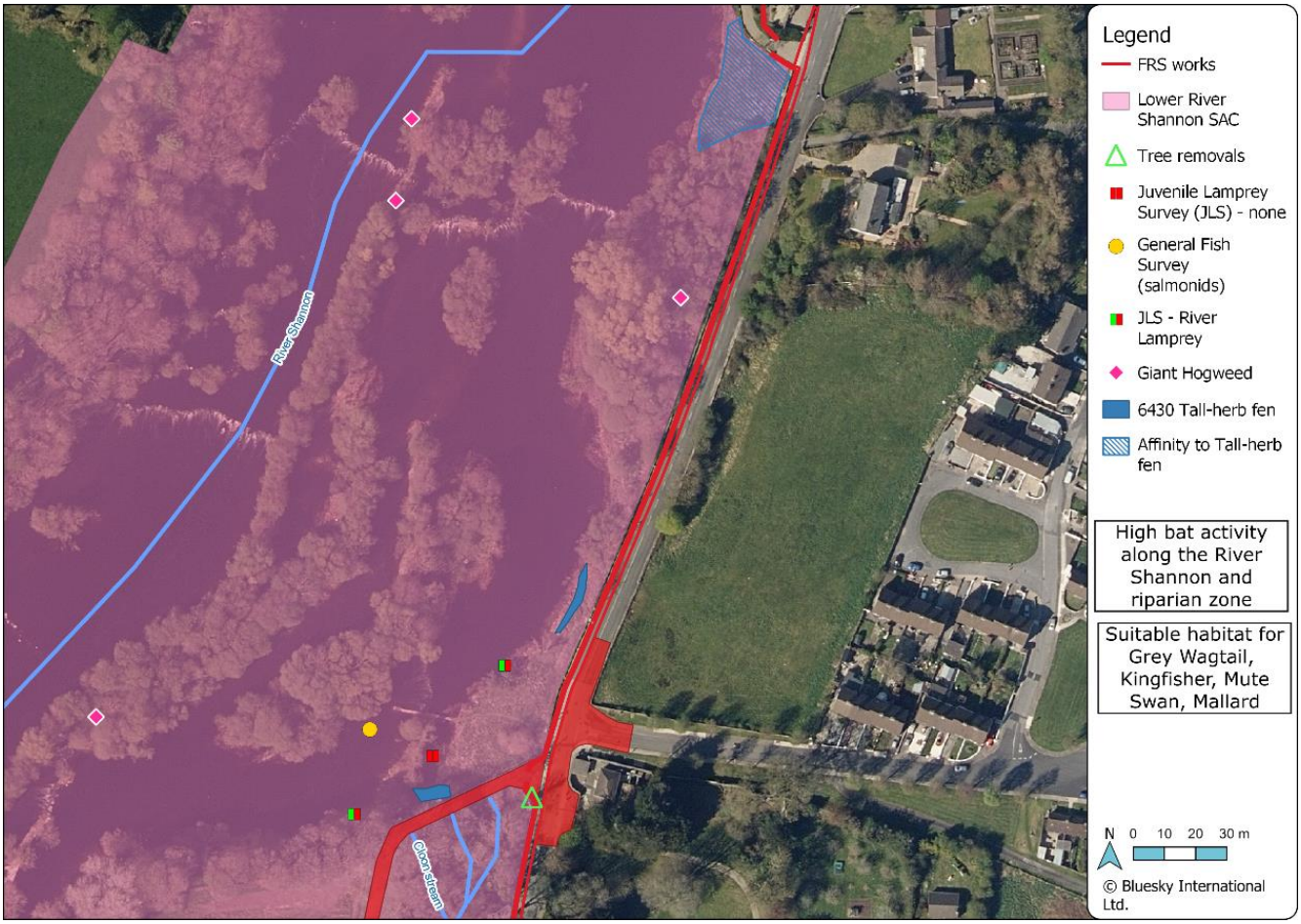

Figure 8-37: Overview of FRS construction works and screened-in ecological features at Mall Road (phase 1)

Hydrophilous tall herb Annex I habitat

This habitat is recorded in the River Shannon next the existing Mall Road Flood Wall. It is also present next to the Island House Causeway. This habitat is an Annex I habitat but not a QI of the Lower River Shannon SAC.

It is not anticipated that any direct impacts will occur to this habitat, although the works will be adjacent to this habitat, all construction of the flood defence measures at the Causeway on Island House will be entirely outside of this habitat.

The use of lightweight concrete casting may be required at the Island House causeway. This will require limited levels of cement use in close proximity to the River Shannon and Cloon Stream. However, it is not expected that this habitat will be impacted by this pollutant, which would be through accidental release only and would have to be in large quantities to smother or permanently damage this habitat. No mitigation required.

Trees

One tree will be removed from this area of the proposed scheme – a White Poplar of moderate quality present within the mixed broadleaved woodland corresponding to affinity to alluvial forests surrounding Island House. A mature beech tree may be removed to facilitate the raising of causeway road level.

Bats

Bats have been recorded commuting and foraging along the extent of the River Shannon and along the Mall Rd. There is the potential for disturbance impacts to these bats during construction works. Mitigation measures

will be required to protect bats from disturbance impacts during construction. The white poplar to be removed has been pollarded in recent years and it is unlikely there are any bats roosting in this tree.

Cloon stream

No direct impact, no works will take place instream. Release of pollutants and sediments during construction may impact fish, as described below.

Fish

Fish present at this location, such as brown trout, eel etc. could be impacted, as well as freshwater invertebrates. Similarly, to Mall House, the wall running along the Mall Road will not be constructed instream. There is potential for sediment and other pollutants (hydrocarbons, cement etc.) to be released into the river given the proximity of construction works. Increase in fine sediment load/turbidity can reduce available spawning habitat when settlement occurs and can result in direct disturbance to fish via gill irritation. High concentrations of hydrocarbons and cement can result in fish mortality. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

The use of lightweight concrete casting may be required at the Island House causeway. This will require limited levels of cement use in close proximity to the River Shannon and Cloon Stream. Cement is highly toxic to fish species, damaging both gills and liver. Its introduction to a watercourse can result in high levels of fish mortality, resulting in an adverse impact on the fish present in the River Shannon. Mitigation measures must be put in place to ensure no cement will enter the river.

Birds

Waterbirds, Riparian species, Passerines: Evidence of breeding birds was recorded along the strip of vegetation between the wall and the river. Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds. Works on bridge to Island House is likely to be a temporary significant negative impact on Dipper and Grey Wagtail.

8.3.1.5 Impact assessment at Mall Road (phase 2) - Scanlon Park Junction up to Maher's Pub.

The proposed Scheme works along the Mall Road consist of:

- Construction of a new reinforced concrete flood wall along the boundary of The Mall Road and the SAC. Sheet piling may be considered at detailed design.
- Reinstatement of the Mall Road and footpath.
- Excavate along the proposed flood wall alignment up to the required foundation depth for the new flood walls.

The new flood wall will be stepped back approximately 1m from the SAC boundary to ensure no excavations are undertaken within the SAC. At the SAC boundary the road excavation depth will be up to the existing ground level of the SAC, and within the road, the excavation will be stepped back deeper to the required foundation level. The works area will encroach approximately 6m from the SAC boundary towards The Mall Road.

Figure 8-38: Overview of FRS construction works and screened-in ecological features at Mall Road (phase 2)

Trees

21 trees will be removed in this area of the scheme during the setback of the footpath along the Mall Rd, all of which are of low quality. Trees to be removed are mostly Sycamore, with some Ash and Alder. White Poplar tree (T091) is noted and considered to be a veteran tree but its condition has declined that its safe useful life expectancy (even in its reduced form) is limited. Therefore, its retention is no longer viable regardless of the proposed flood gates (Arboricultural Impact Assessment Report, JBA).

Approximately 55m of the new flood wall in this section will be within the SAC boundary by 0.5m and the affinity Alluvial woodland from Island House entrance southwards, due to narrowness of the road in this area. This will result in removal of a few trees, notably a large white poplar tree (T091) which is in declining condition will need to be removed. Other trees and flora in this area consisted mostly of non-native trees with an understorey of cherry laurel and is not considered good quality alluvial woodland.

Bats

Bats have been recorded commuting and foraging along the Mall Rd and throughout the woodlands surrounding Island House. There is the potential for disturbance impacts to these bats during construction works.

A dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed along the Mall Rd may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Cloon stream

No direct impacts are anticipated as no works will take place instream. Release of pollutants and sediments during construction may impact fish, as described below.

Fish

Fish present at this location, such as brown trout, eel etc. could be impacted. Similar to Mall House and Mall Road flood wall construction, works will not take place in stream. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

There is potential for sediment and other pollutants (hydrocarbons, cement etc.) to be released into the river given the proximity of construction works. Increase in fine sediment load/turbidity can reduce available spawning habitat when settlement occurs and can result in direct disturbance to fish via gill irritation. High concentrations of hydrocarbons and cement can result in fish mortality. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Birds

Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds. Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

8.3.1.6 Impact assessment at Mahers pub

The proposed Scheme works at Maher's Pub consist of:

- Construction of a new reinforced concrete flood wall along the boundary of the Maher's Pub parking area and the SAC. Sheet piling will be installed along sections in this area, particularly behind Meadowbrook where space is limited.
- The top-of-wall level for the new flood wall will be approximately 1.2m above the existing pavement level at the pub car park and approximately 2.2m beside Meadowbrook.
- The flood wall will be cladded on the property /dry side.

Figure 8-39: ***Overview of FRS construction works and screened-in ecological features at Maher's Pub***

Trees

Twenty-one trees and 4 tree groups will be removed behind Mahers Pub, Meadowbrook and Stormont house collectively, to accommodate the new flood wall. Species include Sycamore, Ash and Beech. The mature Cedar is to be retained and root area protected (RPZ – root protection zone) to ensure no loss of the heron roosts present in the canopy of this tree.

Bats

Bats have been recorded commuting and foraging along the Mall Rd and within the woodlands behind Mahers Pub. There is the potential for disturbance impacts to these bats during construction works. A dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Cloon stream

No direct impact, no works will take place instream. Release of pollutants and sediments during construction may impact fish, as described below.

Fish

Fish present at this location, such as brown trout, eel etc. could be impacted. The construction of the flood walls at Mahers pub comes in close proximity to the Cloon Stream. All efforts will be made to keep works up on the

dry bankside, however, the construction of a cofferdam/sheet piling may be required if deemed necessary during detailed design. The construction of a cofferdam/sheet pilling could result in the disturbance of any fish as well as entrapment mortality as a result. There is also a possibility of fish entrapment and mortality if they are present in the area during the construction of the cofferdam/sheet piling. Mitigation measures will be required to protect these species from entrapment.

There is potential for sediment and other pollutants (hydrocarbons, cement etc.) to be released into the river given the proximity of construction works. Increase in fine sediment load/turbidity can reduce available spawning habitat when settlement occurs and can result in direct disturbance to fish via gill irritation. High concentrations of hydrocarbons and cement can result in fish mortality. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Birds

Passerines: There will be a loss of scrub habitat and trees in the area, leading to reduced roosting, foraging and nesting opportunities. Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds.

Heronry: A large cedar tree with 4-5 heron nests is present here, the flood wall has been designed to avoid this tree and an RPA will be designated to protect this tree from damage during construction. The tree RPA has been calculated by an arborist to allow for tight working space and protection of the tree. Piling will be carried out here to allow for the smallest excavation area possible. Therefore, direct loss of breeding habitat (nests) is not anticipated.

Disturbance impacts are anticipated. Herons are particularly sensitive to disturbance during the breeding season, which begins in February when they start courtship and nest building. There is increased risk of abandonment of nest site with disturbance early in the season, during courting and nest building or maintenance. Disturbance from construction to the heronry during the breeding season is likely to be a temporary significant negative impact.

This will require mitigation to protect the herons breeding in the large cedar and the beech tree on Cloon Island.

8.3.1.7 Impact assessment at Meadowbrook Estate

The proposed Scheme works at Meadowbrook estate consist of:

- Construction of a new reinforced concrete flood wall constructed on sheet piles and a capping beam along the northern property boundary of the Meadowbrook Estate property nr. 7 and the SAC. The top-of-wall level for the new flood wall will be approximately 1.8-2.2m above the existing ground level within the property. The flood wall will be cladded on the property /dry side. The wall to be built as close as possible to the existing property boundary, and to limit excavations towards the SAC.
- Construction of a flood embankment to the north-west of the estate.

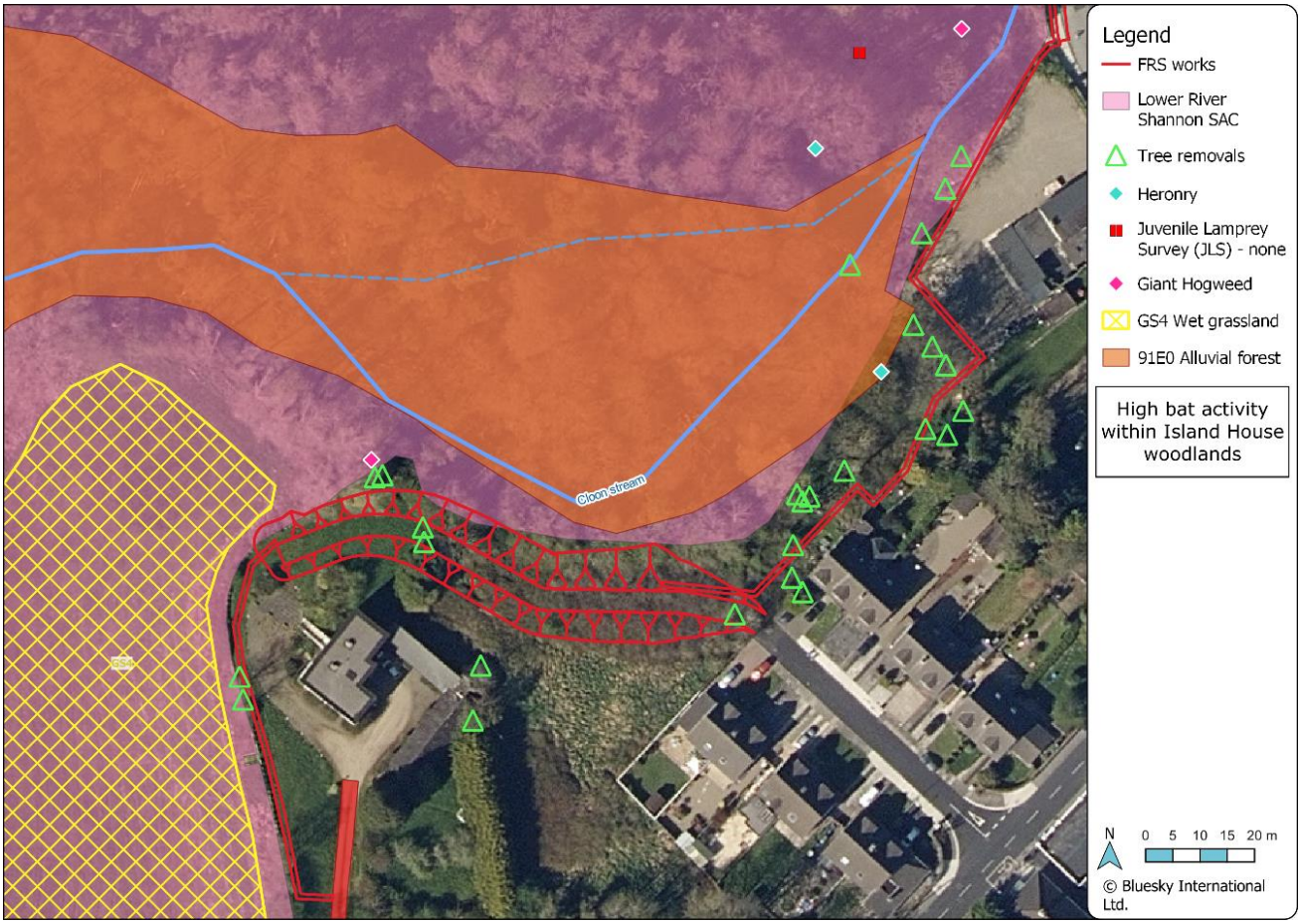

Figure 8-40: Overview of FRS construction works and screened-in ecological features at Meadowbrook Estate

Trees

Twenty-one trees and 4 tree groups will be removed behind Mahers Pub, Meadowbrook and Stormont house collectively, to accommodate the new flood wall (Arboricultural Impact Assessment Report, JBA). Species behind Meadowbrook estate include mostly Sycamore, Beech, Lawson's Cypress and Ash.

Bats

Bats have been recorded commuting and foraging throughout the area, particularly within the woodlands behind Mahers Pub and surrounding Island House. There is the potential for disturbance impacts to these bats during construction works.

A dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Cloon stream

No direct impact, as no works will take place instream. Release of pollutants and sediments during construction may impact fish, as described below.

Fish

The proposed flood wall and embankment running along this section will avoid requirement for instream placement of sheet piling, however, works will still take place in close proximity to the stream.

There is potential for sediment and other pollutants (hydrocarbons, cement etc.) to be released into the river given the proximity of construction works. Increase in fine sediment load/turbidity can reduce available spawning habitat when settlement occurs and can result in direct disturbance to fish via gill irritation. High concentrations of hydrocarbons and cement can result in fish mortality. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Birds

Passerines: There will be a loss of scrub habitat and 20 trees covering approximately 0.13 ha in the area, leading to reduced roosting, foraging and nesting opportunities. Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds.

Heronry: A large cedar tree with 4-5 heron nests is present here. The flood wall has been designed to avoid this tree and a root protection area (RPA) will be designated to protect this tree from damage during construction. The tree RPA has been calculated by an arborist to allow for tight working space and protection of the tree. Piling will be carried out here to allow for the smallest excavation area possible. Therefore, direct loss of breeding habitat (nests) is not anticipated.

Disturbance impacts are anticipated from the construction of the embankment as it is within 50m of the heronry. Herons are particularly sensitive to disturbance during the breeding season, which begins in February when they start courtship and nest building. There is increased risk of abandonment of nest site with disturbance early in the season, during courting and nest building or maintenance. Disturbance from construction to the heronry during the breeding season is likely to be a temporary significant negative impact.

This will require mitigation to protect the herons breeding in the large cedar tree.

Other habitats - Scrub

An area of thick bramble scrub is located between Stormont House and Meadowbrook. This habitat will be removed to construct the floodwall and embankment behind these two properties. Therefore, there will be a permanent loss of 2700m2 of this habitat, which is considered of lower local importance and does not require mitigation or compensation. However, breeding birds may be nesting in this habitat and therefore removal of brambles should be carried out outside of the bird breeding season. As of June 2024, this scrub has been cleared by the owner of Stormont House.

8.3.1.8 Impact assessment at Stormont Property

The proposed Scheme works at the Stormont property consist of:

- Construction of a new reinforced concrete low-level flood wall to the west of the existing house to 0.8m.
- Raising of the access lane of the Stormont property.
- Construction of a new reinforced concrete low-level flood wall (0.3m) which ties into the raised access lane and the Castleconnell rock outcrop located to the east of the access lane.

Figure 8-41: Overview of FRS construction works and screened-in ecological features at the Stormont property

Trees

Twenty-one trees and 4 tree groups will be removed behind Mahers Pub, Meadowbrook and Stormont house collectively, to accommodate the new flood wall (Arboricultural Impact Assessment Report, JBA). This includes non-native trees such as Sycamore, Lawsons Cypress, as well Goat willow, Silver Birch, and Aspen.

Bats

Significant bat activity has not been recorded around the Stormont property. However, bats have been recorded commuting and foraging throughout Castleconnell Village, and treelines in this area are likely commuting and foraging features connecting to woodlands nearby. There is the potential for disturbance impacts to these bats during construction works.

A dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Fish

Construction of the flood relief walls, supporting embankments and the raising of the access road will all take place away from watercourses, with no instream works expected. High rainfall has the potential to wash pollutants (fine sediment, hydrocarbons, cement etc.) down the sloping grassland to the west of the proposed

works and into the river. It is likely that the grassy slope would filter out/absorb the majority of pollutants however mitigation measures should still be taken to ensure there is no impact on fish from a decrease of water quality within the main River Shannon.

Birds

Heronry: Construction of the low wall and road raising will be 50metres or more away and should not cause disturbance to breeding and nesting herons located behind Mahers pub. No mitigation measures required.

Passerines: There may be a temporary disturbance in the area, however works are not expected to extend into the meadow area. Disturbance is not expected to be significant (see Section 6.1.1.2).

Wet Grassland

This habitat is considered of Higher local importance as it is species rich grassland (usually cut for hay in the summer) and is within the Lower River Shannon SAC boundary. This grassland is in the flood plain of the River Shannon and waterbirds were recorded using this wet grassland in river flood conditions during winter months.

This habitat may be slightly impacted during construction by vehicles driving over it to construct the embankment, flood wall and road raining. This will cause compaction and opening of the soil, and tracking over this habitat in the summer which will disturb fauna. Storage of material such as earth for the embankment could also cause compaction and smothering of the grassland. Mitigation measures are required.

8.3.1.9 Impact assessment at Coolbane Woods

The proposed Scheme works at the Coolbane Woods consists of:

- Construction of a new flood embankment to the west of Coolbane Woods estate up to 2.5m high and approximately 20-25m wide.
- Raising of the road at the Coolbane Woods Junction,
- Installation of a demountable flood gate across Chapel Hill road.
- Construction of tie-in of flood wall into rock outcrop of Castleconnell Castle.
- Clearing of vegetation and felling of trees in the surrounding area will be required.

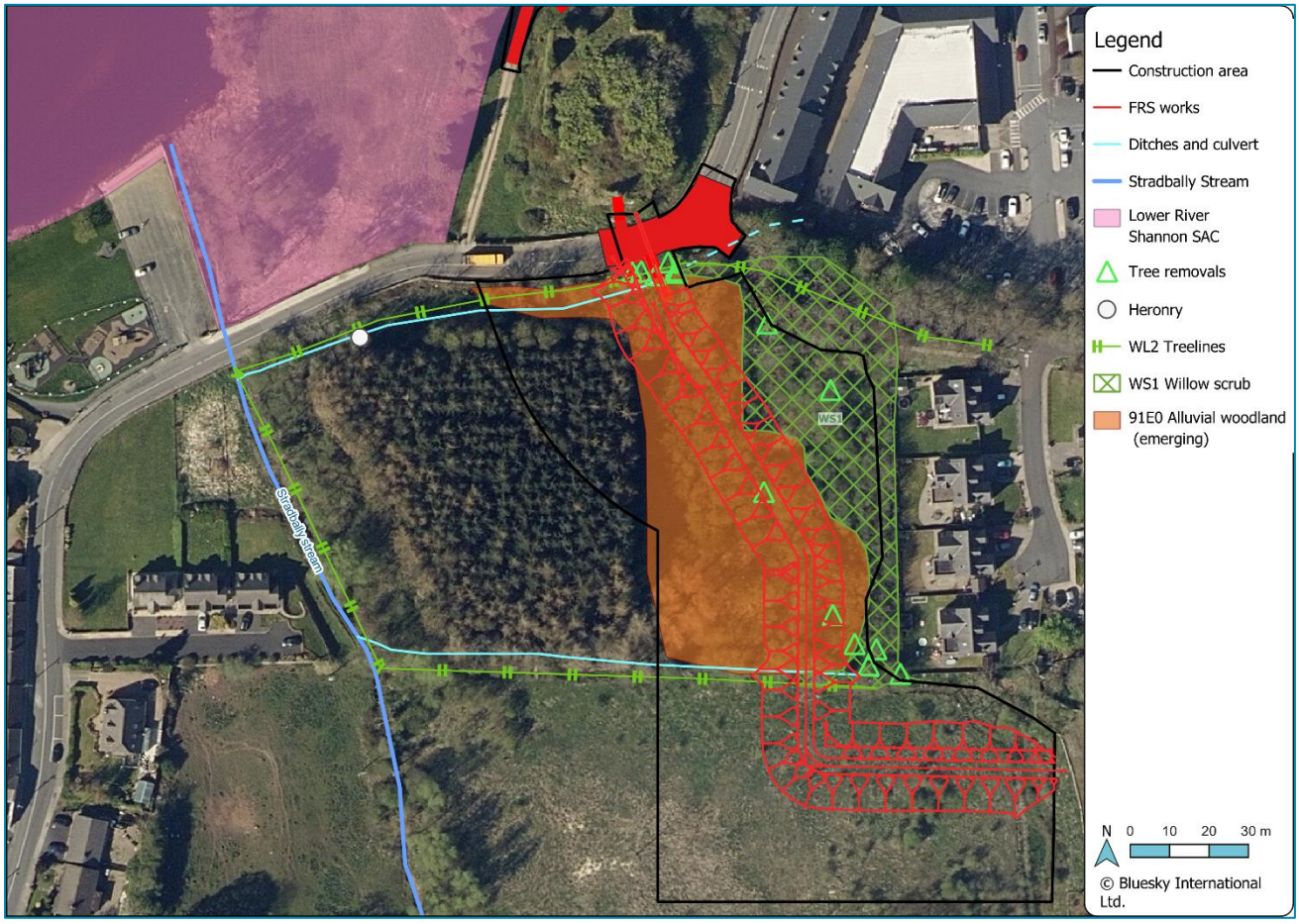

Figure 8-42: Overview of FRS construction works and screened-in ecological features at Coolbane Woods

Alluvial forests [91E0] – Woodland 3

An area of emerging alluvial forest is located adjacent and partially within the footprint of the proposed embankment at Coolbane Woods. This small area of emerging woodland is adjacent to a conifer plantation. This wet woodland is within the winter flood zone and floods from water backing up the Stradbally stream from the River Shannon. Based on past aerial imagery, this area of woodland was Conifer plantation until 2006 when it was cut down and never replanted. This woodland is estimated to be approximately 17 years old, and therefore can be considered establishing or immature woodland and of higher local importance.

This woodland is not within the SAC and does not provide connectivity to other Alluvial woodland or important habitats within the SAC/ River Shannon or connect to other natural woodlands outside of the SAC. Therefore, this woodland does not contribute towards the integrity of the Lower River Shannon SAC. The conservation objectives for Alluvial Forests of the Lower River Shannon will not be impacted as this woodland is outside of the SAC and is not connected to Alluvial Forests within the SAC (i.e. is standalone). However, due to its conservation value, removal of this woodland is assessed below.

In the current design of the embankment, all of this woodland will be removed to facilitate the construction of the embankment. This will result in 3880m2 (0.4ha) of this habitat being permanently lost. Therefore, avoidance of this woodland is not possible, and as the loss of the woodland will be permanent to accommodate the large embankment, then mitigation is also not possible.

Therefore, compensation for this woodland will be required. Compensation for the entirety of this emerging woodland, including construction area, will be required. The existing alluvial woodland is approx. 4000m^2 (0.4ha). This is further described in Operation Impacts in Section 8.3.

There may be indirect impacts from release of sediments from the excavations and building of the new flood embankment. During site preparation, removal of existing infrastructure, excavations, piling and construction of new walls and embankments, there is potential for accidental release of suspended solids, nutrients and pollutants into the adjacent River Shannon associated habitats over the 12- 18-month construction period. Release of suspended solids, dust, hydrocarbons from construction activities could impact through changes in water quality, turbidity, smothering etc. Polluting materials from accidental spills could enter the River Shannon and have a deleterious effect on water quality which can affect Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]. Mitigation measures will be required to protect this habitat from release of any sediment and impacts on water quality.

Trees

13 individual trees and the clearance of approximately 5840m² wooded area by Coolbane Woods will be. Species include Sycamore, Hawthorn, Ash, Willow and Alder.

Bats

Bats have been recorded commuting and foraging throughout Coolbane Woods. There is the potential for disturbance impacts to these bats during construction works.

No trees within Coolbane Woods were identified as suitable for roosting bats, due to their size and lack of roosting features. However, a dedicated tree roost survey of all trees scheduled for removal was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed, including during clearing of vegetation and felling of trees within Coolbane Woods, may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

A roost of >100 pipistrelle bats was recorded emerging from the roof residential building near to Coolbane Woods. This building is not affected by the scheme and it is not anticipated that the bats roosting here will be impacted by the proposed works.

Drainage ditches and Stradbally Stream

The construction of the embankment will require the culverting and removal of some drainage ditches. These of are low ecological importance and no mitigation measures are required. There may be an impact from release of sediments from construction via drainage ditches to Stradbally stream which may affect water quality. This is described further for impacts on fish below.

Fish

Construction of the embankment at Coolbane woods will not have any direct impact on Fish as the water bodies affected (drainage ditches) are too shallow and poor quality to be suitable for fish.

There may be indirect impacts from release of sediments. In the absence of appropriate soil management measures there is potential for loose soil to wash into nearby drainage ditches during heavy rainfall. Rainfall flows through these drainage ditches for approximately 100m into the Stradbally Stream, which then flows another 100m into the River Shannon. Mitigation measures will be required to protect fish from those impacts associated with increased fine sediment load and/or other pollutants entering the river in the case of a pollution event of this type occurring.

Wet grassland

An area of wet grassland is located in the flood plain area south of the Conifer plantation and immature alluvial woodland. This grassland is considered of higher local importance due to its higher species richness and is connected to the River Shannon via the Stradbally Stream and a drainage ditch that drains into the Stream. This grassland will be partially removed to facilitate the construction of the embankment and construction area.

Birds

Heronry: One nest observed in the Conifer plantation opposite from the Ferry Playground entrance. This nest will not be physically impacted from the proposed works. However, removal of the woodland and construction of the embankment and road raising may disturb these birds. Herons are particularly sensitive to disturbance during the breeding season, which begins in February when they start courtship and nest building. There is increased risk of abandonment of nest site with disturbance early in the season, during courting and nest building or maintenance. Disturbance from construction to the heronry during the breeding season is likely to be a temporary significant negative impact. This will require mitigation to protect the herons breeding in this location.

Passerines: There will be a loss of wooded and scrub habitat covering approximately 0.5ha, with an additional 17 trees to be felled in the area, leading to reduced roosting, foraging and nesting opportunities. Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds.

8.3.1.10 Impact assessment at Cedarwood Stream (at Cedarwood Grove)

The proposed scheme works on the Cedarwood stream consists of:

- Vegetation removal from approximately 270m of the stream from Cedarwood Grove downstream.
- Replacement of culvert at one private property Coole House.

Figure 8-43: Overview of FRS construction works and screened-in ecological features at the Cedarwood stream

Alluvial forests [91E0]

Not present at this section of the scheme. Alluvial woodland lies within the River Shannon which is approximately 165m downstream of the proposed works in this section of the scheme.

There may be indirect impacts from release of sediments from the excavations and building of the new flood wall. During site preparation, removal of existing infrastructure, excavations, piling and construction of new walls and embankments, there is potential for accidental release of suspended solids, nutrients and pollutants into the adjacent River Shannon associated habitats over the 12- 18-month construction period. Release of suspended solids, dust, hydrocarbons from construction activities could impact through changes in water quality, turbidity, smothering etc. Polluting materials from accidental spills could enter the River Shannon and have a deleterious effect on water quality which can affect Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]. Mitigation measures will be required to protect this habitat from release of any sediment and impact water quality.

Trees

Trees are to be removed from the Cedarwood Stream behind Cedarwood Grove residential houses during vegetation clearance works to ensure conveyance of the stream. Trees will also be removed behind the properties at Cedarwood Grove, which are mostly Ash trees, some of which are affected by Ash dieback disease. It has not yet been determined how many trees are to be removed. Additionally, a row of degraded cedar trees may also be removed, these have been heavily cut back and are of low ecological importance.

A mature Lime tree (Tree group T228) will be removed to facilitate the replacement of a culvert in the rear of a private property Coole House. The retention of this lime tree is not considered viable, as the excavation of the old culvert and footings for the proposed larger culvert, has the potentially to impact its stability and result in a decline in its overall condition. Its removal is therefore considered necessary to undertake the culvert works (from Arboricultural Impact Assessment Report, JBA).

Bats

The mature Lime tree at Coole House, and Ash trees behind Cedarwood Grove are to be removed for conveyance and construction of a new culvert. These may contain roosting bats.

Bat activity in this area is unknown. However, given the high levels of activity observed throughout Castleconnell, and with the presence of treelines along the Cedarwood Stream in close proximity to the River Shannon, it is likely that bats are foraging and commuting in this area. There is the potential for disturbance impacts to these bats during construction works.

A dedicated tree roost survey of trees scheduled for removal in this area was not conducted, and under the precautionary principle, it is assumed that some bats are likely to be roosting in some trees. Any bats roosting in trees to be removed, including during clearing of vegetation along the stream may be impacted through direct injury or death during the proposed works. Removal of trees may also result in the loss of roosting sites.

Therefore, mitigation measures will be required to protect bats from disturbance impacts and to designate bat-sensitive methods for tree removals.

Cedarwood stream

The replacement and re-design of an existing culvert on the Cedarwood stream in the rear of a private property is expected to have a neutral to positive impact to the stream. The culvert will be wider and deeper below the stream bed to prevent erosion and undercutting, and to reintroduce a natural sediment movement through the culvert. This will be an improvement to the stream from the existing baseline.

Fish

The culvert and weir system at the outfall of the cedarwood stream (at Grange house) restricts Lamprey movement upstream. Therefore, no direct impacts associated with the culvert replacement are anticipated for Lamprey QIs. It is possible that Salmon parr, and other course fish can reach this section of the stream however it is unlikely that there is a significant population given the size of the stream, and the series of obstacles that need to be crossed before reaching this point in the river. An eDNA test of the stream found Eel is present in this stream. The temporary restriction of movement resulting from stream diversion required to replace the culvert is unlikely to have an adverse impact on any fish present in the stream.

The instream works required to replace the existing culvert at Cedarwood Grove has the potential to release pollutants in the absence of mitigation measures. If these pollutants travel downstream, they will adversely impact on fish within the River Shannon as described in Section 7.4.2 above. Mitigation measures will be required to protect fish species from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Breeding birds

Cedarwood stream clearance will lead to the loss of scrub and trees leading to reduced roosting, foraging and nesting opportunities. Any disturbance to vegetation during the breeding season is likely to be a temporary significant negative impact on breeding birds. Any vegetation removal may impact breeding birds nesting in trees and scrub.

Badger

A Badger scat was observed in the amenity grassland area of Cedarwood grove. No setts were found around the Cedarwood Stream / area of works. As the works in this area will be light-touch, with some vegetation removal and in-stream silt removal, and removal of a few trees, it is not anticipated that badger will be impacted by the works and no mitigation is required.

8.3.1.11 Summary of Construction impacts on Ecological Receptors

Table 8-21: Summary of construction phase impacts

Designated site / Ecological feature	Value	Impacts from Construction phase	Effect without mitigation
Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] Woodland 3- Coolbane Woods	Higher Local	Woodland in Coolbane woods will be removed entirely to facilitate the construction of the embankment. 3000m2 will be removed,	Permanent impact to Woodland of Higher Local importance
Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]	National	Direct impact to habitat to construct flood walls at River grove and Grange House Water quality – release of sediments and pollution during construction.	Temporary impact to habitat of national importance
Wet grassland	Higher to Lower local	Habitat in SAC boundary and River Shannon floodplain could be tracked over during construction	Temporary impact to locally important habitat
Treelines and Mature trees	Higher Local	Removal of 55 no. of trees	Permanent loss of 89 no of trees of local importance – slight negative impact
Cedarwood Stream	Higher Local	Vegetation removal and silt removal, construction of 2	Temporary impact to water quality habitat of local

		culverts Impacts to aquatic fauna (fish) direct injury from silt removal (assessed in fish)	importance Culvert replacement is discussed in the operational phase below.
Cloon Stream	International	No direct impact to habitat (no instream works) Water quality – release of sediments and pollution during construction.	Temporary impact to water quality habitat of local importance
River Shannon	International	Instream works at Rivergrove affecting Riparian habitat Tall Herb Fen. Water quality – release of sediments and pollution during construction.	Temporary impact to riparian margins of River Shannon
Drainage ditches and Stradbally stream	Lower (Ditch) and Higher (Stream) local importance	Water quality impacts on Stradbally stream Water quality – release of sediments and pollution during construction.	Temporary slight negative impact to water quality
Birds - Heron	Higher Local	All Heronry trees are to be retained (no direct impact). Disturbance to breeding herons	Disturbance to herons during breeding season could result in nest abandonment, causing Temporary to Short term effects on local Heron population
Waterbirds Swan and Mallard	Higher Local	Direct habitat disturbance Disturbance to birds foraging and moving along River Shannon and Cloon Stream	Temporary displacement
Riparian species – Kingfisher and Grey Wagtail	Regional	Direct habitat disturbance Disturbance to birds foraging and moving along River Shannon and Cloon Stream Water quality – release of sediments and pollution during construction across all of the scheme	Temporary displacement Reduced foraging
Passerines	Higher Local	Habitat loss from removal of Scrub, trees etc. Permanent loss of nests if carried out in Breeding Season	Loss of nests; reduced productivity
Badger	Lower Local	Foraging badgers in Cedarwood grove (no sett found) Unlikely to be impacted from the proposed works here. No Impact	None
Bat Roosts	Lower local	Under precautionary principle, bats may be roosting in some trees to be removed. No buildings will be altered or changed which may contain	Loss of trees without check of bats before felling could cause direct mortality and long-term loss of roosts.

		roosting bats.	
Commuting and foraging Bats	Higher local	High number of Bats foraging along River Shannon and next to Scheme.	Temporary impact from noise disturbance
Brown Trout *Salmo trutta subsp. Fario* Eel *Anguilla anguilla*	National	Habitat disturbance in riparian area at Rivergrove and Grange House, and Cedarwood Stream Water quality – release of sediments and pollution during construction across all of the scheme	Temporary impact from habitat disturbance Temporary impact from sediment/pollutant release
Flounder *Platichthys flesus* Pike *Esox lucius* Three-spined Stickleback *Gasterosteus aculeatus*	Higher Local	Habitat disturbance in riparian area at Rivergrove and Grange House, and Cedarwood Stream Water quality – release of sediments and pollution during construction across all of the scheme	Temporary impact from habitat disturbance Temporary impact from sediment/pollutant release
Other coarse fish: Minnow *Phoxinus phoxinus* Stone Loach *Barbatula barbatula* Gudgeon *Gobio gobio* Perch *Perca fluviatilis*	Higher Local	Habitat disturbance in riparian area at Rivergrove and Grange House, and Cedarwood Stream Water quality – release of sediments and pollution during construction across all of the scheme	Temporary impact from habitat disturbance Temporary impact from sediment/pollutant release
Freshwater Invertebrates	Higher Local	Water quality – release of sediments and pollution during construction across all of the scheme	Reduction in water quality from release of pollutants could result in temporary impact to Freshwater invertebrates.
Invasives species – Giant Hogweed, Zebra mussel	N/A	Spread of 3rd Schedule species along scheme during construction	N

8.3.2 Operational impacts

8.3.2.1 Positive impacts

General positive impacts

Once operational, the proposed Scheme will reduce the flood area in urban parts of Castleconnell, reducing the likelihood of pollutants being mobilised and entering the watercourse during flood events. Point sources which will be protected from flooding include houses, roads, cars and parking areas, and sewers. Additionally, emergency use of sandbags and other emergency measures will be reduced, which can cause additional sources of pollution. This is expected to have a positive impact on the water quality of the River Shannon and the habitats and species it supports.

Connection to foul water services

A foul water pipe currently flows into the Cedarwood Stream from Grange house. In current condition, untreated foul water is entering the Cedarwood Stream and River Shannon. Works along the Cedarwood stream at Grange House, will require this foul water line to be redirected and connected with the local foul water sewer which is treated at Castleconnell Wastewater Treatment Plant (WWTP). This will improve local water quality and is considered a positive impact for fish species in the River Shannon.

Removal of sluices at Island House Causeway

During operation, the sluices on the bridge will no longer be required due to the measures implemented by the Scheme, such as road raising, demountable barriers and higher flood walls. Therefore, the sluices will become obsolete and can be removed from the causeway structure. This will result in the Cloon Stream becoming open and accessible for species such as fish, mammals and waterbirds at all times of the year. Currently, the sluices are closed in high water levels (Figure 8-44) to prevent the Cloon Stream from flooding, but as this is manually carried out, it has been observed that the sluices remain closed or partially closed for many months. In 2022-2023, the sluices were partially closed for 6 months. Note that in the current condition, fish species are not trapped, as the Cloon Stream is open at the downstream end, where it joins the River Shannon. However, the closed sluice effectively closes off the Cloon Stream as a corridor for Otter, water birds and for any fish.

Removing the sluice gates will have a positive impact for fish species and otter, and other wildlife such as ducks and herons that use the Cloon Stream as it will be accessible all year around.

Figure 8-44: Three sluices at Island House Causeway, shut during winter flooding

8.3.2.2 Permanent loss of habitat

Emerging Alluvial Woodland 3 – Coolbane Woods

There will be permanent loss of 0.4hectares of emerging alluvial woodland at Coolbane Woods of higher local importance. This will require habitat compensation as the embankment will be in the footprint of the woodland and will be permanently managed as a grassy embankment.

Compensation for the entirety of this emerging woodland, including construction area will be required. The existing alluvial woodland is approx. 4000m^2 (0.4ha).

Loss of individual trees

There will be a permanent loss of 89 no. trees, the majority of these are non-native or ornamental species. Remedial planting of native species in the Affinity to Alluvial woodland will be required.

8.3.2.3 Modification of existing culverts in Cedarwood Stream

The modification of the existing culverts within cedarwood stream may have the potential to have an adverse effect on Salmon parr that may use this adjoining tributary of the River Shannon as a feeding territory during years 1 – 3 after spawning, before migrating to sea, as well as local Brown Trout that may move between the main River Shannon and this tributary. Eel are present in the channel and can move up and down the channel more easily as they can move over weirs. Other species such as Stone Loach, Three Spined stickleback and cyprinids etc. may be present in the stream but are mainly disconnected from the River Shannon with very little

movement between the stream and river. Lamprey are not considered to be using the stream. The current series of obstacles to fish movement reduce the potential for Salmon and Brown trout to use this channel.

In the worst-case scenario that these culverts are replaced with culverts that do not follow best practice guidance for fish passage, movement of Salmon, trout, etc, upstream will be completely restricted. Although use of the stream by salmonids is considered to be limited to relatively low abundance, reduced access to a second order stream within the River Shannon of channels would be in be impactful for these protected species. Increasing fish passage for other species is also an objective of the Water Framework Directive (WFD), and as such should be achieved where possible.

In the absence of appropriate mitigation measures, an improperly designed culvert would have a slight adverse impact on fish such as Brown Trout, Eel, and other coarse fish.

8.3.3 Potential Sources of Impact on Water quality

As the flood defence walls are permanent structures, and the embankments will be revegetated, the operation of the proposed Scheme will generally not result in any additional discharges into the River Shannon.

However, periodic/annual maintenance of embankments and drainage scheme (i.e., clearing of build-up of silt) will contribute additional particulate matter to the water courses. In particular, the Cedarwood Stream will require removal of silt and vegetation along approximately 400m of the stream, which will need to be carried out annually. This will result in continued disturbance to local fish species present within the stream.

This could have an impact on water quality and sensitive species present in the River Shannon such as Brown Trout, Eel, and other coarse fish. Mitigation measures are required to ensure annual maintenance of the Scheme will not impact fish species.

8.3.3.1 Control of Giant Hogweed

Seeds of this plant can remain viable for many years (possibly up to 15) although most will become unviable after just 2 years. Following the completion of the scheme, due to the disturbance of the soils from machinery and excavations, Giant Hogweed seeds may be encouraged to germinate from the soil disturbance in the following years. This may occur via disturbance to the ground flora during construction of scheme beside the Alluvial woodland which may facilitate the spread of the non-native species.

Mitigation to control germination of Giant Hogweed seeds during operation will be required.

8.3.3.2 Lighting

No new lighting columns are proposed for the scheme. Where lighting columns have to be taken out to construct the new flood walls and embankments, the columns will be replaced. For instance, on the Mall road, the existing columns will be removed and replaced in line with the new wall.

As no additional lighting is to be provided, no impacts on commuting and foraging bats are likely to occur as a result of the proposed scheme.

8.3.3.3 Annual maintenance program

An annual maintenance program will be completed which is anticipated to include the following elements:

- Annual inspection of Cedarwood Stream and removal of vegetation for improved conveyance if required.
- Twice-annual cutting of grass on embankments
- Inspection of entire scheme following a flood event
- Annual inspection and installation of demountable barriers and flood gates, and inspection non-return valves and drainage outfall

These works are not expected to significantly impact any ecological receptors. Therefore, no mitigation is required.

8.3.3.4 Summary of Operation impacts on Ecological Receptors

Table 8-22: Summary of operational phase impacts

Designated site / Ecological feature	Value	Impacts from Operation phase	Effect without mitigation
Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] Woodland 3- Coolbane Woods	Higher Local	Loss of alluvial woodland 3 at Coolbane Woods will be permanent. Any compensation woodland is expected to take 10- 15 years before it is of similar ecological value.	Moderate negative impact - loss of woodland
Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]	National	No impact anticipated	No effect
Wet grassland	Higher to lower local	No impact anticipated	No effect
Treelines and Mature trees	Higher Local	Permanent Loss of 55no. trees The majority of trees removed are non-native ornamental trees of low quality.	Slight to imperceptible negative impact
Cedarwood Stream	Higher Local	Replacement of two culverts at Grange house (40m culvert) and Private property (3m culvert) could physically impact structure of Cedarwood stream. Annual vegetation removal from banks is not expected to have any negative impact.	Slight positive impact due to replacement of both culverts as natural bed level will be reinstated, resulting in an improvement of natural sediment transportation regimes through the stream. Neutral impact from annual vegetation removal
Cloon Stream	International	Removal of sluices on causeway	Slight positive impact - improved conveyance of Cloon Stream
River Shannon	International	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in Built ground	Slight positive impact on water quality
Drainage ditches and Stradbally stream	Lower (Ditch) and Higher (Stream) local importance	Change in drainage ditches	No effect
Birds - Heron	Higher Local	No impact anticipated	No effect
Riparian species - Grey Wagtail, Kingfisher	Regional	No impact anticipated	No effect
Passerines	Higher Local	No impact anticipated	No effect
Badger	Lower Local	No impact anticipated	No effect
Bat Roosts	Higher local	No impact anticipated	No effect
Commuting and foraging Bats	Higher local	No impact anticipated	No effect

Brown Trout *Salmo trutta subsp. Fario* Eel *Anguilla Anguilla,* Flounder *Platichthys flesus* *Pike Esox lucius* *Three-spined Stickleback Gasterosteus aculeatus,* Other coarse fish: Minnow *Phoxinus phoxinus* Stone Loach *Barbatula barbatula* Gudgeon Gobio gobio Perch *Perca fluviatilis*	National, Higher Local	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in built ground Replacement of two culverts at Grange house (40m culvert) and Private property (3m culvert) could physically impact fish passage on Cedarwood stream. Removal of sluices on Cloon Island causeway will allow fish to enter stream from upstream year-round	Slight positive impact to water quality conditions for fish. If culvert is improperly designed, there will be a negative impact on fish passabillity if new culvert at Grange House. Design mitigation/ specification required to improve passabillity for fish. Slight positive impact to conveyance through Cloon Stream from removal of sluices
Freshwater Invertebrates	Higher Local	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in built ground	No change
Invasives species – Giant Hogweed	N/A	Spread of seeds from 3rd Schedule species along scheme during construction could continue for 5-10 years	Slight negative impact

8.3.4 Do Nothing Impact

If the 'do-nothing' approach is adopted and the development of the Castleconnell Flood Relief Scheme does not take place, flooding events will keep occurring within the residential and road/access areas of the Village, resulting in re-occurring and long-term socio-economic pressures on the local community. This could result in the requirement for emergency works or ad-hoc remedial measures in the future, such as sandbags and re-pointing of walls, which may negatively affect the River Shannon and its tributaries, and the protected species and habitats supported by the river, if they proceed without a coherent and rational approach of a flood relief scheme.

8.4 Mitigation Measures

This section describes the avoidance and mitigation measures required to prevent or reduce impacts on the Screened-in Ecological Features that will be incorporated into the proposed Scheme.

The ecological features that have been assessed that require mitigation include:

- Woodland No. 4 at Coolbane Woods - Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland]
- Tall-herb fen (6430) [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]
- Wet grassland
- Treelines and Mature trees
- Birds – Heron (including 8-10 nests)
- Birds- Kingfisher
- Birds- Dipper and Grey Wagtail
- Badger
- Bats

- Fish – Brown trout, Eel, other coarse fish
- Invasive species

Measures to reduce siltation and pollution will be discussed and agreed with Inland Fisheries Ireland (IFI) to ensure that they meet their required standards.

All the works and mitigation measures will be monitored by a suitably qualified ecological clerk of works (ECoW) during the construction period, with findings reported to the competent authority. The ECoW should have experience in riverine infrastructure works and should have a high-level knowledge of fisheries. This knowledge base and on-site construction experience is required given the sensitivity of the Lower River Shannon as an internationally important habitat for fish. The contractor in association with the scheme ECoW will liaise with IFI for approval of silt reduction measures in advance of any works.

Mitigation measures listed below will be included as part of tendering documents and used during preparation and construction phases of the FRS.

The appointed contractor will follow the site-specific Construction and Environment Management Plan (CEMP) prior and during works commencing. This CEMP incorporated the mitigation measures listed in this NIS as well as those in the EIAR.

8.4.1 Construction mitigation- Habitats and Species

8.4.1.1 Protection of Woodlands and trees throughout the Scheme

Planting of trees in the Affinity to Alluvial woodland No. 1 is outlined in the NIS, to compensate for removal of 21 no. of trees from the Mall Road (Phase 2) construction. The canopy structure of this woodland is mostly composed of non-native trees such as Beech, Sycamore, and White Poplar. Any of these trees to be removed may be done so without damage to the woodland. However, any other tree species such as Alder, Ash and Willow will be protected where possible. If native tree species are to be removed, post-construction tree planting, using suitably sourced native species, should occur to replace these native trees. Where construction is taking place next to a protected habitat, an Ecological Clerk of Works should be present at the start of the work anywhere beside the Alluvial Forests. The ECoW should provide a toolbox talk to the construction team prior to any ground works taking place, advise on any areas where:

- The woodland will be demarcated by fencing to prevent access or potential damage to the alluvial woodland adjacent to the riverbank and north of the works on new western outfall. Mitigation will ensure location of new outfall is not located within Alluvial forest habitat.
- No construction work, storage or dumping of material will be undertaken in the Alluvial Forests 91E0 exclusion area.
- As works will be undertaken inside the existing SAC boundary, an adequate buffer zone will be provided to ensure that the alluvial woodland and riparian zone is not degraded and there is no bankside erosion.
- Deadwood: During construction work, any deadwood located within the construction area will not be removed from the woodland. Branches and deadwood removed during pruning activity (during construction and ongoing maintenance) will be placed in various locations within the woodland (as advised by a woodland ecologist) to increase the dead wood present.
- Tree root protection: An Arborist has carried out an assessment of works next to trees in Alluvial Forest on the Mall road. In the Arborist Report (JBA Consulting 2022), the proposed wall raising and footpath intrusion along The Mall road was assessed and it was noted the construction will intrude into the RPA of a number of trees of the Annex I habitat Alluvial Forests. It is considered that a number of trees have been recommended for removal due to the works required within the immediate locations of their stems. It is however considered that this will be minimal, and there are sufficient areas outside the affected rooting areas of these retained trees. The potential impact upon retained trees is therefore considered limited.
- Tree pruning will be undertaken in late winter/early spring (November to March) under supervision of a woodland ecologist. This includes the initial tree-pruning during construction and maintenance pruning works post construction.
- No landscape planting.

8.4.1.2 Protection of Annex I Tall Herb Fen [6430]

The proposed method for constructing the flood wall at Rivergrove will require entering the riparian habitat, and mitigation will be required to protect this habitat. NPWS Divisional Ecologist has been consulted on the proposed construction methodology for this section. This will include the following measures as discussed with NPWS:

- A stone platform can be installed in this section, for machinery to enter into the riparian area, which will be underpinned by terram to ensure the stone can be completely removed after construction and keep release of dusts and small stones from entering the river.
- Seasonal constraint: works should be completed during the summer months and should be finished by the end of September ahead of any anticipated flood. Any machinery would be removed ahead of a flood if flooding is forecast during this season.
- Stone used for the platform should be pre-washed aggregate only, to minimise leaching of stone dust into the River Shannon.
- Any concrete should be pumped from the dry side.
- A Translocation survey for Lamprey and fish is required due to presence of soft sediments before temporary working platform is placed (detailed in Section 8.4.1.3).
- High tensile geotextile should be used under the stone to ensure the textile does not rip. No stones should be allowed to fall into the river (off the terram).
- Re-instatement of habitat - after works are complete the stone platform and geotextile will be removed. It is likely the soil under the platform will be compacted from the weight of the machinery and soil, and therefore habitat remedial works should be carried out. Loosening of the soil should be done with hand tools only as there will be no machinery allowed into the riparian area. This should be carried out under supervision of the ECOW.
- ECOW: where construction is taking place at Rivergrove and Grange house protected habitat, an Ecological Clerk of Works should be present at the start of the work anywhere beside the Tall Herb Fen.
- Toolbox talk: The ECoW should provide a toolbox talk to the construction team prior to any ground works taking place, advise on any areas to avoid if possible. Lamprey and fish are also present here.
- It is expected that this habitat will re-instate itself within 1-2 years.
- Post construction monitoring of this habitat should be carried out. This will be undertaken for a minimum of five years some impacts (e.g. spread of invasive species), may not be immediately apparent. The results of the 5-year monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or shows an unfavourable trend);

8.4.1.3 Fish Translocation efforts -Rivergrove/Grange House Walls and Cedarwood Outfall

The construction of improved flood relief walls along the banks of the River Shannon will require works to place on the river side of the bank. This will require the placement of sheet piling to create a dry cell for the works. With limited construction space at Rivergrove in the garden area, a temporary working platform will be constructed within the wet side of the bank to facilitate the construction of the wall and piling works. Works at Grange house will be carried out from the dry side in the footprint of the existing wall.

Fish in the area will likely leave through disturbance, however, if any become entrapped, they will also require removal. Mitigation for Lamprey ammocoetes in the fine sediment along the banks will also require translocation, as described in the NIS

The zone of works for translocation efforts is shown in Figure 8-45 below.

Figure 8-45: Location of fish translocation efforts

Translocation efforts will follow guidelines for standard electrofishing surveys as set out in Harvey and Cowx (2003)[56]. To successfully translocate fish (and Lamprey ammocoetes), this work should be carried out following the criteria below:

- This work is conducted by an electrofishing team which is led by a qualified aquatic ecologist and/or ECoW under license - Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962.
- The precise location of the proposed piling must be communicated with the Electrofishing lead who will conduct the translocation work in tandem with the piling efforts. Stop nets reaching to the river bottom will be erected around affected areas.
- The electrofishing lead will assess the substrate conditions to determine if appropriate habitat is present before fishing the areas using a zigzag pulse and draw manner with a minimum effort of 1 minutes fishing per sq. m.
- Captured fish will be quickly removed using a dip net (not the electrofishing anode) and placed in a storage tank with aeration system. Lamprey will be spread out across appropriate habitat at a density of <10 sq. m.
- If adult salmon/trout and other coarse fish are trapped and subsequently recovered, they should be returned to the river as soon as they are caught. Others that may be caught during fishing efforts should be moved to an aeration system before being transported to a section of the River Shannon with appropriate habitat. Fish should not be kept within the aeration system for more than 2 hours.
- Fishing efforts should continue until it there is successive efforts with no catch return.

[56] Harvey J & Cowx I (2003). Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

- Works should not take place if the water temperature exceeds 20°C to avoid thermal stress to fish. Dissolved oxygen levels should also be kept to 90% or above. If there is a significant reduction in oxygen level or if significant stress/mortality s observed fishing efforts should be suspended.
- Fishing efforts should be described in detail within the Construction Methodology and project CEMP. This methodology should be approved by IFI in advance of works.

8.4.1.4 Wet grassland

Wet grassland is of higher local importance as it is species rich grassland located in the SAC boundary and connected to the flood plain. This habitat may be impacted during construction by vehicles driving over it to construct the embankment, flood wall and road raining. This will cause compaction and opening of the soil, and tracking over this habitat in the summer which will disturb fauna. Storage of material such as earth for the embankment could also cause compaction and smothering of the grassland. The following mitigation measures are required:

- Fence off access to this grassland before construction begins.
- No vehicles are allowed to track over this grassland during construction, they must stay to the existing road up to Stormont house.
- No storage of materials such as earth/soil, stone etc.
- No storage/parking up of vehicles allowed.
- ECoW present to monitor this habitat is not being disturbed/ tracked over.

8.4.1.5 Herons – Protection of nests from construction disturbance

Timing of works within 50m of the sensitive Heronry on Cloon Island and also one nest at Conifer plantation next to Ferry Playground. Disturbance during breeding season, particularly in the early spring season could result in nest abandonment.

Work around the heronry will be carried out outside of the Heron breeding season which begins in February and ends in August. Construction should start as soon as the last chicks have fledged in August and must be finished by January.

A suitably qualified ecologist or ECOW will be present to carry out pre work check of the nests in August to ensure the chicks have fledged.

If the works stray into the next breeding season, the use of heavy machinery, and loud disturbance should not occur from the month leading to the start of the breeding season (February) as this is likely to cause abandonment. Works may have to halt in until chicks have fledged.

Monthly monitoring of the heronry should be carried out in, prior, during and post construction to assess the impact of the disturbance and whether further measures need to be implemented. This will be carried out by a suitably qualified ecologist.

8.4.1.6 Birds – general measures

General construction mitigation measures will minimise risk of disturbance to breeding and non-breeding birds:

- Limit displacement and habitat degradation by controlling vehicle movement and working from non-vegetated areas as much as possible.
- Vehicles will not encroach onto habitats beyond the proposed Scheme footprint.
- Tree felling and vegetation clearance will take place outside the breeding season (March to August, inclusive), unless permission is obtained from NPWS outside of these times. Any clearance outside this timeframe will require a suitably qualified ecologist or ECOW to be present and to check the area for nesting birds prior to any vegetation removal.
- Work around the heronry will be carried out outside of the breeding season and will be able to start as soon as the last chicks have fledged provided there are no other nesting birds around. A suitably qualified ecologist or ECOW will be present to carry out pre work checks. The use of heavy machinery, and loud

disturbance should not occur in the month leading to the start of the breeding season (February) as this is likely to cause abandonment.

- Where possible, construction will take place outside the breeding season to minimise disturbance, and/or displacement to breeding birds. Where works are necessary, a suitably qualified ecologist or ECOW will be present and carry out pre work checks to ensure that not nesting birds are disturbed. If nesting birds are present, works in the area will be postponed until the birds have fledged; advice may be sought from a suitably qualified NPWS ecologist / ranger.
- All plant and equipment will conform with the Construction Plant and Equipment Permissible Noise Levels Regulations 1996 (SI 359/1996) and other relevant legislation.
- Plant and equipment will be turned off when not in use, with no unnecessary revving.
- Lighting will not shine directly onto surrounding areas and will be switched off at night.
- Dipper / grey wagtail nesting box to be installed under the arches of the bridge to Island house.

8.4.1.7 Bats – commuting and foraging

Construction should take place within daylight hours, outside of bat activity hours (i.e., one hour pre-sunset) to minimise the risk of disturbance to commuting and foraging bats

8.4.1.8 Bats - roosting

Mitigation measures are required to minimise the risk of disturbance to roosting bats, including those potentially roosting in trees scheduled for removal:

- A suitably qualified ecologist (ECoW) should be present during the removal of any trees with bat roost potential, to monitor for bats during felling.
- Any clearing of vegetation/trees with the potential for bat roosting should be completed in September/October (i.e., before the hibernation period begins, so that bats have the opportunity to move on from the site while conditions are still favourable to find new roosts) and can be carried out without a licence.
- Soft-felling techniques should be employed, with trees left to lie for 24 hours before removal, in order to allow any roosting bats to escape.
- Lighting will not shine directly onto any roosts identified within the works area.

8.4.1.9 Invasive species

As Giant Hogweed is present in the construction area of the Scheme, there is a duty to ensure this species is not further spread due to construction activities.

Giant hogweed is a biennial/perennial plant and spreads prolifically by productions of thousands of seeds. Any flowering stalks should be removed immediately by cutting the flower head off. Giant hogweed flowers from approximately May/June/July and sets seed from July to August. Hand cutting should only be carried out if operator is wearing full protective clothing to prevent skin contamination by the sap. Note: removal of flowering heads is already being informally controlled by local river conservation group.

Any Giant Hogweed that is growing in the location of proposed walls or embankment should be dug up to take the root out. If it is not possible to dig up, treatment with herbicide will be necessary. For spot treatment of Giant Hogweed, the most effective chemical for the control of giant hogweed is glyphosate. Injection into the stem of the plant approximately 30cm above the ground with 5ml of a 5% v/v solution can be used where spot treatment is required. Foliar spray application should be undertaken before the flowering stem has fully elongated in mid-spring during periods of mild, dry weather. Where control is being undertaken later in the year after stem elongation, the stems should be cut back to ground level and the re-growth sprayed.

However, it is likely that seeds will be present in the soil. It is therefore important to control the movement of soil from around the construction site, and offsite. No soil should be removed from the site, as this will spread Giant hogweed to a new location. Any movement of soil created during construction should be stored as close as possible to the original location and placed back where it originated from where possible.

8.4.1.10 Biosecurity Measures – Zebra mussel

Although no instream works are required, precautionary measures should be taken in terms of biosecurity to prevent spread of Zebra and/or Quagga mussel. The juvenile stages of zebra and quagga mussel can be less than 1mm in size - cleaning should take place even if nothing is visible to the naked eye, as they can attach to any equipment or clothing that comes in contact with water.

The follow biosecurity measures should be adhered to prevent spread of aquatic animals, plants and diseases:

- Check any equipment, and clothing after leaving the water for mud, aquatic animals or plant material. Remove anything you find and leave it at the site.
- Clean everything thoroughly as soon as possible. Use hot water (at least 45°C), steam or a high-pressure spray if possible.
- Dry - drain water from every part of equipment before leaving the site. Dry the surfaces of everything and allow to air dry for at least 48 hours – some species can live for many days or weeks in moist conditions. Disinfect cleaned items if complete drying is not possible. Use disinfectant such as Virkon Aquatic, Virasure or any other proprietary disinfectant product. Areas difficult to dry can be sprayed or wiped down with disinfectant.[57]

8.4.1.11 Construction mitigation - Water Quality Control Measures

Mitigation measures to prevent to prevent sediments and pollutants from entering watercourses are outlined in this section and mitigation section 10.5.2 of the Water Chapter of this EIAR. Any silt fences and geotextile barriers to be used will be regularly inspected by an ECoW. Any build-up of sediment or other pollutants will be immediately reported, and the relevant contractor will have the silt fence/geotextile barrier replaced. The ECoW will decide when there is sufficient growth on the embankments to allow for the silt fencing to be removed. The ECoW will oversee all aspects of the silt fence removal and will inspect the structural integrity of all pollution control measures.

Parts of the wall and embankment construction will be built on the dry bankside but will come in close proximity to sensitive habitats such as the Annex I Alluvial Woodland, as well as the Cloon Stream. To ensure there will be no impact on water quality via release of pollutants, specific measures will be put in place.

Construction Walls along Mall Road.

The walls running along Mall Road will be removed and replaced with a higher wall which will be set back almost 1.5m towards the road.

[57] NBDC (2022) Ireland's Invasive Alien Species Recreational Boating and Watercraft Pathway Action Plan 2022-2027, National Parks and Wildlife Service / Department of Culture, Heritage and Gaeltacht, available: https://www.npws.ie/sites/default/files/IAS_Boating-and-watercraft_PAP_FINAL_June2022.docx.

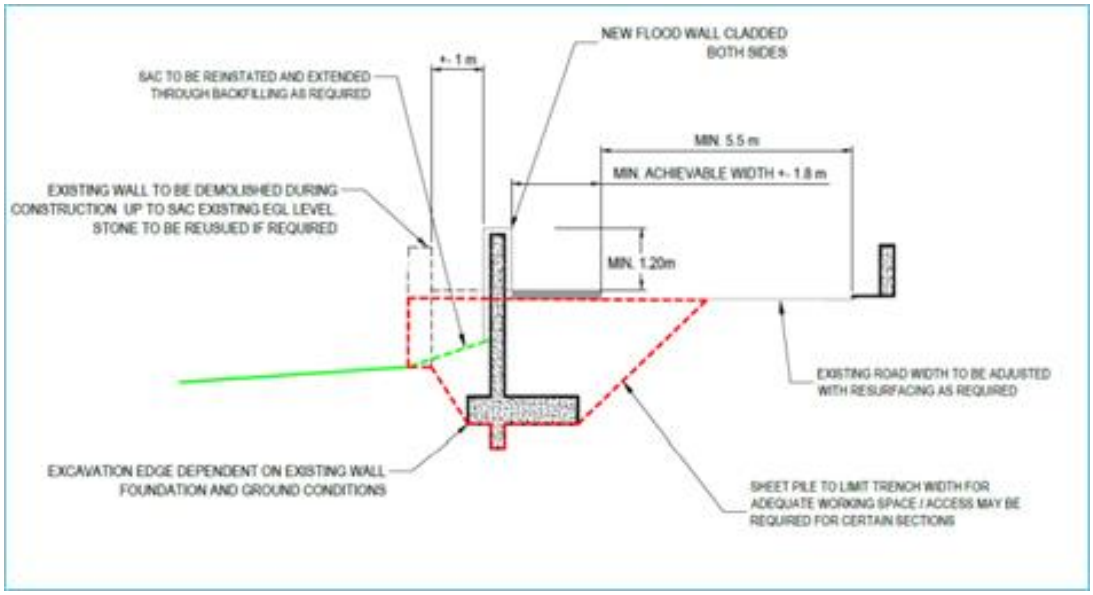

Figure 8-46: Cross section of new proposed wall

Standard trenched silt fencing is not feasible in this location due to the presence of trees nearby. Construction works should take place as follows:

- If demolition of the existing wall takes place first, a light silt fence with shallow stakes will be placed between the existing wall and the alluvial woodland in advance of deconstruction. This light silt fence will be lined with terram/geotextile material which will be held down with geotextile sandbags, the fence itself can also be reinforced with geotextile sandbags to the rear. This lightweight silt fence will sit on the surface of the woodland and can be manoeuvred around trees, limiting damage to trees and particularly their roots. This method will be used instead of normal silt fencing which requires a shallow trench to be dug. The silt fence will prevent any silt or debris created during the deconstruction of the wall from entering the woodland and potentially into the River Shannon aquatic habitat;
- After the wall is demolished/disassembled, excavations for the new wall foundations can be constructed. Once this works is complete, any sand and silt build up in the silt fencing should be removed in the direction of the road and away from the SAC. Any silt should be carefully disposed of away from watercourses;
- The flood wall and foundations will be built with poured cement. The newly excavated space to facilitate the wall foundations should be lined with geotextile to create a sealed working space with a fenced buffer between any works involving cement. Once this area is lined the foundation and wall can be constructed; and
- Once the wall is constructed the silt fencing should be carefully removed so as to not introduce any trapped pollutants into the SAC. This should be completed by hand with silt fencing transported out of the area by wheelbarrow. Alternatively, the silt fencing can be placed in a suitable container and lifted over the wall using machinery placed on the road.

Construction of walls and embankments along Cloon Stream, Mahers Pub, Meadowbrook, Stormont House

The construction of the new flood wall behind Mahers Pub will be within 5-7 metres from the Cloon Stream. Construction should follow the same mitigation measures as the construction of walls along Mall Road, however, there is no requirement for deconstruction of an existing wall in this section. Lightweight silt fencing with geotextile sandbags will be placed on the boundary of the proposed excavation area. A geotextile lining will be placed in the excavation foundation trench as described above after which the same method is followed.

The embankment behind Meadow brook and Stormont House will be constructed near the Cloon Stream. The embankments will require some level of excavation at the foot of the proposed slope which will be filled in after construction. Lightweight silt fencing with geotextile sandbags will be put on the boundary of this excavation zone between the Cloon Stream and the proposed embankment.

The silt fence will stay in place until the soil on the bank has settled and grass has rooted, keeping potential loose soil in place and preventing any soil from washing into the Cloon Stream.

Construction of culverts at Cedarwood Stream.

Two culverts are required along the Cedarwood Stream, one at the outfall and another approximately 160m upstream at the location of an existing culvert in the rear garden of a private property. An assessment of the current design of these culverts and weir creates an obstacle to fish passage.

There is an opportunity to design the new culverts so that they are not an obstacle to fish passage. Mitigation is required during the installation of the culverts to protect fish and water quality.

Culvert design

The construction of these culverts should follow best practice guidance outlined in OPW (2021) 'Design guidance For Fish Passage On Small Barriers'.

The OPW document is the preferred best practice document for engineering reference however a concise description of preferred culvert design is also described in the IFI and Loughs Agency Documents:

- IFI (2016) - Guidelines on protection of fisheries during construction works in and adjacent to waters
- Loughs Agency (2011) - Guidelines for Fisheries Protection during Development Works (Foyle and Carlingford areas)

The culvert nearest the outfall will be approximately 40m in length, so mitigation must be put in place to ensure its length is not an obstacle to fish passage. The culvert must meet the following criteria:

- A gradient of 5% should never be exceeded, with 3% being the preferred upper limit.
- Be positioned such that both the upstream and downstream invert shall be 500mm below the upstream and downstream riverbed invert levels respectively.
- Piped culverts should be avoided wherever possible, with inverted U shape or box culverts over the existing stream bed being the preferred option. If a piped culvert is the only option at detailed design, IFI must be consulted in advance of works, and the piped culvert must be buried deeper than bed level so that the natural bed material can be retained. This is to maintain natural roughness throughout the culvert.
- Pools should be formed at each end of the culvert to provide transition from the shape of the opening to the shape of the river downstream. Pools should, ideally, be built in natural rock and be designed to provide take-off conditions for upstream migrants entering/ leaving the culvert.
- The areas around the inlet and outlet should be planted with transitional planting (Willow or Alder) so that there is not a stark difference in lighting between the open channel and culvert.
- Flow velocity should be as slow as possible with water depth through the culvert kept as deep as possible. Maximum flow velocities during standard flow should not exceed 1.2m/sec. Power densities should not exceed 150Wm^3.
- Head drops should be avoided during detailed design, but if absolutely required a maximum head drop of 0.1m can be permitted.
- If trash screens are required, they should be adequately spaced to approximately 230mm to allow for fish passage. Mesh screens should be avoided.
- The upstream culvert will be smaller in length but should still follow the same principles regarding bed level, gradient, flow velocities, head drops, take off pools and transitional planting out outlet and inlet.

8.4.1.12 Cedarwood Culvert Construction

Stream Diversion

The construction of both culverts will require significant instream works. Temporary stream redirection is considered preferable, particularly in the case of the 40m long culvert at the outfall.

These recommendations as well as any other recommendations that come as a result of consultation with IFI should be detailed in the final CEMP and referred to in the Construction Methodology report prior to any works commencing. All stages of the stream diversion should be overseen by an ECoW who will monitor all stages of instream works, with regular reporting to the LCCC and Inland Fisheries Ireland.

The proposed stream diversion will outfall north of the current Cedarwood alignment. The proposed new culvert will be constructed first. Once construction is complete, the stream will be diverted into the new culvert, and the old culvert disconnected. The dried-out channel will be checked for invertebrates and fish, and the substrate/bottom material moved to the new channel. This work will be overseen by IFI.

There is limited space in the smaller upstream culvert for a stream diversion, over pumping will be required at this location.

Dry works area

To ensure the safeguarding of the River Shannon and its downstream habitats which support a variety of protected species; the presence of an ECoW will be required during the installation of the dry cell sheet piling within the stream at the upstream and downstream boundaries of the zone of works. The precise location of these temporary dry cell areas should be set out in the CEMP following detailed design.

Dewatering of the proposed dry cell area will require installation of sheet pilings from bank to bank. Water should be introduced back into the river only after suspended sediment has settled and/or filtered from the water. The methodology for this water reintroduction should follow best practice guidance as set out by the contractor and ECoW in the final CEMP, which should be approved by IFI and LCCC. One approved method involves pumping water into a settling pond more than 30m from the stream before slowly spilling the water through silt bag traps into a discharge point located on the edge of the newly diverted stream or directly into the River Shannon. The discharge point will consist of a circle of triple silt fences surrounding a circle of straw bales wrapped in Terram geotextile. All waters pumped from the dry cell area will first settle within the pond and then filter though the silt bag, straw bales and silt fences before diffusely discharging back into the river. The discharge points will be constructed prior to commencement of construction works and will be monitored on a daily basis when in use to ensure that the release of any polluting material is mitigated. These works will need to be scheduled for a dry weather period, as heavy rains during these works will compromise the absorption ability of the discharge point. Should any aquatic fauna enter the dewatering system the ECoW will be there to secure them and ensure their safe return to the temporarily redirected Cedarwood Stream or River Shannon, whichever is suitable. Fish salvage and translocation efforts will ensure that there will be no entrapment as a result of the dry cell dewatering as described below.

All instream works should be conducted between July and September inclusive as per IFI recommendations.

Fish Translocation and Salvage

Fish salvage and translocation works will need to take place in advance of dry cell dewatering. This will require electrofishing efforts which follow the same methodology as a standard survey with release at a separate location. Methodologies set out in CFB (2008)[58] and SFCC (2007)[59] should be followed, as well as the following the criteria set out below:

- Silt curtains must be placed in stream 5m up and downstream of the dry cell piling locations before they are constructed.

[58] CFB (2008) Methods for the Water Framework Directive - Electric fishing in wadable reaches. Central Fisheries Board.

[59] SFCC (2007) Electrofishing Team Leader Training Manual, Scottish Fisheries Co-ordination Centre, available: http://www.gov.scot/resource/doc/295194/0096726.pdf.

- The area can then be fished using electrofishing techniques by a qualified aquatic ecologist and/or ECoW under license - Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962.
- Captured fish will be removed from the stream using a dip net (not the electrofishing anode) and placed into a bucket of river water for no more than 5 minutes before being transferred to a storage tank with aeration system. Fish can then be transported to a designated area outside of the zone of impact (preferably downstream) to an ecotope similar to that from which they were recovered.
- Adult salmon should be returned to the river as soon as they are caught, while other fish species should not be kept within the aeration system for more than 2 hours.
- Works should not take place if the water temperature exceeds 20°C to avoid thermal stress in fish. Dissolved oxygen levels should also be kept to 90% or above. If there is a significant reduction in oxygen level or if significant stress/mortality is observed fishing efforts should be suspended.

Fishing efforts is described in detail within CEMP as well. This methodology should be approved by IFI in advance of works.

8.4.1.13 Cedarwood vegetation and silt removal, replacement of culvert at private property

The cedarwood stream will require vegetation removal from the banks to increase conveyance. The stream is currently choked with brambles, as well as some trees that are growing on the bank. Trees on top of the bank will not be removed, however, some lower branches may be cut back.

Additionally, a culvert over the Cedarwood stream will be replaced. This is located in an unnamed private property (Eircode V94 PY9X).

This work will require the following mitigation:

- Tree and vegetation removal should be carried out from 1st September to 28th February only. Where possible, remove vegetation and branches by hand.
- It is expected that the removal of silt in stream will result in a high load of sediment release downstream and therefore mitigation to prevent release of silt downstream should be installed. A series of silt screens should be placed downstream of the silt removal works on the Cedarwood stream. This will be under advisement from the ECOW on the placement and number required. Sediment/silt removal within the stream should be carried out from downstream to upstream. Only sediments should be removed, and the bank and stream bed should be left intact.
- Before instream silt removal, translocation of fish, notably Eel, should be carried out.
- The replacement of the culvert at the private unnamed house will require works to be carried out in the dry. The stream will be blocked off to create a dry bed, and overpumping of the water will be carried out. The process for this work is described in Section 4.2.3.2.
- ECOW will be present to advise and monitor the works within this sensitive environment.

8.4.1.14 Protection of River Shannon at Rivergrove works in Riparian area

The proposed method for constructing the reinforced concreate flood wall will require entering the riparian habitat and directly impacting Hydrophilous Tall Herb habitat. Construction method for protecting this habitat is described in Section 8.4.1.2, and will involve placing a stone platform underpinned by terram to allow machinery to enter the soft riparian area. The terram will minimise the release of dusts and small stones from entering the river.

- Before works begin, translocation of fish, should be carried out, with advice from ECoW;
- Seasonal constraint: works should be completed during the summer months and should be finished by the end of September ahead of any anticipated flood. Any machinery would be removed ahead of a flood if flooding is forecast during this season;
- The riverbank will be reinstated with oversight from ECoW after the construction works have been completed;

- Precast concrete will be used mostly for this construction, however any concrete to be poured should be pumped from the dry side; and
- ECOW will be present to advise and monitor the works within this sensitive environment

8.4.1.15 Protection of Stradbally stream from sediment during construction

Two drainage ditches that drain into the Stradbally stream (and thus the Lower River Shannon SAC) will be within the working area of the new embankment to be constructed at Coolbane woods. Mitigation to prevent sediment release from construction should be put in place to protect the water quality of the local watercourses, and the species they support.

- Prior to any work commencing at this site, a silt-screen/trap will be staked into the ditches to safeguard the Stradbally stream from substantial sediment input. This can either be strawbale screen or fabric silt screen;
- The appointed ECoW will be present to initially inspect the structural integrity of the silt-screen. Furthermore, the ECoW will be there to monitor its sediment loading and bring it to the attention of site workers if the screen's silt capacity has been reached and needs changing. The removed silt-laden material will need to be disposed of at least 20m away from the aquatic habitats

8.4.1.16 Works at Island house causeway

Road raising will occur at the Island House causeway, which lies directly over and adjacent to the Cloon Stream. Lamprey are present in this stream. The works will require some excavation of existing material, pouring of lightweight cement, and topping with gravel. The Cloon Stream should be protected to prevent any material from falling off the causeway during the works.

The following measures are proposed:

- During construction the existing sluices will be fully closed to control the water entering stream. This will reduce the flow temporarily while the works are being carried out;
- Sandbags and geotextile will be used to create a temporary wall beside the steep banks that are unprotected either side of the causeway where sediment/ water could drain off into the Cloon Stream
- ECOW will be present to advise and monitor the works next to this sensitive environment,

8.4.1.17 Surface Water Management Plan

In order to safeguard the local surface water network, and in turn the local groundwater network, from surface water-based pollution events, the following must be strictly adhered to:

- The principal contractor will ensure compliance with environmental quality standards specified in the relevant legislation, namely European Communities (Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009 and amendments), and the European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988);
- Oil booms and oil soakage pads should be maintained on-site to enable a rapid and effective response to any accidental spillage or discharge. These shall be disposed of correctly and records will be maintained by the environmental manager of the used booms and pads taken off site for disposal;
- Management of silt-laden water on-site, including procedures for accidental leaks / spills to ground, as well as water quality monitoring to ensure compliance with environmental quality standards specified above;
- At no point during the construction phase will treated-water be discharged to local surface water network without the water quality meeting the statutory limits as set under the environmental quality standards specified above;
- Fail-safe site drainage and bunding through drip trays on plant and machinery will be provided to prevent discharge of chemical spillage from the sites to surface water;
- Any accidental discharge will be controlled by use of oil booms in the water prior to construction starting.
- Washout of concrete plant will occur at a designated impermeable area with waste control facilities;
- Wherever reasonably possible, pre-cast concrete bridge features should be utilised to minimise the risk of a concrete-based pollution event;

- Concrete delivery, concrete pours and related construction methodologies will be part of the procedure agreed with the contractor to mitigate any possibility of spillage or contamination of the local environment. Particular attention will be paid during the pouring process in order to avoid leakages or spills of concrete.
- Temporary stockpiles will be monitored for leachate generation. These stockpiles will be placed within designated areas and not located within the vicinity of watercourses, wetlands or artificial surface water drainage features;
- Excavated contaminated soils will be segregated and securely stored in a designated area where the possibility of runoff generation or infiltration to ground or surface water drainage has been eliminated through bunding and imperviable geotextile linings. The contaminated soils will then be classified as clean, inert, non-hazardous or hazardous in accordance with the EC Council Decision 2003/33/EC. Furthermore, the contractor will ensure that no cross-contamination with clean soils happens elsewhere throughout the development site;
- Silt fencing will be installed prior to the commencement of any construction works in order to enhance the protection of identified water features. An Ecological Clerks of Works (ECoW) will be present during the installation of these protective measures to ensure that they are installed to best practice standard and correctly located in their assigned areas. The following sub-section (8.4.1.18) will provide greater detail on specific locations of these silt fence / trench sections; and
- Silt fences will be repaired and/or replaced as necessary by the principal contractor as part of the on-going environmental monitoring programme.

8.4.1.18 Pollution Control Plan

The majority of the Scheme will be constructed from the existing built ground (i.e. on existing roads etc.). All large machinery will be situated only on the dry side, and any work on the wet side (River Shannon riparian area) will be carried out by hand. Therefore, it is not expected that any hydrocarbons will be spilled directly into the River Shannon. However, in case of accidental spills the following should be taken into account:

Spill kits containing absorbent pads, granules and booms will be stored in the site compound with easy access for delivery to site in the case of an emergency. A minimum stock of spill kits will be maintained at all times and site foremen's vehicles will carry large spill kits at all times. Absorbent material will be used with pumps and generators at all times and used material disposed of in accordance with the Waste Management Plan. All used spill materials e.g., Absorbent pads, will be placed in a bunded container in the contractor's compound. The material will be disposed of by a licenced waste contractor at a licenced facility. Records will be maintained by the Ecological Clerk of Works (ECoW) and/or an environmental site manager.

Regular inspections and maintenance of plant and machinery checking for leaks, damage or vandalism will be made on all plant and equipment.

In the event of a spill the principal contractor will ensure that the following procedure are in place:

Emergency response awareness training for all Project personnel on-site works.

- Appropriate and sufficient spill control materials will be installed at strategic locations within the site. Spills kits for immediate use will be kept in the cab of mobile equipment;
- Spill kits will be stored in the site compound with easy access for delivery to site in the case of an emergency. A minimum stock of spill kits will be maintained at all times and site vehicles will carry spill kits at all times. Spill kits must include suitable spill control materials to deal with the type of spillage that may occur and where it may occur. Typical contents of an on-site spill kit will include the following as a minimum:
  - Absorbent granules;
  - Absorbent mats/cushions;
  - Absorbent booms
  - Track-mats, geotextile material and drain covers;
- All potentially polluting substances such as oils and chemicals used during construction will be stored in containers clearly labelled and stored with suitable precautionary measures such as bunding within the site compound;

- All tank and drum storage areas on the site will, as a minimum, be bunded to a volume not less than the following:
  - - 110% of the capacity of the largest tank or drum within the bunded area, or
  - - 25% of the total volume of substances which could be stored within the bunded area;
- All hydrocarbons to be utilised during construction are to be appropriately handled, stored and disposed of in accordance with the TII document 'Guidelines for the crossing of watercourses during the construction of National Road Schemes'[60];
- The site compound fuel storage areas and cleaning areas will be rendered impervious and will be constructed to ensure no discharges will cause pollution to surface or ground waters;
- Designated locations for refuelling are within site compound;
- Potentially contaminated run off from plant and machinery maintenance areas will be managed within the site compound surface water collection system; and
- Damaged or leaking containers will be removed from use and replaced immediately.

8.4.1.19 Dust Management Plan

The following measures will be implemented to prevent excavation- and cement-based dusts entering the local surface water network and habitats:

- Limit the breaking of the topsoil or earth stripping from occurring during dry and windy weather.
- Wheel washing of vehicles leaving the site, covering of fine dry loads or spraying of loads prior to exiting the site, and if necessary regular cleaning of public roads in the vicinity of the entrance.
- The utilisation of pre-cast concrete features will minimise the generation of the concrete-based dusts throughout the development site.
- Stockpiling of spoil and spoil-like materials will be appropriately located and covered and/or sprayed where possible to minimise exposure to prevailing winds, which will in turn minimise the generation of dust within the site.

8.4.2 Operation Mitigation

8.4.2.1 Alluvial Woodland 3 Compensation woodland

One woodland of Annex I Quality is located outside of the SAC boundary, woodland 3 at Coolbane Woods section of the Scheme.

In the current design of the embankment, all of this woodland will be removed to facilitate the construction of the embankment. This will result in 3880m^2 (0.4ha) of this habitat being permanently lost. Therefore, avoidance of this woodland is not possible, and as the loss of the woodland will be permanent to accommodate the large embankment, then mitigation is also not possible.

Therefore, compensation for this woodland will be required. Compensation for the entirety of this emerging woodland, including construction area will be required. The existing alluvial woodland is approx. 4000m^2 (0.4ha).

There are three options for compensation for loss of this woodland (to replace 0.4ha) – shown in Figure 8-47.

- Reinstate as much area as possible of existing alluvial woodland next to the embankment post-construction.
- Buy conifer plantation adjacent to the existing woodland, it will have the same or similar flooding conditions from the Stradbally stream as the existing., This area, when felled, is likely to regenerate into alluvial woodland.

[60] NRA (2008) Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes, available: https://www.tii.ie/tii-library/environment/construction-guidelines/Guidelines-for-the-Crossing-of-Watercourses-during-the-Construction-of-National-Road-Schemes.pdf.

- Regenerate land to south of embankment and ensure it is connected to the flood plain. Allow to naturally regenerate.

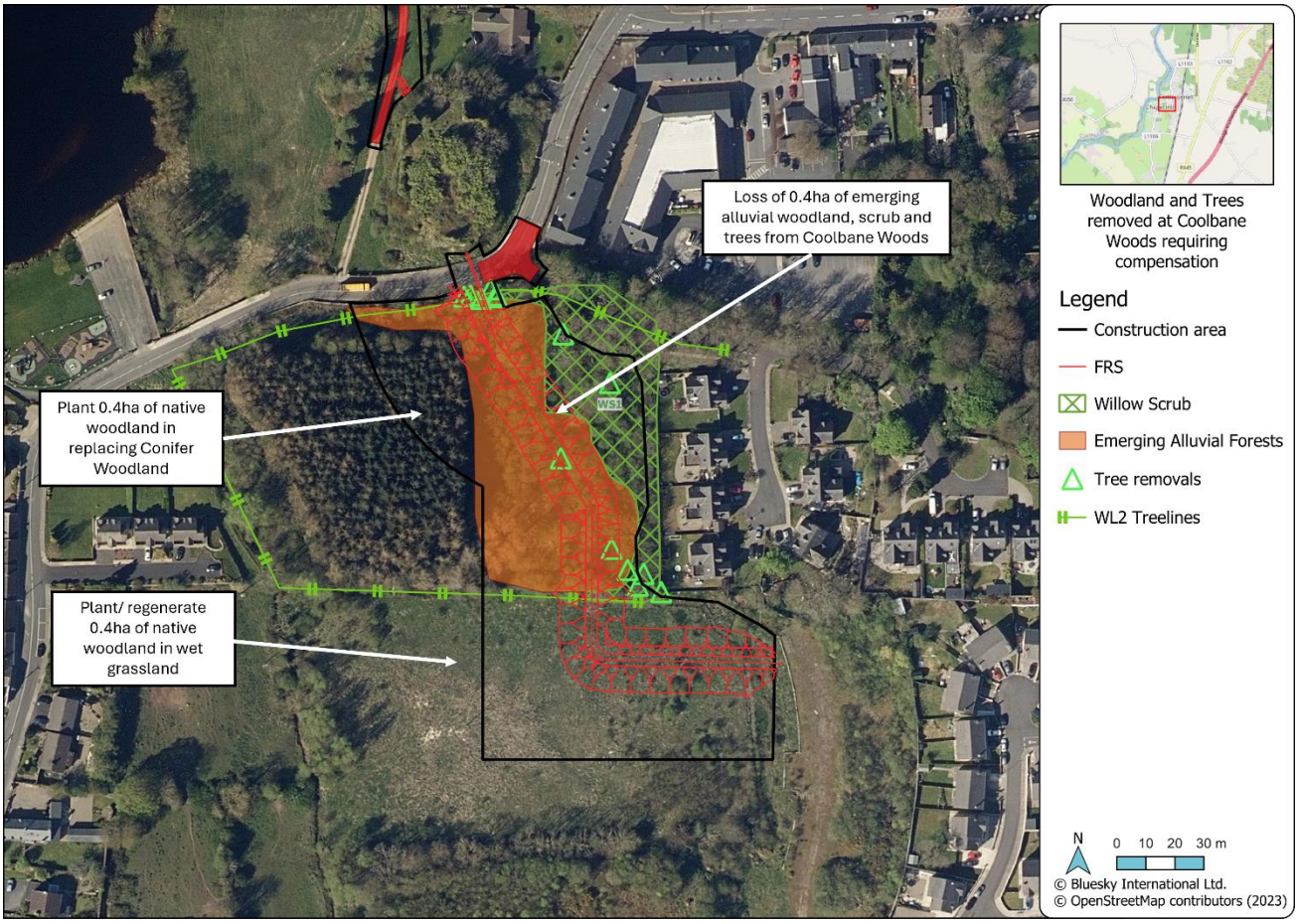

Figure 8-47: Options for areas for alluvial woodland compensation

8.4.2.2 Remedial tree planting

86 no. trees will be removed during the construction of this scheme. In the majority, these are non-native trees and/or ornamental trees, located in back gardens and in built environment and of low ecological importance.

However, some native trees, particularly Ash and Alder will be removed, as well as some mature trees of local importance such as mature Beech trees in Grange House.

Where scrub and trees need to be removed, they should be replaced in adjacent locations where possible. The selection of tree species when planting new trees should consider their value for wildlife and similarity to the existing native vegetation. The proposed species to be planted should be mostly native or additional beneficial species.

Where some trees are to be removed within the Affinity to Alluvial Woodland 1 habitat along Mall Road (Phase 2), tree planting to replace any trees felled will occur. The canopy structure of this woodland is mostly composed of non-native trees such as Beech, Sycamore, and White Poplar. Any of these trees to be removed may be done so without damage to the woodland. However, any other tree species such as Alder, Ash and Willow will be protected where possible. If native tree species are to be removed, post-construction tree planting, using suitably sourced native species, should occur to replace these native trees. This measure is included in the NIS.

8.4.2.3 Giant Hogweed control

Seeds of this plant can remain viable for many years (possibly up to 15) although most will become unviable after just 2 years. Following the completion of the scheme, due to the disturbance of the soils from machinery

and excavations, Giant Hogweed seeds may be encouraged to germinate from the soil disturbance in the following years.

Eradication will require regular annual-monthly checks during the growing season to ensure that any late germinating plants are controlled before they can set seed. Follow-up removal will be required for a period of at least 5 years to ensure complete control. Subsequent soil disturbance in the area, however, may give rise to a new flush of seedlings.

8.4.2.4 Monitoring of protected habitats

Alluvial woodland (91E0)

Post construction monitoring of all Alluvial woodlands should be carried out. This should include a condition assessment of 91E0 woodlands and removal of negative indicator species, such as Sycamore and invasive species. These species may be more prevalent post-construction due to movement of soil. This will be undertaken for a minimum of five years some impacts (e.g. spread of invasive species), may not be immediately apparent. The results of the 5-year monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or shows an unfavourable trend)

Monitoring should be carried out of development of compensation woodland to mitigate for the permanent loss of emerging woodland at Coolbane woods to facilitate construction of the embankment.

Tall herb fen (6430)

Post construction monitoring of this habitat should be carried out. This will be undertaken for a minimum of five years as some impacts (e.g. spread of invasive species), may not be immediately apparent. The results of the 5 year monitoring should be used to assess whether further monitoring or management action is required (e.g. if the monitoring relevé(s) fail or shows an unfavourable trend);

8.5 Residual Impacts

Residual ecological impacts are those that remain once the development proposals have been implemented. The main aim of ecological mitigation is to minimise or eliminate residual impacts.

8.5.1 Construction Phase

The enabling and construction works will potentially result in the disturbance of birds, particularly an important Heron breeding site, water quality impacts on fish and riparian habitats, direct disturbance to fish species, loss of trees and emerging Alluvial Woodland, spread of invasive species.

Implementation of mitigation measures during the construction phase, along with good site management and construction practices will help to minimise any significant and/or permanent impact on the environment. This will be included in a Construction Environmental Management Plan (CEMP) and monitoring by suitably qualified ECoW in all sensitive locations.

Included in this will be mitigation measures for timing of works, avoidance of sensitive habitats, biosecurity measures, fish translocation, pre-construction surveys of mammals and bats, as well as control of surface water, and dust which will negate any residual impacts on the local surface water networks, and associated habitats and species.

8.5.2 Operational Phase

The proposed development will generate residual impacts from loss of emerging alluvial woodland at Coolbane Woods. Compensation woodland will be provided adjacent to this woodland and will be also connected to the flood plain. This is expected to be a moderate residual impact in the medium term while the new woodland establishes.

The loss of 87 trees from the scheme will cause a slight to negligible residual impact from loss of individual trees that are locally important with medium term effect while trees establish.

No other negative residual effects are anticipated.

8.6 Impact and Mitigations Summary

Table 8-23 overleaf summarises the potential impacts on the important ecological features, along with the mitigation measures and residual impacts.

Table 8-23: Significance of construction-phase effects after mitigation is applied

Designated site / Ecological feature	Value	Impacts from Construction phase	Impacts from operation phase	Effect without mitigation	Mitigation	Significance of residual effects
Alluvial Forests (91E0) [WN5 - Riparian woodland / WN6 Wet willow-alder-ash woodland] Woodland 3- Coolbane Woods	Higher local	Woodland in Coolbane woods will be removed entirely to facilitate the construction of the embankment. 3000m2 will be removed,	Loss of alluvial woodland 3 at Coolbane Woods will be permanent. Any compensation woodland is expected to take 10- 15 years before it is of similar ecological importance/value	Permanent impact to Woodland of local importance	Compensation woodland next to embankment, ensure similar flood conditions as described in 8.4.2.1. Post construction monitoring as described in 8.4.2.4	There will be a moderate residual impact to this locally important woodland with medium term effect while new woodland establishes
Tall-herb fen (6430) / Affinity to Tall-herb fen [FS2 - Tall-herb swamps / FS1 Reed and large sedge swamps]	National /Local	Direct impact to habitat to construct flood walls at River grove and Grange House Water quality – release of sediments and pollution during construction.	No operation impact anticipated	Temporary impact (damage) to 1,050m2 locally important riparian habitat of which 157m2 is habitat of national importance. Permanent loss of habitat if not reinstated	Temporary working platform to be built under specification outlined in Section 8.4.1.3 ECOW monitoring Reinstating compacted soil once temporary working platform is removed.	Temporary damage of 1,050m2 of riparian habitat, this habitat will recolonise within 1-2 years. Negligible to Slight residual significance
Wet grassland	Lower local	Habitat in SAC boundary and River Shannon floodplain could be tracked over during construction	No operation impact anticipated	Temporary impact to locally important habitat	Prevent construction vehicles from tracking over grassland and storing materials in this area, as outlined in Section 8.4.1.4	Avoidance of impact – no residual impact.
Treelines and Mature trees	Higher to lower Local	Removal of 83 no. of trees across the Scheme (not including Coolbane Woods removal of woodland)	Permanent Loss of 83no. trees The majority of trees removed are non-native ornamental trees of low quality.	Slight to imperceptible negative impact	Remedial tree planting as outlined in Section 8.4.2.2	There will be slight to negligible residual impact from loss of individual trees that are locally important with medium term effect while trees establish
Cedarwood Stream	Higher	Vegetation removal and silt removal, construction	Replacement of two culverts at	Neutral impact from annual vegetation	Water quality protection measures outlined	Avoidance of impact – no residual

	Local	of 2 culverts Impacts to aquatic fauna (fish) direct injury from silt removal	Grange house (40m culvert) and Private property (3m culvert) could physically impact structure of Cedarwood stream. Annual vegetation cutting on banks is not expected to have any negative impact	cutting during operation	in Section 8.4.1.11 Follow best practice guidance and specifications set out in Section 8.4.1.11 Slight positive impact due to replacement of both culverts as natural bed level will be reinstated, resulting in an improvement of natural sediment transportation regimes through the stream during operation	impact.
Cloon Stream	International	No direct impact to habitat (no instream works). Water quality – release of sediments and pollution during construction.	Removal of sluices on causeway permanently	Slight positive impact to conveyance of Cloon Stream during operation	Water quality protection measures outlined in Section 8.4.1.11 Follow specifications set out in Section 0	Avoidance of impact – slight positive residual impact.
River Shannon	International	Instream works at Rivergrove affecting Riparian habitat Tall Herb Fen. Water quality – release of sediments and pollution during construction.	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in Built ground	Slight positive impact on water quality during Operation	Water quality protection measures outlined in Section 8.4.1.11	No residual effects are anticipated
Drainage ditches and Stradbally stream	Lower (Ditch) and Higher (Stream) local importa	Water quality impacts on Stradbally stream Water quality – release of sediments and pollution during construction.	Change in drainage ditches	Decrease in water quality and increased sediment load within drainage ditches.	Placement of silt fence/traps which will be monitored by ECoW, as outlined in Section 8.4.1.15	No residual effects are anticipated.

	nce					
Birds - Heron	Higher Local	All Heronry trees are to be retained (no direct impact). Disturbance to breeding herons	No operation impact anticipated	Disturbance to herons during breeding season could result in nest abandonment, causing Temporary to Short term effects on local Heron population	Timing of works at Mahers and Meadowbrook to be conducted outside Heron breeding season (from August to January), monitored by ECOW as set out in 8.4.1.5	Avoidance through timing. If works are completed outside of Heron breeding season, no residual effects are anticipated.
Waterbirds Swan and Mallard	Higher Local	Direct habitat disturbance Disturbance to birds foraging and moving along River Shannon and Cloon Stream	No operation impact anticipated	Temporary displacement. Temporary loss of breeding potential (Mallard) Temporary slight negative effects	Works to be carried out outside of the statutory bird nesting season March-August inclusive. Any work during nesting season to be carried out under supervision of suitably qualified ECoW. Mitigation described in 8.4.1.6	No residual effects are anticipated.
Riparian species – Kingfisher and Grey Wagtail	Regional	Direct habitat disturbance Disturbance to birds foraging and moving along River Shannon and Cloon Stream	No operation impact anticipated	Temporary disturbance. Loss of water quality reducing foraging opportunities. Temporary negative effects.	Works to be carried out outside of the statutory bird nesting season March-August inclusive. Any work during nesting season to be carried out under supervision of suitably qualified ECoW. Mitigation described in 8.4.1.6	No residual effects are anticipated.
Passerines	Higher Local	Habitat loss from removal of Scrub, trees etc. Short term loss of nests if carried out in nesting season	No operation impact anticipated	Loss of breeding, foraging and roosting habitat. Temporary negative effects.	Works to be carried out outside of the bird nesting season March-August inclusive. Any work during nesting season to be carried out under supervision of suitably qualified ECoW. Mitigation described in 8.4.1.6 Compensatory planting to mitigate loss of trees and scrub areas as described in 8.4.2.2	No residual effects are anticipated.
Badger	Lower Local	Foraging badgers in Cedarwood grove (no sett found) Unlikely to be impacted from the proposed works here. No Impact	No operation impact anticipated	None	N/A	N/A

Bat Roosts	Lower local	Under precautionary principle, bats may be roosting in some trees to be removed. No buildings will be altered or changed which may contain roosting bats.	No operation impact anticipated	Loss of trees without check of bats before felling could cause direct mortality and long-term loss of roosts.	Tree removals to take place under the supervision of a suitably qualified ECoW as described in 8.4.1.8 Any clearing of vegetation/trees should be completed in September/October Soft-felling techniques employed during tree removals; trees/limbs left to lie for 24hrs before removal to allow bats to escape Lighting will not shine directly onto any roosts identified within the works area.	No residual effects are anticipated.
Commuting and foraging Bats	Lower local	High amount of Bats foraging along River Shannon and next to Scheme. Further assessment required.	No operation impact anticipated	Temporary impact from noise disturbance	Works to take place outside bat active hours – i.e., one hour pre-sunset, as described in 8.4.1.7	No residual effects are anticipated.
Brown Trout Salmo trutta subsp. Fario Eel Anguilla Anguilla Flounder Platichthys flesus Pike Esox lucius Three-spined Stickleback Gasterosteus aculeatus Other coarse fish: Minnow Phoxinus phoxinus Stone Loach Barbatula barbatula Gudgeon Gobio gobio Perch Perca fluviatilis	National, Higher Local,	Habitat disturbance in riparian area at Rivergrove and Grange House, and Cedarwood Stream Water quality – release of sediments and pollution during construction across all of the scheme	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in built ground. Replacement of two culverts at Grange house (40m culvert) and Private property (3m culvert) could physically impact fish passage Cedarwood stream. Removal of sluices	Temporary impact from habitat disturbance during construction Temporary impact from sediment/ pollutant release during construction Slight positive impact to water quality conditions for fish during operation If culvert is improperly designed, there will be a negative impact to fish passability if new culvert at Grange House. Design mitigation/ specification required to improve passability	Translocation required for Cedarwood Stream culvert replacement (Section 8.4.1.3) Translocation required for construction of in-stream working platform at Rivergrove and Grange House Culvert design on Cedarwood to be improved for fish passability (Section 8.4.1.12) Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 8.4.1.17 including but not limited to silt fencing around work areas and unvegetated areas to prevent silt release, use of bunding and spill kits and appropriately location site compounds, appropriate stockpiling of spoil, working in the dry, water quality monitoring, and protection of water from cement leachate, use of geotextiles to create sealed work areas. ECoW present to monitor water quality protection measures/	Temporary impact from habitat disturbance, but no fish deaths/ mortality. River/Stream will be reinstated. Culvert design will result in slight positive impact No significant residual impact.

			on Cloon Island causeway permanently will allow fish to enter stream from upstream year-round.	for fish. Slight positive impact to conveyance through Cloon Stream from removal of sluices during operation		
Freshwater Invertebrates	Higher Local	Water quality – release of sediments and pollution during construction across all of the scheme	Water quality expected to be slightly improved from redirect of foul water at Grange House and improvement in water quality during flood conditions as flooding will not be in built ground	Reduction in water quality from release of pollutants could result in temporary impact to Freshwater invertebrates. Slight positive impact to water quality	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 8.4.1.17 including but not limited to silt fencing around work areas and unvegetated areas to prevent silt release, use of bunding and spill kits and appropriately location site compounds, appropriate stockpiling of spoil, working in the dry, water quality monitoring, and protection of water from cement leachate, use of geotextiles to create sealed work areas. ECoW present to monitor water quality protection measures/	No significant impact
Invasives species – Giant Hogweed Zebra / Quagga mussel	N/A	Spread of 3rd Schedule species along scheme during construction.	Spread of 3rd Schedule species along scheme during construction For Giant Hogweed, this could continue for 5-10 years and effect Scheme (e.g. growing on embankments)	Slight negative impact on habitats from spread of 3rd schedule species during construction and mitigation.	Mitigation to prevent spread and control of GH outlined in 8.4.1.9 during construction, and Section 8.4.2.3 during operation. Biosecurity measures to prevent spread of Zebra/Quagga mussell during construction outlined in Section 8.4.1.10	No significant impact

8.7 Interactions

The construction of flood walls and embankments could potentially increase the sediment loading to surface water environments. Adequate mitigation measures for sediment control relating to the construction phase are addressed above in Management Measures for surface water and in Chapter 10 (Surface and Groundwater).

8.7.1 Cumulative Impacts

The site of the proposed works is situated on a major river (Shannon) in the Village of Castleconnell. Projects within the Village environs or along the River Shannon that could have a cumulative or in-combination impact are listed in Chapter 15 of this EIAR, which generally include new housing developments. None of their associated Environmental reports indicate significant cumulative impacts.

Following implementation of mitigation during Construction and Operation, there is expected to be residual impacts on the following ecological receptors:

- Moderate residual impact from loss of locally important Woodland Habitat while compensation planting
- Slight residual from loss of locally important trees
- Temporary residual impact from disturbance to tall herb fen Annex I habitat
- Temporary impact to fish translocation in Cedarwood stream

Table 8-24: Cumulative impacts on biodiversity of the scheme with other projects

Reg/Ref	Location	Project summary	Cumulative impact assessment
Killaloe Bypass / Shannon Bridge Crossing / R494 Upgrade	Killaloe, Co. Clare	Bypass and bridge crossing and road upgrading at Killaloe. Construction progressing as of October 2023, likely to continue into 2026	An NIS and EIAR has been carried out for this project. This project is not expected to have cumulative impacts on water quality with the Scheme (if construction overlaps) due to distance (10km away), dilution factor, and the barrier of Parteen Weir restricting water movement between the two project areas. This is not expected to have an impact on fish populations in the catchment (due to Parteen weir barrier).
178006	Knockbrack Lower, Cloonlara Townland, Clonlara	Nine houses constructed and associated site works Permission granted 08/01/2018	No pathway identified, therefore no cumulative impact expected
188003	St. Patrick's Villas, Stradbally North, Castleconnell Co. Limerick.	Provision of 4 no. residential units, upgrading and re-routing of foul sewers and surface water drainage and all associated site works Permission granted 13/06/2018	Located 700m from FRS, no pathways identified, no cumulative impact anticipated
188007	O'Briensbridge, Co. Clare	Repair to O'Briens Bridge protected structure, and repair to public footpath. Provision of traffic signals and traffic detection system and all necessary signs and road markings Permission granted 09/07/2018	Located 5km upstream, no pathways identified, no cumulative impact anticipated
191011	Gooig, Castleconnell, Co. Limerick.	The restoration of the combined quarries through importation if uncontaminated soils and stones. And The provision and operation of a wheel wash facility and use of the site access and infrastructure of existing permitted Roadstone manufacturing operations to fully	Located 3km north of FRS, no pathways identified, no cumulative impact anticipated

		restore the land to agricultural use. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) accompany this planning application. Permission granted 02/04/2020. Expires 01/04/2025	
19518	Coolbane, Castleconnell, Co. Limerick.	Construction of 52 no. dwellings as follows The planning application is also accompanied by a Nature Impact Statement. Permission granted 03/10/2019. Expires 20/12/2025 Under construction – Current programme suggests completion in April 2024 (as advised by Torca Homes)	Located adjacent to Scheme at Coolbane Woods. Housing development likely to be completed by time FRS construction begins. No cumulative impact anticipated
198009	Brookhaven, Montpelier, Co. Limerick.	Construction of 12 no. residential units, provision of new water connections, a foul sewer connection, and a surface water drainage system; and all associated site works Permission granted 12/12/2019	Located 4.5km upstream of Scheme. no pathways identified, no cumulative impact anticipated
19943	The Parochial House, The Mall, Castleconnell Co. Limerick.	Construction of a driveway and entrance to parochial house Permission granted 30/06/2020. Expires 29/06/2025	Located adjacent to the scheme, Minimal construction works no cumulative impact anticipated
20740	Clonlara, Co Clare	Construction of a total of 70 Dwellinghouses, and for new connections to public services including water & foul sewerage including pumping station, rising main and associated plant. A Natura Impact Statement (NIS) shall be submitted to the Planning Authority as part of this application. Permission granted 29/09/2021. Expires 28/09/2026	Located 3.5km away, no pathways identified, no cumulative impact anticipated
211348	"The Lodge", Coolbawn, Castleconnell Co. Limerick	the construction of a extension to a dwelling Permission granted 17/11/2021. Expires 13/04/2027	Located adjacent to the scheme, Minimal construction works no cumulative impact anticipated
218009	Cappamore Road(R506) & Dublin Road(R445) Junction, Garraunykee & Woodstown, Co. Limerick.	Improvements to road junction. Permission granted 29/12/2021	Located 4.5km away. no pathways identified, no cumulative impact anticipated
221261	The Commons, Cloon & Commons, Castleconnell	Construction of 1 no. detached dwelling house, Permission granted 06/03/2023. Expires 05/03/2028	Located adjacent to Scheme. Minimal construction works no cumulative impact anticipated
22394	Coolbawn Meadows, Coolreiry, Castleconell Co. Limerick	Construction of 13 houses, as partial completion of the development approved under planning file reference. p.06/1354 and associated site works	Under construction, likely to be complete before the proposed scheme begins construction. no pathways identified, no cumulative impact anticipated

		Permission granted 27/10/2022. Expires 26/10/2027	
22591	Ballyglass Coolderry Dromintobin North Reanabrone, and Oakfield (townlands) Ardnacrusha, Co Clare	Development of solar array. The solar array will connect to the national grid and will have an operational lifespan of 35 years. A Natura Impact Statement (NIS) has been prepared in respect of the proposed development and will be submitted to the planning authority with the application. Appealed to ABP. Decision due 17/07/2023	Located 5km away, no pathways identified, no cumulative impact anticipated
2360808	Coolbawn Meadows, Castleconnell	Development of 74 no. residential units. All associated site works including pumping station and emergency storage; and 2 no. attenuation tanks. The existing temporary construction access from Station Road / Railway Road shall continue to be used to facilitate construction of the development. NIS has been prepared for this project. Pre-Validation Planning Submission lodged on 06/11/2023	Located 500m from the scheme. Upstream of Stradbally stream, no other pathways identified. No cumulative impact anticipated

On examination of the above projects, there are no anticipated pathways for impact from the Scheme, either through distance, temporary or minimal nature of the works, timing of works, to act in-combination with residual impacts from the Scheme.

9 Land and Soil

9.1 Introduction

This chapter of the EIAR comprises an assessment of the likely significant effects of the proposed development with respect to land, geology and soils. This chapter should be read in conjunction with Chapter 10 (Water) due to overlapping impacts and mitigation measures.

The following legislation was consulted during the preparation of this chapter:

- Water Framework Directive (2000/60/EC);
- Groundwater Directive (2006/118/EC);
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010);
- European Union Environmental Objectives (Groundwater) (Amendment) Regulations, 2016 (S.I. No. 366 of 2016);
- Waste Management Act 1996, as amended;
- Habitats Directive (92/43/EEC); and
- Classification of waste material that may be taken off-site for disposal is based on the Commission Decision of 18th December 2014, amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC of the European parliament and Council (2014/955/EEC) [the List of Waste (LoW)]. These enable waste to be classified as either hazardous, non-hazardous or minor (either hazardous or non-hazardous).

9.2 Assessment Methodology

The methodology for assessment of the impacts on soil and geology has been undertaken in accordance with the following guidance documents and recommendations:

- Environmental Protection Agency (EPA) (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Institute of Geologists of Ireland (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- Department of Housing, Planning and Local Government (DHPLG) (2018) Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment;
- National Roads Authority (NRA) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; and
- The Commission Communication of 22 September 2006 entitled ‘Thematic Strategy for Soil Protection’ and the Roadmap to a Resource-Efficient Europe.

Sources of Information

Several sources of information were used to establish baseline environment conditions, through desktop surveys and site work.

- EPAMaps - gis.epa.ie;
- GSI maps - gsi.ie;
- Teagasc soil and subsoil database and mapping keys;
- Aerial photography;
- Google Earth;
- Google Maps;
- Priority Geotechnical Ltd (PGL) carried out site investigations between September and December 2020 and groundwater monitoring between February and September 2023; and
- Site walkover

A Conceptual Site Model for the site has been developed based on the site investigations undertaken, the information on groundwater levels in the boreholes and the proposed flood relief scheme.

9.2.1 Assessment Criteria

The significance or sensitivity of receptors and assessment of effects has been described following criteria outlined in the EPA guidelines (Section 1.6) and IGI guidance.

In accordance with the IGI guidance (2013), the study area has been set as a 2km radius from the site boundary. This is the recommended minimum distance in the Institute of Geologists of Ireland (IGI) guidelines and takes into account the lack of karstic or other sensitive subsurface features at the site, and the scale and nature of the development.

Table 9-1: Criteria for Rating Importance of Soil and Geology Attributes (NRA, 2009)

Importance	Criteria	Typical Examples
Very High	Attribute has a high quality, significance or value on a regional or national scale Degree or extent of soil contamination is significant on a national or regional scale Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale*	Geological feature rare on a regional or national scale (NHA) Large existing quarry or pit Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale Degree or extent of soil contamination is significant on a local scale Volume of peat and/or soft organic soil underlying route is significant on a local scale*	Contaminated soil on site with previous heavy industrial usage Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site) Well drained and/or highly fertility soils Moderately sized existing quarry or pit Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale Degree or extent of soil contamination is moderate on a local scale Volume of peat and/or soft organic soil underlying route is moderate on a local scale*	Contaminated soil on site with previous light industrial usage Small recent landfill site for mixed wastes Moderately drained and/or moderate fertility soils Small existing quarry or pit Sub-economic extractable mineral resource
Low	Attribute has a low quality, significance or value on a local scale Degree or extent of soil contamination is minor on a local scale Volume of peat and/or soft organic soil underlying route is small on a local scale*	Large historical and/or recent site for construction and demolition wastes Small historical and/or recent landfill site for construction and demolition wastes Poorly drained and/or low fertility soils Uneconomically extractable mineral resource

Note: “Very high”, and “high” in Table 9-1 will both correspond to “high” significance or sensitivity of a feature in Figure 1-2.

9.3 Receiving Environment

Table 9-2 below shows a summary of the land, geology, and soils features identified, and their importance ranking. These are further discussed in the following sections.

Table 9-2: Site feature importance ranking

Feature		Ranking	Comment
Land/land take	Residential/urban areas	Medium	Areas designated for excavation are in residential or urban areas.
	SAC	High	Excavations, temporary works, and a temporary working platform are proposed in the SAC or along the SAC boundary. Clearing of vegetation along the SAC boundary at Meadowbrook estate may disturb soil and be a source of sediment input.
Soil and subsoil	Made ground	Low	A monitoring program will be implemented during construction in order to detect the presence of any contaminants.
	Topsoil	Medium	Luvisols, tidal marsh soils and alluvial soils are generally fertile. There is evidence for these soils across the scheme area. Majority of the defences will be erected in areas of urban ground

			or peaty soil which have less value. Soil samples taken during the site investigation show predominantly gravelly clays and silts with evidence of peat near Coolbane Woods.
	Till	Low	Low value
Geological Heritage sites	No sites	n/a	No sites of geological heritage were identified.

9.3.1 Land-Use

Land-use in Castleconnell is predominantly residential, with over 20 residential estates arranged around the tightly concentrated town centre. To accommodate the target population growth, several parcels of land have been zoned for new residential developments in the Castleconnell LAP (2023-2029).

Agricultural land use has declined in terms of area since the previous LAP, while enterprise and employment and education and community facilities have increased. Open space and recreation saw the largest increase from 22.39ha in 2013 to 74.121ha in 2023. The open spaces and walkways along the River Shannon are considered exceptional recreational facilities.

The Flood Relief Scheme is crucial to the sustainable development of the town and meeting the needs of the growing population. Land acquisition will be required from private landowners to construct flood walls and demountable barriers in parts of the scheme area. Embankments proposed fall within the SAC beside Meadowbrook Estate and land zoned for open space and recreation to the east of Coolbane Woods.

9.3.2 Bedrock Geology

Castleconnell is underlain by a wide vein of Waulsortian Limestones which comprise massive, unbedded lime-mudstones formed during the early or mid-Carboniferous period. The vein curves west and south and underlies all areas where defences are proposed. There is a vein of pale cherty crinoidal limestone to the southwest of the site, and wavy-bedded cherty limestone and thin shale to the north and east.

To the southwest small areas of undifferentiated Visean Limestone lie within the 2km boundary from the site. Bands of Ballysteen Formation and Lower Limestone shale run through the northern section of the 2km boundary. A small patch of Tuff lies to the south.

A syncline intersects the entire site from the northeast to the southwest and further west there is a Syncline-Anticline-Syncline pattern indicating compression between the older Waulsortian Limestones and younger, overlying Lough Gur formation.

Proposed flood defences will be underlain in their entirety by Waulsortian Limestones.

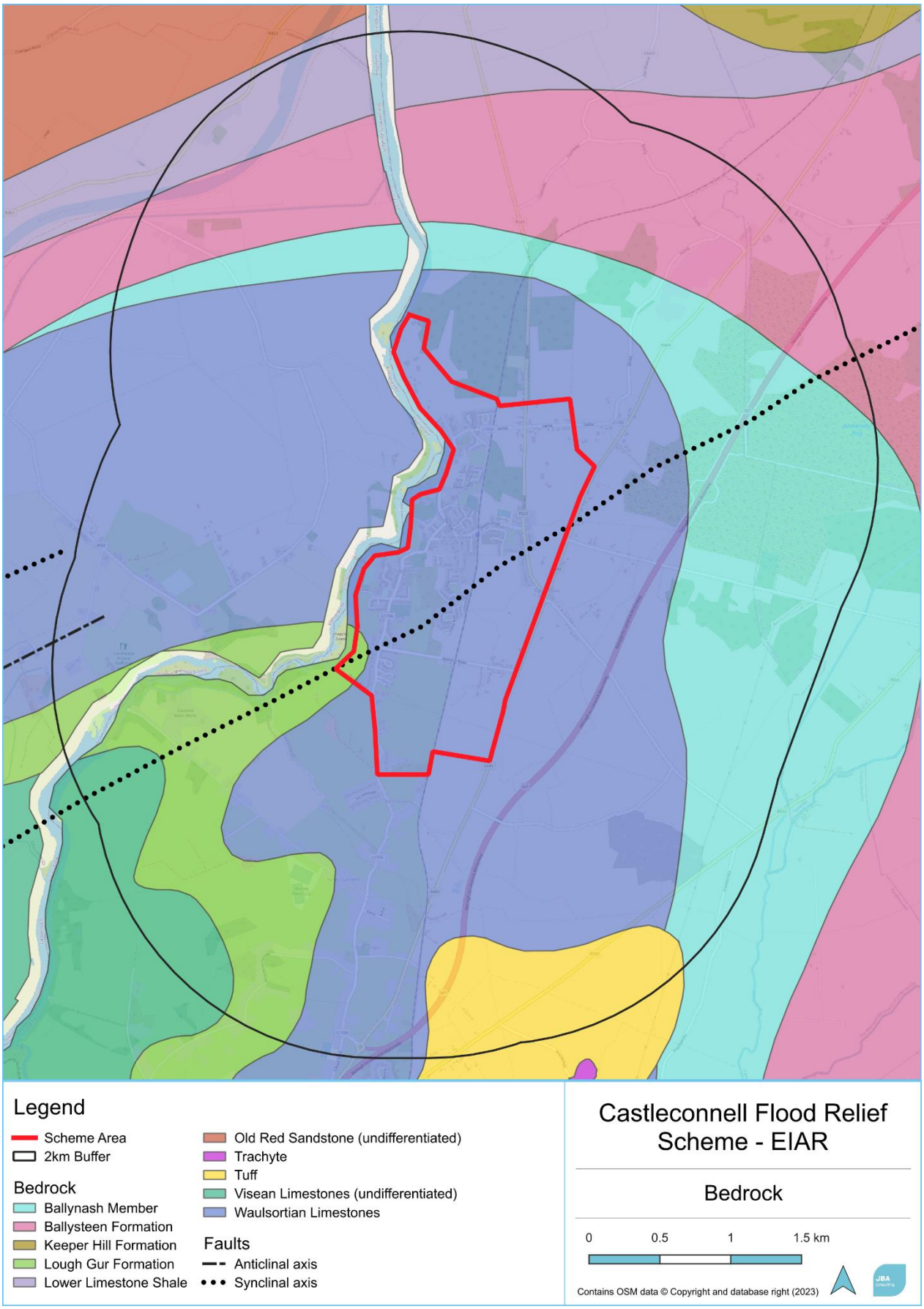

Figure 9-1: Bedrock geology

9.3.3 Quaternary Sediments

Quaternary sediments are dominated by Limestone till over the western half of the scheme area and Lower Palaeozoic/Devonian Sandstone till over the eastern half. An area of estuarine silts and clays is located at the north and areas of cutover peat lie in the centre and the south. Within 2km of the area are larger sections of cutover peat that form Annaholty bog to the east.

Results from the Site Investigation show that till thickness across the area is on average ~4.3 m. Estuarine and lake silts were found to be between 0.8 – 1.5m thick and areas of peaty subsoil were between 1.4 – 2.0m thick.

All flood defences will interact with areas of limestone till. Flood walls to the west of Meadowbrook estate, and flood walls proposed at Mall House and Grange House may overlap with areas of estuarine silts and clays. The Coolbane Woods embankment will sit atop peaty subsoils.

9.3.4 Topsoil

Topsoil underlying the scheme area is dominated by Luvisols and tidal marsh silts and clays. To the south soils are comprised of soil series belonging to the Brown Earth and Brown Podzolic Great Groups. There are small areas of peaty topsoil derived from the underlying cutover peat, as well as large areas of made ground on which majority of the town is built.

Flood defences across the scheme area are located in areas where topsoil is categorised of made ground. Flood walls along the Mall Road at the boundary with the SAC, and the Meadowbrook embankment and low-lying flood walls may overlap with may tidal marsh soils associated with the SAC.

The Coolbane Woods embankment will be constructed upon an area of soil categorised as peat which is embedded within an area of Luvisols.

Table 9-3: Soil descriptions

Soil Association	Great Groups	Description
05LAK	Alluvial	Predominantly loamy, clayey, and silty soil series. Gleyic soils.
05RIV	Alluvial	Predominantly loamy, clayey, and silty soil series. Gleyic soils.
Tidal Marsh	Tidal Marsh	Silty and clayey soils.
1030a	Luvisols, Brown Earth, Surface Water Gley and Groundwater Gley	Luvisols dominate. Coarse and fine loamy soils.
0900a	Brown Podzolic, Brown Earth, Podzol and Groundwater Gley	Loamy soils, predominantly coarse loamy.
0660c	Surface Water Gley, Groundwater Gley, Lithosol, Ombrotrophic and Brown Podzolic.	Coarse and fine loamy soils.
1xx	Peat	Peat
Urban	Urban	Made ground

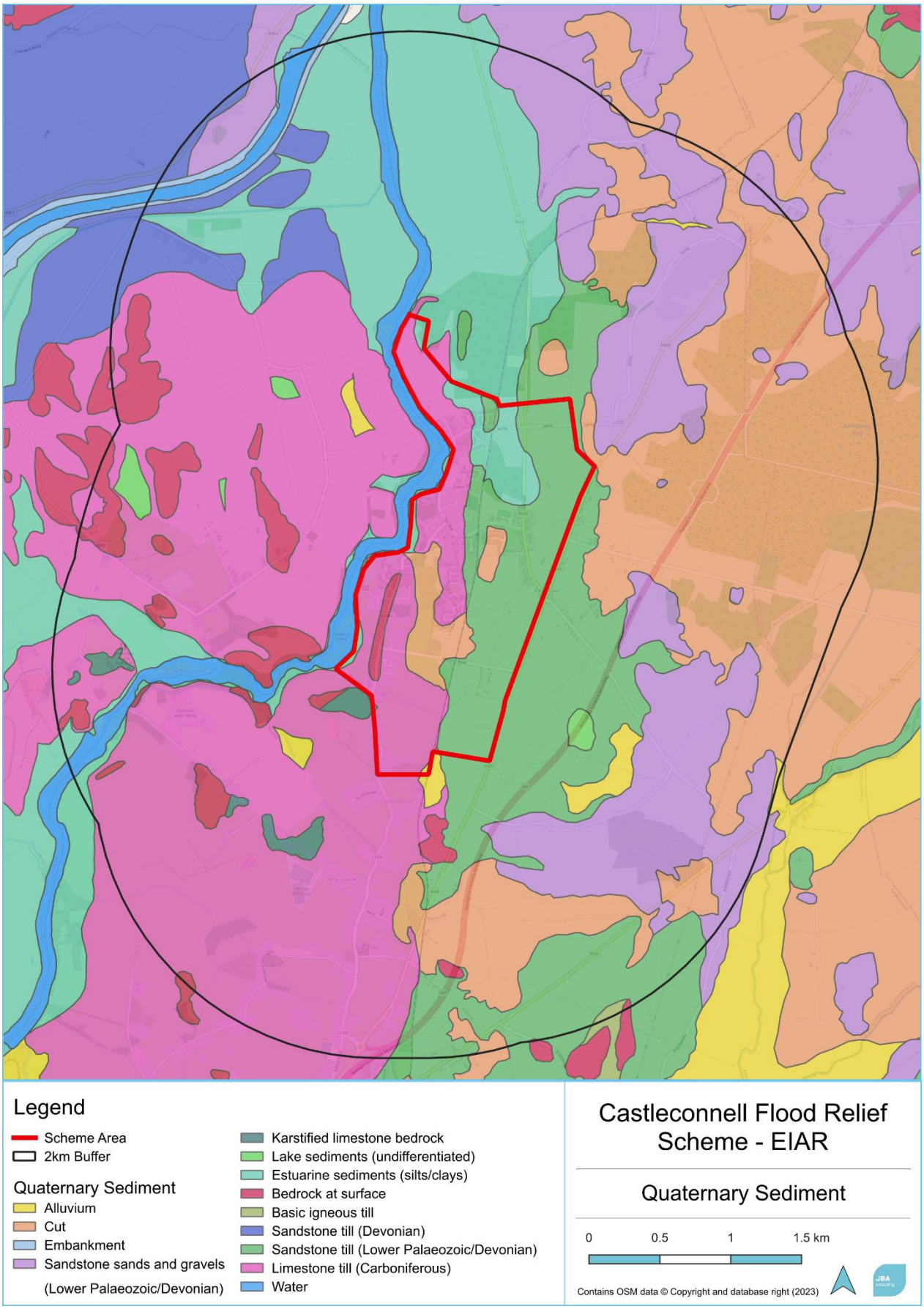

Figure 9-2: Quaternary sediment

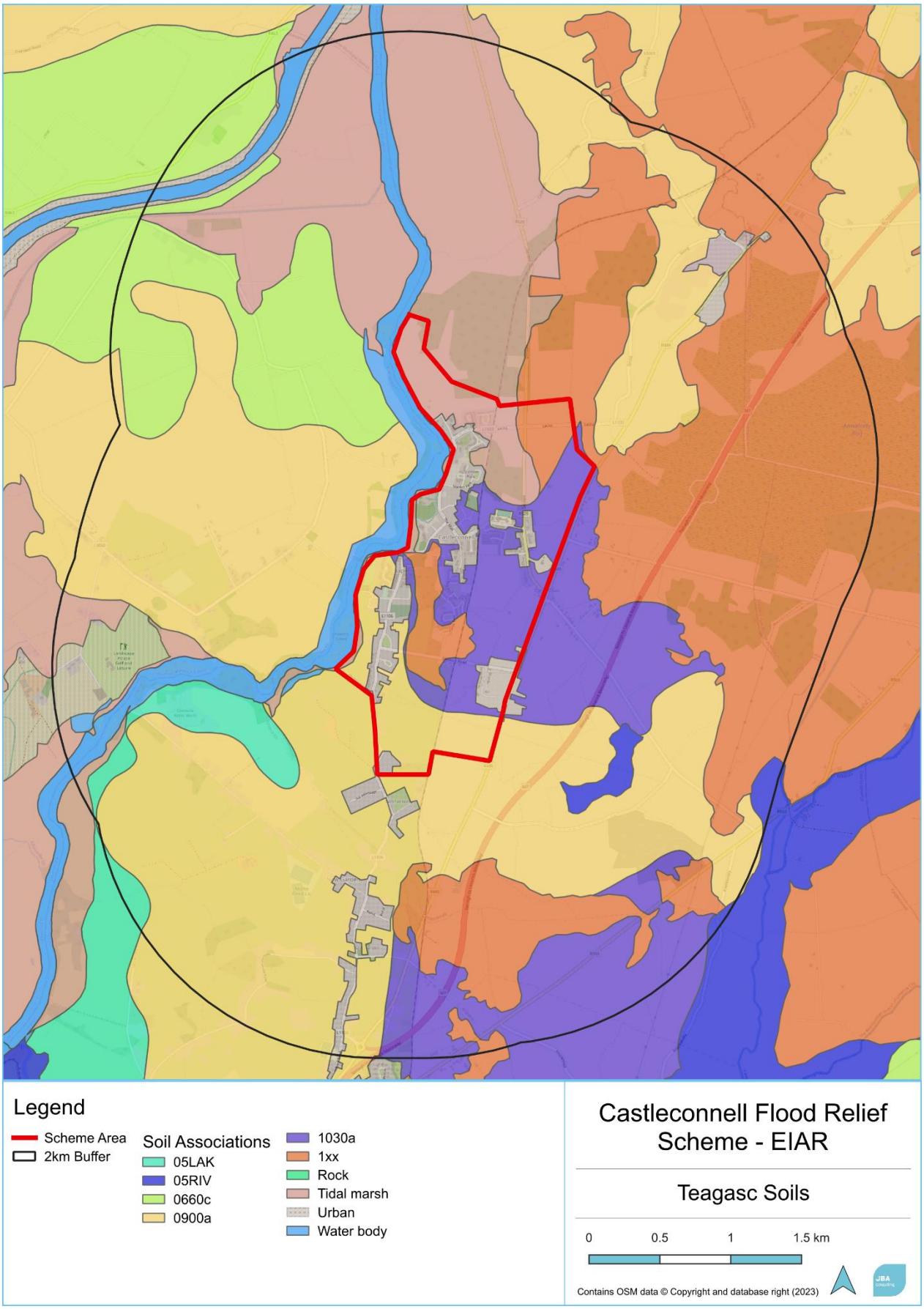

Figure 9-3: Teagasc soil associations

9.3.5 Karst

No karst features were identified within the 2km study area during the desktop study.

9.3.6 Geohazards

The Castleconnell area is classified as having a high risk for radon, 1 in 5 homes is likely to have high radon levels. No other potential geohazards were identified during the desktop study.

9.4 Site Investigation

Site investigations were carried out by Priority Geotechnical Ltd (PGL) in respect of the proposed scheme between September and December 2020 (PGL, 2020) and groundwater monitoring standpipes and data loggers were deployed between February and March 2023 and removed in September 2023 (PGL, 2023). The investigations involved cable percussion boreholes, rotary core boreholes, trial pits, slit trenches, inspection pits and associated in situ and laboratory testing.

9.4.1 Ground Conditions

Ground across all trial pits, slit trenches, and foundation pits was described as having moderate stability.

Groundwater was encountered at depths between 0.117mbgl to 8.0mbgl within the rotary boreholes. Soil moisture content ranged from 11 – 521% and pH ranged from 6.9-8.8. Groundwater is discussed in Chapter 10 of the EIAR.

9.4.2 Contaminated Ground

An area of land directly north of Island House, which partially blocks a culvert travelling under the entrance to the House, was previously believed to be composed of excess material that was placed there during construction of the adjacent foul pumping station and as such was recorded as a source of potential contaminated soil in the FRS Options Report. No material removal from this area is proposed.

9.4.3 EPA Licensed Facilities and Waste Facilities

There are no licenced facilities within the 2km study area. The nearest facility is the Brookhaven sewage treatment plant (Reg No. A0499-01 located in Montpelier approximately 3.2km upstream of the scheme boundary. Castleconnell Pumping Station No. 1, situated at the Scanlon Park/Island House junction on the Mall Road, is a secondary discharge point for Castletroy WWTP. Emergency overflows and storm water overflows both discharge from the same discharge point.

9.4.4 Minerals/Quarries/Mines

The Extractive Industry Register (www.epa.ie) and the GSI mineral database (www.gsi.ie) were consulted to identify any historic/existing mineral sites within the study area. No active mines or quarries were identified within the study area.

No metallic mineral deposits are located within the assessment area. Sands and gravels are indicated on a GSI mineral location map at the northeast of the scheme area. There are no active quarries or mines within the study area. Gooig Pit lies within 500m to the north and Garden Hill Pit lies approximately 1.2km to the southeast. Both quarry sands and gravels for the production of fine sand for applications including mortar sand, plastering sand and roadmaking.

9.4.5 Geological Heritage Sites

No recognised site of geological heritage lies within the area. A narrow line of bedrock outcrop is present from Chapel Hill to Saint Patricks Villas, however, this has been assigned no special status.

9.5 Predicted Impacts

Potential impacts are discussed under the 'do nothing' scenario, during construction of the scheme, and during operation of the scheme, without mitigation measures in place. Mitigation measures are outlined in Section 9.6.

9.5.1 Do Nothing Scenario

In the event of the proposed scheme not being implemented, the intermittent deposition of alluvial sediment onto the flood plain of the Shannon would continue during flood events. Parts of Castleconnell which flood would also be vulnerable to contamination through pollutants borne by flood waters settling onto the land as flooding recedes. Outside of flood events there would be no resulting effects on land and soils in the scheme area.

9.5.2 Construction Phase

Construction activities pose a risk to land and soils. The key civil engineering works which could impact land and soils are:

- Establishment and operation of site compounds, including storage of potential pollutants such as fuels, oils, etc.;
- Excavations for the construction of flood walls, demountable barriers and installation of culverts;
- Import of material for the construction of flood embankments; and
- Export of material from excavations.

The sections below outline the potential effects during construction on land and soils without any mitigation. Mitigation measures are discussed in Section 9.6.

Excavation

Excavations will be required for majority of the proposed works. During construction, removed topsoil held on site and exposed soils have the potential to be eroded by wind and rain. Eroded material may enter surface and ground waterbodies causing an influx of sediment. Inert topsoil will be reused on site where possible. Approximately 33,000m^3 of material will be excavated across the scheme. Of this, approx. 11,800m^3 is proposed as backfill and the remaining approx. 21,300m^3 will be exported off site. This is in addition to approx. 29,400m^3 of other materials which will be required to be imported during construction (refer to Appendix 11.3 for full details of material volumes). The unused material will be removed from the site using licenced hauliers to a licenced recovery/disposal facility. No other mitigation measures are proposed. The effects of the proposed development on topsoil would be **short-term, slight, negative**.

Quaternary sediment on the site is identified as limestone and sandstone till from the Carboniferous period. Till was observed in the soil profile at a depth of 8m during the site investigation conducted at Rivergrove B&B and Grange House. Excavations will be to a depth of 1-2m in this area. Excavation of quaternary sediments is therefore not anticipated. The effects of the proposed development on quaternary sediments will be **permanent**, **imperceptible, negative**.

Accidental Spills and Leaks

There is a risk of localised accidental pollution incidences from the following sources:

- Spillage or leakage of temporary oils and fuels stored on site.
- Spillage or leakage of oils and fuels from construction machinery or site vehicles.
- Spillage of oil or fuel from refuelling machinery on site.
- Run-off from in-situ concrete casting.
- Release of pollutants from contaminated excavated material.

Accidental spillages may result in localised contamination of soils, geology, and groundwater underlying the site, should contaminants migrate through the subsoils. The significance of effects of pollution on soils and

geology would depend on the type of contaminant and extent of the spill. Likely effects arising from spills without mitigation measures would be **short-term, moderate, negative**.

Import of Soil and Stone

It is estimated that approx. 25,000m^3 of clay, gravel, and stone materials will be imported onto the site for construction of the embankments and temporary working platform. The importation of infill material may introduce contamination to the site if sourced from inadequate facilities. Responsible sourcing will ensure this impact does not arise. Clean soil will be imported to the site, and the contractor will be required to source the soil from areas that are free of invasive species, i.e., containing no Japanese Knotweed seed or legumes.

An indirect impact of the soil import to the site during the construction phase will be the increase in truck movements to the site. This will have a subsequent impact on air quality, noise and nuisance. These impacts are further described in Chapter 11 Material Assets and are not anticipated to be significant.

9.5.3 Operational Phase

Embankments

Once operational, any impacts on land and soils from the proposed development are likely to be associated with the embankments. The construction of embankments at Coolbane Woods will require the use of impermeable clay and a reinforced geogrid for stability in the predominantly peaty area. This will ultimately change the soil environment in these areas to a hard-standing area, with the consequential change in rainwater soakage and storage. The area is an empty site currently supporting colonising plants, shrubs, scrub, and wildflowers. Embankments proposed for Meadowbrook Woods are situated in an area where topsoil is classified as urban with grass cover and has a low value. The change in environment will therefore be imperceptible.

There will be an initial flush of loose material during the next heavy rainfall event following construction of the earthen embankments. This will cause an increase in suspended solids in the surface water run-off from the embankment sites. The suspended solids will contribute to the overall solids loading in the River Shannon and other local watercourses. The impact of this on water quality will not be significant and will be short-term. As the embankments stabilise and grass cover becomes thicker, the problem of suspended solids run-off from the embankments will lessen. In the long-term no significant impacts on water quality are anticipated. In accordance with the methodology, the overall effects from embankments during the operational phase are expected to be **short-term, slight, negative**.

Flood Walls

Flood walls are proposed for many areas bordering the SAC which is an area particularly sensitive to environmental changes. Removal of fertile alluvial topsoil to accommodation foundations and walls may have a short-term, imperceptible, negative impact, however, approx. 11,800m^3 of excavated material will be returned as backfill. Removal of this material will be limited in location and will not be along the Mall Road or within the Lower River Shannon SAC or Annex I alluvial woodland habitat. Foundations have been designed so as not to have a significant impact on groundwater flow patterns in the area. Sheet piles will be used at Rivergrove B&B and Grange House, which may impact groundwater flow. However, given the short extent of sheet piling required, the impact is not expected to be significant. Impacts during the operational phase will be **long-term, imperceptible, negative**.

9.6 Mitigation Measures

9.6.1 Construction Phase

A Construction Environmental Management Plan (CEMP) has been prepared by JB Barry for the proposed development. The site-specific mitigation measures outlined in the CEMP are summarized below, however, the CEMP should be read in full in conjunction with this report.

- The Contractor will be required to install a Soil Management Programme for the operations at the site. The Programme will contain as a minimum, ways to minimise truck movements across the site to avoid soil compaction, and re-use of suitable material on-site to minimise the quantities that need to be imported.
- Temporary storage of soil will be carefully managed in such a way as to prevent any potential negative impact on the receiving environment. Covering of topsoil stockpiles with rapid vegetation or other means is proposed as part of the construction methodology. The material will be stored away from any surface water drains. Movement of material will be minimised in order to reduce degradation of soil structure and generation of dust.
- Fill material will be tested and imported from a licensed facility to ensure no external contamination is introduced to the soil and geological environment.
- Oil and fuel storage tanks shall be stored in designated areas, and these areas shall be bunded to a volume of 110% of the capacity of the largest tank/container within the bunded area(s) (plus an allowance of 30 mm for rainwater ingress). Drainage from the bunded area(s) shall be diverted for collection and safe disposal.
- Re-fuelling of construction vehicles and the addition of hydraulic oils or lubricants to vehicles, will take place in a designated area (or where possible off the site) which will be away from any existing surface water gullies or drains, or exposed ground or excavations.
- An adequate supply of spill kits and hydrocarbon adsorbent packs will be stored in any refuelling areas and site compounds. All relevant personnel will be fully trained in the use of this equipment.
- A suitable risk assessment for wet concreting will be completed prior to works being carried out which will include measures to prevent discharge of alkaline wastewaters or contaminated stormwater to the underlying subsoil.
- The pouring of concrete will take place within an impermeable area using a geo-synthetic material to prevent concrete runoff into the soil/ groundwater media. Wash down and washout of concrete transporting vehicles will take place at an appropriate facility off site. During detailed design, the potential use of pre-cast concrete sections will be evaluated.

The contractor will be required to carry out a waste characterisation of the material that will be taken off site for disposal. A waste acceptance criteria (WAC) analysis and asbestos levels should be determined on any material that will be taken off site for disposal. All wastes in the European Waste Catalogue are classified by a unique 6-digit code. In this case (waste soil/stones), two List of Wastes (LoW) Codes are applicable to material that may be taken off site for disposal during the construction phase:

- 17 05 03* - Soil and stones containing hazardous substances
- 17 05 04 - Soils and stones other than those mentioned in 17 05 03.

Any soil samples that are found to contain contaminants should be subjected to full quantification analysis. If the waste soil is sent to a waste licenced soil recovery facility, the chemical analysis of the soil must meet the requirements given in Table 3-3 (Summary of Soil Trigger Levels for Soil recovery Facilities) of the Environmental Protection Agency's Draft Publication – Guidance on waste acceptance criteria at authorised soil recovery facilities[61]. The acceptance of this material at a licenced soil recovery facility will be subject to the approval of the facility operator. Soils at Coolbane Woods are peaty and works will require a surcharge programme (with or without vertical wick drains) to increase the strength of the peat. This should be completed in advance of the main contract. A programme of settlement and porewater pressure monitoring during the surcharge programme will verify the progress. Alternatively, a dig-and-replace option will be used, whereby peat is excavated and replaced with a suitable clay/foundation material. In this scenario a surcharge programme will not be required, and excavated peat will be reused as fill elsewhere on the site or on another site as an Article 27 byproduct, or exported off-site as a waste. The use of a strengthening

[61] EPA (2020) Guidance on waste acceptance criteria at authorised soil recovery facilities. Available at https://www.epa.ie/publications/compliance--enforcement/waste/Guidance-on-Waste-Acceptance-Criteria-at-Authorised-Soil-Recovery-Facilities.pdf

geogrid for load spreading and staged construction can be adopted to prevent bearing capacity and stability issues.

Accidental Spills and Leaks

- No bulk chemicals will be stored within the active construction areas. Temporary oil and fuel storage tanks will be kept in the material storage area in suitable containers and will be appropriately bunded as required. Refuelling of vehicles and the addition of hydraulic oils or lubricants to vehicles will take place in designated areas of the site, where possible, which will be kept away from surface water drains;
- Spill protection equipment such as absorbent mats, socks and sand will be available to be used in the event of an accidental release during refuelling. Training will be given to appropriate site workers in how to manage a spill event;
- The following mitigation measures will be taken at the construction site in order to prevent any spillages to ground of fuels during machinery activities and prevent any resulting soil and/or groundwater quality impacts:
    - Refuelling will be undertaken off site where possible;
    - Where mobile fuel bowsers are used the following measures will be taken;
    - Any flexible pipe, tap or valve will be fitted with a lock and will be secured when not in use;
    - The pump or valve will be fitted with a lock and will be secured when not in use
    - All bowsers must carry a spill kit;
    - Operatives must have spill response training; and
    - Portable generators or similar fuel containing equipment will be placed on suitable drip trays

9.6.2 Operational Phase

Where embankments have been constructed, silt fences will remain in place until the soil on the banks has stabilised and grass has rooted. This is to mitigate against sediment flush during rain events. The Ecological Clerk of Works (ECoW) will oversee the implementation and any necessary replacement of silt fences and will liaise with IFI to decide when suitable growth conditions have been reached such that silt fences may be removed. No other significant effects are anticipated during the operational phase. Therefore, no other mitigation measures have been proposed.

9.7 Residual Impacts

9.7.1 Construction Phase

Following implementation of the proposed mitigation measures, the residual effects of the proposed development on land and soil will be minimised. Therefore, the effects during the construction phase will be **short-term, imperceptible, neutral.**

9.7.2 Operational Phase

The design of the scheme has been such that there are no predicted effects on land and soils during the operational phase of the development.

Overall, the effects of the proposed development during operation will be **permanent, imperceptible, neutral**.

9.8 Monitoring

Visual monitoring will be undertaken during the construction including the mitigation measures. Any potential contamination such as hydrocarbon and concrete spillages should be immediately investigated and remedied.

Direct discharge to the underlying geological environment during the operational phase is not anticipated and will require no further monitoring.

9.9 Interactions

The EIAR must also consider in-combination effects, or the interactions between different factors and resulting cumulative impacts.

Surface and groundwater

Soils and geology share direct links with groundwater. Hydrogeology is further linked with surface water networks. Soil quality and condition affects the rate of recharge, infiltration, percolation, and drainage for groundwater bodies. Similarly, surface water run-off can directly affect soil quality and condition through deposition or withdrawal of chemicals, suspended solids, and nutrients. Effects arising from surface water run-off are further discussed in Chapter 10 of this EIAR. Without mitigation, the interaction of negative effects on Hydrology and Soils and Geology could result in **a short-term, significant, negative** effect. Through implementation of mitigation measures outlined in this chapter and Chapter 10 of the EIAR, the potential impact through interaction is reduced to **short-term, slight, negative**.

Biodiversity

Interactions between soils, geology, and biodiversity can occur through surface, groundwater, and air pathways. The proximity of the Lower River Shannon SAC poses a significant risk for the entry of contaminants via surface water run-off, dewatered groundwater, and soil erosion. Introduction of contaminants and suspended solids could lead to habitat degradation of the adjacent SAC or downstream groundwater or surface water receptors.

With the implementation of mitigation measures outlined in this chapter and Chapter 8, potential impacts through interaction would be **short-term, imperceptible, not significant**.

Material Assets

The import and export of materials and equipment will require large vehicles using the local road network. Adequate traffic management measures, including localised signage and advanced advertisement and site accommodation works will ensure that impacts to traffic and transport will not be significant as discussed in Chapter 11 of this EIAR.

Diversion of several utilities will be required to accommodate the flood wall proposed along Mall Road, including a gas main, surface water and sewer networks, overhead electricity cables, and underground broadband cables. Works for the Mall Road will be carried out in two phases, whereby diversion and relocated of utilities will be carried out in phase one, while flood defence measures will be constructed in phase 2. This will ensure no disruption to or impact on services during construction. As a result of mitigation measures further discussed in Chapter 11, the overall potential impacts from interaction with material assets will be **temporary, slight, negative**.

Climate

Excavation of material across the scheme area will release sequestered carbon increasing greenhouse gas levels in the air. These effects are further discussed in the Construction Impacts Chapter 6, where they were assessed as being a negligible impact. The interaction of these effects will be **long-term, imperceptible, not significant**.

9.10 Cumulative Impacts

Cumulative effects are the result of several minor or insignificant effects combining to create a larger, more significant effect. The assessment of cumulative effects considers existing stresses on the baseline environment as well as developments that are in planning or are underway.

Developments within 5km of the proposed development that are in planning or have been granted permission are fully outlined in Chapter 15.

There are several developments located within the scheme area that have either been granted permission or are under construction. Two minor developments, located in the Commons to the north of the scheme, are close to flood defences proposed for the Mall Road and Cedarwood stream maintenance. Minor works to a property (Ref. 221261) were granted permission in 2020 which include a new entrance, boundary alterations, and connection to the mains drainage network. Adjustments to the entrance and driveway of Parochial House (Ref. 19943) were granted permission in 2023 and are expected to overlap with the proposed works along the Mall Road. Due to the nature of the works, cumulative effects are not anticipated to be significant.

Planning for a 52no. dwelling housing development (Ref. 19518) was granted in 2020 and construction is currently ongoing. This development is located to the south of Coolbane Woods, and the northern boundary of the site encroaches onto an area designated for embankments under the proposed scheme. The embankments overlap with an area allocated for open space in the Masterplan of the housing development. Construction in this section of the proposed scheme is likely to commence after construction of the residential development has been completed, and therefore, cumulative effects from construction will not be significant. Once construction of both developments is completed the land use in the intersection will have remained largely unchanged with minimal conversion of open space into hard standing area. Infiltration and run-off rates will not be significantly changed. The combined effects will be imperceptible.

Permission was granted in 2020 for a project northeast of the scheme area at Gooig Pit (Ref. 191011), a series of decommissioned quarries. This project will involve the removal of the 80,000m^3 of aggregate reserve currently dividing the quarries and see it's replacement with approximately 1,250,000m^3 of uncontaminated soils and stones. This is a restoration project that aims to return the land to a condition suitable for agricultural use and is expected to have a permanent slight positive effect on the soil and underlying geology of the site in addition to reducing the current erosion of loose material and dust. The project is expected to coincide with the proposed development with an estimated end date in 2025. Cumulative impacts are not anticipated to be significant.

A development of 4 residential properties at St. Patrick's Villas, Stradbally North recently completed construction. Associated works included hard and soft landscaping, upgrade of foul and surface water networks, and new surface and foul water connections. Residual effects are not anticipated and cumulative impacts with the proposed scheme will not be significant.

Planning permission has been granted for developments outside the scheme area within the 5km boundary including the construction of protective structures and repairs to O'Briens Bridge (Ref. 188007) which is a protected structure (RPS No, 215) granted in 2018 located north of Castleconnell, and a 10-year planning permission for a solar farm (Ref. 22591) at Ballyglass, Coolderry located to the west. This planning has been appealed to An Bord Pleanala with a decision due 17/07/23. Should planning be granted, works will include the laying of underground cables across the site and local roads to connect to the national grid. A Natura Impact Statement has been included with the application. Due to the distance of the development, cumulative effects are not expected to be significant.

There are also several small to medium sized residential developments that have been granted permission within the 5km study area. Permission for 70 properties (Ref. 20740) in Clonlara, west of the scheme, was granted in 2021 which has not yet begun construction and 12 properties (Ref. 198009) in Montpelier, north of the scheme, granted in 2019, which has also not yet begun construction. Permission for 9 properties with an access road, public lighting, and all associated ancillary site development works (Ref. 178006) in Clonlara was granted in 2018 and has completed construction. Due to the distance between these sites and the scheme area, significant cumulative impacts with regards to soil and geology are not expected.

A project involving upgrades to the Killaloe Bypass, Shannon Bridge, and R494, located north of the scheme, fall outside the 5km boundary for this assessment, but due to reported impacts on the road network, it has been included. Construction is currently ongoing with an estimated completion date in 2027. Due to the distance and nature of the works, significant cumulative impacts with this development on soils and geology are not expected.

On the whole, ensuring relevant legislation and proposed mitigation measures are adhered to and implemented, the cumulative effects associated with developments in the area are long-term with an imperceptible impact on land, soils, and geology.

10 Water – Surface and Groundwater

10.1 Introduction

This chapter assesses and evaluates the surface and groundwater aspects of the proposed FRS. This chapter should be read in conjunction with Chapter 8 (Biodiversity) and Chapter 9 (Land and Soil) due to overlapping impacts and mitigation measures.

The following legislation was consulted during the preparation of this chapter:

- The Water Framework Directive (WFD)(2000/60/EC) that established a framework for the protection of groundwater, surface water and transitional waters;
- The European Communities Environmental Objective (Surface Water) Regulations 2009 as amended (S.I. No. 792 of 2009);
- European Communities Environmental Objectives (Surface Waters) (Amendment) Regulations 2019 (S.I. No. 77 of 2019);
- European Communities (Quality of Salmonid Waters) Regulations (S.I. No. 293 of 1988);
- The Foreshore Acts, as amended;
- The European Communities (Water Policy) Regulations (S.I. No. 722 of 2003);
- The EU Floods Directive 2007/60 EC;
- Groundwater Directive (2006/118/EC); and
- The European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010).

10.2 Assessment Methodology

The methodology used in this assessment follows current Irish guidance as outlined above in Chapter 1, and in the following:

- OPW / DoECLG planning guidance (2011), "The Planning System and Flood Risk Management".
- Environmental Protection Agency (2022) 'Guidelines on the Information to be contained in Environmental Impact Statements'.
- Department of Housing, Planning and Local Government (DHPLG) (2018) 'Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment'.
- National Road Authority (NRA) (2009) 'Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes' by the National Roads Authority'.
- Institute of Geologists of Ireland (2013) 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements'.
- Environmental Impact Assessment of Projects – Guidance on the preparation of the Environmental Impact Assessment Report (Directive 2011/92/EU) as amended by 2014/52/EU). European Union 2017.

10.2.1 Assessment Criteria

The criteria for assessment of impacts in the receiving environment are explained in the first chapter of this report. In addition to the EPA (2022) Guidelines, the NRA (2009) criteria for assessing the importance of surface water and hydrogeological attributes are useful (Table 10-1 and Table 10-2). These criteria have been used to assist in rating the importance of features, which is then combined with the description of effects as shown in the matrix of significance in Figure 1-2 in the Chapter 1 of this EIAR.

Table 10-1: Criteria for Rating Importance of Hydrological Attributes (NRA, 2009)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g., 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.

Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Table 10-2: Criteria for Rating Importance of Hydrogeological Attributes (NRA, 2009)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g., SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale	Regionally Important Aquifer with multiple well fields Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source
High	Attribute has a high quality or value on a local scale	Regionally Important Aquifer Groundwater provides large proportion of baseflow to local rivers Locally important potable water source supplying >1000 homes Outer source protection area for regionally important water source Inner source protection area for locally important water source
Medium	Attribute has a medium quality or value on a local scale	Locally Important Aquifer Potable water source supplying >50 homes Outer source protection area for locally important water source
Low	Attribute has a low quality or value on a local scale	Poor Bedrock Aquifer Potable water source supplying <50 homes

Note: “Extremely high”, “very high”, and “high” in Table 10-1 and Table 10-2 will all correspond to “high” significance or sensitivity of a feature in the effects significance matrix (EPA, 2022) in Figure 1-2, in Chapter 1 of this EIAR.

10.3 Receiving Environment

10.3.1 Baseline Assessment

This assessment was considered in the context of the available baseline information, potential impacts, consultations with statutory bodies and other parties, and other available relevant information. In collating this information, the following sources of information and references were consulted:

- Latest EPA water quality monitoring data for watercourses in the area, available on www.epamaps.ie;
- EPA Catchment website (www.Catchment.ie);
- Draft Castleconnell Local Area Plan 2023 - 2029,
- Limerick Development Plan 2022-2028;
- The Planning System and Flood Risk Management, Guidelines for Planning Authorities (Department of the Environment, Heritage and Local Government (DoEHLG) and the Office of Public Works (OPW));

- Office of Public Works flood mapping data (www.floodmaps.ie);
- Classification (regionally important, locally important) and extent of aquifers underlying the site perimeter area (www.gsi.ie);
- Natural hydrogeological/karst features in the area and potential for increased risk presented by the activities at the site (www.gsi.ie);
- National Parks and Wildlife Services (NPSW) www.npws.ie on-line database; Protected Register; and
- River Basin Management Plan 2018-2021.

Along with the desktop assessment, a Biological Water Quality Assessment survey took place. The survey was carried out by Ecofact (2021) in accordance with prescribed EPA methodologies. The survey was carried out in August 2021 across six sites. A summary of results of the survey are provided in Section 0. Site investigation including groundwater tests was conducted by PGL in 2021 and are summarised in Section 10.3.3.

The assessment considered all possible waters in the FRS area. This includes all surface waterbodies, such as rivers, streams, ditches, drains and the stormwater network, and groundwater. The wider context of the surface waters in terms of their designation as part of Water Framework Directive (WFD) waterbodies was also considered where relevant.

10.3.2 Surface water; hydrological environment

The proposed site lies on the eastern banks of the Lower River Shannon. The site is within the Water Framework Directive (WFD) Lower Shannon catchment, Shannon [Lower]_SC_090 subcatchment and Shannon (Lower)_060 subbasin.

River Shannon

The River Shannon is the largest river in Ireland, with a total catchment area covering approximately 17,000km^2. The river rises in the Cuilcagh Mountains, at Shannon Pot, in Co. Cavan. The river flows in a roughly south-westerly direction, discharging into the Shannon Estuary. Castleconnell is located on the eastern bank of the River Shannon, approx. 15.9km upstream of Limerick City and 8.2km downstream of Lough Derg. Approximately 6km upstream of Castleconnell Village is the Parteen Weir and an artificial channel constructed for use by the Ardnacrusha Hydroelectric station.

Local waterbodies – tributaries of Shannon River

A number of small streams identified as tributaries of the River Shannon flow within the Castleconnell FRS study area. The Cedarwood Stream, to the north of Castleconnell, has a sand and pebble bed, steep banks and is culverted for long portions of its reach. No aquatic vegetation was observed in-stream. During the initial CFRAM surveys, several structures were identified along the length of the stream such as culverts, bridges, and weirs. The drainage maps from LCCC do not identify any surface water drainage entering the Cedarwood Stream. Foul water enters at Grange House.

The Stradbally Stream is located in the south and enters the River Shannon by the Ferry Playground.

Lough Derg and Parteen Weir

The River Shannon is the main source of flood flows in Castleconnell and is heavily influenced by Parteen Weir (approx. 6.1km upstream) and Lough Derg (approx. 14.1km upstream). Lough Derg is a freshwater lake and is the third largest lake in Ireland, with shores in Counties Clare, Galway, and Tipperary. The lake is 36 metres (118 feet) deep at its deepest point and covers an area of 130 km^2.

Flooding

Areas at risk of flooding in the OPW National Flood hazard maps are defined through collection of recorded data and observation of flood events. For Castleconnell, major flood events have occurred in November 2009, and in 2015/2016. During these events there was inundation of the R525 Castleconnell to Montpelier,

areas within Castleconnell Village from Charco's Pub to Scanlon Park and town car park, Chapel Hill and significant flooding along the River Shannon.

Large parts of Castleconnell are in CFRAM Flood Zones A (1% AEP) and B (10% AEP).

Water Services Infrastructure

Clareville Water Works is the intake for the Limerick Water Resource Zone, and is approx. 2.5km downstream of the site. The Clareville Water Works currently treats and delivers 48,000-50,000 m^3/day, which is about two thirds of the capacity of the plant. Approximately 60% of the water from the plant is consumed by residents of Limerick City, with the remainder supplying parts of County Limerick and County Clare[62].

According to the Limerick Development Plan 2022-2028, 61% of private households in Limerick City and County are connected directly to the public sewerage network, which is below the state average of 65.9%. As of March 2022, Irish Water estimated that 41 of the 53 wastewater treatment plants (WWTP) in Limerick had capacity available. These included Castletroy WWTP, which is approx. 8km downstream from Castleconnell. Castleconnell is part of the Castletroy WWTP agglomeration Castletroy WWTP, meaning wastewater from Castleconnell is treated at Castletroy WWTP. Castletroy WWTP has a capacity of 45,000 population equivalent (PE) and is currently operating at the upper limits of this capacity. The WWTP is compliant with Emission Limit Values (ELVs)[63].

Upgrades to the plant are currently planned by Irish Water in partnership with Limerick City and County Council[64]. These upgrades will allow the plant to continue operating successfully as Limerick meets its population growth and industrial development targets. The planned upgrades will increase capacity to 77,500 PE.

Castleconnell Pumping Station, situated at the Scanlon Park/Island House junction on the Mall Road, is a secondary discharge point for Castletroy WWTP. Emergency overflows and storm water overflows both discharge from the same discharge point.

Water Framework Directive Assessment and EPA Q values

The section of the River Shannon flowing through Castleconnell as specified above, is within the Shannon (Lower)_060 sub-basin. According to the WFD 2016-2021 assessment, the waterbody has a Moderate status. This means that overall biological, physico-chemical, hydromorphological and pollutants do not support a good ecological status. Its WFD risk status is under review.

The EPA's biological river water quality classification (Q values) is based on macroinvertebrate biological sampling at water monitoring stations. The nearest Q value point to the site is just upstream of the northern end of the proposed development, north of Rivergrove B&B. The latest Q value recorded here was 3 which means the location has moderate water quality.

Visual and Biological Water Quality Assessment Q value

The outcomes of the visual and biological quality assessment survey are provided under separate cover (Baseline Aquatic Ecology Survey Report by Ecofact, November 2021) showing the assets observed, and

[62] https://www.limerick.ie/european-green-leaf-city/about/green-city/water

[63] Irish Water (2020) *Annual Environment Report, Castletroy D0019-01*. Irish Water

[64] https://www.water.ie/projects/local-projects/castletroy-wastewater-tre/

the Q value rating of the biological assessment on each surveyed site. Each site was assessed as Q 3-4, moderately polluted.

Overall evaluation of Hydrological Features

Following the NRA (2009) guidelines on the evaluation of hydrological features, the surface water bodies around Castleconnell are of Extremely High Importance, due to the designation of the Lower River Shannon as a Special Area of Conservation, along with the visual amenity that it provides.

10.3.3 Groundwater; hydrogeological environment

The groundwater body underlying Castleconnell (IE_SH_G_052) has a good status according WFD classification for the 2016-2021 assessment period and no risks are identified. Drainage density is low throughout the majority of the GWB, being greater just south of the GWB's centre, close to the Volcanic rocks. The permeability of subsoil is classified overall as ‘moderate’, with the northern portion of the FRS ranked as ‘low’.

Aquifer Classification and Groundwater Vulnerability

The GSI mapping services (GSI, 2023) indicate that the scheme is underlain by a Regionally Important Aquifer composed of karstified bedrock. Southeast of the site there is a locally important aquifer with a generally moderately productive zone, while a locally important gravel aquifer is to the east, see Figure 10-1 (GSI, 2023).

The groundwater vulnerability underlying Castleconnell, that describes the hydrological and geological characteristics controlling the ease at which a groundwater body may be contaminated, is primarily classified as “Moderate”.

Estimated groundwater recharge values for the area range from 28mm/yr in areas with peat to 427mm/yr in areas with more permeable subsurface materials. Groundwater is discharged to the surface as baseflow to streams and rivers crossing the GWB, and to the River Shannon. Overall given the depth to bedrock the contribution of groundwater to flood risk within the area is considered minimal.

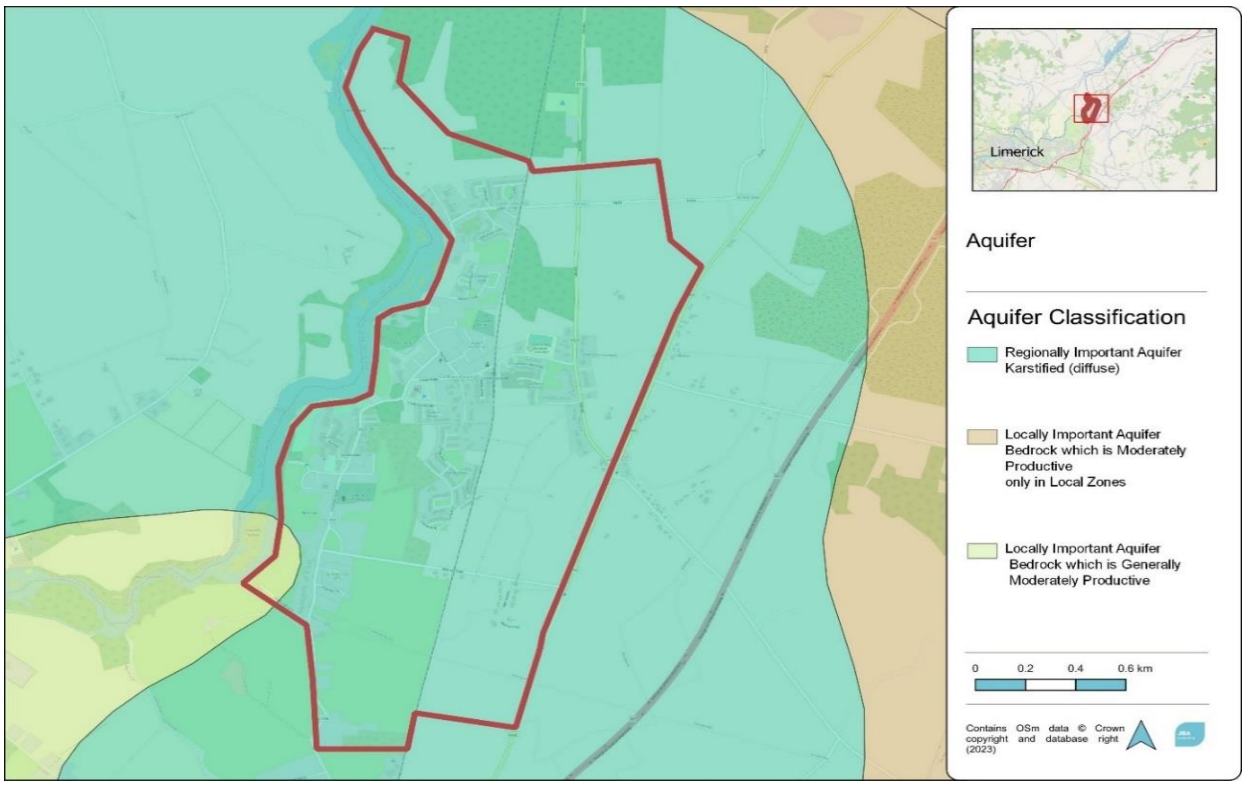

Figure 10-1: Aquifer in the FRS area, ref. GSI

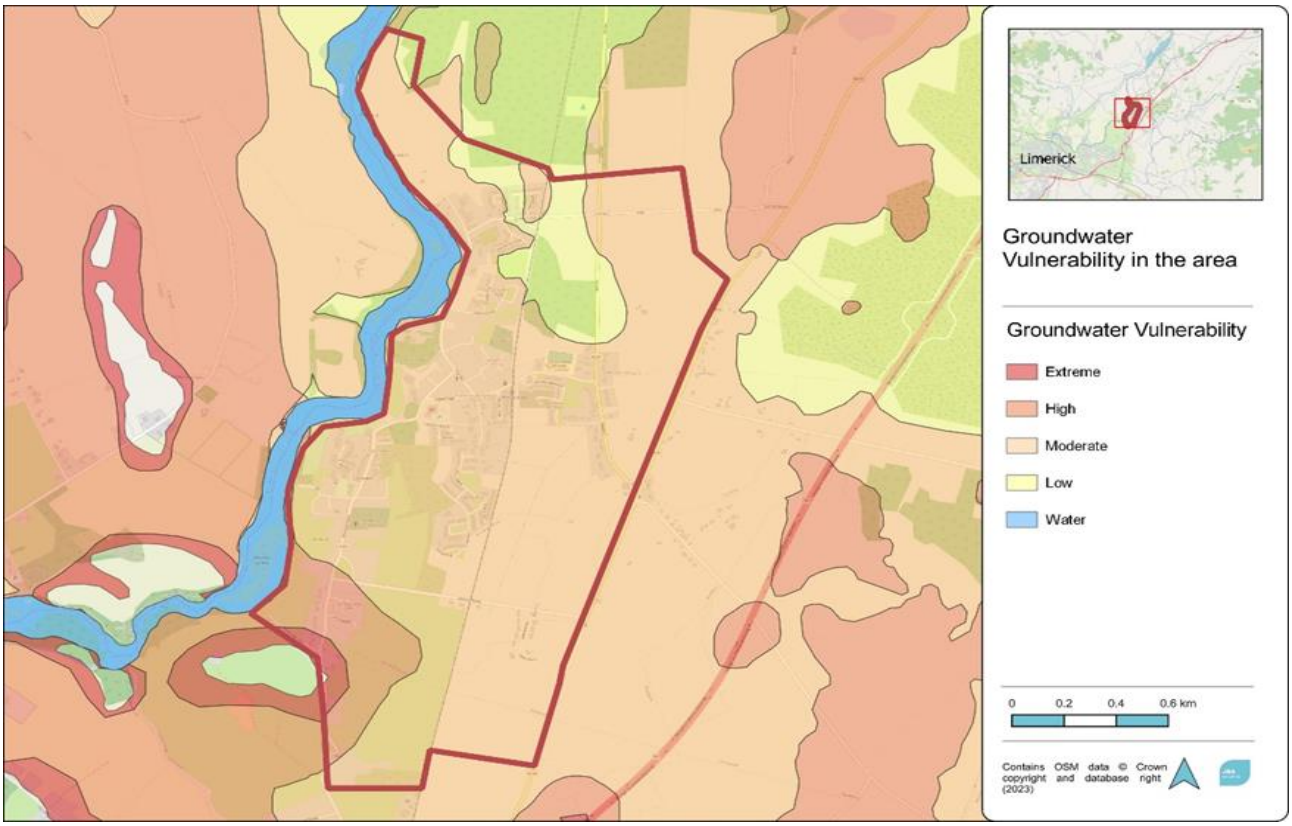

Figure 10-2: Groundwater vulnerability in the FRS area, ref. GSI

Groundwater Testing (Site Investigation)

Groundwater monitoring was conducted in different sites within the FRS area. Groundwater depths among all the sites during rotary borehole excavations ranged from 1.4 to 8 m bgl.

10.4 Predicted Impact

Predicted impacts are discussed under the 'do nothing' scenario which presents an outline of the evolution of the baseline in the absence of the proposed scheme, during construction of the scheme, and during operation of the scheme. This EIA focused on likely significant effects.

10.4.1 Do-Nothing Scenario

As large parts of Castleconnell are located within Flood Zone A, there is a medium to high probability of continuing flooding of residential and commercial buildings if the Flood Relief Scheme does not go ahead. Several areas of the town are at risk of flooding such as Rivergrove B&B, Scanlon Park, Island House, Meadowbrook Estate and Coolbane Woods. In the event of a flood without adequate standard of protection, the effect on existing surface water due to likely contamination by floodwaters from urban environments is extremely high. Contamination would occur as a result of inundation of roads and potentially contaminated land as the flood waters recede and enter the River Shannon. There is also a risk of failure of existing informal flood defences such as the stone wall along the Mall Road. Failure of these could increase residual flood risk or lead to contamination of the river with damaged masonry.

The effect of the do-nothing scenario is **long-term significant negative**.

10.4.2 Construction phase

During construction, the water environment is at risk from contaminated water entering the waterbody (either surface or groundwater), or likely changes to watercourse morphology and flow patterns. The potential construction phase effects on the water environment will be outlined in the sections below, without mitigation. Mitigation measures will be discussed following this.

Construction will take place adjacent to the River Shannon in some parts of the scheme as described in Chapter 4. The key civil engineering works which have potential to impact on the surface and groundwater environment are detailed in Section 4.4.6. The potential impacts of these works to the water environment (without mitigation) are discussed below:

Fine Sediment Pollution

During construction, the water environment is at risk from fine sediment pollution from the following sources:

- Excavation of, or import of, fill material on site that is stored near or adjacent to the river network;
- Ground that is exposed following vegetation clearance adjacent, or near to, the river network;
- Interaction between machinery and the riparian environment, such as for excavations required for flood wall installation; and
- Instream works

There are several potential pathways for fine sediment to be mobilised from these sources to receptors. Surface water runoff during a precipitation event could wash fine sediment from stores or exposed ground into the river network, either directly via surface runoff pathways or indirectly via the stormwater drainage network. During construction, machinery operating within the riparian environment may knock exposed sediment directly into the river channel or move material to a position where, should a precipitation event occur, it would be more vulnerable to mobilisation by surface water runoff (either as sheet flow or slumping of sediment piles into the channel). Instream works offer a direct pathway from source to receptor by mobilising fine sediment within the water column or within the riverbed and bank environment.

Fine sediment pollution refers to both the fine sediment itself and urban pollutants that can be adsorbed onto the fine particles and transported along with them. Once fine sediment enters the water, it can disperse through the water column (referred to as suspended sediment) affecting physico-chemical water quality parameters by increasing turbidity and reducing dissolved oxygen. Changes in these conditions, along with toxicity effects associated with adsorbed urban pollutants, can pose a risk to the life of aquatic species. Settlement of fine sediment over instream geomorphic features such as coarse sediment deposits (e.g., riffles and bars) can smother these important physical habitat environments, rendering them unsuitable for aquatic species.

A fine sediment pollution event would be expected to immediately impact the local environment, and to subsequently affect downstream environments as the fine sediment is flushed through the system during flushing flow conditions (e.g., winter high flow events). It may take several years for a single fine sediment event to be flushed through the system, but given flushing is expected the effect on water quality and instream features is expected to be reversible. The effects of urban pollutants on aquatic life are unclear. While these pollutants are expected to already be entering the river network to some degree, a fine sediment pollution event would represent an intensification of that pollution pressure. Taken together, the magnitude of potential impacts on water without mitigation measures in place is high, leading to a **significant short term negative** impact on the surface water environment due to fine sediment pollution.

Accidental Spills and leaks

During construction, there is a risk of localised accidental pollution incidences from the following sources:

- Spillages or leakage of temporary oils and fuels stored on site;
- Spillages or leakage of oils and fuels from construction machinery or site vehicles;
- Spillage of oil or fuel from refuelling machinery on site; and
- Run-off from concrete and cement during the construction of flood walls.

There are several potential pathways for these pollutants from their sources to receptors. A direct hydrological link to surface water exists should an accidental spill or leak occur directly into the watercourse during construction, or on land and be allowed to flow overland to the watercourse. A spill or leak could also discharge to the existing surface water drainage network and subsequently discharge to the river network. During construction, compaction of the soil or subsoil could occur due to the use of heavy machinery in

green areas. This could reduce infiltration rates and increase surface water runoff, further acting as a pathway for potential pollutants.

There is also potential for contaminants to migrate through the subsoils to the underlying groundwater. Soil stripping and foundation construction have the potential to further reduce the thickness of subsoils and the natural protection they provide to the underlying aquifer.

The potential pollutants described above could negatively impact surface water or groundwater quality if allowed to reach them. Concrete (specifically, the cement component) is highly alkaline, and any potential spillages can be detrimental to surface and groundwater quality. Changes in pH of the waterbody resulting from spills of concrete material would have a consequent effect on aquatic species. Spillage of oil or other similar contaminants which are likely to be in use during construction would similarly negatively impact the water environment.

An accidental spill or leak is likely to be an isolated event if it occurs, in a specific geographical area. The entire water environment as described above is therefore not likely to be affected, with effects likely on one river reach and the immediate area downstream, or likely to be contained to the local groundwater environment. Based on the likely length of construction at any one works site being not greater than one year, an unmitigated spill or leak would be temporary. The effect on water quality of such an unmitigated leak would be reversible. According to the significance of effects matrix (EPA, 2022) the magnitude of potential impacts on water will be medium, leading to a **Moderate Temporary Negative** impact on surface and groundwater due to accidental spills and leaks.

Groundwater pumping

Groundwater pumping will be required at the proposed wall on Mall Road, Rivergrove B&B and Grange House. This has the potential to temporarily alter the groundwater level locally.

According to the significance of effects matrix shown in Figure 1-2 on the first Chapter of this EIAR, the magnitude of potential impact on groundwater will be low, leading to ***an overall slight temporary negative impact on water due to groundwater pumping.***

Instream Works

Works near water will take place at various points throughout the proposed FRS, such as at the Cedarwood Stream, Rivergrove B&B and Grange House, and Mall Road. The potential impacts from these works are described in the above sections and relate to potential disturbances leading to fine sediment pollution, and potential for accidental spills and leaks.

The instream works required are limited, and they include the works during culvert installation at Grange House, and stream maintenance works at the Cedarwood Stream. After replacement of the culvert, there will be reconstruction of the banks and the sides and culvert inlet and outlet will be reinstated to the original ground level. This will result in disturbance to the riverbed and aquatic species, causing sediment mobilisation. This is discussed further in Chapter 8.

The extent of instream works required is limited. According to the significance of effects matrix shown in Figure 1-2, the magnitude of potential impact on water will be medium, leading to ***an overall moderate temporary negative impact on water due to instream works and works near water.***

10.4.3 Operation Phase

The potential impacts on the water environment during the operation phase will be as follows.

Water Quality

In general, due to the static operating nature of the scheme, the effect on water quality once construction has finished will be neutral. However, the proposed FRS will result in decreased fluvial flooding of urban areas. Flooding of urban areas can mobilise urban pollutants (waste, vehicle pollutants such as hydrocarbons and tyre microplastics) which, either directly or via the stormwater drainage, can enter the

river network. The foul water connection to the Cedarwood Stream at Grange House will also be removed, resulting in a further benefit to water quality. With these changes, input of pollutants to the water environment will be decreased, which is a **long-term, positive impact.**

Hydromorphology

The scheme has the potential to change the hydromorphological regime of the River Shannon. Defences can change the flow patterns which has the potential to impact both upstream and downstream flow. The constructed flood wall along Mall Road will disconnect the river from a small part of its floodplain on the left bank, which will impact the natural functioning of the river. During flood events the raised walls and embankments have the potential to increase water conveyance resulting in higher flow velocity and depth. However, due to the large span of the River Shannon, through Castleconnell the impact of the defences on level and velocity are negligible.

The overall potential impact on hydromorphology once operational will be **long-term imperceptible.**

10.5 Mitigation Measures

In the impact assessment discussed above, a range of potential effects on water were identified. Mitigation measures in the construction and operational phase of the proposed scheme will be implemented to reduce these adverse effects. Most measures are required during the construction phase as it will pose the greatest level of risks due to the construction activity on site, plant construction and use of construction materials and the soil on site.

In the sections below, the mitigation measures for the do-nothing scenario, construction phase and operation phase are discussed.

10.5.1 Do Nothing Scenario

In the do-nothing scenario, no mitigation measures will be required.

10.5.2 Construction Phase

Mitigation measures during the construction phase are discussed below. These mitigation measures have been developed with the source-pathway-receptor links above in mind and are designed to break this link either by removing the source, or disrupting the pathway for pollution.

Best Practice Construction Methods

A preliminary Construction Environmental Management Plan (CEMP) has been prepared for the proposed scheme and will be put in place by the appointed contractor. The preliminary CEMP was prepared in accordance with the following:

- National and International Legislation;
- Environment Liability Regulations; and
- Best Management Guidelines.

The CEMP will be used by the contractor to prevent and minimise environmental effects during construction.

Fine Sediment Pollution

Mitigation for the protection of surface and groundwater quality from runoff carrying fine sediments and urban pollutants involves silt control measures. These include proper planning of works, site compound construction, storage management and excavation plans, as follows:

- The CEMP includes a Storm Water Management Plan. It will address sediment control during the construction works and address the potential risk to release of sediments and various pollutants into local watercourses;

- Planning of works should be conscious of available weather forecasts and avoid working during heavy rain/storm events to minimise the risk of runoff that may be in excess of the capacity of the runoff control measures outlined in the preliminary CEMP. If working during precipitation events cannot be avoided, then runoff control measures should be actively monitored during the works to ensure their capacity is not compromised;
- Adherence to best practice guidance for pollution prevention and sediment management measures (e.g., use of oil booms, spill kits, and silt fences etc.) will be applied.
- The contractor will construct a site compound at a location remote from any drains;
- Storage locations and topsoil piles will be placed in appropriate places, distant to existing drains/sewerage within site;
- All soil stockpiles shall be covered (i.e., with a tarpaulin or vegetated) to minimise the risk of rain/wind erosion. Vegetation will be established as soon as possible on all exposed soils;
- In the event of an extended dry period, stockpiles will be dampened using water to minimise the risk of airborne particles entering watercourses;
- Excavations will remain open for as little time as possible before the placement of fill to minimise the potential of water ingress into excavations;
- Management/Response plans will be implemented to identify mobilisation of soil particles/pollution and initiate the interception and treatment of pollution/silt run-off;
- Silt fencing or other appropriate measures shall be put in place downstream of exposed soils or soil stockpiles.

Accidental Spills and Leaks

To avoid and manage accidental spills and leaks a series of measures listed below will be implemented. The Main Contractor and sub-contractors will be responsible for their implementation.

- An Emergency Plan for the site will be established by the Main Contractor prior to work commencing at the site. As a minimum the Emergency Plan will contain contact details for statutory bodies such as the NPWS and IFI. All site workers will be made aware of the plan and its location in the site offices;
- There will be no refuelling of machinery within or near the river channel. Refuelling will take place at designated locations at distances of greater than 30 metres from the watercourse;
- No vehicles will be left unattended when refuelling and a spill kit including an oil containment boom and absorbent pads will be on site at all times;
- Any fuel needed to be stored on the site will be stored appropriately and at a location that is set back from the river. All other construction materials will be stored in this compound. The compound will also house the site offices and portable toilets. This compound will either be located on ground that is not prone to flooding or will be surrounded by a protective earth bund to prevent inundation;
- All vehicles will be regularly maintained and checked for fuel and oil leaks;
- All liquids, solids and powder containers will be clearly labelled and stored appropriately in sealable containers. Storage of fuels and oils will be in the main contractor's compound only;
- Spill protection equipment such as spill kits, absorbent mats, oil booms, and sand will be available for use in the event of an accidental spill. These will be disposed of correctly if used and replaced with new ones immediately. Disposal records for used absorbent materials will be retained by the Site Manager;
- The contractor shall implement measures for the regular inspection of bunds and emptying of rainwater (when uncontaminated). Bunding must have a minimum capacity of 110% of the volume of the largest tank or 25% of the total storage capacity, whichever is the greater. Bunding shall be impermeable to the substance that is being stored in the tank;
- The use of settling lagoons, settling tanks, or equivalent, with outflow control measures may be used for the interception of surface water or groundwater pumped from an active working area;
- If a spillage of a hazardous material to groundwater occurs, the groundwater will be contained and pumped to a tank or holding vessel prior to shipment off site for disposal. The contractor will maintain disposal records. The contractor will identify the cause of the spillage and mitigation measures and controls will be put in place to prevent a repeat. The CEMP for the site will be updated and contractors and sub-contractors will be made aware of the amendments;
- The Contractor will clean equipment prior to delivery to site. The Contractor will avoid using any equipment which leaks fuel, hydraulic oil, or lubricant. The Contractor will maintain equipment to ensure efficiency and minimise emissions. Where possible, the contractor should maximise the use of biofuels;

- Management/Response plans will be implemented to identify mobilisation of soil particles/pollution and initiate the interception and treatment of pollution/silt runoff; and
- The use of precast elements should be maximised to avoid wet concreting in close proximity to water.

Instream Works

To reduce the potential impacts from instream works and from the temporary working platform, the following mitigation measures are proposed;

- All instream works will be supervised by an Ecological Clerk of Works;
- Netting or similar should be used in the space between the temporary working platform and the walls to trap any falling debris which would otherwise fall into the River Shannon;
- Construction should be phased appropriately to avoid multiple movements of the temporary working platform, therefore limiting disturbance to the riverbed; and
- Reference Chapter 8 Biodiversity to mitigate impacts to any fauna or flora which may be impacted as a result of instream works, and seasonal restrictions on instream work.

Flooding during construction

There is a possibility that a flood will occur during the construction phase. To ensure that Castleconnell does not become vulnerable to floods during construction, the contractor will be required to monitor storm and conditions that may cause inundation, including daily flows over Parteen Weir. In the event of a storm event, temporary flood barriers will be erected at the exposed locations. All works undertaken near the banks will be fully consolidated to prevent scour and run-off of silt. Consolidation may include use of protective and biodegradable matting or geotextiles on the banks and the sowing of grass seed on bare soil. Earthworks will be aimed to take place during the driest season to ensure that any flooding during the wet season does not result in mobilisation of significant quantities of unconsolidated material.

10.5.3 Operation Phase

Impacts to surface and groundwater during the operation phase of the scheme are negligible and no mitigation is needed.

10.6 Residual Impact

Following the implementation of the recommended mitigation measures and the final design and layout of the scheme, the magnitude and significance of the residual impacts is discussed in the following sections.

10.6.1 Construction Phase

Provided that mitigation measures are followed closely during the construction phase of the scheme, the residual impact to surface water and groundwater bodies will be reduced to **temporary, slight negative to imperceptible**.

10.6.2 Operation Phase

During the operation phase of the project, considering the design considerations benefitting surface and groundwater bodies, the residual impact will be **long-term and slight, with a neutral impact on quality**, i.e., an effect which causes noticeable changes the character of the environment without affecting its sensitivities.

10.7 Monitoring

The site-specific CEMP sets out the monitoring requirements for the scheme during the construction stages. Monitoring will ensure the implementation of mitigation measures during construction. The frequency and reporting procedures should be agreed with the NPWS and IFI before commencement of the work. All monitoring records should be maintained by the Project Manager or his nominated assistant. The monitoring will include:

- Records of regular inspection, on bunds, vehicles oil storage on site according to the CEMP;
- Records of silt fencing conditions and placement; and
- Records of any water ingress during excavation.

Monitoring of surface water and groundwater on quantitative and qualitative parameters during construction will be carried out. As a minimum the following parameters will be recorded in surface waters: pH, conductivity, chemical oxygen demand, suspended solids and total dissolved solids. Parameters for groundwater will include as a minimum, total petroleum hydrocarbons, pH, conductivity, suspended solids and total dissolved solids. If monitored levels exceed the recommended threshold, mitigation measures to protect surface and groundwater will be reviewed by the environmental manager acting on behalf of the contractor.

10.8 Interactions

Impacts to surface and groundwater have the potential to interact with the following environmental factors:

Biodiversity, discussed in Chapter 8: The Lower River Shannon SAC is a valuable habitat for a number of significant and protected species. Impacts on waterbodies (i.e., the River Shannon itself or its tributaries) could affect the SAC or aquatic habitats and species. The main potential impacts identified in the Biodiversity chapter include accidental sediment release or pollution due to spills or leaks, or disruption to habitats due to instream or bank-side works. Mitigation measures included in the Water chapter and the Biodiversity chapter will ensure that no significant interactive effects occur.

Land and Soil, discussed in Chapter 9: Soils and geology share direct links with groundwater. Hydrogeology is further linked with surface water networks. Soil quality and condition affects the rate of recharge, infiltration, percolation, and drainage for groundwater bodies. Similarly, surface water run-off can directly affect soil quality and condition through deposition or withdrawal of chemicals, suspended solids, and nutrients. During construction eroded material can enter the surface and ground water causing influx of sediments. During operation there will be an initial flush of loose material during the next heavy rainfall event following construction of the earthen embankments. This has the potential to increase suspended sediments. Through implementation of mitigation measures outlined in Chapters 9 and 10 of the EIAR, the potential impact through interaction is reduced to short-term, slight, negative.

10.9 Potential Cumulative Impacts

Chapter 15 discusses the identification of nearby projects that have the potential to cause cumulative impacts with the proposed FRS. The Killaloe Bypass / Shannon Bridge Crossing / R494 Upgrade improvement scheme has the potential to interact with the surface and groundwater environment of Castleconnell FRS. An Environmental Impact Statement[65] was prepared to assess the impact of the Scheme. In the report, the worst residual impact magnitude considered is classified minor to insignificant magnitude. Any potential cumulative impacts to surface water quality as a result of the Killaloe Bypass construction (i.e., suspended solids entering the Shannon through surface water runoff) would have appropriate mitigation measures in place.

Other projects outlined in Chapter 15 will not have a significant cumulative impact with the proposed development, due to their small size and lack of complex likely effects.

[65] Roughan O'Donovan (2012) *Killaloe Bypass Shannon Bridge Crossing and R494 Environmental Impact Statement*. Available online at: https://www.clarecoco.ie/services/capital-projects/roads-and-bridges/killaloe-bypass-shannon-bridge-crossing/documents/killaloe-bypass-shannon-bridge-crossing-and-r494-improvement-volume-2-environmental-impact-statement-11300.pdf

11 Material Assets

11.1 Assessment Methodology

Material assets, as described in the EPA Guidelines (2022) covers three separate aspects: roads, traffic, and transport, built services or utilities, and waste management. These three aspects will be discussed in this chapter.

The roads, traffic, and transport section describes the existing roads, traffic and transportation system in the vicinity of and leading to the proposed Castleconnell FRS. This section also examines the various aspects of the construction and operation of the development which have the potential to impact on roads, traffic and transportation, and the magnitude of these impacts are considered prior to mitigation. Mitigation measures are then discussed, and the residual impact (post mitigation) is outlined. This section was undertaken using a desk-based study. The assessment of roads and traffic identifies roads, footpaths, and public transport routes that will be affected during the construction phase of the proposed scheme. The information in this chapter is developed from the preliminary engineering details of the proposed development.

Transport Infrastructure Ireland's (TII) 2014 publication "Traffic and Transport Assessment Guidelines"[66] was consulted to determine whether standalone or not Traffic and Transport Assessment was required for the proposed development. Using the thresholds contained in Section 2 of the above guidelines, it was determined that the proposed development does not require a Transport Assessment.

The assessment of utilities included a desk-based exercise to identify utilities (i.e., underground utilities, electrical infrastructure) that could be affected by the proposed scheme, and a manhole survey. Prior to construction, test trenching will be carried out on site by the utility companies to accurately locate services in proximity to proposed construction excavation sites.

The assessment of waste included a calculation of quantities of waste likely to be produced during the construction phase. Details of likely truck movements in relation to waste are also included in the chapter.

11.2 Receiving Environment

11.2.1 Site Compound Locations

The main site compound will be located in the field along the eastern side of the Mall Road, north of the Scanlon Park junction. The field is currently a greenfield site, with an existing entrance onto the Mall Road, approx. 50m north of the Scanlon Park junction. This compound will be used for all works areas and will be reinstated following the construction phase.

Several secondary compounds will also be used. The first of these will be on the closed lane of the Elvers Road, immediately north of Rivergrove B&B. This will be used for materials storage and will be fully reinstated following the construction phase.

The second secondary compound area will be on a greenfield site between Stormont House and Meadowbrook Estate. The site will be used as storage for spoil of embankment material and will be fully reinstated following construction.

[66] TII (2014) *Traffic and Transport Assessment Guidelines*, PE-PDV-02045. Available at: https://www.tiipublications.ie/library/PE-PDV-02045-01.pdf [Accessed 09/01/2024]

The third secondary compound area will be in a greenfield site southwest of Coolbane Woods. The site will be used as storage for spoil embankment material. Following the construction phase, the compound area is to be developed as part of a permitted development, Planning Ref. 19518.

11.2.2 Roads, Traffic, and Transport

Roads in Ireland are classified as motorways, national (primary and secondary), regional and local roads. Transport Infrastructure Ireland (TII) has overall responsibility for the planning and supervision of the construction and maintenance of motorways, national primary and national secondary roads. Local authorities have responsibility for all non-national roads. The hierarchy of road types throughout Ireland is outlined in Table 11-1 below.

Table 11-1: Road classification in Ireland

Road Category	Description
Motorways	These are high quality multiple lane roads with limited grade separated junctions. They are high speed (120kph) roads predominantly provided to facilitate strategic traffic, with reduced journey times.
National Primary Roads	These are predominantly single carriageway, with some that are dual carriageway. Generally high speed (100kph) roads they also facilitate strategic traffic, with reduced journey times.
National Secondary Roads	These are medium distance through-routes connecting important towns, serving medium to large geographical areas and links to primary routes to form a homogeneous arterial network.
Regional Roads	Predominantly single carriageway roads of regional and local importance. These receive higher priority in maintenance criteria than Local Roads; hence tend to be structurally sound.
Local Roads (Primary, Secondary and Tertiary)	The local road system is operated in three tiers defining local importance, usage and maintenance priorities. They form a network of single carriageway roads of varying quality.

The existing road network in the general vicinity of the proposed development is outlined below and shown in Figure 11-1. The M7 motorway passes approximately 1.6km to the east of the proposed FRS, and connects Castleconnell to Limerick City and Dublin. The R445 is approx. 1km east, and was previously the main Dublin to Limerick road in the area before the construction of the M7. The R525 passes close to Castleconnell, intersecting with the R445 at Daly's Cross. All other roads and streets in Castleconnell are local roads.

Within Castleconnell, the Mall Road is the main north-south local road, roughly adjacent to the River Shannon and connecting the northern parts of Castleconnell with the town centre. The Mall Road is connected to the R525 in the north by The Commons Road, and in the south by Station Road/Railway Road. Castleconnell town centre is formed by a triangle of intersecting roads; Castle Street to the south, Main Street to the east, and New Street to the west. Chapel Hill connects Castle Street and New Street to the south.

Castleconnell has one railway station which connects the town to Limerick City to the south, and to Dublin via Nenagh, Roscrea, and Ballybrophy.

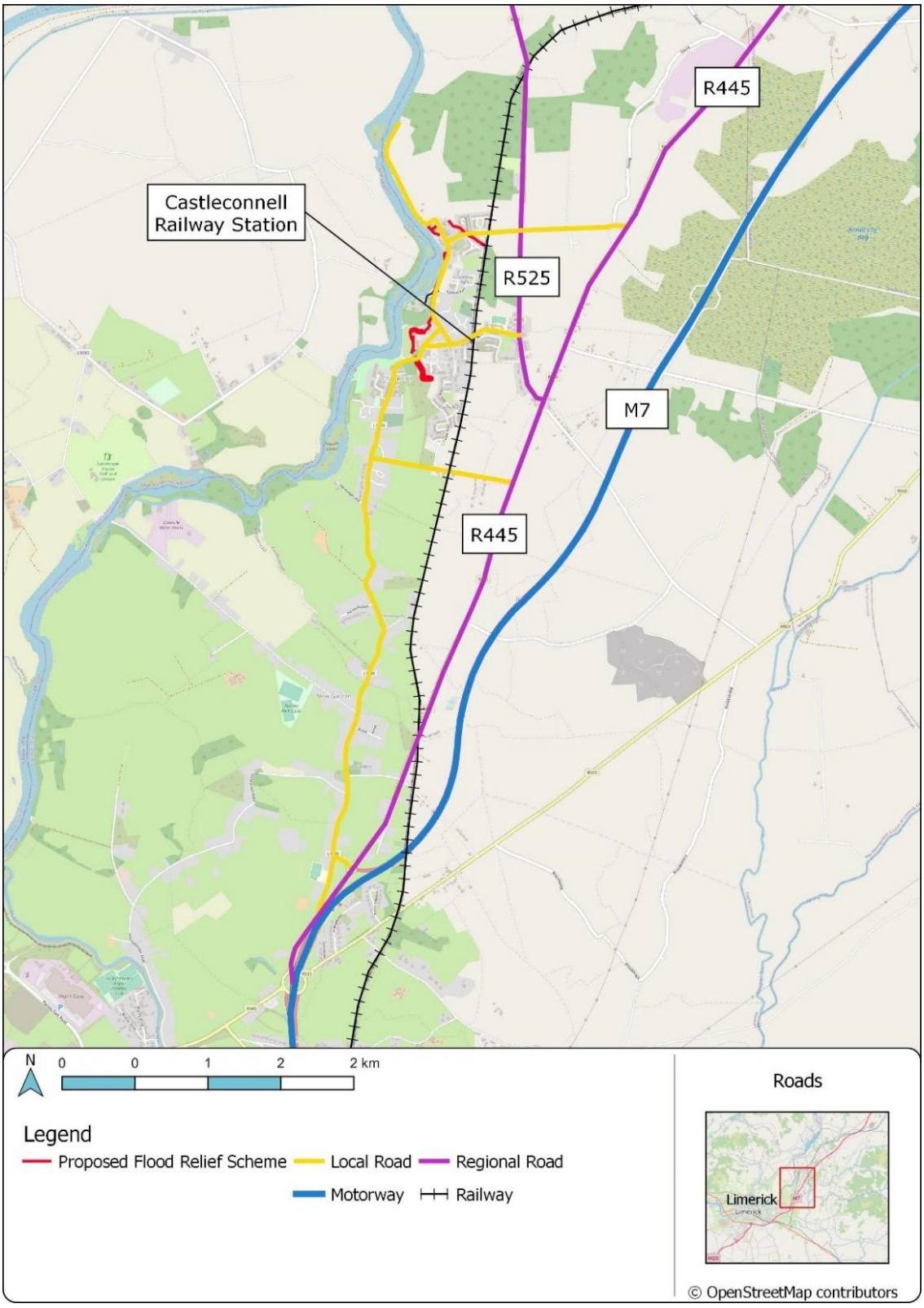

Figure 11-1: Transport network in the area

11.2.3 Utilities

Utilities in Castleconnell

Underground utilities are present in multiple locations around the site, and already serve Castleconnell. While deep excavations are generally not required, interactions with utilities are possible during construction.

All services are present throughout the Village, with works proposed in close proximity to the areas listed below:

- **Gas Networks Ireland (GNI) medium pressure distribution pipelines** are located along Elvers Road north of Mall House, house connection for Mall House, along Elvers Road east of Grange House and along The Mall Road, Meadowbrook Estate, the Coolbane Woods junction, and Coolbane Woods itself.
- **ESB low voltage overhead lines** are along Elvers Road north of Mall House, along Elvers Road east of Grange House and along The Mall Road, Meadowbrook Estate, and the Coolbane Woods junction.
- **ESB medium voltage overhead line** passes over the proposed Coolbane Woods embankment location, at its southern end.
- **ESB medium voltage/low voltage underground cable routes** along The Mall Road.
- **Watermains** at Elvers Road north of The Mall house and The Mall Road.
- **Overhead Telephone Cables** along Elvers Road north of The Mall house, along Elvers Road east of Grange House and along The Mall Road.
- **Drainage network** including foul, combined, surface, and gravity sewers are along Elvers Road east of Grange House and along The Mall Road, at Meadowbrook, Coolbane Woods junction, and Coolbane Woods itself.
- **Eircom cable ducts** along Elvers Road north of Mall House, along Elvers Road east of Grange House and along The Mall Road, Meadowbrook Estate, and the Coolbane Woods junction.

Foul flows from Grange House are currently discharged to the Cedarwood Stream without treatment. As part of the proposed development, a pumped connection will be provided from this property to the public foul sewer to the north of the property. This will prevent untreated sewage from being discharged directly to the Cedarwood Stream at this property and prevent backing up of foul flows during a flood event. A pre-connection enquiry has been submitted to Uisce Éireann for this.

ESB Infrastructure

The River Shannon and flood flows through Castleconnell are strongly influenced by the Parteen Weir, approx. 6km upstream, and the Ardnacrusha Power Station, operated by ESB. Ardnacrusha was first developed between 1925 and 1929, and today supplies electricity to over 46,000 homes[67]. The construction of the dam at Parteen Weir raised the river level by 7.5 metres. The river was then diverted into a 12km long canal (the head-race) and conveyed to Ardnacrusha, where it passes through the turbines and generates electricity. The water is then returned to the main River Shannon by another canal (the tail-race).

The operational conditions of the power station were discussed in a meeting held between JBA, ESB, OPW and LCCC on 22/04/20. In this meeting the ESB advised that in high flow conditions, 345m³/s can be delivered down the head race to the power station, but a number of factors should be taken into account and this is not a fixed quantity and could be lower. With this assumed head race flow a ”504” Event was established for the Old River Shannon at the HEP downstream of Parteen Weir (HEP ref 25_3886_1), with a 1% AEP peak flow of 504 m3/s. This flow is similar in scale to that experienced in the 2009 flood event.

For the purpose of the design of the Castleconnell FRS, an allowance has been made for operational conditions at Ardnacrusha that could, within reasonable contemplation, occur. In the event of one turbine being out of operation for maintenance or as a result of a mechanical failure, ¾ of the 345m³/s (258 m3/s) has been assumed to continue down the head race and the rest, ¼ (87m³/s) would pass over Parteen Weir into the Old River Shannon. In a planned situation, a spillway can be opened at Ardnacrusha and the flows along the canal maintained. However, as the spillway is not automatic, in an unplanned situation it cannot pass the full flow immediately. Therefore, a reduced flow down the head race must be considered in the

[67] ESB (2017) *Ardnacrusha Generating Station*. Available at: https://esb.ie/docs/default-source/education-hub/ardnacrusha-power-station.pdf?sfvrsn=38c739f0_3 [Accessed 03/01/2024]

design of the scheme. This scenario was discussed with ESB and the proposed development was designed based on this scenario.

This approach has been adopted to ensure that appropriate contingency is accommodated in the design of the flood relief scheme to afford a high level of flood protection to Castleconnell Village and the scheme area, allowing for limitations in operational conditions at the power station.

Water Services Infrastructure

Clareville Water Works is the intake for the Limerick Water Resource Zone, and is approx. 2.5km downstream of the site. The Clareville Water Works currently treats and delivers 48,000-50,000 m^3/day, which is about 2/3 of the capacity of the plant. 60% of the water from the plant is consumed by residents of the city, with the remainder supplying parts of County Limerick and County Clare[68].

Wastewater Treatment Plants

According to the Limerick Development Plan 2022-2028, 61% of private households in Limerick City and County are connected directly to the public sewerage network, which is below the state average of 65.9%. As of March 2022, Uisce Éireann estimated that 41 of the 53 wastewater treatment plants (WWTP) in Limerick had capacity available. These included Castletroy WWTP, which is approx. 8km downstream from Castleconnell. Castleconnell is part of the Castletroy WWTP agglomeration Castletroy WWTP, meaning wastewater from Castleconnell is treated at Castletroy WWTP. Castletroy WWTP has a capacity of 45,000 population equivalent (PE), and is currently operating at the upper limits of this capacity. The WWTP is compliant with Emission Limit Values (ELVs)[69]

Upgrades to the plant are currently planned by Uisce Éireann in partnership with Limerick City and County Council[70]. These upgrades will allow the plant to continue operating successfully as Limerick meets its population growth and industrial development targets. The planned upgrades will increase capacity to 77,500 PE.

Castleconnell Pumping Station No. 1, situated at the Scanlon Park/Island House junction on the Mall Road, is a secondary discharge point for Castletroy WWTP. Emergency overflows and storm water overflows both discharge from the same discharge point.

There is a second Uisce Éireann pumping station at Belmont Road. This is at risk of flooding, but is outside the scope of the FRS.

11.2.4 Waste

Waste management in the Limerick/Clare/Kerry region complies with the Waste Management Act 1996. Municipal waste from the city and county is normally collected by private waste contractors with waste collection permits. According to the Local Authority Waste Facility Register, there are 4 no. waste facilities that are registered in the Castleconnell area, and approx. 60 in Limerick City and County Council.

[68] https://www.limerick.ie/european-green-leaf-city/about/green-city/water

[69] Uisce Éireann (2020) *Annual Environment Report, Castletroy D0019-01*. Uisce Éireann

[70] https://www.water.ie/projects/local-projects/castletroy-wastewater-tre/

11.3 Predicted Impacts

11.3.1 Site Compounds

A small section of the western side of the main compound, plus large parts of the 2nd and 3rd secondary compounds, are within the 1% AEP flood extent (Figure 11-2). During construction, there is potential for a flood event to occur which would result in flooding of these compound areas. As potential pollutants are likely to be stored in the compounds, this could lead to indirect negative impacts on water, biodiversity, and human health. With no mitigation measures in place, this would result in a **temporary moderate negative impact.**

11.3.2 Roads, Traffic, and Transport

It has been estimated by the Design Team that HGV vehicle movements will be in the region of 12-19 vehicles per hour during the busiest period of construction works. Therefore, at peak times there will be >50 outward HGV trips in any one day. This is discussed further below.

Construction Phase

It is anticipated that the construction phase of the scheme will take approximately 18-24 months. During construction, impacts to traffic and access due to heavy vehicle movements, temporary road closures or one-way stop-and-go systems, and impacts on access to private properties will occur. These are discussed in detail in the sections below

Construction Vehicle Movements

During construction, HGV movements will be required. For the embankment works only, bulk excavations and removal of material are estimated to be 4-6 outward (i.e., leaving site) trips per hour over a period of approx. 6 months. Import of clay, fill and compact clay embankment material for the inward trip are estimated to be 4-6 trips per hour. This results in a total of 8-12 one-way HGV trips per hour over an approx. 6-month period due to embankment works.

For structural works, trench excavations and removal of material will require 2–4 trips per hour, while concrete delivery will require 2–3 trips per hour.

Total maximum construction vehicle movements are estimated to be approx. 12–19 one-way HGV trips per hour across an approx. 6-month period. Dependent on the contractor's approach, it is likely that construction works will be phased, and it is unlikely that all of the above activities will be happening on-site at once. Therefore, typical construction vehicle movements per hour will be lower than quoted above. This will result in an **intermittent, temporary slight negative impact.**

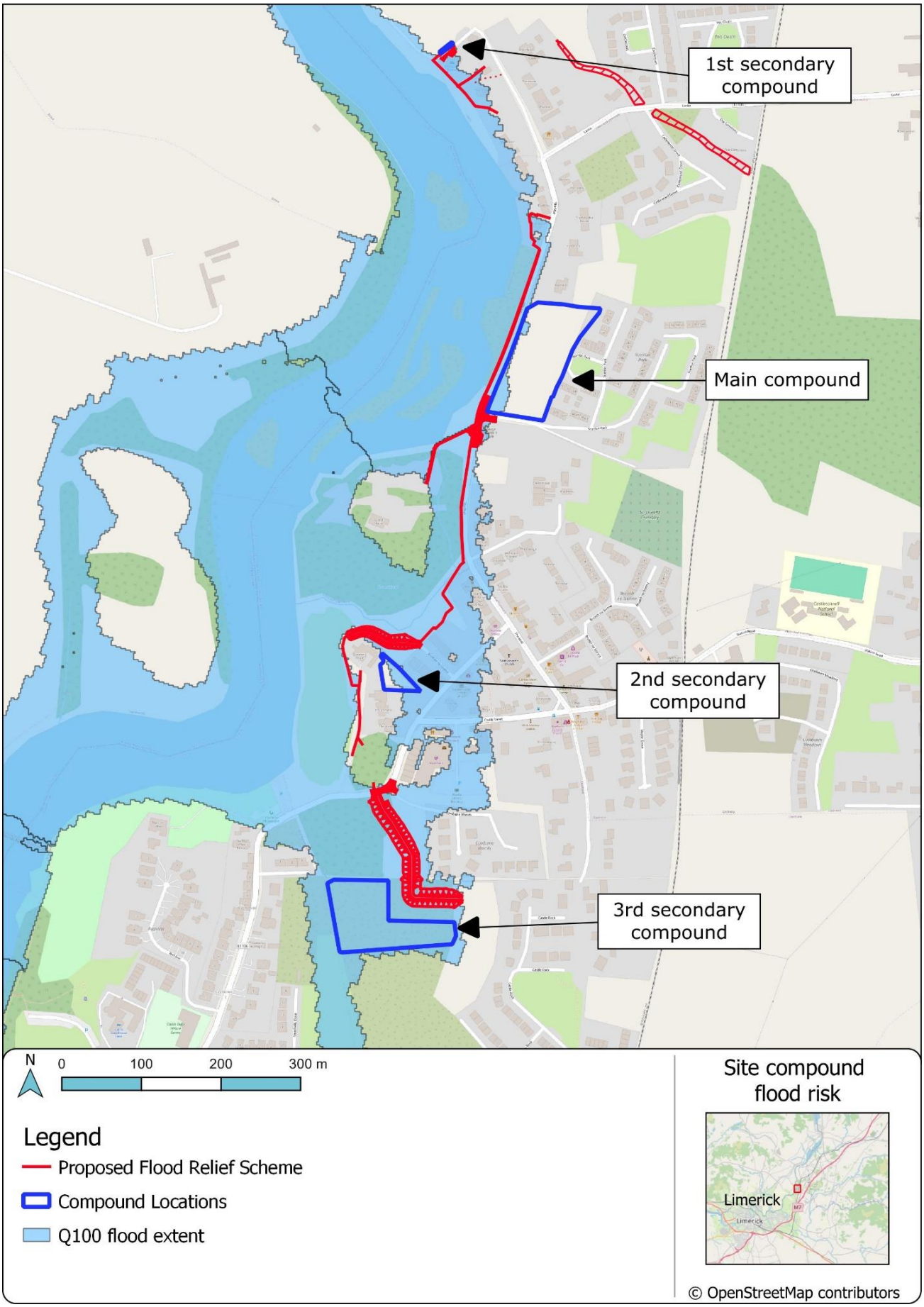

Figure 11-2: Construction compound flood risk

Impacts to Private Access

The construction works of the new flood wall along the northern property boundary of the Rivergrove B&B will result in the relocation of the main entrance. This will result in temporary disruptions to access to and from Rivergrove B&B.

The construction of the new reinforced concrete flood walls along the western and northern boundaries of Mall House will impact the existing boundary wall and the garden of the property and there will be temporary restricted access to the two properties located to the east of Mall House. It is also proposed that the access lane to the Dunkineely House is closed during the implementation of the works. These works will result in temporary disruptions to access for these households.

The raising of the Island House causeway will restrict private access to Island House for the duration of those works. Alternative arrangements will be required for the owners of Island House during construction.

It is proposed that the Stormont House access lane will be utilised for construction access. Access to the property will be impacted. Access through the Meadowbrook estate will be required to construct the flood embankment and flood wall resulting in controlled and restricted private access.

Construction access will be required at Coole house to facilitate the Cedarwood Stream culvert works. During the works, the householder will experience temporary disruption to their driveway and access.

The proposed works will result in temporary restrictions or disruptions to access for these properties. Without mitigation measures in place, these impacts will be **temporary moderate negative**, with impacts restricted to householders or those using the properties. The project team will work closely with the impacted residents and the contractor to minimise the impacts on residents.

Temporary Road Closures

During the proposed construction works, one lane of the Worlds End Road, located north of the Rivergrove B&B, will be closed temporarily. Raising of the road at Scanlon Park junction and Coolbane Woods junction will also require temporary phased lane closures. Access will be maintained through stop-and-go systems at each of these locations. The latter two locations are both expected to take approx. half a month each to complete. Construction at Rivergrove B&B will take up to 4 months, however disruption to one lane of the Worlds End Road will likely not last this long. Stop-and-go systems will be put in place at each of these locations, allowing traffic to continue to pass the works areas. Slight delays are likely to occur while the stop-and-go systems are in place. These impacts will be **temporary, slight, negative.**

Works along The Mall will be undertaken under temporary closure of The Mall Road, however the works will be appropriately phased in two sections. The first phase on Mall Road north, from Mall House to the Island House/Scanlon Park junction, will take approx. 3 months to complete, subject to the contractor's approach. In this time, this stretch of the Mall Road will be closed to vehicle traffic in both directions. The proposed public diversion routes are provided in drawing 19104-JBB-XX-XX-DR-C-2011_Traffic Plan, which is an approx. 5-minute diversion by car. Restricted access will be provided to the two properties along the north section of the Mall Road opposite Mall House. Access to Scanlon Park estate will be maintained through the Scanlon Park junction.

The second phase on Mall Road south, from the Island House/Scanlon Park junction to Maher's Pub will also take approx. 3 months to complete, dependent on the contractor's approach and site conditions. In this time, this stretch of the Mall Road will be closed to vehicle traffic in both directions. The proposed public diversion routes are provided in drawing 19104-JBB-XX-XX-DR-C-2011_Traffic Plan, which is an approx. 5-minute diversion by car. Restricted access will be provided to the four properties and the ESB sub-station located along the southern section of the Mall Road. Access to Tonville Road, Tonclose Road, and Tontines Road will be maintained. In both phases, pedestrian access along the Mall Road will be maintained along the eastern footpath.

Despite the full road closure, due to the short length of the diversion to be put in place and the fact that pedestrian access will be maintained, impacts due to closures of both sections of the Mall Road will be **temporary, slight, negative.**

The construction of a new reinforced concrete flood wall between Maher's Pub parking area and the wooded area to the west will be undertaken under temporary full closure of the parking area. The impact of this closure will be **temporary, slight, negative.**

Operational Phase

The proposed works along The Mall Road will result in a narrowing of the road to a minimum final road width of 5.5m and a footpath width of 1.8m. No negative impacts will occur as a result of road narrowing as the proposed minimum width is sufficient for traffic to pass on both sides, as in the existing road. During flood events, the proposed defences will protect the Mall Road from flooding and prevent its closure. This will result in an **intermittent, long term positive impact.**

There will be a Demountable Barrier placed across the Chapel Hill and Coolbane Woods junction during flood events. This is the main road into Castleconnell from the residential areas to the south. When operational, the structure will result in the temporary closure of the road. This will cause disruption, with people wishing to enter Castleconnell from south of the Coolbane Woods junction obliged to use an alternative route. Two alternative routes are available between Castleconnell and the areas to the south of Chapel Hill. These are via Belmont Road and the R445, or a longer route via the L1106 south to the L1106/R445/M7 junction, and then north via the R445.

The demountable barrier at Coolbane Woods junction, when in place will protect properties and business from flooding, but will cause an approximate 8-minute detour by car and approx. 45-minute to 1 hour detour walking. This will cause disruption and inconvenience residents and workers, as well as emergency services. However, this will occur infrequently, for events greater than the 1 in 10-year event, as calculated by the Design Team. A demountable barrier will also be placed at the entrance to Dunkineely House for events greater than the 1 in 2-year event, at the Fisherman's Entrance on the Mall Road for events greater than the 2-year event, and at the Island House entrance for events greater than the 1 in 10-year event, during flood events. The impact of these closures will be **intermittent, slight negative.**

The placement of the flood wall at Maher's Pub car park will result in a permanent loss of part of the car park. The impact of this loss will be **long-term slight negative** for the pub.

11.3.3 Utilities

Construction Phase

Utilities in Castleconnell

Utilities e.g., sewer networks and electricity network will require identification on the ground by the appointed contractor prior to work proceeding on the scheme. There will be temporary disruption to utilities during the construction stage from diversions and upgrades that will be required, which will result in **temporary slight negative** effects. All utilities will be reinstated resulting in no long-term impacts.

Services will be temporarily disrupted at the Rivergrove B&B including; the water connection to be relocated/replaced, the ESB overhead cable and an overhead telephone cable are to be diverted. There will be a new connection to the sewer main for Grange House. The following services will be diverted to the eastern side of The Mall Road reducing risk during construction; GNI distribution pipeline, ESB overhead cable, telephone overhead cable, Eircom cable ducts, surface water sewer on The Mall Road North and a combined sewer on The Mall Road South. At the Coolbane Woods junction, ESB will be engaged on whether a medium-voltage overhead cable is to be diverted prior to construction of the embankment.

Any disruptions to services will be agreed with the relevant service providers and the property owners. Impacts to utilities during construction will be **temporary, slight negative to negligible.**

ESB Infrastructure

Direct impacts are not expected to occur on the Parteen Weir or Ardnacrusha Power Station, due to the distance from the site and the nature of the proposed works. Indirect impacts are also not expected on either the Parteen Weir or Ardnacrusha Power Station.

Water Infrastructure

Direct impacts are not expected to occur on any other utilities, such as Clareville Water Works or Castletroy Wastewater Treatment Plant, due to their distance from the site.

Indirect impacts could occur downstream at either of these two facilities due to an accidental spill or leak on site during construction, or due to increased sedimentation of surface water leaving the site. Due to the distance downstream and volume of water passing through Castleconnell and past the two facilities, the indirect impact on them with no mitigation measures in place would be **temporary, slight, negative.**

Operational Phase

Once the proposed development is operational, no impacts to utilities are expected to occur. The proposed development has been designed with the operational conditions of Parteen Weir and Ardnacrusha Power Station in mind, in consultation with ESB. The operational impact on utilities will therefore be **neutral**.

11.3.4 Waste

Construction Phase

Demolition of walls is required at the following locations:

- Northern properties;
- Grange House and Rivergrove B&B;
- Mall House;
- The Mall Road;
- Maher's Pub;
- Meadowbrook Estate; and
- Stormont House

This will result in approx. 990m^3 of material. The majority of this will be disposed of as waste and will be removed to an approved waste recovery facility. A portion of the demolition volume will be reused as wall cladding on the new flood wall along Mall Road.

Approximately 130m^3 of concrete waste will be generated, as will approx. 530m^3 of waste during paving and road works.

Most waste will be generated due to excavation of soil. Approximately 33,000m^3 of soil will be excavated, with approx. 11,800m^3 of that amount reused on site to backfill excavations. The remaining 21,300m^3 of excavated material will be removed from the site as waste to an appropriate licenced soil recovery facility. Alternatively, the contractor can reuse this material on another site as a by-product while adhering to Article 27 of the EC (Waste Directive) Regulations (2011). This would further reduce the volume of waste generated during excavation.

Small volumes of general construction waste will be generated, typical of construction activities. This will be collected, segregated, and disposed of by licensed waste contractors.

The construction phase impact on waste will be **temporary slight negative**.

Operational Phase

Once the proposed development is operational, no waste will be generated. The operational impact on waste will therefore be **neutral**.

11.4 Mitigation Measures

11.4.1 Site Compounds

The following mitigation measures will be put in place in relation to flood risk at site compounds:

- The 2nd and 3rd secondary compounds will be used for the temporary storage of excavated and imported materials for the construction of embankments only. Any lubricants, oils, fuels, cement or other potentially harmful chemicals or substances will be stored in the main compound.
- Lubricants, oils, fuels, cement or other chemicals will be stored in sealed containers in a bunded area. This storage area will be located in the main compound, outside the flood extent shown in Figure 11-2.
- The contractor will only store a manageable quantity of materials in the secondary compounds at any one time. The contractor will also import and export soil continuously, to limit the quantity of soil stored on site at one time.
- At present, a flood risk text alert system is in operation for residents of Castleconnell. This system will be extended for use by the contractor, who will monitor flood risk and remove any heavy machinery, materials, or substances from flood zones prior to a predicted flood event.

11.4.2 Roads, Traffic, and Transport

Construction Phase

Construction Vehicle Movements

Construction vehicles will be required to adhere to the Construction Traffic Management Plan (CTMP) to be prepared by the appointed contractor. The CTMP will include the following:

- Adherence to relevant laws, regulations, and standards governing construction activities and traffic management. Key aspects will be adherence to traffic regulations, permitting and licensing, environmental regulations, health and safety standards, local authority requirements, emergency response plans, and public consultation;
- Deliveries will be limited to working hours (08:00 to 19:00 Monday to Friday, 08:30 to 14:00 Saturday, and none on Sundays or public holidays, or as determined by the County Council);
- Construction vehicles will use the haul route as shown on Figure 4.3. This utilises the M7 and National Roads, and avoids the use of Castleconnell Town Centre where possible. Some limited use of the centre of Castleconnell will likely be required due to the location of proposed works (e.g., Meadowbrook Estate and Maher's Pub car park), however this will be kept to a minimum;
- A wheel wash facility will be setup if required to ensure that sediment does not leave site and get deposited on roads to and from the site. Periodic road cleaning around the site will also take place if required; and
- All necessary traffic safety precautions shall be undertaken by the Contractor to ensure the safety of all traffic and pedestrians using the existing roads adjacent to the site and connecting minor roads during the execution and completion of the Works, and all precautions shall be taken to minimise disruption to the local residents.

Temporary Road Closures and Private Access Impacts

During the flood relief works at Rivergrove B&B and Grange House a single lane closure will be required at Elvers Road for the duration of the works. It is proposed that a Stop-and-Go traffic management system is implemented at Elvers Road during the construction phase. Access to all properties located north of Rivergrove will be facilitated by the single lane access at the Worlds End Road. Access to Rivergrove B&B will be through the same Stop-and-Go traffic management system, while continuous access to Grange House will be facilitated by means of a traffic management system along with adequate site segregation within the property. Appropriate phasing of construction works will enable access to the properties in a safe and controlled manner. This system will be in place for up to 4 months.

The Mall Road will be fully closed in two phased sections as detailed in Section 11.3.2 above; the first phase will require road closure from the Mall House up to the Island House entrance/Scanlon Park Junction, and

the second phase will require road closure from the Island House entrance/Scanlon Park Junction down to Maher's Pub car park. In both cases, restricted access will be provided to properties directly affected along the stretch of closed road, with a stop-and-go traffic system in place at the Scanlon Park junction. Access to properties from Tonville Road, Tonclose Road and Tontines Road will be maintained through phasing the proposed construction works and implementing a Stop-And-Go traffic management system at the junction. All other access from the south to the north of Castleconnell, and vice versa, will be maintained by an alternative route through Station Road, Railway Road, the R525, Commons Road and Elvers Road. Each phase will last for approx. 3 months, meaning disruptions to the Mall Road will take approx. 6 months in total. Access for pedestrians along Mall Road will be maintained throughout the construction phase. Advance notice of the works will be communicated to all residents in Castleconnell via leaflet drop.

During the flood relief works at Meadowbrook Estate, appropriate traffic management systems will be put in place to facilitate access from The Mall Road to Maher's Pub parking area. Access through the Meadowbrook Estate will be required to construct the flood wall along the estate house and the flood embankment to the north of the estate, this will result in controlled and restricted private access. The construction of the flood walls and tie-in embankment at Stormont Property and Meadowbrook Estate will be phased appropriately, once the flood walls have been constructed

During the flood relief works at Stormont House, a traffic management system will be implemented. Restricted private access will be maintained and managed, through a temporary access lane and/or by phasing the works to allow restricted access through the raised road.

The flood relief works at Coolbane Woods junction will be implemented in phases facilitating continuous traffic access at the junction. A Stop-And-Go traffic management system will be utilised controlling construction and traffic.

All traffic management proposals will be agreed with Limerick City & County Council and the relevant property owners prior to commencement of the works.

Once the proposed mitigation measures are put in place, impacts to roads, traffic and transport during construction will be **temporary, slight, negative.**

Operational Phase

Once operational, no impacts on traffic and transport are expected outside of flood events, and therefore no mitigation measures are required.

During flood events, demountable flood barriers will be erected at the Coolbane Woods junction and the entrance to Island House (for events greater than the 1 in 10-year event), the entrance to Dunkineely House (for events greater than the 2-year event), and at the fisherman's entrance on Mall Road (for events greater than the 2-year event). Before this occurs, advance notice will be given to the affected property owners (in the case of Dunkineely House and Island House) and to residents of Castleconnell and the wider area in general (for Coolbane Woods junction and the fisherman's access). An alternative route will be in place for the Coolbane Woods junction, via Belmont Road, R445, R525, and Station Road. Advance notice of this closure will be given, and signage will be erected highlighting the alternative route to be taken.

11.4.3 Utilities

Construction Phase

Any disruptions to services will be agreed with the relevant service providers and will be communicated in advance to the relevant property owners. Further mitigation measures for utilities are not required.

Mitigation measures outlined in Chapter 10 for the protection of surface and groundwater will further reduce potential for impacts on Clareville Water Works and Castletroy Wastewater Treatment Plant. With these mitigation measures in place the potential impact on these utilities during construction will be negligible.

Operational Phase

As no impacts on utilities are expected once operational, no mitigation measures are proposed for the operational phase.

11.4.4 Waste

Construction Phase

A Resource Waste Management Plan (RWMP) will be produced by the appointed contractor to help manage, reduce, and dispose of waste arising during the construction phase. The RWMP will outline waste reduction techniques, guidelines to be followed, and the waste disposal streams to be used during the development. All construction waste will be segregated and removed to an approved location.

A key waste reduction strategy will be reuse of material where feasible. Over one third of excavated soil will be reused as backfill on site. The contractor will also explore other reuse options off-site, such as reuse as a byproduct under Article 27. These strategies will reduce the amount of material being exported off-site as a waste.

With the CEMP and proposed RWMP in place, the impact on waste during the construction phase will be **temporary, slight, negative.**

Operational Phase

As no impacts on waste are expected once operational, no mitigation measures are proposed for the operational phase.

11.5 Residual Impacts

11.5.1 Site Compounds

With the proposed mitigation measures outlined in Section 11.4.1 in place, flooding is not likely to negatively impact the site compounds. The residual impact to site compounds will be **temporary, imperceptible, negative.**

11.5.2 Roads, Traffic, and Transport

The CTMP will take into account construction vehicles and mitigate against any issues with vehicles on public roads, minimizing the impacts to the public road network during construction stage. Appropriate phasing of construction works will enable access to affected properties in a safe and controlled manner, with the exception of Island House which will not have access during the works to the entrance causeway; alternative arrangements will be made with the owners of Island House for this period. Once the proposed mitigation measures are put in place, the residual impact to roads, traffic and transport during construction will be **temporary, slight, negative.**

During the operational phase, no impacts on roads, traffic and transport are expected outside of flood events. Before the erection of the demountable flood barriers in advance of a flood event, advance notice will be given to the affected property owners (in the case of Dunkineely House and Island House) and to residents of Castleconnell and the wider area in general (for Coolbane Woods junction and the fisherman's access). An alternative route will be in place for the Coolbane Woods junction, via Belmont Road, R445, R525, and Station Road. Advance notice of this closure will be given, and signage will be erected highlighting the alternative route to be taken. During flood events, the residual impact on roads, traffic and transport will be **intermittent, temporary, slight negative** due to these limited closures.

11.5.3 Utilities

Mitigation measures discussed in previous sections will reduce the environmental impact of the proposed development however, there are some impacts that cannot be avoided in the short term, such as short-term disruptions to watermains, foul sewer, ESB or gas stoppages for several hours during the connection of services. Residents will receive notices if stoppages are foreseen. There are no additional impacts expected

once services are introduced. The overall residual impact during the construction phase from the relocation of services has been assessed as **temporary, imperceptible, negative.**

11.5.4 Waste

Mitigation measures such as the reuse of materials where feasible and the production of a RWMP will be put in place. The overall residual impact on waste has been assessed as **temporary, imperceptible, negative.**

11.6 Interactions

Impacts to material assets have the potential to interact with the following environmental factors:

Soil and Geology, discussed in Chapter 9: The excavation of material will directly interact with the soil and geology environment at the site. Impacts such as soil compaction, removal of soil from site, and import of new material will affect soil quality and quantity. Mitigation measures such as the safe sourcing of imported material, and reuse of material on site, will ensure that interactions between these effects are not significant.

Population and Human Health, discussed in Chapter 7: Impacts to access and roads will likely affect the population of Castleconnell and their daily activities during the construction phase, and during operation when the demountable flood barriers are in place.

Water, discussed in Chapter 10: Impacts arising from construction vehicle movements, interactions with utilities on-site, and waste generation are all likely to interact with the surface water and groundwater environments. There is also the potential for a flood event to occur during construction, which would be influenced by the Parteen Weir and Ardnacrusha Power Station. Mitigation measures outlined in this chapter and in Chapter 10 will ensure that the interaction of these impacts is not significant.

11.7 Cumulative Impacts

The cumulative effects of the proposed development in combination with other relevant projects outlined in Chapter 15 have been assessed to determine whether these would give rise to significant effects on the environment.

The removal of the intervening aggregate reserve c. 1.47ha. and 80,000m^3 of aggregate at Gooig, Castleconnell, will result in a large number of trucks due to the volume of material to be removed. If that work coincides with the construction phase of the proposed development, the number of additional trucks on the roads would result in negative impacts. However, due to the location of the aggregate reserve, trucks leaving there will not need to pass through Castleconnell.

12 Cultural Heritage

12.1 Methodology

12.1.1 Introduction

This chapter describes the proposed flood alleviation measures for the Castleconnell FRS and assesses the potential impact on archaeological, architectural heritage and cultural heritage assets. The methodology has been designed so a full understanding of the potential effects on the character of the historic landscape can be assessed. A detailed archaeological and historical background has been included which describes the character of the immediate and wider historic landscape, as well as the individual heritage assets, and highlights the potential to reveal subsurface features. The methodology used is based on the EPA Guidelines (EPA 2022[71]), and both direct physical effects, as well as impacts to the setting of individual heritage assets, have been assessed. The assessment of the proposed scheme includes a comprehensive consideration of the potential direct, indirect, residual and cumulative impacts and includes, where applicable, an assessment of visual impacts on cultural heritage constraints.

12.1.2 Defining Cultural Heritage

The EPA (2022[1]) includes under the heading of Cultural Heritage;

Archaeology

- Known archaeological monuments;
- Areas of archaeological potential (including unknown archaeology);
- Underwater archaeology;

Architectural heritage

- Designated architectural heritage;
- Other significant architectural heritage; and

Folklore and history

- Designations or sensitivities.

Cultural heritage as set out in the Environmental Protection Agency (EPA) Guidelines on Information to be Contained in Environmental Impact Assessment Reports (hereafter referred to as the EPA Guidelines) (EPA 2022[1]) includes archaeology, architectural heritage, folklore and history. It is a broad term that includes a wide range of tangible and intangible cultural considerations. Cultural heritage can relate to settlements, former designed landscapes, buildings and structures, folklore, townland and placenames, and historical events, as well as traditions (e.g. mass paths and pilgrim ways) and traditional practices (e.g. saints' pattern days).

Cultural heritage is part of our cultural identity and contributes to defining a sense of place. The value of a strong sense of place is likely to become more important as the world grows increasingly homogenised. Recognising the unique sense of place in our towns and villages, whilst also respecting the individual heritage assets, is critical.

Cultural heritage assets are valued for the important contribution they make to the understanding of the history of a place, an event or people. Sites of cultural heritage interest are often afforded protection either

[71] EPA (Environmental Protection Agency) (2022) 'Guidelines on the information to be contained in Environmental Impact Assessment Reports'. EPA.

as national monuments, recorded archaeological monuments (on the Record of Monuments and Places (RMP)/Sites and Monuments Record (SMR)) or as protected structures (on the Record of Protected Structures (RPS) in the relevant City or County Development Plan), or as structures within the National Inventory of Architectural Heritage (NIAH) (the various designations[72] are defined in Appendix 12.3 in Table 12.3).

Each of these provides a unique cultural record and acts as a carrier of memory, meaning and cultural value. When considered in its wider context, they can form an essential component in the mechanism for analysing the broader cultural character and context of an area. Together, these can assist in mapping the changes that have led to the development of the modern environment. Such analysis provides insight into the communication, trade, transport, growth and associations of past societies.

As part of the reporting process, the chapter assessed and collated information from archaeological and conservation assessments and investigations conducted to inform this scheme, namely:

- Appendix 12.1 Legislation, Standards and Guidelines
- Appendix 12.2 Local Authority Policies in Relation to Cultural Heritage
- Appendix 12.3 Glossary of Impacts and Assessment Methodology
- Appendix 12.4 Inventory of Cultural Heritage Sites Within and in Proximity to the Proposed FRS
- Appendix 12.5 Inventory of Cultural Heritage Sites Within 100m not Subject to Impact
- Appendix 12.6 Archaeological Monitoring of Site Investigations
- Appendix 12.7 Archaeological Wade & Metal Detection Survey
- Appendix 12.8 Archaeological Test Excavation
- Appendix 12.9 Conservation Architecture Report (Southgate Associates)

12.1.3 Study Area

The Flood Relief Scheme (FRS) study area is centred on the village of Castleconnell, the boundary of which is defined by the Castleconnell Local Area Plan (LAP) (Limerick City & County Council 2022a[73]).The constraints study and options study (O' Brien 2019[74]; 2022[75]) for the FRS scheme examined the designated cultural heritage sites within this area (Figure 12-1). Using data from initial stages of the FRS, this Environmental Impact Assessment Report (EIAR) considers sites and their settings within 100 meters of the proposed flood measures; these sites are discussed in the context of the cultural heritage environment to understand and characterise the character, context and significance of the archaeological, architectural and cultural heritage environment that falls within and surrounding the proposed FRS. To ascertain the likely and significant effects of the proposed development on Archaeology, and, Architectural Heritage and Cultural Heritage sites, the study area for the assessment included all sites in the immediate vicinity of each of the flood measures.

This methodology has ensured that a robust assessment has taken place on all recorded cultural heritage assets within and in proximity to the proposed development and that the likely and significant impacts are considered.

[72] World Heritage Properties, National Monuments, Recorded Monuments, Protected Structures, Architectural Conservation Areas, NIAH and Undesignated Sites

[73] Limerick City & County Council (2022a) 'Castleconnell Local Area Plan 2023-2029'. Limerick: Limerick City & County Council.

[74] O' Brien, Y. (2019) 'Castleconnell Flood Relief Scheme, Castleconnell, Co. Limerick. Cultural Heritage Constraints Study'. Unpublished report: Courtney Deery Heritage Consultancy Ltd.

[75] O' Brien, Y. (2022) 'Cultural Heritage Options Assessment Report. Castleconnell Flood Relief Scheme, Co. Limerick'. Unpublished report: Courtney Deery Heritage Consultancy Ltd.

The proposed scheme will not result in any changes to flooding outside of the protected areas and it was consequently not necessary to expand the study area to include areas of redirected floodwater.

Figure 12-1: Assessment Study Area

12.1.4 Relevant Guidelines, Policy and Legislation

This EIAR chapter will be guided by the methodologies and recommendations outlined in 'Archaeology and Flood Relief Schemes: Guidelines' (NMS 2023[76]). These guidelines have been prepared by the National Monuments Service (NMS) of the Department of Housing, Local Government and Heritage (DHLGH) to provide a framework for the integration of archaeology in Flood Relief Schemes (FRS).

A full list of legislation, standards and guidelines that were consulted to inform the assessment are contained in Appendix 12.1 in Volume 3 of this EIAR along with excerpts from the principal legislation governing archaeology, the National Monuments Acts 1930-2014. The Historic and Archaeological Heritage and Miscellaneous Provisions Act 2023 was enacted in October 2023 and this this Act is now law. The Minister for Housing, Local Government and Heritage commenced certain provisions in May 2024 (S.I. No. 252/2024); however, until the Act is fully commenced, the National Monuments Acts have therefore not yet been repealed and remain in force.

The Limerick Development Plan (2022-2028[77]) and Castleconnell Local Area Plan (2023-2029[78]) outline specific policies and objectives for the archaeological heritage in the county, these are outlined in Appendix 12.2 in Volume 3 of this EIAR.

12.1.5 Desk Study

The desk study availed of the following sources:

- UNESCO World Heritage Sites (WHS) and Tentative World Heritage Sites and those monuments on the tentative list;
- National Monuments in State care, as listed by the National Monuments Service (NMS) of the Department of Housing, Local Government and Heritage (DHLGH);
- Sites with Preservation Orders;
- Sites listed in the Register of Historic Monuments;
- Record of Monuments and Places (RMP) and the Sites and Monuments Record (SMR) from the Archaeological Survey of Ireland; The statutory RMP records known upstanding archaeological monuments, their original location (in cases of destroyed monuments) and the position of possible sites identified as cropmarks on vertical aerial photographs. Archaeological sites identified since 1994 have been added to the non-statutory SMR database of the Archaeological Survey of Ireland (National Monuments Service, DHLGH), which is available online at www.archaeology.ie and includes both RMP and SMR sites. Archaeological sites identified since 1994 are placed on the SMR and are scheduled for inclusion on the next revision of the RMP;
- Record of Protected Structures (RPS) listed in the in the Limerick Development Plan (2022-2028[79]);County Councils Architectural Conservation Areas (ACAs) and their statements of character;
- National Inventory of Architectural Heritage (NIAH) Building Survey (NIAH ratings are international, national, regional, local and record, and those of regional and above are recommended for inclusion in the RPS);
- National Inventory of Architectural Heritage (NIAH) Garden Survey (paper survey only);
- Topographical files: review of artefactual material held in the National Museum of Ireland;
- Archaeological Inventory of County Limerick;

[76] NMS (National Monuments Service) 2023. 'Archaeology and Flood Relief Schemes: Guidelines'. Department of Housing, Local Government and Heritage.

[77] Limerick City & County Council (2022b) 'Limerick County Development Plan 2022-2028'. Limerick: Limerick City & County Council.

[78] Limerick City & County Council (2022a) op. cit.

[79] Limerick City & County Council (2022b) 'Limerick County Development Plan 2022-2028'. Limerick: Limerick City & County Council.

- National Monuments Service Wreck Viewer;
- Cartographical Sources, OSi Historic Mapping Archive, including early editions of the Ordnance Survey including historical mapping (such as Down Survey 1656 Map);
- The Irish archaeological excavations catalogue i.e., Excavations bulletin and Excavations Database;
- Place names; Townland names and toponomy (loganim.ie);
- National Folklore Collection (Duchas.ie);
- Local Authority survey of industrial heritage (Limerick City & County Council 2019[80]);
- Limerick Development Plan (2022-2028[81]): A Summary of relevant Limerick County Council Policies in relation to Cultural Heritage is provided in Appendix 12.2 in Volume 3 of this EIAR;
- Castleconnell Local Area Plan (2023-2029[82]): A summary of relevant Castleconnell LAP Policies in relation to Cultural Heritage is provided in Appendix 12.2 in Volume 3 of this EIAR;
- A review and interpretation of aerial imagery (OSI Aerial Imagery 1995, 2000, 2005, Aerial Premium 2013-2018, Digital Globe 2011-2013, Google Earth 2001–2023, Bing 2023) to be used in combination with historic mapping to map potential cultural heritage assets;
- Collation of information from similar or other infrastructure projects in proximity to the proposed scheme, for example EISs, SEAs, conservation plans, archaeological test assessments and excavations.
- A review of existing guidelines and best practice approaches.

A bibliography of sources used is provided in the References section.

12.1.6 Field Survey

Castleconnell was visited on a number of occasions for the EIAR, on the 9th February 2023, 23rd and 24th April and the 16th of July 2024 by Dr Yolande O' Brien and Siobhán Deery of Courtney Deery Heritage Consultancy. In order to assess the potential impact from the proposed FRS, the aim of the field survey was to assess the character and setting of the recorded cultural heritage features, to identify any low-visibility archaeological features with little surface expression, and to identify properties, structures or features considered to be of architectural or cultural heritage merit or areas of archaeological potential.

12.1.7 Archaeological investigations

Archaeological monitoring of geotechnical site investigations (Licence no.: 20E0542, 20R0204; McCarthy & Haskins[83]) was undertaken in June, September and October 2020.

An underwater archaeological impact assessment (UAIA) which included a wade and metal detection survey was carried out by Courtney Deery Heritage Consultancy out along two stretches of the Cedarwood Stream in Lacka townland, to the north of Castleconnell. It was carried out under licence to the National Monuments Service (NMS) DHLGH under Dive Licence Ref. No: 23D0117 and Detection Licence Ref. No: 23R0558.

Archaeological test trenching was also carried out by Courtney Deery Heritage Consultancy on the 23rd and 24th April and 25th July 2024 across the proposed embankments at Stormont House and Coolbane Woods. It was carried out under licence to NMS DHLGH under Licence Ref. No. 24E0386. The surveys

[80] Limerick City & County Council (2019) 'Evolutionary Study Report on the Maritime, Military and Industrial Heritage of Limerick City and County'. Limerick: Limerick City & County Council.

[81] Limerick City & County Council (2022b) op. cit.

[82] Limerick City & County Council (2022a) 'Castleconnell Local Area Plan 2023-2029'. Limerick: Limerick City & County Council

[83] McCarthy, J. & Haskins, C. (2021) 'Castleconnell Flood Relief Scheme, Site Investigation Works, Archaeological Monitoring Report'. Licence no.: 20E0542, 20R0204. Unpublished report: Mizen Archaeology.

took place to inform the decision-making process and to provide greater certainty as to the below ground potential throughout the scheme.

The monitoring report, UAIA, testing report are summarised in this chapter and the full reports are provided in Appendix 12.6, 12.7 and 12.8 respectively.

12.1.8 Data Analysis Mapping

Previous phases of the proposed FRS involved the compilation and mapping of available cultural heritage data sets (O' Brien 2019[84]; 2022[85]). The outputs of the project included GIS layers and the creation of a database for archaeology, architectural heritage and as far as possible, cultural heritage, as well as associated mapping. This formed a permanent renewable database that can be utilised by multiple specialist users to provide information for the project design and the EIA process. This phase of the project has updated the GIS and mapping for the project with the latest data from statutory authorities and the design team, as well as additional features identified through further desk-based study and fieldwork.

The locations for all archaeological and cultural heritage assets identified in the course of the assessment have been mapped and are shown on map figures throughout this chapter. The coordinates for each asset are provided in Irish Transverse Mercator (ITM) in the inventory of archaeological and cultural heritage sites in Appendix 12.4 in Volume 3 of this EIAR.

12.1.9 Appraisal Method for the Assessment of Impacts

Archaeological and cultural heritage sites are considered to be a non-renewable resource and cultural heritage material assets are generally considered to be location sensitive. In this context, any change to their environment, such as construction activity, ground disturbance works and changes to setting, could adversely affect these sites. Similarly, architectural heritage is a unique and irreplaceable material asset which is given value by its design, setting, quality of workmanship and use of materials. In this context, any change to the architectural heritage fabric, structure and setting, resulting from construction and operation activity, may adversely affect these sites.

The likely significance of all effects is determined in consideration of the magnitude of the impact and the baseline rating upon which the impact has an effect (i.e., the sensitivity or value of the cultural heritage asset). Having assessed the potential magnitude of effect with respect to the sensitivity/value of the asset, the overall significance of the effect is then classified as not significant, imperceptible, slight, moderate, significant, very significant, or profound as per the EPA guidance (2022).

A glossary of impact assessment terms, including the criteria for the assessment of effect significance, is contained in Appendix 12.3 in Volume 3 of this EIAR.

12.1.10 Consultation

Consultation has been undertaken with the wider Project Team, including designers and landscape/visual specialists to ensure that cultural heritage considerations have been duly considered in the design and assessment phases.

During the initial phase of the project, discussions were held with the Executive Archaeologist and the Conservation Officer of Limerick City and County Council on matters related to cultural heritage.

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[84] O' Brien, Y. (2019) 'Castleconnell Flood Relief Scheme, Castleconnell, Co. Limerick. Cultural Heritage Constraints Study'. Unpublished report: Courtney Deery Heritage Consultancy Ltd.

[85] O' Brien, Y. (2022) 'Cultural Heritage Options Assessment Report. Castleconnell Flood Relief Scheme, Co. Limerick'. Unpublished report: Courtney Deery Heritage Consultancy Ltd.

The Scoping Report was submitted to the Development Applications Unit (DAU) of the National Monuments Service by way of initial consultation. A detailed response was received through the DAU (Ref.: G Pre00273/2023) which outlined the potential impacts of flood relief scheme and recommended investigations and mitigation measures. These have been considered throughout the assessment. Both online and on-site meetings were held with the Underwater Archaeological Unit National Monuments Service (NMS), and the National Built Heritage Service (NBHS) from the Department of Housing Local Government and Heritage, these are discussed in Section 12.5.1 and in detail in Chapter 5 of the EIAR. As a result of these meetings numerous design mitigation measures have been made in relation to the built heritage which have been developed in consultation with conservation engineers Southgate Associates.

12.1.11 Limitations or difficulties encountered

No difficulties were encountered during the compilation of this chapter.

12.2 Receiving Environment

12.2.1 Archaeological and Historical Background

Introduction

The following provides a chronological account of the development of the study area spanning from the prehistoric to modern period. It illustrates the archaeological, architectural and cultural heritage character, as well as context and archaeological potential, of the study area. Additional detailed historical and cartographic background and descriptions for specific archaeological sites and historic properties in proximity to the FRS measures are provided in Appendix 12.4.

The eastern border of Limerick is covered by portions of the bishopricks of Killaloe, Cashel and Emly. They roughly represent the old states of Ara, Coonagh, Uaithne, Grian and Aherloe. Castleconnell lies within the diocese of Killaloe in the parish of Clanwilliam. The land that surrounds the town consists of both arable and pasture land and to the north is reclaimable bogland on the banks of the Shannon River.

Prehistoric Activity (c. 8000BC – AD 400)

The Leap of Doonass, located just outside of the study area between Hermitage, Co. Limerick, and Doonass Demesne, Co. Clare, is the location of powerful rapids at the narrowest point of the River Shannon. It made it a particularly important location for salmon catching which no doubt attracted activity in prehistory. It also required those traveling by boat to disembark and to carry their vessel or to meet another one on either side of the rapids. This made it a strategic location for control of the area up until early modern times.

The vicinity of Castleconnell is of particular significance for prehistoric studies, following the discovery of two cremations of Early Mesolithic date, the oldest recorded burial in Ireland, in the townland of Hermitage to the south of the study area (Licence no.: 01E0319; Collins & Coyne 2003[86]; 2006[87]). The discovery comprised of the cremated bones of a probable male adult within a subcircular pit. A posthole was found in the base of the pit, and the cremated remains appeared to have been placed around the former post, which may have functioned as a burial marker. A polished stone axe head and two burnt microliths, all of which showed signs of burning, were placed within the burial pit. The second burial was a large pit containing a small amount (possibly a token burial) of burnt bone of indeterminate sex, heat-shattered stone and pieces of burnt and baked clay, suggesting the remains were shovelled from fire to pit. Radiocarbon dating

[86] Collins, T. & Coyne, F. (2003) 'Fire and Water… Early Mesolithic Cremations at Castleconnell, Co. Limerick' in Archaeology Ireland. Volume 17, No. 2. Wicklow: Wordwell.

[87] Collins, T. & Coyne, F. (2006) 'As old as we felt…' in Archaeology Ireland. Volume 20, No. 4. Wicklow: Wordwell.

demonstrated that the first burial dated to c. 7400BC, while the second was from c. 7000BC. Two more cremations were found which were of later date (6610-6370 cal. BC and 2310-1750 cal. BC).

Twelve axes in total were found, including an adze, as well as worked flint and chert pieces. The quantity of axes suggests that this was an important fording point at the time, and several other fording points on the River Shannon (e.g., Killaloe) were sites of significant deposition of polished stone axes. It is possible that the fording point at Castleconnell was the reason for the siting of these burials and the river was likely wider at the time, making these features closer to the river course than they now appear.

Given that only a small area was excavated as part of the Castleconnell Sewerage Scheme, they may be part of a larger group of features. A geoarchaeological landscape assessment of the Hermitage environs (Licence no.: 18E0356) included augurs which suggest that further Mesolithic activity may be preserved in the area. Furthermore, the quantity of polished stone axes may suggest Neolithic settlement in the vicinity. Although Mesolithic examples of this artefact exist, such as the one in the cremation pit, it is an object more usually associated with the Neolithic period.

Early Medieval Period (400-1200)

This area is in the ancient territory of the '*Tuath Luimeach'* and was held by the Uí Chonaing or O'Gunnings. Castleconnell was known as *Mur mic an Duinn* or the Fortress of the son of Donn. Donn was well known in Celtic mythology, and it is likely his son is Eogabal, father of *Fer Fill* and *Áine* of Knockainy, Gods of the *Eoghanachta*. The later name of Castleconnell is also related to this group, being derived from *'Carrig-Cnuil'* (the fort of the O'Gunnings). Their lands stretched along the Shannon over the Tuath Luimneach, to the east of the Maigue, and to the north of Crewally, or Knocknagall. The Gunning's were Eoghanacht chieftains, kinsmen of the O'Brien's, until they were ousted by the O'Brien's and Bourke's. The fort was later a stronghold of the O' Briens of Thomond.

The small church at Cloon Island-or *Inis Cluan* 'the Island of the Meadow' on (RMP LI001-004001[88]) is traditionally said to have been a friary founded in the 13th century, there is evidence however that this was originally an early medieval foundation that may date to the 11th century. The church was located on a small island within the River Shannon joined to the mainland by a 23feet wide causeway. In particular, there are two early Christian cross slabs (RMP LI001-004002/3) incorporated into the gable of the church. The provenance of the church is also uncertain and the name of Cloon Island, being a Gaelic name, also suggest an early Christian monastery. Tradition also records that Cloon House was built on the site of a holy well (SMR LI001-004004), the presence of which is consistent with early medieval foundations. One the cross-slabs (RMP LI001-004002) is carved with a Greek cross, and some indistinct markings may be part of an Ogham inscription. The other (RMP LI001-004003) is carved with a Latin cross.

Medieval Period (1200-1600)

Castle Connell (RMP LI001-003[89]) stands on the summit of an isolated rock close by the town and within a short distance of the River Shannon. The castle is an important strategic point for holding the upper reaches of the river. The castle helped guard the passes from Killaloo and the flank of the dangerous Slieve Phelim hills, grouped around Kimalta. In 1199 King John granted five knight's fees to William de Burgh, including this parish, with a condition that he should erect a castle thereon (Lenihan 1866[90], 727). This and the

[88] See Appendix 12.4 for further details on this site.

[89] See Appendix 12.4 for further details on this site.

[90] Ferrar, J. 1787. 'An Essay on Castle Connell Spa, On Water in General and Cold Bathing, in The History of Limerick: Ecclesiastical, Civil and Military, From the Earliest Records to the Year 1787.

adjoining parishes were the first places in Limerick where the English obtained a foothold (ibid). It is thought there may have been an earlier timber castle on the site (Hannon[91] 1984).

The castle was described by Westropp (1906-7, 83-5) as following; 'There was a residence called *Caslaun Uí Chonaing* (the castle of the O'Gunnings) in 1174, where Dermot and Mahon O'Brien were blinded by their relative King Donald. The Prince of Thomond had left his followers on the other side of the Shannon to be received by the O' Brien's, but they crossed the river by night and ambushed the fort. The Annals of the Four Masters (O'Donovan 1966[92]) record that in the year 1200, the bawn wall of the castle was burnt by Crovderg O'Connor.

This name and its Norman counterpart 'Castro Iconing' (-konyng, -conyn) appear in many documents from its grant to William de Burgo from King John in 1201 who is noted to having said 'If he fortify the castle, and we desire to have it we will give him a reasonable rate' in the Ware's Annals (Ferrar 1786[93]). He also came into possession of it through marriage to Domhnall More O'Brien's daughter.

By 1242 the castle was held by Richard de Burgo which was worth £57 10s (Westropp 1906–7, 83). In 1261 under the command of Irish King of Thomond Conor na Siudaine the castle was destroyed and its garrison killed (ibid). From 1285–7 de Burgo, harboured the Prince of Thomond, Terdeluath O'Brien in the castle in his anticipation of the raid on de Clare's lands at Cahirconlish and Grean (ibid, 84). The castle was repaired and enlarged by 1299 but shortly after in 1315 during the Wars of Turlough, the castle was attacked by the Bruce's (ibid, 84).

In 1578 Queen Elizabeth wrote letters of condolence to William de Burgh for the loss of his eldest son, who was slain in a skirmish with the Earl of Desmond, and the same year created him Baron of Castle-Connel.

The castle was described by Salter (2004, 72) as standing on '*a 6m high vertical-sided rock near the Shannon are overgrown fragments of a 13th century de Burgh castle with a court measuring 48m by 30m with at least one circular tower'*. It is said to have had towers at each angle; traces remain to the south-west and north-west, with fragments of curtain walls and well-built arches. The court measures 160 feet [49m] by 100 feet [30m]. Local tradition attributes it to the O'Brien's and its destruction to Cromwell [OSL Stradbally Parish]'.

The castle was described by Dowd (1896, 270) as measuring 'about one hundred and sixty feet [49m] long by one hundred [30m] wide, and it probably had round towers at each of the four corners of the rectangular area it enclosed. Of these only two can now be identified, and their resemblance to the towers of King John's Castle at Limerick is striking'.

In the early 15th century, Walter Duff, son of Richard owned the castle amongst other large holdings and made a partition of his lands to his eldest son Richard in which it was held in the family until the mid-17th century (ibid, 84).

A friary, variously described as being Franciscan (RMP files) or Augustinian was founded on Cloon Island in 1291 by Reginald de Burgh, baron of Castleconnell (RMP LI001-004001). According to Gwynn and

[91] Hannon, K. 1984. Castleconnell, part one. Old Limerick Journal, vol. 15, 23–28

[92] AFM - Annals of the kingdom of Ireland by the Four Masters from the earliest period to the year 1616, ed. and trans. John O'Donovan (7 vols., Dublin, 1851; reprint New York, 1966)

[93] Ferrar, J. 1787. 'An Essay on Castle Connell Spa, On Water in General and Cold Bathing, in The History of Limerick: Ecclesiastical, Civil and Military, From the Earliest Records to the Year 1787.

Hadcock[94] (1976, pp. 303, 364), a monastery was founded at this place by the Augustinian Friars c. 1300, and Westropp (PRIA, 1904-5, P. 436) tells us of a "… so called "friary" of unknown identity, on an islet in the Shannon." It marked on the 1st edition Ordnance Survey map as a 'friary', on the 2nd as a 'friary (in ruins)', and on the 3rd as a 'church (in ruins)'.

Not much is known of this friary, and it was not depicted on the Down Survey of 1656-8 (Figure 12-2). Lewis commented on how it was converted into an outhouse for a newly erected cottage in 1837.

In comparison, the medieval parish church (RMP LI001-002001) in Stradbally townland remained in use throughout the medieval period and was eventually replaced with a 19th century Church of Ireland structure. This church was known as 'Idumyn' in 1302. Castleconnell, allias Stradbally, alias capella de l'dum; Idumyn, alias Stradbally rectory was part of the lands in 1633, owned by the Earl of Ormond. Donald O'Mullyyn was the Vicar of Castra Conayng in 1412. A late 16th / early 17th century round-arched doorway with punch dressed jambs and hood-moulding above has been inserted into the west gable of the Church of Ireland church where it is now used as the main doorway into this church (SMR LI001-002003).

In 1578 Queen Elizabeth wrote letters of condolence to William de Burgh for the loss of his eldest son, who was slain in a skirmish with the Earl of Desmond, and the same year created him Baron of 'Castle-Connel'.

Post-Medieval and Early Modern Periods

The terrier of the Down Survey parish map recorded that in 1640 the castle of Castleconnell belonged to William Lord Bourk, Baron of Castleconnell. In the war of 1641 'Lord Castle-Connel' forfeited his estate and title, which were restored on the accession of James II. The title became extinct in 1691.

In 1651 a garrison was placed at the castle by General Ireton while on his march to blockade Limerick. The lands of Clanwilliam were described in the Civil Survey as '*Parte parish of Stradballie W. Lord Borke, Barron of Castlecon, Irish Papist. The manor of Castlecon, both Portcrussies, Parcke, Stradbally, and Bohirkeyle, 6 plough lands with a castle, ffishing weares, one mill, a Courte Barron and other privileges'*.

[94] Gwynn A. & Neville Hadcock N. 1970 Medieval Religious Houses: Ireland. 303,364 London.

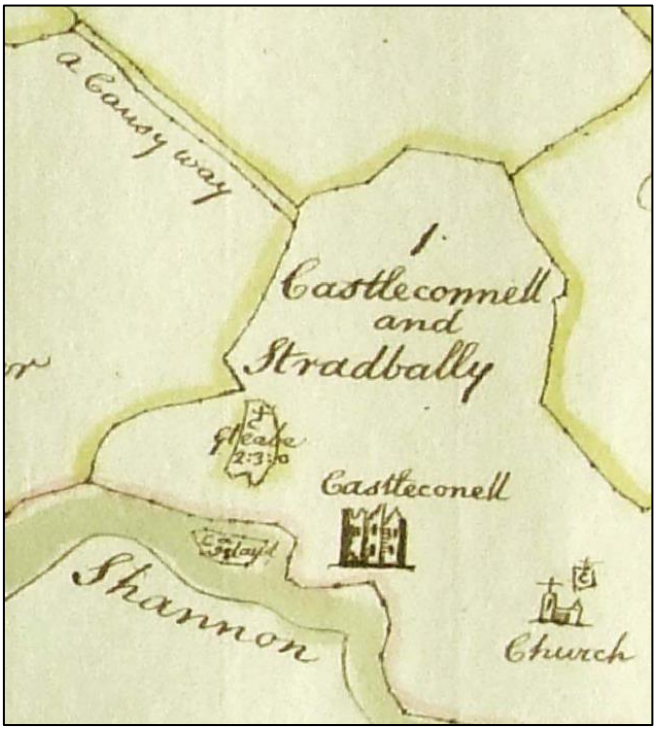

Figure 12-2: Castleconnell depicted on the Down Survey map of the Parish of Stradbally (1656-8)

The Down Survey map of 1656-8 demonstrates that a large part of the surrounding landscape comprised of bog. 'A Causeway Through the Bog' is illustrated through the narrowest part of the bog which appears to follow the orientation of the existing R445. This bog, along with the course of the River Shannon, would have created a defensible position in which to construct the fortification at Castleconnell. The castle and the medieval church are depicted as upstanding buildings.

During the revolution in 1688, the castle held a garrison of King James' forces, and it was consequently ordered to be destroyed by General Ginkle in 1691. The destruction of the castle in 1691 was described by Ferrar (1787, 470) as following; *'The castle had a strong garrison of King James's forces, and General Ginkle sent 700 men from Limerick, under the command of the Prince of Hesse, when the garrison surrendered after a siege of two days. Ginkle considering it a strong hold, ordered it to be dismantled and blown up; the explosion was so great, that it shook the houses in Limerick and broke several windows. The castle was so spacious, and the ascent by steps so easy, notwithstanding its being built on a very high rock, that a troop of horse has been drawn up in the hall'*. Large blocks of masonry are scattered around the base of the castle, and a substantial piece is located in Coolbane Woods to the south are thought to date from this period.

Ferrar's 18th century image of the castle (Figure 12-3) shows several structures between the castle and the river.

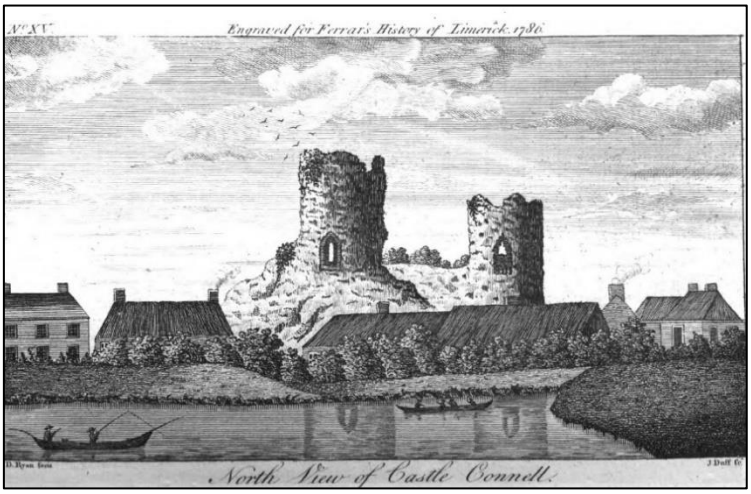

Figure 12-3: 18th century engraving of Castle Connell (Ferrar 1787)

The castle stands on a steep flat-topped rock, it is located inside the lands associated with Stormont House. it is in a ruinous state and is completely overgrown in vegetation Figure 12-4.

Figure 12-4: Drone view of the castle (view east) (April 2024, Courtney Deery)

The town of Castleconnell was noted in the 18th and 19th centuries for it curative waters and the site of a Spa. The soil is of a calcareous nature with ferrous inclusions and the sediment of the water was successfully applied to cure ulcers, bilious complaints, obstruction in the liver and jaundice. The water was chiefly consumed, but the curative properties of cold-water bathing were also reported (Ferrar 1786). The spa-well, still extant, was the focus of activity and during the early part of the 19th century a building known as the Assembly Rooms was built between it and the Shannon.

In the mid-18th century, Castleconnell enjoyed a building boom with the development of large Georgian houses in the village on the fringes of the River Shannon, taking advantage of the river scenery and, spacious private grounds and fishing grounds e.g. Lacka, the Grange, Island House, Stormont to name but a view. Much of the early modern prosperity of the town was derived first from the patronage of the Burke or Bourgh family, who were the descendants of William de Burgh, and secondly from the commercial opportunities afforded by the presence of a chalybeate spa in the area.

During the latter half of the 19th century, the layout of the approach road into the core of Castleconnell from was altered. Prior to the mid-18th century, the village had a linear plan form, consisting of two main streets: one running from northwest to southeast, and another running from east to west. The original east-west

street approaching the town from the west, ran between Stormont House and Castle Connell caste as shown on the first edition OS Map; the castle being south of this street (Figure 12.5). In the late 19th century, the east-west road was rerouted to the south of the castle and as a result, the ruins were incorporated into the grounds of Stormont House (Figure 12-5). A new northeast to southwest connection to the east of the Stormont House led to the formation of a new triangular area focal point in the village around a new catholic church (built in 1863). The old road that ran to the west of the castle became part of the new access road into Stormont House and its former gate lodge became redundant.

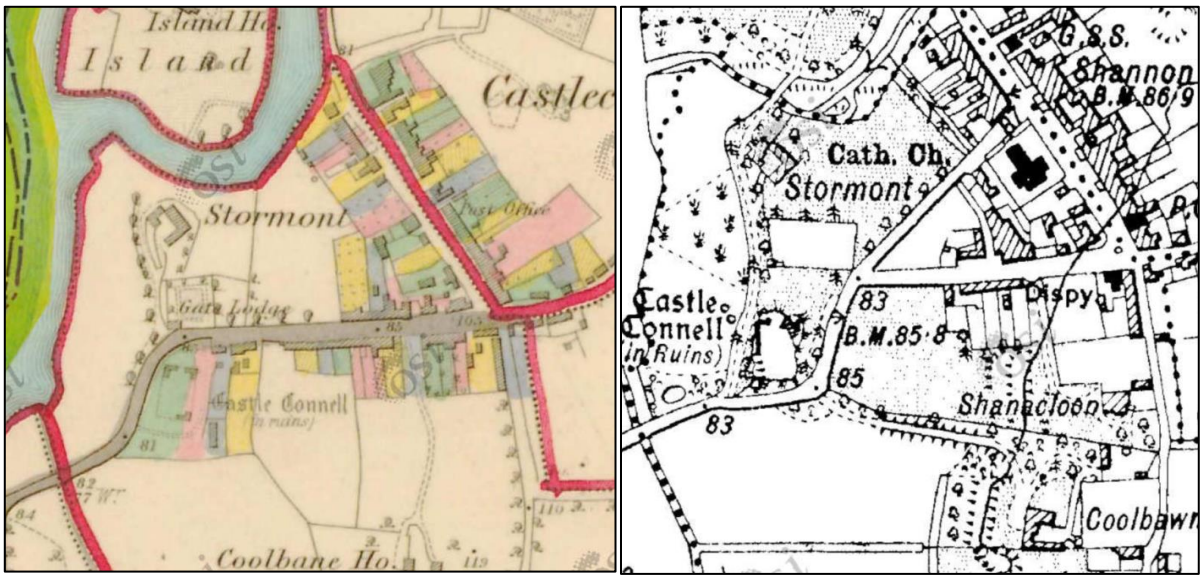

Figure 12-5: First (1844) and revised edition (1909) OS maps of Castle Connell village demonstrating the change in plan form of the village core - note the road between Castle Connell and Stormont House on the first edition map and the road realigned to the south of Castleconnell in the revised edition OS map.

12.2.2 Placenames

The study area includes all or part of a total of nine townlands in the Parish of Stradbally and the Barony of Clanwilliam in County Limerick, with the River Shannon forming the boundary between Limerick and the neighbouring County Clare. Townlands are land divisions that form a unique feature in the Irish landscape; their origins can be of great antiquity, and many are of pre-Norman date. They existed well before the establishment of parishes or counties. Townland boundaries can take the form of natural boundaries or routeways as well as artificially constructed earthen banks and ditch divisions. They are predominantly formed of substantial boundaries which are usually distinguishable from standard field division boundaries

The townland names within the study area are anglicised version of Irish words. They provide a topographical description of the landscape, the presence of pastureland and the colour of the vegetation or soil. The name of Stradbally is likely to be later than the other Irish names, as it describes the development of the village itself. The meanings of the townlands are recorded in Table 4 below.

The name of Castleconnell itself is derived from '*Carrig-Cnuil'*, the fortress that was originally the seat of the O'Briens, Kings of Thomond (See Section 12.2.1). It is only after 1564 that the modern suffix as in 'Kislaney connell' and 'Castle Connel' is found.

Table 12-1: Townlands and their meanings within the study area

Townland	Parish	Barony	Placename origin/meaning (Logainm.ie)
Lacka	Stradbally	Clanwilliam	May be derived from the Irish word *leaca* meaning hill, or 'lake' and is a reference to the spa waters.
Cloon and Commons	Stradbally	Clanwilliam	An anglicisation of the Irish word *Cluain* – Meadow or pasture. This land evidently functioned as commonage.

Coolbane	Stradbally	Clanwilliam	An anglicisation of the Irish word *An Chúil Bhán* – 'The white corner'.
Stradbally North	Stradbally	Clanwilliam	An anglicisation of the Irish word *An Stráidbhaile* – 'The Village'. A village consisting of one street, undefended by walls (Street town).

12.2.3 Topographical Files of the National Museum of Ireland

Several stray finds from Castleconnell in the Topographical Files of the National Museum of Ireland demonstrate prehistoric activity in the bogs surrounding the village, including a shale stone axe head at Worldsend Bog in Lacka (NMI ref.: 1931:108) and another in Thoreen Bog (NMI ref.: 1934:435). Also, in Lacka a fragment of a flint blade with no secondary working was found (NMI Ref: Record [LM 1988:3]).

In unspecified locations in Castleconnell a stone axehead is of a 'river ford type', water worn by limestone pebbles was found (NMI ref.: 1932:6377) and elsewhere an iron spearhead object inset with gold and a portion of the original haft is remaining was found (NMI ref.: S.A. 1919:1). A decorated bone marrow-scoop (decorated) was at the bottom of the River Shannon while excavating for a concrete sluice just above the site of the Old Salmon Crib at Cloon Island in 1904 (NMI ref.: 1945:74). A later find was also found in the Shannon Five gaffs used for the illegal capture of salmon (NMI Ref: . 1943:329-33).

12.2.4 Previous Archaeological Investigations

Eight previous archaeological investigations have been undertaken within Castleconnell. Three investigations have targeted the site of a burial ground on Chapel Hill (RMP LI001-008001), the earliest being in 1974 (IA/142/74; Cahill & Sikora 2011, 494[95]). Another investigation in 1990 revealed one, and possibly two, shallow graves ('Excavations' ref: 1990:085; Hodkinson 1990[96]), with the most recent archaeological works revealing at least thirteen individuals, including ten articulated human remains and disarticulated remains representing at least three other individuals (Licence no.: 03E0214; Lynch 2003[97]; Coyne 2003[98]). The name of 'Chapel Hill' would suggest the presence of a church, with local tradition also recording a church at the site of a nearby old schoolhouse, which would suggest that this was the associated burial ground. There was also a tradition of the site having functioned as a famine plot.

Archaeological investigations as part of the Castleconnell Sewerage Scheme revealed the remains of a burnt spread behind the primary school in Coolreiry and medieval layers in the vicinity of the castle (RMP LI001-003; Licence no.: 01E0416; McCutcheon 2001a[99]; 2002[100]). Post-medieval remains were noted throughout the village.

[95] Cahill, M. & Sikora, M. (2011) *Breaking Ground, Finding Graves – reports on the excavations of burials by the National Museum of Ireland, 1927-2006*. National Museum of Ireland Monograph Series 4, Volume 2. Dublin: Wordwell.

[96] Hodkinson, B. (1990) 'Stradbally North, Limerick'. Available at https://excavations.ie/report/1990/Limerick/0001020/ [Accessed 09/10/23]

[97] Lynch, L. (2003) 'Stradbally North, Limerick'. Licence no.: 03E0214. Available at https://excavations.ie/report/2003/Limerick/0010241/ [Accessed 09/10/23]

[98] Coyne, F. (2003) 'Stradbally North, Limerick'. Licence no.: 02E0214. Available at https://excavations.ie/report/2003/Limerick/0010242/ [Accessed 09/10/23]

[99] McCutcheon, S. (2001a) 'Ballyvollane / Prospect / Newgarden North / Cooleiry / Derreen / Lacka / Coolbane / Cloon / Commons, Limerick'. Licence no.: 01E0416. Available at https://excavations.ie/report/2001/Limerick/0006686/ [Accessed 09/10/23]

[100] McCutcheon, S. (2002) 'Ballyvollane / Prospect / Newgarden North / Hermitage / Stradbally North / Cooleiry / Derreen / Lacka / Coolbane / Cloon / Commons, Limerick'. Licence no.: 01E0416. Available at https://excavations.ie/report/2002/Limerick/0008442/ [Accessed 09/10/23]

Testing was carried out on the 'Track of Cromwell's Road' on the existing R525, revealing what may have been an original dirt track predating surfacing efforts in the 19th / 20th century (Licence no.: 98E0429). Investigations in the vicinity of a recorded souterrain (RMP LI001-007) revealed nothing of archaeological significance.

A test excavation at a low mound in Stradbally North showed the mound to have been natural (Licence no.: 01E0318; McCutcheon 2001b[101]).

Investigations in advance of a housing development in the vicinity of a souterrain (RMP LI001-007; Licence no.: 02E0435; Collins 2002[102]) revealed nothing of archaeological significance.

12.2.5 FRS Site Investigations Monitoring

Archaeological monitoring of site investigation works which were carried out at an early stage of this flood relief scheme in June, September and October 2020 (Licence no.: 20E0542, 20R0204; McCarthy & Haskins[103]). The archaeological monitoring programme included metal detection of spoil and comprised;

- 4 trial pits, one of which was within the Zone of Notification (ZoN) for the castle (RMP LI001-003);
- 4 slit trenches, one of which was within the ZoN for the castle and
- 2 inspection pits at the boundary wall between the castle and Coolbawn Meadows road (CH12).

No evidence of archaeological features, stratigraphy or artefacts were uncovered during archaeological monitoring of the test pits or slit trenches. Borehole logs were also obtained for investigations within the ZoN of the castle or in proximity to it (BH1-06, 07 and 08) and nothing of archaeological significance was identified within them.

However, within borehole logs RC1-01 (ITM 566029, 663360) on the riverbank of the River Shannon to the north of the village in Lacka and close to Grange House, the presence of timber and metal inclusions was noted at a depth of 3.00–3.20m. The borehole was then relocated c. 5m to the north-east (RC1-01A, ITM 566030, 663360). also recorded metal objects at a depth of 1.50–2.90m. Due to the small size of the rotary core at approximately 0.20m in diameter, no further information could be obtained. The nature of the wooden and metal material recorded in RC1-01 and RC1-01A could not be determined and it is possible that it represents archaeological material. These findings, though not fully determined to be archaeological, illustrate the potential for finds/ features to be buried deep in the silts of the river banks.

[101] McCutcheon, S. (2001b) 'Stradbally North, Limerick'. Licence no.: 01E0318. Available at https://excavations.ie/report/2001/Limerick/0006741/ [Accessed 09/10/23]

[102] Collins, T. (2002) 'Stradbally North, Castleconnell, Limerick'. Licence no.: 02E0435. Available at https://excavations.ie/report/2002/Limerick/0008461/ [Accessed 09/10/23]

[103] McCarthy, J. & Haskins, C. (2021) 'Castleconnell Flood Relief Scheme, Site Investigation Works, Archaeological Monitoring Report'. Licence no.: 20E0542, 20R0204. Unpublished report: Mizen Archaeology.

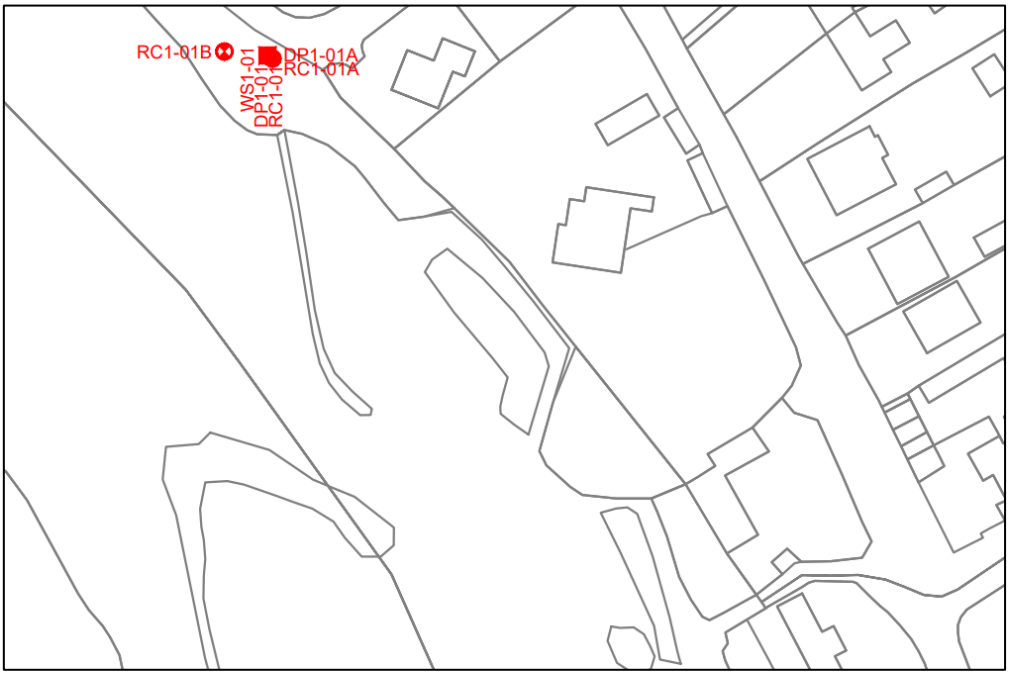

Figure 12-6: Location of RC1-01 and RC1-01A

The archaeological monitoring report is included in Appendix 12.6 in Volume 3 of this EIAR.

12.2.6 Underwater Archaeological Impact Assessment– Cedarwood Stream

An Underwater Archaeological Impact Assessment (UAIA) comprising a wade survey and metal detection survey along two sections of the Cedarwood Stream in Lacka townland was carried out under licence to the National Monuments Service (NMS) of the Department of Heritage Local Government and Heritage (DHLGH): Dive Licence Ref: 23D0117 and Detection Licence Ref: 23R0558.

The aim of the assessment was to determine the impact of the FRS measures on unknown and potential archaeological remains; and to recommend mitigation measures for any underwater archaeological remains recorded within the works area. Instream works required for the proposed FRS scheme are limited to the Cedarwood Stream, no excavation works are required to the River Shannon, or to the Cloon or Stradbally streams which lie further to the south.

The proposed works to Cedarwood Stream is concentrated to the rear of Coole House (RPS 1074) and Glenbrook House (RPS 1076) where it is proposed to widen the existing stream for 15m and to replace an existing culvert/footbridge with a larger box culvert with a new headwall arrangement (Figure 12-7). The proposed culvert will be wider and deeper below the stream bed to prevent erosion and undercutting, and to reintroduce a natural sediment movement through the culvert.

At the time of the survey, it was also proposed to replace a 40m section of an open culvert along the Cedarwood Stream at Grange House (RPS 1075) to its discharge into the River Shannon, the culvert is associated with a former mill building and is part of the landscaping of Grange House. This measure however was subsequently redesigned, and the stream is proposed to be realigned to the north of the existing culvert (see Section 12.4.3.).

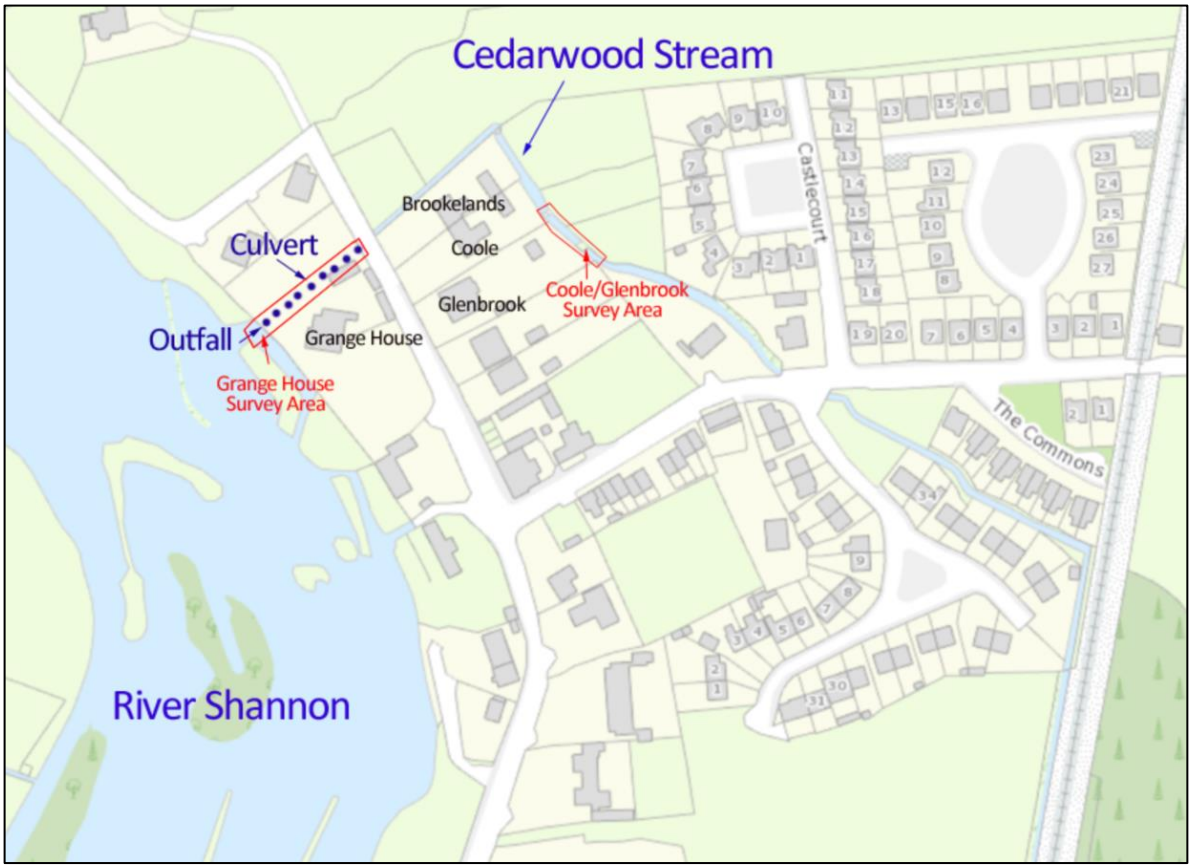

Figure 12-7: Cedarwood Stream site location and wade and metal detection survey areas

Based on a review of the historic Ordnance Survey maps, it is probable that Cedarwood Stream was initially diverted and culverted in the early 19th century towards Grange House to harness the stream's power for a small mill building. The wade survey identified the presence of building material in the clay banks (stone, roof tiles, etc.), loose rubble stone, later concrete plinths, culverts, and crossings, which suggest that the stream banks and channel were worked on in the 19th century for the mill and perhaps during the construction of the houses that envelop it, and once again in the early 20th century. No features, structures, or finds earlier than the 19th century were identified during the survey.

The metal detection of the streambed revealed modern metal (steel pipes and a metal plate) and nothing of archaeological significance. The visual survey identified glass and pottery all of 19th century date and two pieces of butchered animal bone.

No archaeological sites, features or finds were recorded as a result of the wade and metal detection survey indicating that the FRS measures will not impact on any standing/in-situ underwater or riverbank remains. However, the absence of definitive archaeological features does not necessarily exclude the potential for buried archaeological material within the stream sediment and along the river banks.

The assessment concluded that due to the scale of the proposed FRS works in the two survey areas examined, that a programme of archaeological monitoring would be an appropriate strategy for identifying any potential archaeological remains that may survive subsurface, for both the works to the Cedarwood Stream and the construction of the new culvert in Grange House which crosses a greenfield garden area.

The wade survey report may be found in Appendix 12.7 in Volume 3 of this EIAR.

12.2.7 Archaeological Test Excavation Results- Coolbane townland

An Archaeological Impact Assessment (UAIA) comprising the test excavation of the accessible areas of the flood relief measures was carried out over a three-day period, on the 23rd and 24th April and 25th July 2024, under licence to the NMS of the DHLGH: Excavation Licence Ref: 24E0386.

The aim of the test excavation was to determine the presence, extent, character and nature of archaeological features, deposits or material within the site and offers recommendations to mitigate the impact of development on any such archaeology.

Given the flood relief measures proposed (predominantly flood walls) and their location in immediate proximity to River Shannon SAC, to existing walls and public footpaths, only two areas could feasibly be tested. Two test trenches were opened across the two proposed FRS embankment measures, test trench 1 in Stormont House at the western end of the proposed embankment measure (Figure 12-8) and test trench 2 in Coolbane Woods, on the southern end of the Coolbane Woods embankment measure (Figure 12-9).

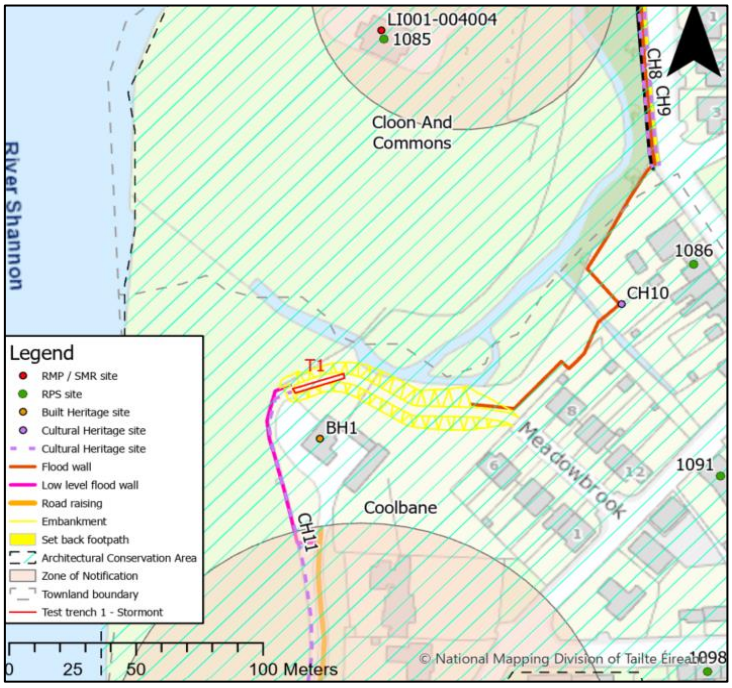

Figure 12-8: Test trench 1 at the eastern end of the Stormont House embankment measure

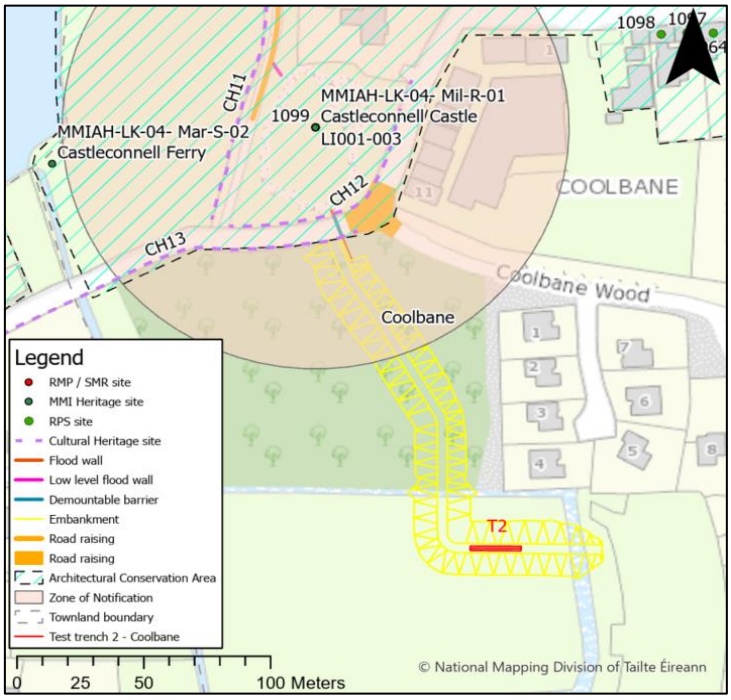

Figure 12-9: Test trench 2 at the southern end of the end of the Coolbane Woods embankment measure

No structures, artefacts or features of archaeological significance however were discovered as a result of the test trenches opened.

Test trench 1 in Stormont House, Coolbane established that the land at the western end of the embankment comprises natural bedrock boulders close to the surface, on a natural rise in the landscape. Test trench 2 in Coolbane Woods provided evidence of a dynamic riverine floodplain environment with layered well sorted alluvial deposits of clay, sand and a thin layer of peat (0.15m) overlying an impermeable clay layer. The natural dynamics of the floodplain would have been altered by the implementation of water management practices and the introduction of culverts/drainage ditches located to the north and west of the field. This finding is unsurprising considering that the area is shown as being 'Liable to floods' on historic mapping.

Due to the scale of the proposed FRS works in the two survey areas examined, it was concluded in the assessment that a programme of archaeological monitoring of all earthmoving works associated with the proposed embankments would be an appropriate strategy for identifying any potential archaeological remains that may survive subsurface, for construction of the proposed embankments. Consideration should be given to the anaerobic conditions of peat and its potential to preserve organic artefacts and ecofacts.

The test excavation report may be found in Appendix 12.7 in Volume 3 of this EIAR.

12.2.8 Archaeological Heritage Sites

There are no national monuments (state owned or vested in the care of local authorities), sites with Preservation Orders or Register of Historic Monuments sites within the study area. There are two recorded archaeological sites (RMP / SMR sites) located within the study area, comprising a castle and a friary complex on Cloon Island.

The castle (in ruins) (RMP LI001-003) is located on a flat-topped rock which was originally the site of an O'Brien fort, *Caslaun Uí Chonaing*, overlooking the Shannon (RMP LI001-003). It was an important strategic point for holding the upper reaches of the river and the village developed around it following the granting of the fort to William de Burgo.

A complex of five further sites (RMP LI001-004001/2/3; SMR LI001-004004/5) on Cloon Island are associated with a friary founded in 1291, although it is thought that this may have been a pre-Norman foundation. This includes the holy well and cross which have only recently been added to the record.

Table 12-2: RMP / SMR sites in the study area

RMP/SMR no.	Class	Townland	ITM E	ITM N	FRS Measure
LI001-003	Castle – Anglo-Norman masonry castle	Coolbane	565965	662480	Stormont house FRS measure is within the ZoN of the site Coolbane Woods FRS measure is within the ZoN of the site
LI001-004001	Church Ruins- Religious house – unclassified	Cloon & Commons	566005	662803	The Island House FRS measure is partly within the ZoN of this complex
LI001-004002	Cross-inscribed stone	Cloon & Commons	565998	662802	
LI001-004003	Cross-inscribed stone	Cloon & Commons	565998	662803	
LI001-004004	Ritual site – holy well	Cloon & Commons	565973	662784	
LI001-004005	Cross	Cloon & Commons	565984	662804	

Figure 12-10: RMP / SMR sites in study area

These sites are described in detail in Appendix 12.4.

12.2.9 Architectural Heritage Sites

Architectural Conservation Area

Castleconnell has an Architectural Conservation Area (ACA) which is divided into three distinct character areas, 'Spa-well and Worldsend' on the north, 'Village Core' in the centre, and 'Stradbally North' on the south (Figure 12-11).

An ACA could include any group of buildings, which together give a special character to an area. Protection generally relates to the external appearance of structures, views and vistas and features of the streetscape. The aim of ACA designation is to guide sensitive, good quality development, which will enhance both the historical character of the area and the amenity of those who enjoy it, and not to prevent development. Any development within an ACA must take into account the material effect that the proposed development would be likely to have on the character of the ACA.

The majority of the built heritage sites in Castleconnell are related to the development of the village in the 18th and 19th centuries along the main street, as well as the several country houses and estates in the wider area and adjacent to the river course. The common character in each ACA area is the River Shannon to the west. A feature of the houses/structures along the river was the prized views and vistas of the river to be had from their principal rooms and locations within the property. While many of the houses have been developed, land management features such as ha-has which allowed for uninterrupted views of the river's waters still survive, along with demesne walls, gateways, and the occasional building associated with the estates. Another common characteristic of the ACAs is the presence of historic stone walls along the roads, river and property boundaries.

In accordance with the Department of Arts, Heritage, and the Gaeltacht's (DAHG) 2011[104] 'Architectural Heritage Protection, Guidelines for Planning Authorities' any work to or in the vicinity of a Protected Structure, a National Inventory of Architectural Heritage (NIAH) site or an ACA requires prior consultation with a conservation specialist.

The undesignated rubble stone walls flanking the Mall Road which connects the two ACA's are considered to be of local significance. They support the visual character of the ACA's to the north and south. The walls are discussed in further detail in Section 12.2.11 below.

Record of Protected Structures (RPS Sites) and NIAH Surveys

There are 23 Protected Structures listed in the Record of Protected Structures (RPS) which are all recorded in the NIAH, and one NIAH site not on the RPS located within 100m from the FRS study area. The RPS sites predominantly comprise of late 18th and 19th century houses and structures, although two archaeological sites are also included (RPS nos.: 1084- RMP Ref: LI001-004001; 1099 - RMP Ref: LI001-003). Appendix 12.4 provides a full inventory of these sites. Twenty-two of the protected structures are within 100m of proposed flood relief measures (See Appendix 12.4).

Table 12-3: RPS and NIAH structures in the study area

RPS ref.	NIAH ref.	Name	Site type	Townland	FRS Measure
1072	21900109	Lacka House	Country house	Lacka	No effect
1073	21900110	Brooklands	House	Lacka	No effect

[104] DAHG (Department of Arts, Heritage and the Gaeltacht) (2011) 'Architectural Heritage Protection. Guidelines for Planning Authorities'. Department of Arts, Heritage and the Gaeltacht.

1074	21900111	Coole	House	Lacka	Within the Cedarwood Stream Measure
1075	21807037	Grange House	Country house	Lacka	Within the Cedarwood Stream Measure
1076	21807038	Glenbrook	House	Lacka	Within the Cedarwood Stream Measure
1079	21807040	Meskells	House	Lacka	No effect
5057	21807035	N/A	Post box	Cloon & Commons	No effect
5059	21807036	Spa House	Assembly rooms	Lacka	No effect
N/A	21807034	Mall House	House	Cloon & Commons	Within Mall Road North Measure
5056	21807010	Bridge	Bridge	Cloon & Commons	Within Mall Road North Measure
1084	N/A	Church (in ruins)	Church	Cloon & Commons	Within Mall Road North Measure
1085	21807009	Island House	House	Cloon & Commons	Within Mall Road North Measure
1080	21807008	The Tontines	House	Cloon & Commons	No effect
1081	21807007	The Tontines	House	Cloon & Commons	No effect
1082	21807006	The Tontines	House	Cloon & Commons	No effect
1083	21807005	The Tontines	House	Cloon & Commons	No effect
1086	21807004	Island View House	House	Coolbane	No effect
1087	21807011	Arlington / Hickey's	House	Cloon & Commons	No effect
1088	21807012	Shannon Inn	House	Cloon & Commons	No effect
1089	21807013	Sunnyside	House	Cloon & Commons	No effect
1091	21807001	Castle View House/Bradshaw's Pub	House	Coolbane	No effect
1099	N/A	Castle Connell (in ruins)	Castle	Coolbane	Within the Coolbane Woods and Stormont House FRS measure
5061	21807039	Charco's	House	Lacka	No effect

Figure 12-11: ACA, RPS sites and NIAH sites in study area

12.2.10 Maritime, Military and Industrial Heritage Survey

Limerick City and County Council is a participant in the Military, Maritime and Industrial Atlantic Heritage Project. It comprises an inventory of marine, military and industrial heritage sites on the Shannon River and Estuary. There are five Maritime, Military and Industrial Heritage Sites (referred to as MMI sites) within the study area, with a further one along the River Shannon adjacent to the study area. They comprise one military site, three maritime sites and two industrial sites. Castleconnell Castle is also a recorded monument (RMP LI001-003), while Cloon Island Bridge and Castleconnell Railway Station are also protected structures (RPS 5056, 1095).

There are no wrecks recorded from the study area either in the MMI survey or in the Wreck Viewer hosted by the National Monuments Service at www.archaeology.ie.

Table 12-4: Military, Maritime and Industrial Heritage sites in the study area

MMI ID	Other ID	Type	Condition	Class	Name	ITM_E/N	FRS Measure
MMIAH-LK-04-Mil-R-01	RMP LI001-003	Military	Ruin	Castle	Castleconnell Castle	565965/ 662480	Coolbane Woods FRS measure is within the ZoN of the site
MMIAH-LK-04-Mar-E-03	RPS 5056	Maritime	Extant	Bridge	Cloon Island Bridge Castleconnell	566054/ 662879	XXX measure
MMIAH-LK-04-Mar-S-02	N/A	Maritime	Site of	Ferry	Castleconnell Ferry	565861/ 662465	No effect
MMIAH-LK-04-Ind-R-08	N/A	Industrial	Ruin	Weir	Cloon and Commons Eel Weir	566090/ 663087	No effect

Figure 12-12: Military, maritime and industrial heritage sites in study area and the proposed flood relief measures

12.2.11 Undesignated Cultural Heritage Sites

A field inspection of the FRS scheme identified a number of undesignated cultural heritage sites which lie within or adjacent to the flood relief measures (Table 12-5,Figure 12-10). A full description of each feature is provided in an inventory in Appendix 12.5.3

Table 12-5: Undesignated Cultural Heritage Sites

CH ID	Type	Location	ITM_E,_N	FRS Measure
BH1	House	Coolebane	565949, 662615	Within the Stormont House Measure
CH1	Boundary wall	Lacka	566051, 663365	Within the Rivergrove B&B Measure
CH2	River wall	Lacka	566051, 663365	Within the Grange House Measure
CH3	Culvert	Lacka	566096, 663340	Within the Grange House Measure
CH4	Stone wall	Cloon and Commons	566189, 663192	No impact
CH5	River wall	Cloon and Commons	566163, 663146	Within the Mall House FRS Measure
CH6	River wall	Cloon and Commons	566097, 662915	Within the Mall Road North Measure
CH7	Stone wall	Cloon & Commons	566111, 662923	No impact
CH8	Stone wall	Cloon and Commons	566073, 662794	Within the Mall Road South Measure
CH9	Kerbstones	Cloon and Commons	566073, 662794	Within the Mall Road South Measure
CH10	Stone Wall	Coolbane	566067, 662670	Within the Maher's Pub Measure
CH11	Crenellated wall	Crenelated wall	565934, 662593	Within the Stormont House Measure
CH12	Stone wall	Stone walls	565980, 662446	Within the Coolbane Woods Measure
CH13	Stone wall	Coolbane	565973, 662434	Within the Coolbane Woods Measure
CH14	Culvert (site of)	Lacka	566200, 663372	Within the Cedarwood Stream Measure
CH15	Large masonry fragment associated with Castle Connell	Coolbane Wood		In proximity to

River walls on the Mall Road

A number of the undesignated features listed above are associated with the walls on the Mall Road (North and South). The Mall Road is a straight road that connects the Spa-well and Worldsend ACA to the north and the Village Core' ACA to the south. It is flanked on either side by coursed and uncoursed rubble stone walls. The riverside wall measures approximately 1m high on the roadside and up to at least 2m on the riverside (CH6, Appendix 12.4.5). The walls are of local vernacular significance, they are characteristic of the walls within the village of Castleconnell, they provide a continuity and consistency of character between the ACA's forming part of the amenity of the village.

Little is known about the building of these walls, as is the case of many vernacular structures, they do not appear to be present on the first edition OS Map of 1844. According to a local historian (Murtagh, 2018[105]), most of the river walls of Castleconnell were built in the aftermath of the Shannon Hydroelectric Scheme in the 1920's, though some were constructed before it. The opening of the scheme had a significant effect on the part of the Shannon bypassed by the head-race canal, from Parteen Villa north of O'Briens Bridge. This length of river, especially that running past Castleconnell in the 19th and early 20th centuries world-famous for fishing, particularly salmon fishing. The diverting of water to the power station had a devastating effect on this. The river walls were constructed to regulate the flow of the river and maintain optimal water levels for fishing and navigation. The local expertise in wall building in Castleconnell has been crucial in managing the challenges posed by fluctuating water levels over the years. According to Murtagh most of their work was manual as these walls had to be built by hand using a flat bottom boat or pontoon and a timber made stretcher to carry the stones to advantage points all along the river. The stones had to be of a workable size and for that reason most of the spur walls of Castleconnell ran with the flow starting at a wide point and then narrowing towards the riverbank and as this manmade channel started to squeeze so did the water level rise and the flow regime increased. The walls not only preserve an important part of the river's history and create an amenity in the town today, but also helped to protect the surrounding ecosystem and support local fisheries. The walls have intermittently been restored and maintained and some quite recently have been repointed with lime mortar.

[105] https://lovecastleconnell.com/an-caislean/2018/river-walls-of-castleconnell/ (14 Oct 2022, Mick Murtagh) Accessed June 2024

Figure 12.13: Undesignated Cultural Heritage and Built Heritage Sites

The culvert at CH14 was confirmed to be a modern concrete pipe in the UAIA and is not of any cultural heritage value (Appendix 12.7) and can be scoped out of the assessment.

12.2.12 Areas of Archaeological Potential

By virtue of the nature of the flood relief scheme in close proximity to the River Shannon and the Cedarwood Stream, and also in the vicinity of the friary site on Cloon Island and to Castle Connell, the FRS measures incorporate areas that are considered to be of archaeological potential (as listed in Table 12-6). This relates to the potential for previously unknown subsurface archaeological sites, soils or stray finds to be uncovered during earthmoving works for construction. The proposed compound area in Cloon and Commons townland is located within a field on the eastern side of the Mall Road, it has a general greenfield archaeological potential.

An inventory of these areas is provided in Appendix 12.4.3.

Table 12-6: Undesignated Cultural Heritage Sites

AP ID	Type	Location	ITM_E	ITM_N	FRS Measure
AP1	Area of archaeological potential- Riverine environment (River Shannon)	Lacka	566088	663334	Rivergrove B&B and Grange House
AP2	Area of archaeological potential- Riverine environment (River Shannon)	Cloon and Commons	566171	663145	Mall House Measure
AP3	Area of archaeological potential- Riverine environment (River Shannon)	Cloon and Commons	566147	663038	Mall Road North Measure
AP4	Area of archaeological potential- Riverine environment (River Shannon)	Cloon and Commons; Coolbane	566094	660891	Mall Road South Measure
AP5	Area of archaeological potential- Riverine environment (River Shannon)	Coolbane	566059	662664	Maher's Pub and Meadowbrook
AP6	Area of archaeological potential- Riverine environment (River Shannon)	Coolbane	565935	662633	Stormont House and Coolbane Woods
AP7	Area of archaeological potential- Riverine environment (Cedarwood Stream)	Lacka / Cloon and Commons	566325	663292	Cedarwood Stream
AP8	Greenfield archaeological potential	Cloon and Commons	566145	662968	Compound

12.3 Characteristics of the Proposed Development

The characteristics of the proposed flood relief scheme are set out in Chapter 4 of this EIAR and are discussed in detail in the assessment of potential impact below.

12.4 Potential Impact of the Proposed Development

The construction phase will have the potential to result in direct negative impacts and impacts to setting on cultural heritage receptors, including sub-surface archaeological remains and above ground structures of architectural heritage significance. These potential construction phase impacts on archaeology may arise during ground reduction works undertaken during elements of the proposed development including but not limited to site investigations, enabling works, services diversion, excavation, drainage and hard and soft landscaping, and the provision of a temporary construction compound.

Impacts related to settings include alterations to the ACA or to the grounds of built heritage sites, including changes to the views of the River Shannon from riverside villas. Impacts on the setting of heritage assets describe how the presence of a development changes the surroundings of a heritage asset (archaeological, or cultural heritage sites) in such a way that it affects (positively or negatively) the heritage significance of that asset. Visual impacts are most commonly encountered but other environmental factors such as noise, light or air quality can be relevant in some cases. Such impacts may be encountered at all stages in the life cycle of a development from construction to operational stages.

The potential effects each of the following flood relief measures on cultural heritage sites or areas of archaeological potential are set out below:

- Rivergrove B&B,
- Grange House,
- Mall House,
- Mall Road North and Island House,
- Mall Road South,
- Maher's Pub & Meadowbrook,
- Stormont House,
- Cedarwood Stream
- Compounds

The LVIA of the EIAR provides high quality photomontages representing the visual change of the proposed flood measures (Chapter 13). Extracts of the photomontages is provided below in relation to some of the measures.

Fifteen undesignated cultural heritage features (CH1-CH15) are discussed in the following assessment and are depicted in accompanying mapping. Most of these features are features associated with protected structures and are therefore only assigned IDs for discussion purposes as they will be assessed as part of the protected structure.

A glossary of impacts as defined by the EPA (2022) is provided in Appendix 12.3. The assessment has been carried out according to best practice and guidelines relating to archaeological and architectural heritage assessment (Appendix 12.1). A summary table of potential impacts is presented in Table 12-9.

12.4.1 Effects of the FRS Measures on Architectural Conservation Areas

Spa-well and Worldsend ACA

Rivergrove B&B, Grange House and Cedarwood Stream flood measures lie within the Spa-well and Worldsend ACA. Additionally, Mall House (NIAH 21807034) is adjacent to this ACA. The character of the ACA includes the presence of historic stone walls along the streetscape, and the prized views and vistas to be had from properties along the river. The only area where a change to the streetscape is proposed is adjacent to Rivergrove B&B where the historic portion of the existing boundary wall at Rivergrove B&B (CH1) is part of the original boundary walls of Grange House (RPS 1075). While this portion of wall is no longer associated with Grange House, it is part of the character of the road at this location which is flanked by stone walls. It is proposed to breach the historic portion of the wall to provide a new gateway.

Other changes within this ACA are in areas that are not publicly accessible. This includes the river wall along the Rivergrove B&B and Grange House properties (CH2 is along the Grange House portion). The existing river wall (CH2) follows the original townland boundary which followed the original course of the riverbank. The construction of this wall led to the accumulation of material which has created the SAC in this area, and the townland boundary has moved to follow the new riverbank. This wall will be replaced with a flood wall, but as it will follow the existing footprint, it maintains the line of the historic boundary. Furthermore, it will be clad on both sides with material from the demolished wall or similar, locally sourced, stone. Glass panels will be used to maintain particular views of the river from both properties. Maintenance works will also be undertaken along the Cedarwood Stream (AP7) to the rear of Coole (RPS 1074) and Glenbrook (RPS 1076). This will involve the removal of a modern stone culvert (CH14) and stone lining

along the watercourse at Glenbrook. A low-level flood wall to the north of Mall House (NIAH 21807034) will run along the boundary of the ACA, tying into a stone wall along the Mall Road (CH4).

The Spa-well and Worldsend ACA is of Medium significance. However, as the majority of the proposed works are in private properties which are inaccessible to the public, these areas that do not contribute to the character and amenity of the ACA, the magnitude of effect will be negligible, resulting in an imperceptible negative effect.

There are nine protected structures within 100m of proposed works in this ACA. Of these, Grange House (RPS 1075) is assessed below in the discussion of the Grange House area, while Coole (RPS 1074) and Glenbrook (RPS 1076) are assessed in the discussion of the Cedarwood Stream area. The others (RPS 1072, 1073, 1079, 5057, 5059, 5061) will not be impacted by the proposed flood relief measures and existing vegetation and walls will provide screening from any potential visual impact. An historic eel weir (MMIAH-LK-04-Ind-R-08) is also within 100m, but it will not be impacted by proposed flood relief works.

Village Core ACA

Mall Road South, Maher's Pub & Meadowbrook, Stormont House and Coolbane Woods FRS measures are all located within the Village Core ACA. It comprises the village which developed to the east of the castle when the road was realigned, incorporating the castle into the grounds of Stormont House. Much of the character of this ACA is derived from the stone walls which flank the roads of this area.

Changes in publicly accessible areas comprise the replacement of a stone wall along the Mall Road (CH8) and road raising at the Scanlon Park junction and at the Coolbane Woods junction. A demountable barrier will also be fitted at the Coolbane Woods junction, and a low stub wall will connect it to the rock outcrop where Castle Connell (RMP LI001-003) is located.

It is proposed to replace approximately 160m of stone wall along the Mall Road (CH8) with a flood wall approximately 1m inside the existing line. There is also approximately 76m of limestone kerbing (CH9) where these changes are proposed. A memorial plaque is embedded in the existing stone wall on the south end. The road raising at the Coolbane Road junction low stone walls surround the castle and line both sides of the road will also be as much as 0.3m. This will slightly reduce the level of visible wall in this area. These changes will alter the appearance of the streetscape within the ACA.

Part of the character of the ACA is also derived from the prized views and vistas to be had from properties along the river. Island House (RPS 1085) and Stormont House (BH1) are the only historic riverside properties within this ACA affected by the proposed scheme. The significant views between Island House and the river will not be impacted, although some alterations are proposed for the causeway to the property (RPS 5056) and its driveway which are discussed in further detail below. Stormont House is neither a protected structure or listed on the NIAH, likely due to alterations to the house in c. 1970 when the roof and top storey of the structure were removed due to their poor condition. However, it is contemporary with the other riverside villas of Castleconnell which are significant components of the ACAs. Alterations within this property will include the replacement of a portion of a decorative late 19th century crenelated wall (CH11) with a low-level flood wall, raising of the driveway, an embankment to the rear of the house and the construction of a low-level flood wall abutting the rock outcrop where Castle Connell (RMP LI001-003) is constructed. These alterations are discussed further in the context of Stormont House below.

The Village Core ACA is of Medium significance. As only a portion of the proposed works in this area is along the streetscape, the magnitude of effect will be Negligible, resulting in an Imperceptible negative effect.

There are twelve protected structures within 100m of proposed works in this ACA. Of these, Island House (RPS 1085) and its causeway (RPS 5056) are assessed below in the discussion of the Mall Road South area, while Island View House (RPS 1086) is assessed in the discussion of Maher's Pub & Meadowbrook. The others (RPS 1080, 1081, 1082, 1083, 1087, 1088, 1089, 1090, 1091) will not be impacted by the proposed flood relief measures and existing vegetation and walls will provide screening from any potential

visual impact. The ferry point (MMIAH-LK-04-S-02) is no longer extant and will not be impacted by the proposed works.

12.4.2 Rivergrove B&B Measure

Proposed Development

The proposed development comprises the replacement of the existing river wall to the west of Rivergrove B&B with a new flood wall, and a new flood wall across the existing entrance. The proposed walls will have cladding on both sides of material salvaged from existing walls or similar, local stone. Part of the existing boundary wall along the roadside will be retained with a low-level flood wall to the rear of it with cladding on the property side. A new entrance and raised driveway will be provided. A short length of glass panels will be provided within the flood wall to maintain some of the view of the river from the conservatory.

Construction of the flood walls will require steel sheet piles to a depth of up to 8m depth, these depths are necessary to avoid water seepage. The excavations required for the new floodwalls will encroach approximately 3m into the property and approximately 2m into the SAC, and the total area of works will extend approximately 8-10m into the SAC (including the temporary working area). The temporary working platform, to enable the installation of sheet piles for the walls from the riverside, will consist of the importation, placing and compaction of suitable bearing material along the riverbank on a geotextile (Terram or similar) with silt mitigation implemented if required. The final details of the temporary platform will be dependent on the riverbank slope, the ground and site conditions and may require short sheet piles to retain the platform where it comes close to the water edge.

Archaeological Impacts

The installation of piling and flood walls will require excavation as set out above. The earthmoving works required for the construction of the flood wall has the potential to reveal subsurface archaeological remains associated with the riverine environment (AP1). The sheet piling will have a direct impact on any unknown in-situ archaeological remains that might lie on the riverbanks or deeply buried beneath the riverine silts along the course of the earlier river shoreline. The borehole logs from the SI works recorded metal and wooden material at a depth of 3m just upstream from the measure on the banks of the river, while these findings cannot be fully determined, they indicate the potential for deeply buried objects in the riverine silts.

The sheet piles, if used to stabilise the temporary riverside platform, will have the potential to truncate any in-situ archaeological remains that my lie buried in the mud and silt built up on the river shore. The platform will be removed upon completion of the wall construction.

The potential impact to this area is outlined in the discussion of Grange House below.

Built Heritage Impacts

This area is part of the Spa-well and Worldsend ACA which is discussed above. The historic section of the existing boundary wall at Rivergrove B&B (CH1) is part of the original boundary walls of Grange House (RPS 1075). The existing river wall at Rivergrove B&B is a modern roughly coursed wall, a short section of river wall forming the corner of the property is also part of the original Grange House boundary wall, both sections of the river wall will be replaced. It is also proposed to breach the historic portion of the wall to provide a new gateway. While the boundary wall of Rivergrove B&B is no longer associated with Grange House, it is part of the roadside ACA character at this location.

The boundary wall (CH1) is of Low significance with a Medium magnitude of effect, resulting in a Slight negative effect.

Plate 12-1: Existing roadside boundary wall at Rivergrove B&B

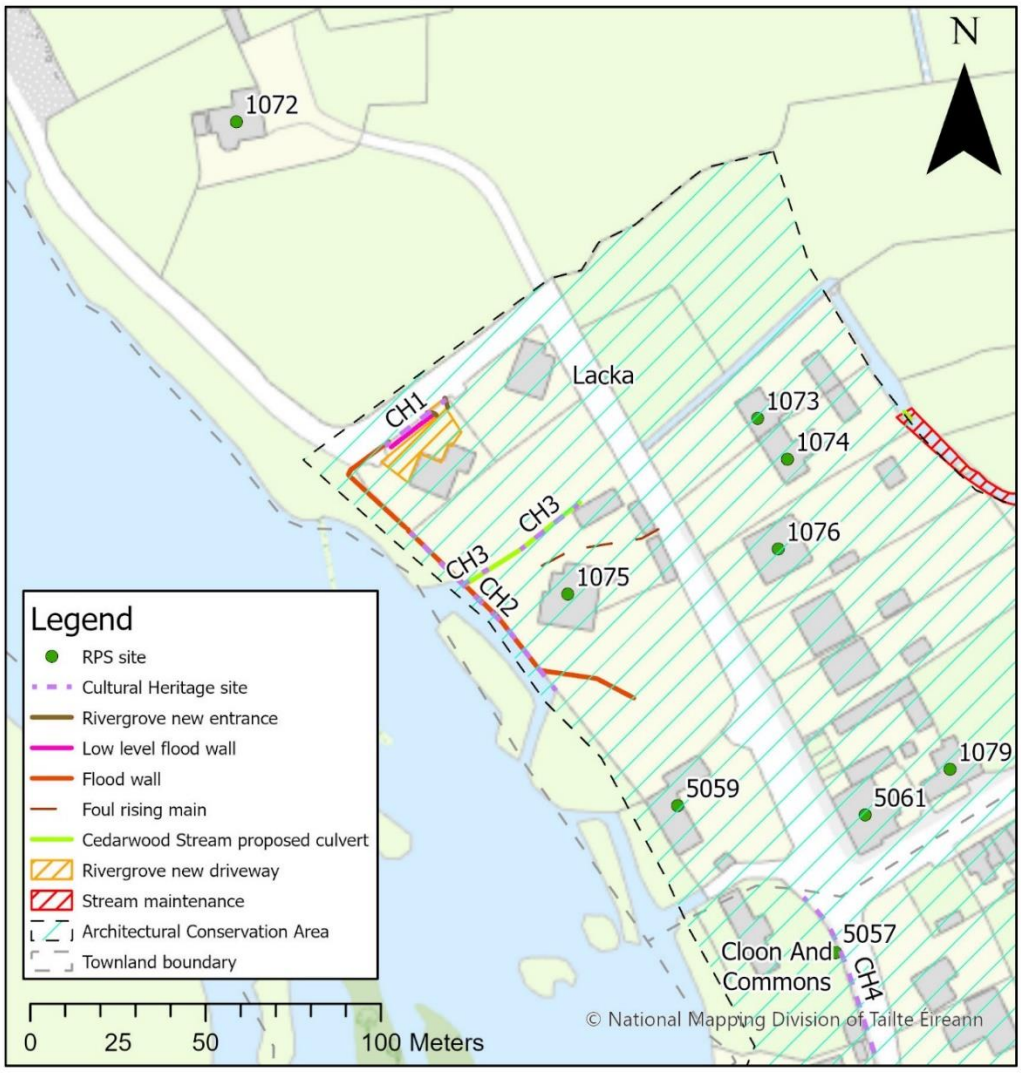

Figure 12-14: Cultural heritage features at Rivergrove B&B and Grange House

12.4.3 Grange House FRS Measure

Proposed Development

Grange House (RPS 1075) is a protected structure located immediately south of Rivergrove B&B. It is proposed to demolish an existing river wall (CH2) which is the boundary wall to this property, and which marks the original townland boundary. It will be replaced with a new flood wall of between 1.5m-2.2m high with stone cladding on both sides. Glass panels will be provided in sections, as agreed with the homeowner, to maintain views of the river from key areas of the house. The wall will continue along the southern side of the driveway.

The excavations required for the new floodwalls will encroach approximately 3m into the property and approximately 2m into the SAC, and the total area of works will extend approximately 8-10m into the SAC (including the temporary working area). As discussed above, the temporary working platform will be located along the riverbank to facilitate excavation, piling and construction, comprising the importation, placing and compaction of suitable material along the riverbank on a geotextile (Terram or similar). The construction of the flood walls will require steel sheet piles to a depth of approximately 8m depth.

The open culverted section of the Cedarwood Stream (CH3) associated with the small mill building in the garden of the house will remain in-situ. The culvert will be replaced by a sealed box culvert of the same size that will follow a diverted route north in the garden area north of the open culvert, it will however tie into the same discharge location as the existing culvert which comprises a rubble stone arch in the river wall. A new pumped foul connection will also be provided to the public foul sewer to replace the existing free outfall from the house to the Cedarwood Stream open feature.

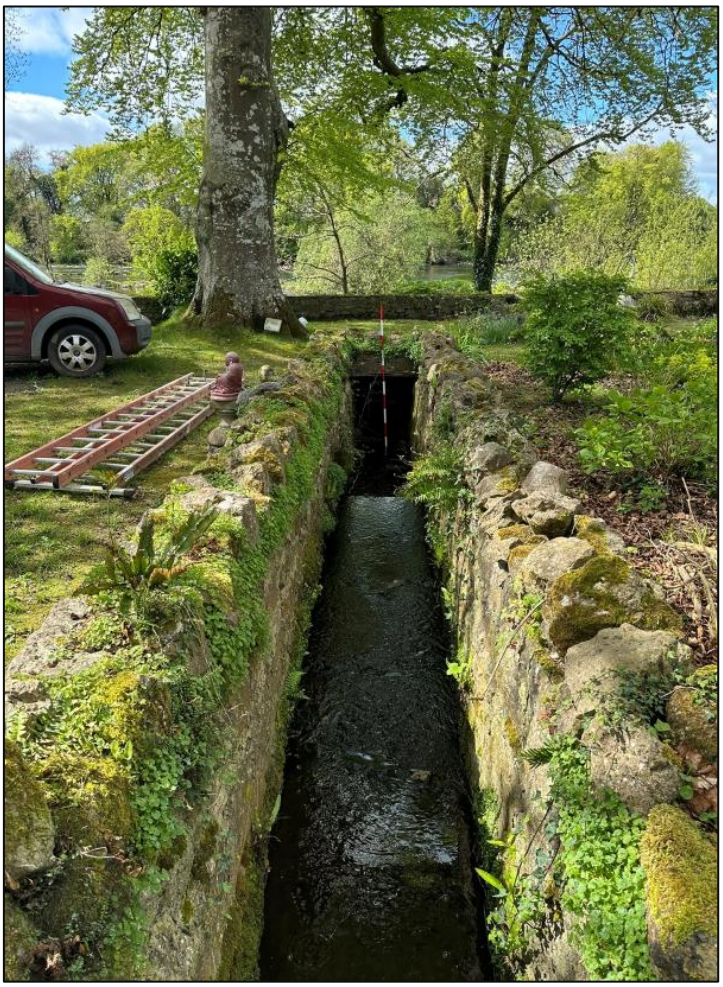

Plate 12-2**: **Open section of Cedarwood Stream culvert (CH3)

Archaeological Impacts

The earthmoving works required for the construction of the flood wall has the potential to reveal subsurface archaeological remains associated with the riverine environment (AP1). As mentioned above the SI works recorded metal and wooden material at a depth of 3m just upstream from the measure in the bore hole logs, while these findings cannot be fully determined, they indicate the potential for the presence of deeply buried objects in the riverine silts. A wade and metal detection survey of the Cedarwood Stream culvert at its outlet with the River Shannon identified 19th century bottles, ceramic and bone which demonstrate the movement and burying of objects even in recent times in the riverine silts. The excavation and sheet piling for the river wall construction will have a direct impact on any in-situ archaeological remains that might lie deeply buried beneath the riverine silts and along the course of the earlier river shoreline where it is proposed to demolish an existing river wall to construct a flood wall. Similarly the realignment of the Cedarwood Stream culvert (CH3) and the installation of a new foul rising main will require excavation and as such previously unknown subsurface archaeological features or finds might be uncovered during the earthmoving works within the property.

In addition to the impact from works at Rivergrove B&B, this area (CH1) is of Unknown archaeological significance with a Low magnitude of effect, resulting in an Indeterminable negative effect on any previously unknown archaeological sites or features which survive below ground.

Built Heritage Impacts

This area is part of the Spa-well and Worldsend ACA which is discussed above. The gated entrance to the property and high boundary wall surrounding Grange House (RPS 1075) is a significant part of the visual amenity of the ACA, the proposed FRS measures will however not impact on the outward amenity of the property.

Within the property however there are a number of notable cultural heritage features including the river wall (CH2), Cedarwood Stream culvert (CH3), mature trees and views of the River Shannon. These features all contribute to the setting of house and support the significance of the protected structure.

The river wall (CH2) which is likely to be contemporary with the house (early 19th century in date), is low (0.4m high) and provides a full panoramic view of the river from the house and garden. This view is integral to the historic setting of the property. Features of note in the wall are the stepped gated access to the river and a metal mooring ring affixed to the wall on the riverside (see Appendix 12.4 for a full description) which will be replaced by the flood wall.

From the west the Cedarwood stream enters the property through an open culvert that follows against the northern wall of a former mill building. It continues west in an underground culvert. A short section of the culvert is presented as an open garden feature (CH3). This segment is lined with rubble stone sidewalls and thick limestone flags at the base, the feature descends in c. 20cm increments downstream to a drop of 1.6m. It then runs beneath the garden and discharges to the River Shannon through a rubble stone arch through the river wall (see Wade Survey Report in Appendix 12.7 for a full description).

The construction of the new river wall will have a direct effect on the setting and visual amenity of Grange House. In addition, the root systems of mature beech trees will be impacted by the insertion of the flood wall and as such the trees will be impacted. Further to detailed on-site discussions with the NMS and NBHS of the DHLGH and the Project's conservation engineer, the impacts the setting of Grange House were minimised as far as possible through design mitigation measures as follows:

- The appearance of the height of the proposed wall, which is 1m high, will be reduced by raising the ground levels between the driveway and the wall in order to minimise the visual dominance of the new wall.
- Glass panels will be set on a plinth on ground level and will extend the full height of the wall in order to ensure that the visual link to the river is retained.
- The new flood wall will be stone clad with reclaimed stone in order to blend into the existing setting.

- Mature native trees will be planted to replace the trees that will be impacted in order to restore the garden landscape.
- The open stone lined culvert feature (CH3), associated with the mill building to the rear of the property, will be retained in-situ, there will be a minor diversion of the Cedarwood Stream which will run north of the culvert. Though the connection to river will be severed a water pump will be installed in order to recreate moving water and its sound.

The detailed specification for masonry, capping and cladding of the new wall was developed by conservation engineers (Appendix 12.9) which includes reclaiming and reusing existing stone as well as sourcing local stone.

A photomontage of the existing river and proposed flood wall with the above design measures in place, (raised ground level, cladding and glass panels) is provided in the LVIA Chapter 13 and is extracted as follows in Plate 12-3 and Plate 12-4, demonstrating the visual change, with the visual link to the river being maintained from the property.

Plate 12-3: Existing view of the river

Plate 12-4: Extract from LVIA Photomontage of new flood wall (Placeholder for final Photomontage)

Grange House (RPS 1075) is of Medium significance (Protected Structure) with a Low magnitude of effect, resulting in a Slight negative effect of the character of the property.

12.4.4 Mall House FRS Measure

Proposed Development

The proposed scheme will comprise flood walls on the eastern side of Mall House (NIAH 21807034). A low level (c. 0.25m high) wall will be constructed on the north, and the existing rear boundary wall on the west will be replaced with a new flood wall measuring 1m high on property side, to be cladded on both sides with material salvaged from the demolished walls or using similar, local stone. A demountable barrier will be fitted to the entrance to the Dunkineely House (immediately to the south of Mall House) with a length of flood wall connecting to the Mall Road defences. There will be no alterations to the front of the property. The excavations required for the new floodwalls area will encroach approximately 3m into the property and 3m towards the access lane.

Archaeological Impacts

Excavations will be required along the proposed flood walls as set out above. There is a potential that previously unknown subsurface archaeological features or finds might be uncovered during the earthmoving works for the flood measure in this riverine environment (AP2). It is evident from historic mapping that the original townland boundary was located along the course of an earlier shoreline where it is proposed to demolish an existing river wall (CH5) to construct a flood wall.

This area is of Unknown significance with a Low magnitude of effect, resulting in an Indeterminable negative effect.

Built Heritage Impacts

This area is adjacent to the Spa-well and Worldsend ACA which is discussed above.

Although Mall House is not a protected structure, it is recorded on the NIAH as a site of regional importance (NIAH 21807034). The house itself will not be directly impacted, but the construction of flood walls around the property has the potential to impact the setting and visual amenity of the house which enjoys views of the river, although as discussed below will be minimal.

It is proposed to demolish existing river wall (CH5) which is c. 1.20m high on its external face (Plate 12-5), with the replacement measuring only 0.8m-1m in height, similar to the existing wall height. The wall will be clad with rubble stone on both sides, while there will be a visual change, it will not have an adverse impact on the setting of the house as the view of the river will be maintained.

Mall House is of Medium significance with a Negligible magnitude of effect, resulting in a Not significant negative effect.

Plate 12-5: Existing boundary wall to rear of Mall House view from the riverside access road west of the property

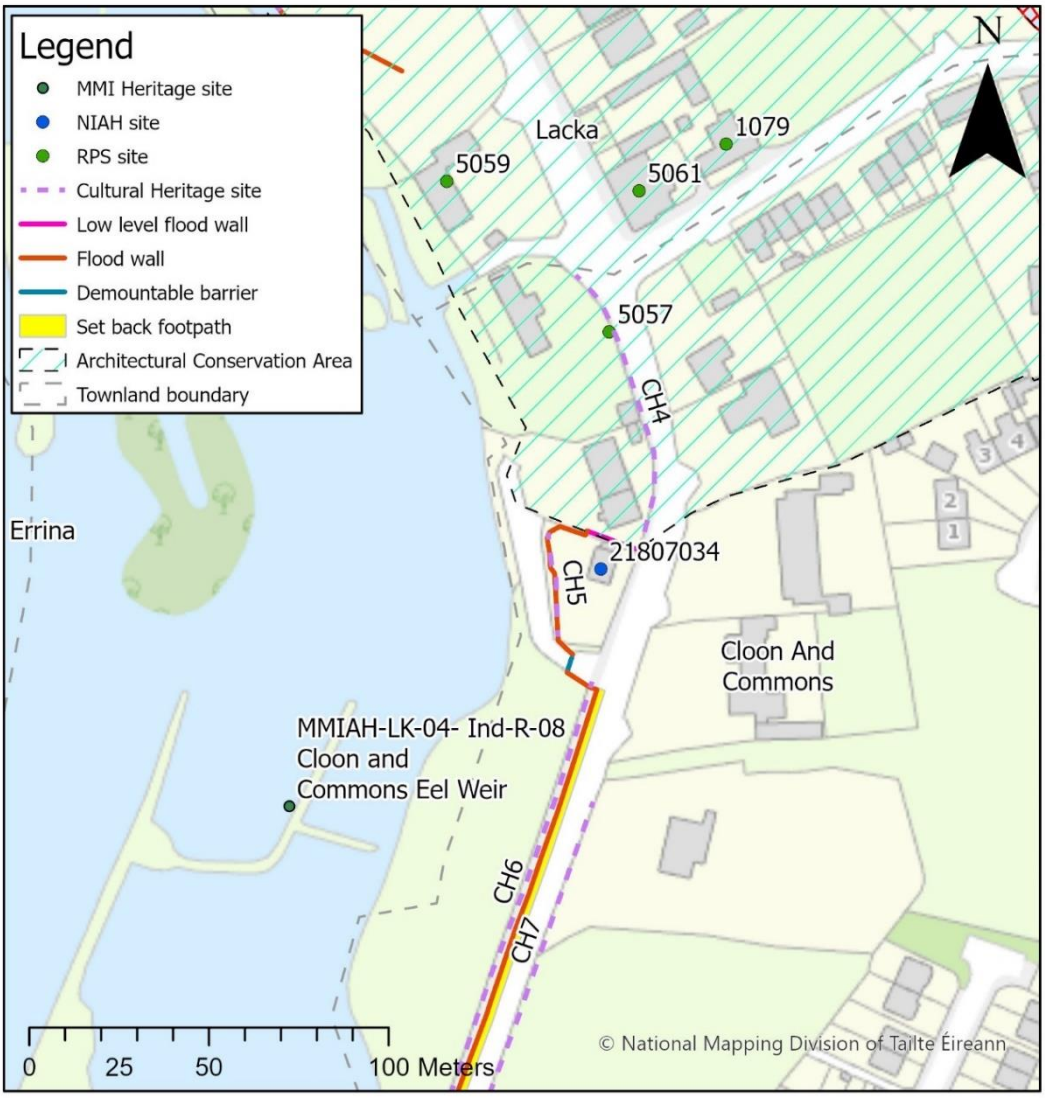

Figure 12-15: Cultural heritage features at Mall House

12.4.5 Mall Road North Measure

Proposed Development

The proposed scheme will involve the removal of the existing Mall Road riverside wall to construct a new flood wall and footpath approximately 1m inside of the existing arrangement. The new flood wall will have cladding on both sides using material salvaged from the demolished wall or similar, local stone, and a new demountable barrier will be installed at the Fisherman's access point maintain access. A construction compound will be located in the greenfield site on the east side of the road in this area.

The new flood wall will be stepped back approximately 1m from the SAC boundary to ensure no excavations are undertaken within the SAC. At the SAC boundary the road excavation depth will be up to the existing ground level of the SAC, and within the road, the excavation will be stepped back deeper to the required foundation level. The works area will encroach approximately 6m from the SAC boundary towards The Mall Road.

Archaeological Impacts

Excavations will be required along the proposed flood wall as set out above. There is a potential that previously unknown subsurface archaeological features or finds might be uncovered during the earthmoving works for the flood measure in this riverine environment (AP3). Apart from the archaeological potential associated with the riverine environment, it is evident from historic mapping that the original townland boundary was located along the course of an earlier shoreline where it is proposed to demolish the existing stone wall (CH6). Historic mapping also shows a number of structures on the east side of the road within what is now a greenfield area where it is proposed to create a construction compound. They were demolished by the time of the 25-inch map of 1901. This area is of Unknown significance with a Low magnitude of effect, resulting in an Indeterminable negative effect.

Built Heritage Impacts

This area is not in an ACA and will not impact any Protected Structures of NIAH sites. It is proposed to replace approximately c. 230m of stone wall to the west of Mall Road (CH6) with a flood wall which will be stepped back and constructed outside the SAC. To minimise the visual impact of the proposed flood wall, a detailed specification for masonry, capping and cladding of the new wall was developed by conservation engineers Southgate Associates (Appendix 12.9) in accordance with best practice measures. The proposal includes reclaiming and reusing existing stone as well as sourcing local stone to ensure the new wall harmonises with the historic character and environment of the river walls.

The existing stone wall (CH6) is of Low significance with a High magnitude of effect, resulting in a Slight negative effect. Another stone wall on the east side of the Mall Road (CH7) will not be impacted by the proposed works.

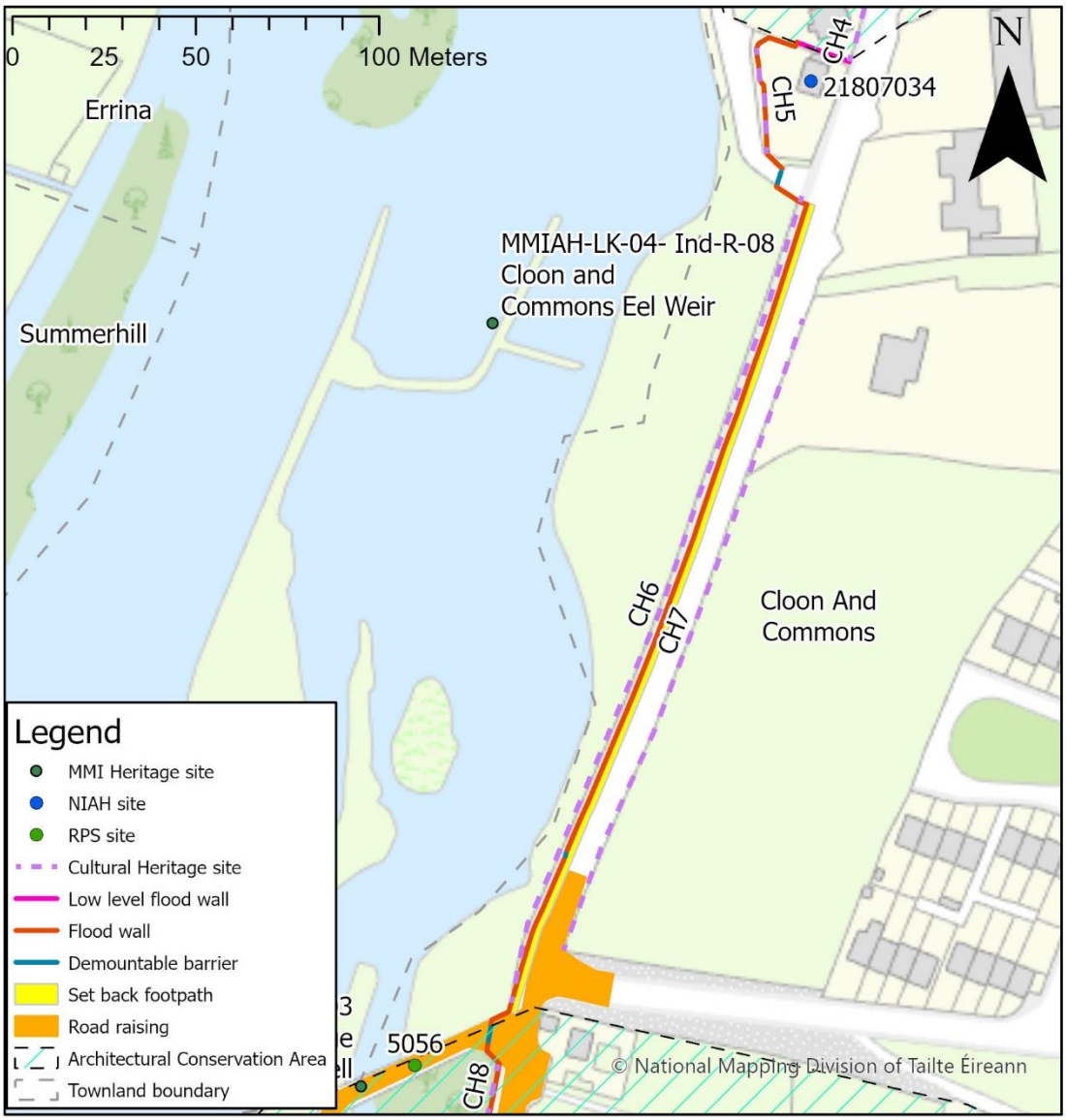

Figure 12-16: Cultural heritage features at Mall Road North

12.4.6 Mall Road South Measure

Proposed Development

The proposed scheme will require road raising at the Scanlon Park junction by 0.4m, and the entrance and driveway to Island House (RPS 1085) by 0.2m. Works to the causeway (RPS 5056) will include the raising of the surface of the deck by 0.2m; this will comprise the replacement of the existing infill with foamed concrete. Additionally, a steel handrail will be added inside both crenelated parapets. The sluice gates on the causeway structure will be removed to allow flow through Cloon Stream. The insertion of a flood gate at the northwestern end of the causeway that can be operated by the landowners will be considered.

It is also proposed to remove the existing stone wall along the Mall Road from Island House to Maher's Pub which will be replaced by a new 1.2m high flood wall. The wall will be stone clad on the footpath side with material salvaged from the existing wall or with similar, local stone. As above a detailed specification for masonry, capping and cladding of the new wall was developed by conservation engineers (Appendix 12.9) which includes reclaiming and reusing existing stone as well as sourcing local stone.

Works along the Mall Road will require diversions of below-ground services. The new flood wall will be stepped back approximately 1m from the SAC boundary to ensure no excavations are undertaken within

the SAC. At the SAC boundary the road excavation depth will be up to the existing ground level of the SAC, and within the road, the excavation will be stepped back deeper to the required foundation level. The works area will encroach approximately 6m from the SAC boundary towards the Mall Road.

Archaeological Impacts

Excavations will be required along the proposed flood wall as set out above. There is a potential that previously unknown subsurface archaeological features associated with the riverine environment might be uncovered during the earthmoving works associated with the new flood wall (AP4). This potential is demonstrated by decorated bone marrow-scoop (decorated) found on the bottom of the River Shannon while excavating for a concrete sluice at Cloon Island in 1904 (NMI ref.: 1945:74). AP4 also includes the vicinity of the 13th century friary and probable Early Christian foundation on Cloon Island (RMP LI001-004001). The official Zone of Notification (ZoN) as it appears in the published Record of Monuments and Places (Dúchas The Heritage Service 1997[106]) is slightly larger than on the digital Historic Environment Viewer (HEV) available as www.archaeology.ie, extending as far as the causeway (RPS 5056). The church itself, as well as the cross-inscribed stone, a cross-slab, a holy well and a cross (LI001-004002/2/3/4) will not be impacted. However, there is the potential that the works proposed in this area could reveal subsurface features related to the ecclesiastical site.

The original townland boundary was located along the course of an earlier shoreline where it is proposed to demolish the existing stone wall (CH8) to construct a flood wall inside it. In addition, it is possible that masonry fragments associated with the friary or indeed other historic structures within the village were reused in the construction of the wall along The Mall Road or indeed in the causeway on island bridge.

This area is of Medium significance with a Low magnitude of effect, resulting in a Slight negative effect.

Built Heritage Impacts

This area is within the Village Core ACA which is discussed above.

The causeway to Island House (RPS 5056) is a masonry structure with crenelated parapets, constructed c. 1815. A number of alterations as outlined above will include the raising of the surface of the deck by 0.2m, installation of a steel handrail on either side of the of the causeway and repointing of masonry joints. A sensitive design for the handrail details was developed by conservation engineers (Southgate Associates) in consultation with the NBHS. The steel handrail will above the finished road level be cast in brackets into every alternative castellation and the handrail will be hinged for future maintenance and repair of the parapet structure. Conservation works will include repointing of masonry joints using best practice conservation methods. A specification for masonry repairs to the Island House causeway and the insertion of the handrail is detailed in Appendix 12.9. The works will visibly alter the causeway structure by adding a modern element, but alternative options included breaking down and reconstructing the crenelated parapets, which would have had a more significant impact to the feature.

The causeway is of Medium significance with Low magnitude of effect, resulting in a Slight negative effect.

While works are proposed within the grounds of Island House (RPS 1085), the setting of the property and views of the river will not be impacted and, apart from the works to the causeway which are discussed above, the only other works comprise the raising of the driveway.

The house is of Medium significance with Negligible magnitude of effect, resulting in a Not significant negative effect.

[106] Dúchas The Heritage Service (1997) 'Record of Monuments and Places: County Limerick'. Department of Arts, Heritage, Gaeltacht and the Islands.

It is proposed to replace approximately 160m of stone wall along the Mall Road (CH8) with a flood wall approximately 1m inside the existing line. To reduce the visual impact of the new wall and to retain the amenity value of the road, a detailed specification for masonry, capping and cladding of the new wall was developed by conservation engineers Southgate Associates (Appendix 12.9). As proposed for the walls on the Mall Road north, it is planned to reclaim and reuse existing stone, as well as the use of locally sourced stone.

There is also approximately 76m of limestone kerbing (CH9) where these changes are proposed, which is within the Village Core ACA. A memorial plaque is embedded in the existing stone wall on the south end, this will not be impacted as the section of the wall will be retained, the new wall will continue to the rear of it.

The stone wall (CH8) and limestone kerbing (CH9) are both of Low significance with a High magnitude of effect, resulting in Slight negative effects.

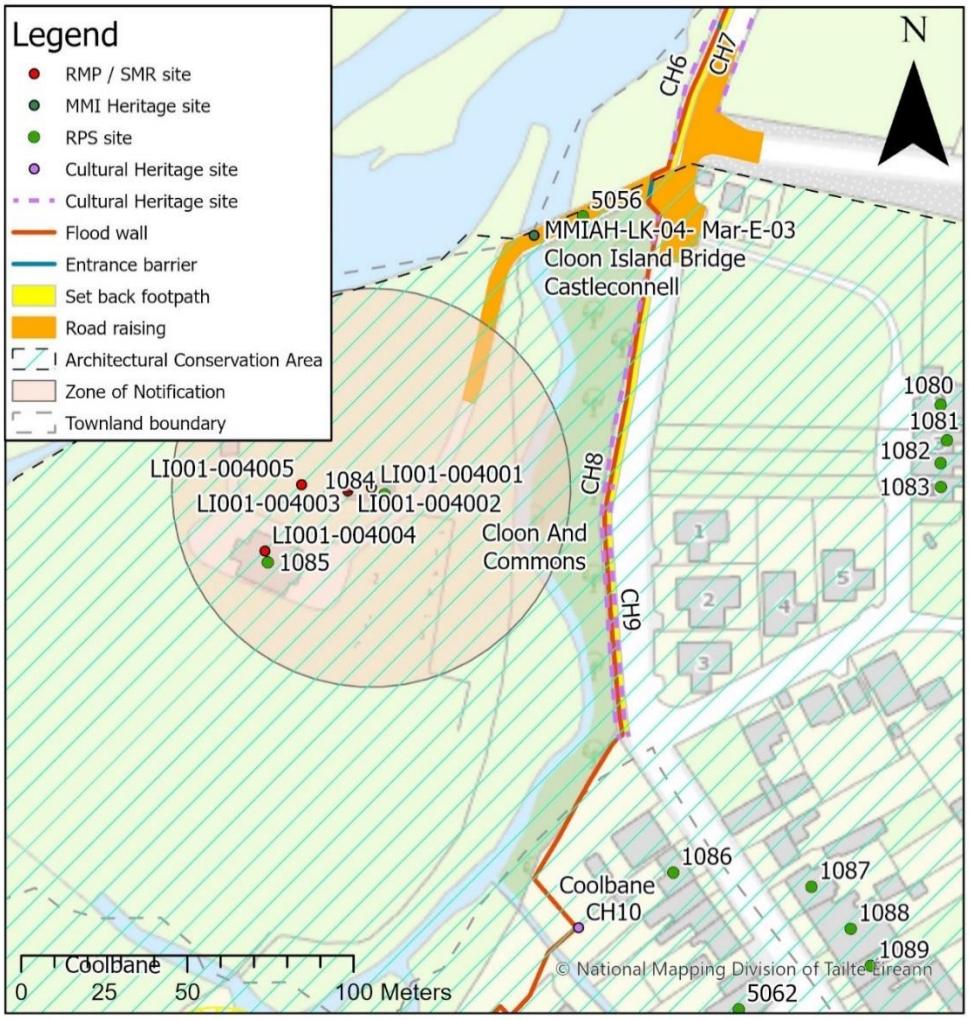

Figure 12-17: Cultural heritage features at Mall Road South

12.4.7 Maher's Pub & Meadowbrook FRS Measure

Proposed Development

It is proposed to continue the flood wall from the Mall Road around Maher's carpark, replacing a portion of existing wall to the north and to be set back c. 6m to the west. It will range in height from 1.2m-1.8m and will be cladded on the property side. The wall continues to outside No. 6 Meadowbrook Estate. An embankment 0.7m-1.6m high will be constructed from No. 7 Meadowbrook Estate to the north of Stormont House, reducing in height closer to the historic house. There may be a construction compound installed in the Maher's pub carpark.

The alignment of the new wall will be along the SAC boundary. The excavations will encroach approximately 4m from the SAC boundary into the parking area and Meadowbrook Estate, and 2m into the SAC. Along the existing house, measures will be implemented to limit the trench width and enable the new wall to be built as close as possible to the property boundary. Sheet piling / cofferdam may be required due to the close proximity of the Cloon Stream to the SAC boundary. The final excavation depth is dependent on the depth of the suitable in-situ bearing stratum.

Temporary working space for the excavators will be required next to the excavation for the proposed embankment. The final depth and width of required excavation is dependent on the additional site investigation information. The excavation will be battered where feasible however sheet piles / cofferdams may be required for the works in close proximity of the Cloon Stream and the existing house. The temporary working area required on each side of the embankment is dependent on the final depth of excavations required. 5 -10m temporary working space may be required on each side of the embankment. The indicative working space required is based on the assumption that dig-and-replace works of approximately 2m deep may be required, however this is dependent on the outcomes of the additional site investigation. The required temporary working space can be reduced by installing temporary sheet piles.

Archaeological Impacts

Apart from the archaeological potential associated with the riverine environment (AP5), this area falls between the ecclesiastical site on Cloon Island on the north (RMP LI001-004001), and Castle Connell (RMP LI001-003) to the south. Excavations will be required along the proposed flood wall as set out above, and topsoil will be removed along the route of the proposed embankment. Whilst the site investigation works did not reveal any potential archaeological soils or finds, there remains a potential that unknown archaeological sites or features associated with the riverine environment might be identified during the earthmoving works for the proposed flood wall at this location.

This area is of Unknown significance with a Low magnitude of effect, resulting in an Indeterminable negative effect.

Built Heritage Impacts

This area is within the Village Core ACA which is discussed above.

Also of note is Island View House (RPS 1086), as a flood wall is proposed in the rear garden of this property. Properties along this section of the Mall Road have long gardens to the rear defined by stone walls, and in the case of Island View House this includes a portion of stone wall (CH10) which is the remains of a structure which is depicted on the First Edition 6-inch map at the end of the long garden associated with Island View House. It is proposed to construct a flood wall measuring approximately 1.2m high in this location.

Island View House is of Medium significance with a Negligible magnitude of effect, resulting in a Not significant negative effect.

The proposed embankment will be to the rear of Stormont House (BH1) and the potential impact to this site will be outlined in the discussion of Stormont House below.

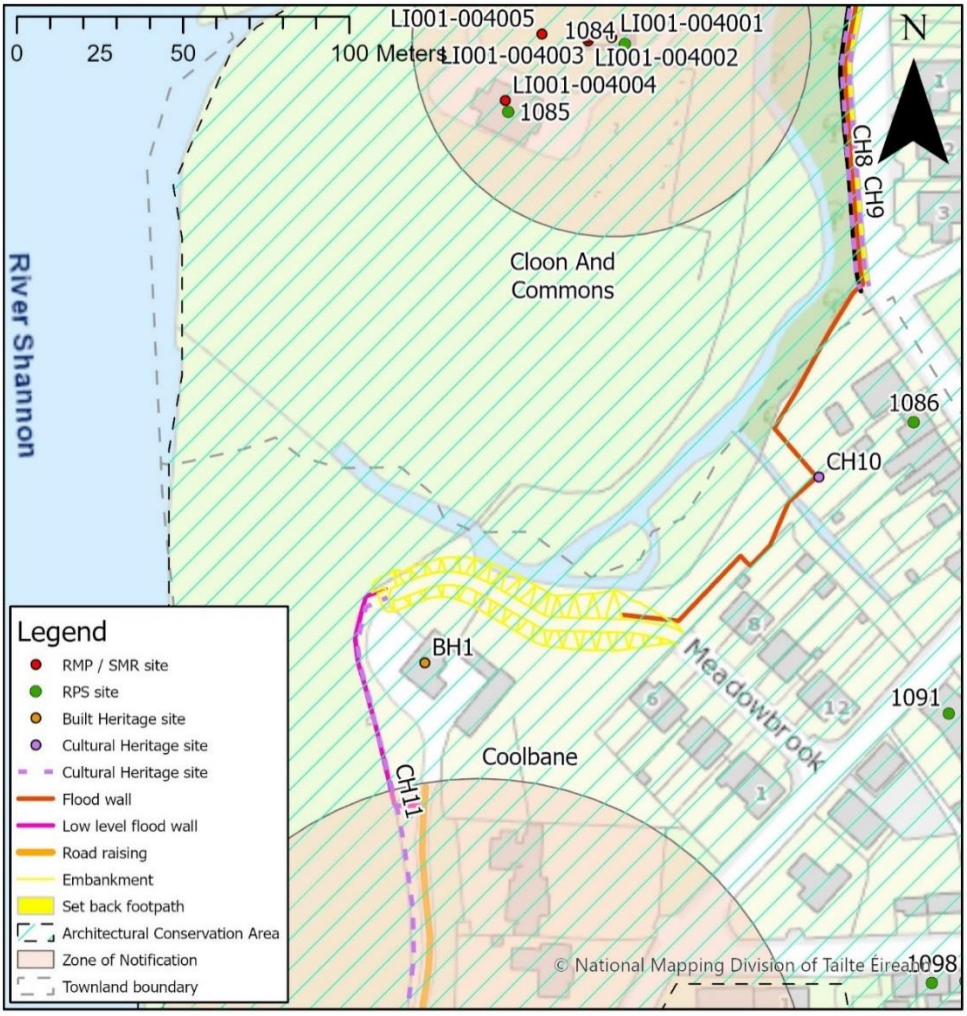

Figure 12-18: Cultural heritage features at Maher's Pub and Meadowbrook

12.4.8 Stormont House Measure/Meadowbrook Estate Measure

Proposed Development

A proposed embankment is proposed running east-west along the northern boundary of Stormont House proposed (Meadowbrook Estate Measure). The embankment will require a temporary working space of 5-10m on each side, it is assumed that dig and replace works of 2m deep will be required. The embankment will tie into a proposed low-level flood wall that runs along the west side of Stormont House, inside the existing crenelated wall, measuring 0.6m-0.7m high. This is up to 0.6m higher than the existing wall in places and will require the demolition of part of the existing wall. The driveway to Stormont House will be raised by approximately 0.7m. Another low-level flood wall will tie into the rock outcrop at the castle, concealed with soil on each side. Due to the low required height of the low-level flood walls, it is not anticipated that the excavations will be deep, however this is dependent on the existing ground conditions.

Archaeological Impacts

Archaeological testing at the eastern end of the proposed embankment in Stormont House was carried out and no features finds or features of archaeological significance was identified in the trench opened. Excavations will be required along the proposed flood wall and embankment as set out above, despite the results of the archaeological testing, there is an archaeological potential in this area associated with the riverine environment (AP6). AP6 also includes the Zone of Notification for Castle Connell (RMP LI001-003), and it is possible that features related to this Anglo-Norman fortification or adjacent settlement activity will survive beneath the surface. There may also be a survival of earlier features related to the pre-Norman fortification which existed on this site, and later structures which are depicted in an 18th century etching (see

inventory entry). While the castle itself will not be impacted, there is potential to reveal related subsurface features. In particular, the localised foundation the low-level flood wall which will tie into the rock outcrop may impact on subsurface features; the concealment of the wall with soil on both sides will mitigate against potential visual intrusion however.

As the ZoN for the castle extends into the Coolbane Wood area, the overall potential impact to AP5 and the castle are outlined in the discussion of Coolbane Woods.

Plate 12-6 Site of proposed low-level flood wall tie-in at Castle Connell

Built Heritage Impacts

This area is within the Village Core ACA which is discussed above.

While Stormont House (BH1) is neither a Protected Structure or listed on the NIAH, it is a significant part of the ACA as it is contemporary with the other riverside villas of Castleconnell, and it incorporates Castle Connell (RMP LI 001-003) into its grounds. The roof and top storey of Stormont House were removed in c. 1970 owing to the poor condition of the structure at the time, hence the undesignated status of this structure. The grounds retain much of the character of the 19th century landscaping, particularly in the low crenelated wall which follows the west side of the avenue to the house (CH11). This was most likely constructed at the time of the road realignment in the late 19th century, with the castle ruins probably providing both the inspiration and material for the construction. Crenelation is a motif found in the architecture of Castleconnell, and it is also used on the bridge to Island House (RPS 5056).

A photomontage showing the visual change of the flood measure to the crenelated wall and road raising is provided in the LVIA Chapter 13 and is extracted as follows in Plate 12-7 and Plate 12-8, demonstrating the visual change. The crenelations are visible above the new wall and the visual link to the river and flood plain being maintained from the property. Similarly, the proposed embankment at the northern boundary will blend into the garden landscape as a grass covered rise (Plate 12-9 and Plate 12-10).

Plate 12-7: Stormont House existing drive and boundary

Plate 12-8: Extract from LVIA Photomontage of the raised drive and flood wall

Plate 12-9: Extract from LVIA northern boundary of Stormont House

Plate 12-10: Extract from LVIA of the proposed embankment at the northern boundary of Stormont House

Stormont House (BH1) is of Medium significance with a Low magnitude of effect, resulting in a Slight negative overall effect.

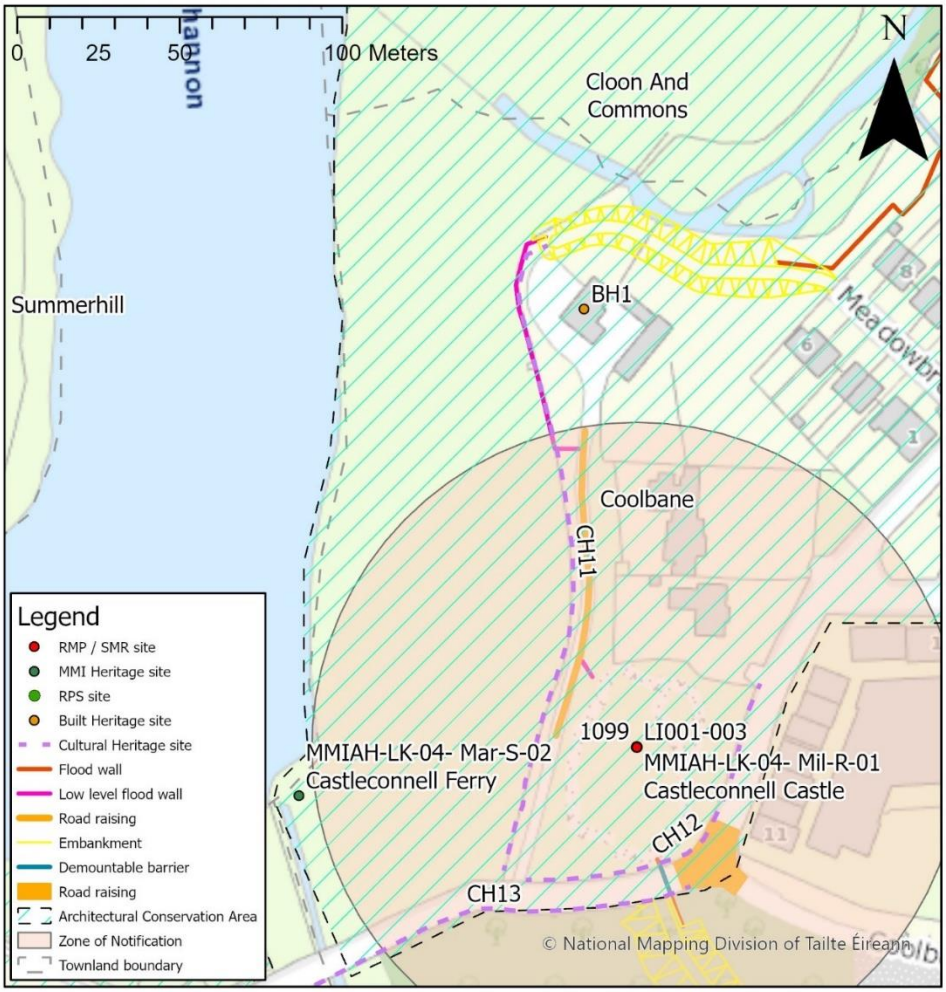

Figure 12-19: Cultural heritage features at Stormont House

12.4.9 Coolbane Woods Flood Measure

Proposed Development

It is proposed to raise the road at the Coolbane Wood junction by up to 0.3m and to install a demountable barrier across the Chapel Hill Road during a flood event. An earthen embankment will extend from the junction along the west side of the Coolbane Wood housing estate, measuring up to 2.5m. Flood walls will tie into the castle rock outcrop and the embankment, requiring excavation. Due to the low required height of this wall, it is not anticipated that the excavations will be deep, however this is dependent on the existing ground conditions.

Ground improvement measures over the peaty ground conditions where the embankment is proposed will be required. This will either comprise deep soil mixing or a 'dig and replace' option. The soil mixing consists of the construction of a central Soil Mixed trench, individually mixed soil columns, up to the required depth, underneath the proposed embankment. A load transfer mattress will also be constructed over the Soil Mixed trench. The approximate permanent footprint will range between approx. 20m-30m and the temporary working space will be approximately 5m each side. The 'dig and replace' option would involve excavation and removal of the peat material and build-up with suitable alternative material. The permanent footprint of the works remains the same for either approach, but additional area would be required on a temporary basis for the 'dig and replace' option. The proposed route for the embankment may also be moved to the west away from the existing properties to allow suitable working space for the required excavations. The excavations to remove the peat layer will be battered and will require larger temporary working space. Sheet piles could also be adopted to limit the excavation.

Archaeological Impacts

This area is partially within the ZoN for Castle Connell (RMP LI001-003) which is part of AP6. It is possible that features related to this Anglo-Norman fortification will survive beneath the surface. There may also be a survival of earlier features related to the pre-Norman fortification which existed on this site, and it is evident from the First Edition 6-inch OS map that there were long burgage-type plots to the east of the castle where the road is now located. While the castle itself will not be impacted, there is potential to reveal related subsurface features. In particular, there is the potential for the foundations of the low-level flood wall which ties into the rock outcrop to impact subsurface features.

In addition to the recorded monument, there is underlying peat in this area which was confirmed by the SI works. Peat has the capacity to preserve organic subsurface features and artefacts. Excavation will be required for the embankment as set out above. Archaeological testing of the southernmost end of the proposed embankment revealed stratified alluvial deposits which included a thin band of peat. Nothing of archaeological significance however was identified in the trench opened (See section 12.2.7 and Appendix 12.8).

AP6 and the area associated with the castle are of Medium significance with a Low magnitude of effect, resulting in a Slight negative effect.

Though outside of the measure, there is a large block of castle masonry fabric (CH15) located south of the Coolbane Woods junction, it is thought to have fallen from the castle tower 1691 destruction of the castle. It is overgrown with vegetation and is immediately behind the road wall. There is a potential that contractors accessing Coolbane Woods may not be aware of its location, and it might be subject to inadvertent damage during construction.

Built Heritage Impacts

This area is partially within the Village Core ACA which is discussed above.

Part of the character of this area is derived from the stone walls which line many of the streets and border the properties of the area (CH12, CH13). It is proposed to raise the road as much as 0.3m at the Coolbane Road junction where low stone walls surround the castle and line both sides of the road. This will reduce the level of visible wall in this area. The walls however will remain in-situ.

The stone walls are of Low significance with a Negligible magnitude of effect, resulting in an Imperceptible negative effect.

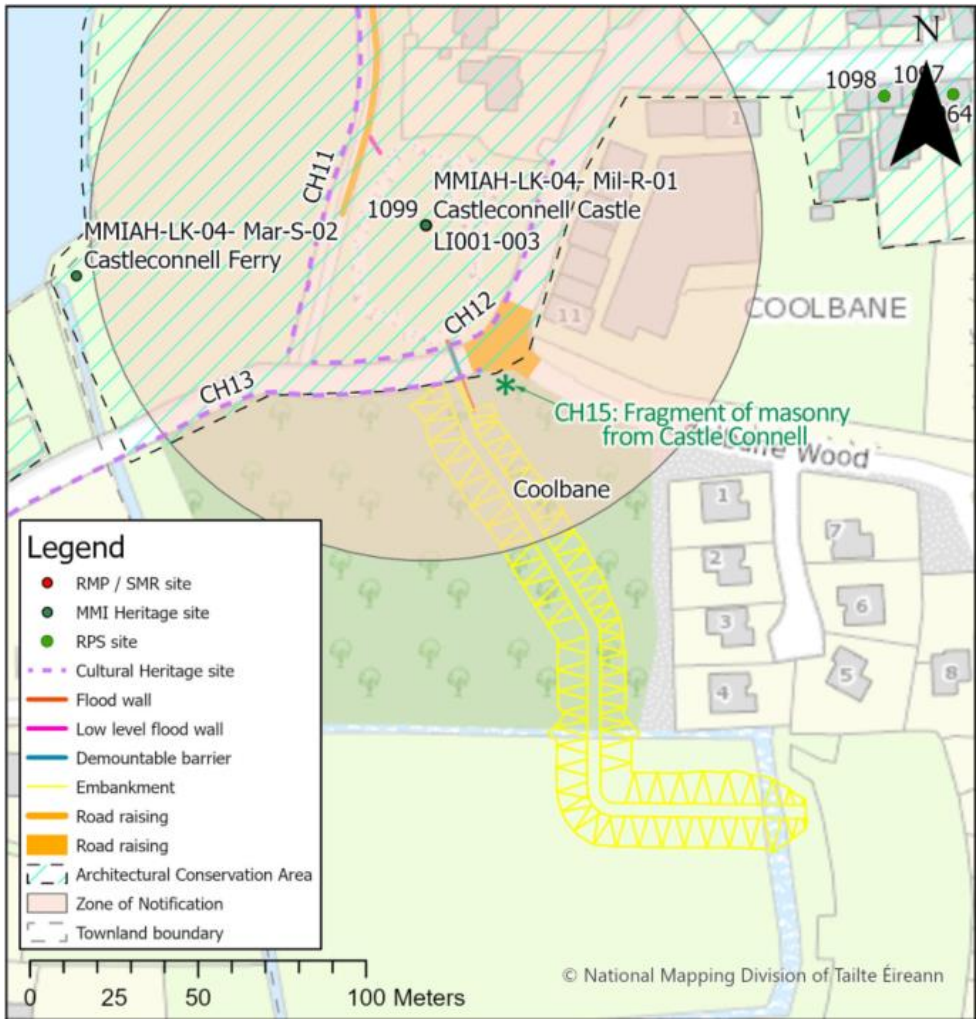

Figure 12-20: Cultural heritage features at Coolbane Woods

12.4.10 Cedarwood Stream Flood Measure

Proposed Development

Maintenance works are proposed at Cedarwood Stream. This will include the widening of the existing stream for a distance of 15m at the rear of Glenbrook (RPS 1076), and the replacement of the existing culvert with a larger box culvert with new headwall arrangement and reinstatement of the stream crossing at the rear of Coole (RPS 1074).

Archaeological Impact

A wade and metal detection survey of the Cedarwood Stream did not identify any finds or features of an archaeological significance (Section 12.26, Appendix 12.7). It established that the natural river channel was somewhat disturbed and reinforced during the construction of the houses in the 1830's. There however remains archaeological potential for any riverine environment (AP7) and the proposed widening of this stream could reveal related subsurface features.

This area is of Unknown significance with a Low magnitude of effect, resulting in an Indeterminable negative effect.

Built Heritage Impact

The Cedarwood Stream runs along the edge of the Spa-well and Worldsend ACA which is discussed above.

Where the stream runs through the Glenbrook property (RPS 1076), a portion of the stream is lined with stone and a modern concrete footbridge crosses the watercourse. The footbridge will not be impacted, but some of the rubble stone lining downstream of this feature will be impacted by the widening of the stream; these however are not considered to be of historic importance.

Glenbrook is of Medium significance with a Negligible magnitude of effect, resulting in an Imperceptible negative effect.

To the rear of Coole (RPS 1074), the existing culvert (CH14) is located on the site of an original culvert depicted on the First Edition 6-inch map of 1844. The existing culvert comprises a large cast concrete pipe with masonry parapets and a deck. A new culvert will restore the crossing over the river.

Coole is of Medium significance with a Negligible magnitude of effect, resulting in an Imperceptible negative effect.

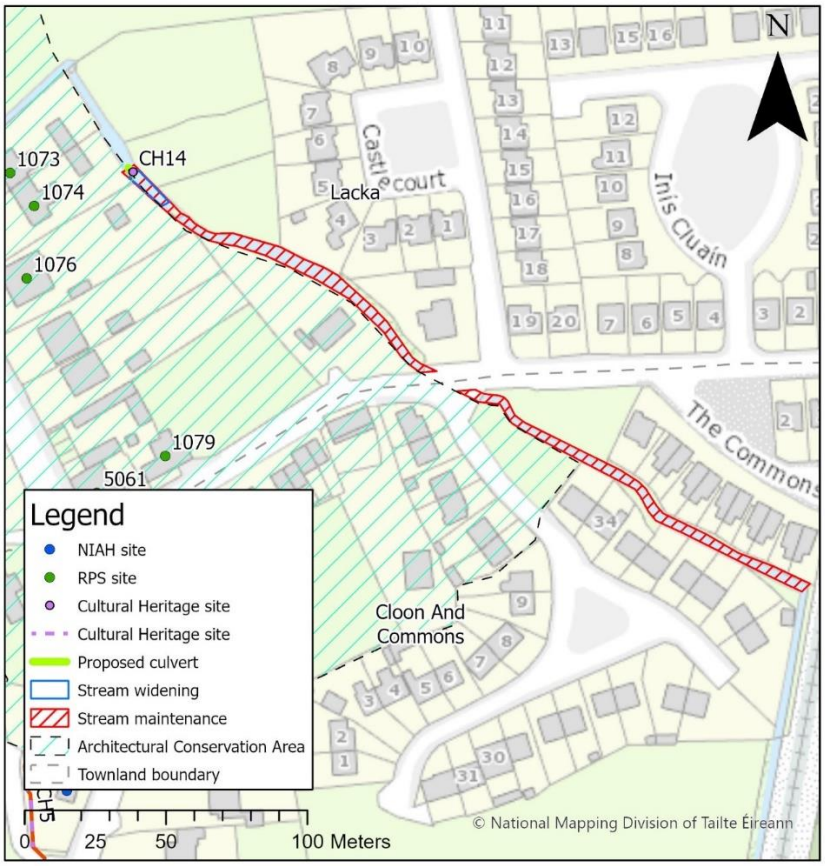

Figure 12-21: Cultural heritage features at Cedarwood Stream

12.4.11 Summary Impacts

To follow in Table 12-7 is a summary of the pre-mitigation potential effects to cultural heritage receptors:

Table 12-7: Potential effects to cultural heritage receptors – pre-mitigation

CH ref.	Significance / Sensitivity Value	Magnitude of Effect	Quality of Effect	Significance of Effect	Duration
AP1 (Riverine potential)	Unknown	Low	Negative	Indeterminable	Permanent
AP2 (Riverine potential)	Unknown	Low	Negative	Indeterminable	Permanent
AP3 (Riverine potential)	Unknown	Low	Negative	Indeterminable	Permanent
AP4 (Riverine potential & ecclesiastical site LI001-004001)	Medium	Low	Negative	Slight	Permanent
AP5 (Riverine potential)	Unknown	Low	Negative	Indeterminable	Permanent
AP6 (Riverine potential & Castle Connell LI001-003)	Medium	Low	Negative	Slight	Permanent
AP7 (Riverine potential)	Unknown	Low	Negative	Indeterminable	Permanent
ACA1 (Spa-well & Worldsend ACA)	Medium	Negligible	Negative	Imperceptible	Permanent
ACA2 (Village Core ACA	Medium	Negligible	Negative	Imperceptible	Permanent
RPS 1074 (Coole)	Medium	Negligible	Negative	Imperceptible	Permanent
RPS 1075 (Grange House)	Medium	Low	Negative	Slight	Permanent
RPS 1076 (Glenbrook)	Medium	Negligible	Negative	Imperceptible	Permanent
RPS 1085 (Island House)	Medium	Negligible	Negative	Not significant	Permanent
RPS 1086 (Island View House)	Medium	Negligible	Negative	Not significant	Permanent
RPS 5056 (Island House Causeway)	Medium	Low	Negative	Slight	Permanent
NIAH 21807034 (Mall House)	Medium	Negligible	Negative	Not significant	Permanent
BH1 (Stormont House)	Medium	Low	Negative	Slight	Permanent
CH1 (Boundary wall)	Low	Medium	Negative	Slight	Permanent
CH6 (Stone wall)	Low	High	Negative	Slight	Permanent
CH8 (River wall)	Low	High	Negative	Slight	Permanent
CH9 (Kerbstones)	Low	High	Negative	Slight	Permanent
CH12 (Stone wall)	Low	Negligible	Negative	Imperceptible	Permanent
CH13 (Stone wall)	Low	Negligible	Negative	Imperceptible	Permanent
CH15 (Masonry fragment)	Medium	Negligible	Negative	Imperceptible	Temporary

12.4.12 Do Nothing Scenario

In a Do-Nothing Scenario, flooding will continue to occur in Castleconnell resulting in the degradation of the built heritage environment including to the ACA, Protected Structures, NIAH sites and stone walls. Any unknown subsurface archaeological sites or features in the footprint of the FRS measures would remain undisturbed.

12.5 Mitigation Measures

12.5.1 Consultation

National Monuments Service and National Built Heritage Unit of the Department of Housing, Local Government and Heritage (DHLGH)

An EIAR Scoping Study Report was submitted on 22nd of December 2023 to the Development Applications Unit (DAU of the National Monuments Service DHLGH by way of initial consultation. A detailed response was received which outlined the potential impacts of flood relief scheme and recommended investigations and mitigation measures (Ref.: G Pre00273/2023, 7th November 2023). These have been considered through the assessment. Some of the principal points from the DAU response and their consideration as part of the proposed scheme are as follows in Table 12-8.

Table 12-8: DAU Response and Project Response

DAU Response	Project Response
Project Archaeologist: The DAU advise that the OPW Project Archaeologist team is consulted.	AMS are OPW Project Archaeologist appointed to this scheme and have been consulted.
Upriver and downriver effects: The DAU advise that consideration be given to unplanned effects, such as the potential for increased flooding upriver or downriver.	Flooding is not expected to change from the baseline situation outside of the protected areas and there will consequently be no indirect impacts outside of the study area.
Submerged archaeology: The DAU advise consideration of the potential for submerged archaeology to become exposed.	Instream works will be limited to short sections of Cedarwood Stream which will be assessed by way of a wade survey with metal detection.
Vibrations: The DAU not the potential for the impact of vibrations on upstanding archaeological remains or built heritage.	Noise and vibration effects and monitoring are discussed in Chapter 6. Guidelines which identify limits for protection against cosmetic damage as a function of vibration frequency are not exceeded through the use of the selected low vibration piling method and continuous monitoring of vibration levels during any piling
Impact to setting: The DAU note the potential for impacts on setting.	Setting and visual impact was considered throughout this assessment, and it was agreed with the Landscape and Visual specialists that the impact to the setting of cultural heritage receptors will be negligible. Designed-in measures include the replacement of like for like with regards to cladding on walls, and the use of glass screens at Grange House (RPS 1075) to maintain views of the river.
Consideration of Do-Nothing scenario and alternatives: The DAU note the need for consideration of a Do-Nothing scenario and alternative options.	The Do-Nothing scenario is considered in Section 12.4.12. A detailed Options Report was prepared with regard to cultural heritage consideration (O' Brien

	2023[107]). This chapter has also discussed the alternative options which were presented for flood relief measures at the Island House causeway (RPS 5056).
Archaeological Investigations: The DAU note a number of types of archaeological investigations which may take place as part of a flood relief scheme.	To date there has been a site inspection and archaeological monitoring of geotechnical site investigations (Licence no.: 20E0542, 20R0204; McCarthy & Haskins[108]). A wade and metal detection survey were carried out under licence to the National Monuments Service (NMS) of the Department of Heritage Local Government and Heritage (DHLGH): Dive Licence Ref: 23D0117 and Detection Licence Ref: 23R0558. An Archaeological Impact Assessment (UAIA) comprising the test excavation of the accessible areas of the flood relief measures was carried out under licence to the NMS of the DHLGH: Excavation Licence Ref: 24E0386

An online introductory presentation of the scheme was given to the Underwater Archaeological Unit of the National Monuments Service and the National Built Heritage Unit on the 15th of January 2024 of the Department of Housing, Local Government and Heritage. This was followed by an onsite meeting on the 6th of February 2024 where each flood measure location was visited and reviewed. The outcome of this meeting included a recommendation for a wade and metal detection survey of the Cedarwood Stream, where stream widening is proposed, and archaeological test excavation where feasible. Additionally, it was recommended that a conservation engineer review the design details of the flood measures on built heritage.

A second onsite meeting with the National Built Heritage Unit and the Project's Conservation Engineers (Southgate Associates) was carried out on the 26th of July 2024, to discuss the mitigation strategy for the built heritage impacts at Grange House, the Mall Wall (north and south), Island House and Stormont House

The Underwater Archaeological Unit has also been consulted as the section of the National Monuments Service of the Department of Housing, Local Government and Heritage with responsibility for flood relief schemes in order to confirm that the NMS are satisfied with the approach being taken with regard to cultural heritage.

Further details of the consultation are provided in Chapter 5 of the EIAR.

Local Authority

The Limerick County Council Conservation Officer Tom Cassidy was consulted on site during the constraints study stage and has been consulted with throughout the project. He has requested that the handrail proposed along the Island House causeway (RPS 5056) which is to be fitted for safety reasons be of a modern style. It is additionally requested that existing stone be re-used as much as possible as part of the scheme which has been adhered to in the design.

[107] O' Brien, Y. (2022) 'Cultural Heritage Options Assessment Report. Castleconnell Flood Relief Scheme, Co. Limerick'. Unpublished report: Courtney Deery Heritage Consultancy Ltd.

[108] McCarthy, J. & Haskins, C. (2021) 'Castleconnell Flood Relief Scheme, Site Investigation Works, Archaeological Monitoring Report'. Licence no.: 20E0542, 20R0204. Unpublished report: Mizen Archaeology.

The Executive Archaeologist for Limerick City and County Council has been consulted with regard to cultural heritage.

12.5.2 Mitigation by Design

Following guidance from the NMS and NBHS, a multidisciplinary approach was undertaken by the project engineers, archaeologists, and conservation engineers to develop the detailed design for the FRS measures on features of cultural heritage importance. A best practice conservation approach was adopted, focussing on minimising impact at each cultural heritage site, for example: the causeway to Island House (RPS 5056), the proposed flood wall at Grange House (RPS 1075), the crenelated wall at Stormont House (B1) and the undesignated river walls on the Mall Road (CH5, CH6, CH8). It was also possible to preserve in situ the Cedarwood Stream culvert (CH3) at Grange House (RPS 1075).

A detailed specification for masonry, capping and cladding of the new flood walls was developed by the conservation engineers Southgate Associates (Appendix 12.9). It is proposed to reclaim and reuse existing stone, as well as the use of locally sourced stone. Where new flood walls are proposed, wall cladding will be of the same or similar stone. Where possible, the stone from existing walls which are to be demolished will be used for cladding. Otherwise, local stone will be used. This measure will ensure that the visual impact to the setting and character of the ACAs, protected structures and built heritage of Castleconnell is eliminated or much reduced.

Furthermore, all of these features are vulnerable to flood events, and fieldwork revealed several portions (particularly along the Mall Road) where lime mortar had eroded and sections had to be repaired. The construction phase will provide an opportunity to make repairs to retained sections of wall using suitable materials (e.g., salvaged stone from demolished sections, lime mortar). The memorial plaque embedded in stone wall CH8 and the limestone kerbstones on the Mall (CH9) will be reinstated within the new floodwall and footpath.

The removal of the culvert (CH14) to the rear of Coole (RPS 1074) to be replaced by a larger box culvert is mitigated by the reinstatement of the stream crossing. The new culvert should include stone parapets to maintain the aesthetic appeal of the existing culvert which, though not old, contributes to the setting of Coole, a protected structure. Where possible, some measure of reinstatement should also be considered in the design along the stream widening to the rear of Glenbrook (RPS 1070).

A public realm plan will be devised in advance of the construction phase which will ensure effective integration of the flood relief works into the historic townscape and river setting in a manner that seeks to contribute positively to the riverfront taking into consideration the historic and riverine heritage of the scheme area.

12.5.3 Archaeological Investigations

As the majority of the proposed flood relief measures will comprise flood relief walls along existing alignments and are quite close to the riverbank and the SAC, existing walls and footpaths/roads, widespread archaeological testing was unsuitable for much of the proposed scheme, owing to restricted space, ecological impacts and the obstacle of the existing walls. Testing was however carried out in the areas of the proposed embankments at Stormont House and at Coolbane Woods.

12.5.4 Archaeological Monitoring

The construction phase will involve earth moving activities including excavations for the construction of flood walls, a stream diversion and instream works at Cedarwood Stream, the relocation of services, and topsoil removal for the embankments, provision of a construction compound and temporary roads and any further site investigation works. There will be no instream works within the River Shannon.

All earth moving activities, including any additional site investigation works will be subject to archaeological monitoring under licence from the NMS of the DHLGH and the NMI, and will ensure the full recognition of, and the proper excavation and recording of, all archaeological soils, features, finds and deposits which may be disturbed below the ground surface.

The archaeologist will have the power to inspect all excavation to formation level for the proposed works and to temporarily halt the excavation work, if and as necessary. They will be given the power to ensure the temporary protection of any features of archaeological importance identified. The archaeologist will be afforded sufficient time and resources to record and remove any such features identified in accordance with the licensing requirements agreed. All archaeological issues will be resolved to the satisfaction of the DHLGH and the NMI.

Archaeological excavation ensures that the removal of any archaeological soils, features, finds and deposits is systematically and accurately recorded, drawn and photographed, providing a paper and digital archive and adding to the archaeological knowledge of a specified area (i.e. preservation by record). As archaeological excavation involves the removal of the archaeological soils, features, finds and deposits, following this mitigation measure there is no further impact on the archaeological heritage.

A detailed written and photographic record of the walls on Mall Road will occur in the advance of the dismantling of walls, this will assist in identification any reuse of decorative masonry fabric in its construction which can be feature in historic towns and villages. The heritage masonry contractor will set aside any decorative masonry fabric that might be found in the walls during its dismantling, for the archaeological examination and recording. If such fabric is discovered, its relocation into the new wall in a prominent spot for public display will be discussed with the National Monuments Service if deemed appropriate.

12.5.5 Construction / Traffic Management Plan

The construction phase will have a detailed Construction Plan and Traffic Management Plan which will include measures to protect cultural heritage receptors. This will include the use of light machinery and bog mats in archaeologically sensitive areas with soft soils to avoid compression / rutting, and the provision of signage alerting construction workers to cultural heritage features under the direction of the monitoring archaeologist.

Under the supervision of the monitoring archaeologist, a robust cordon must be placed around the large masonry fragment of Castle Connell in Coolbane Woods (CH15) to protect it from any inadvertent damage by construction traffic. Signage must be placed in a visible location, so all visitors are aware of the presence of the site.

12.5.6 Archaeological Management of Construction Works and Compliance

As recommended in the NMS in the ‘Archaeology and Flood Relief Scheme Guidelines‘ Limerick County Council and OPW have engaged a Project Archaeologist to advise on the archaeological aspects of the FRS. This role will continue into the construction stage of the FRS where they will advise on archaeological mitigations, including surveys, archaeological monitoring, the assessment of potential on archaeological discoveries, archaeological excavations, and reporting requirements. This may include inspections of archaeological heritage (both terrestrial and underwater). They will also advise the contracting authority on post-excavation progress, requirements, and archiving and finally the publication and dissemination of results of archaeological works.

The PA will advise on compliance with relevant legislation (including the Planning and Development Act, 2000, as amended), the implications of local authority listing of Protected Structures and ACAs, and compliance with the National Monuments Acts.

12.5.7 Flood Protection of Cultural Heritage Receptors

In addition to mitigation measures, the overall effect of the proposed FRS will be a reduction in flood extents, which will have a positive effect on cultural heritage receptors. At present, sites such as Grange House (RPS 1075), Mall House (NIAH 21807034), the grounds of and causeway to Island House (RPS 1085, 5056), Island View House (RPS 1086) and the grounds to Stormont House (BH1) are vulnerable to flood events, as are the stone walls and river walls outlined above.

Other sites which have not been discussed above owing to their distance from the flood relief measures (and hence construction phase impacts or impacts to setting), are also currently vulnerable to flood events

in the do-nothing scenario, such as at A.C.M. Community Resource Centre (RPS 1097, 1098), Castle View House (RPS 1091), Spa House (RPS 5059) and Shannon Stores (RPS 5062). The flooding of these sites can cause a degradation to these cultural heritage receptors and their setting. The protection of these cultural heritage assets from flood events serves as a mitigating factor to potential construction phase effects and effects to setting.

12.6 Residual Impacts

A residual effect is determined to be the degree of change to the cultural heritage environment that will occur after the proposed mitigation measures have taken effect. No significant negative residual impacts have been identified either in the Construction or Operational Phase of the Proposed Scheme, whilst meeting the scheme objectives set out in Chapter 1.

There will be no negative residual effect to the archaeological heritage of Castleconnell.

The overall effect on the built heritage environment will be positive, as potential negative construction phase impacts are mitigated by design and by the positive effect of preventing / reducing flooding which would cause degradation of the built heritage. Potential impacts to archaeological heritage sites (RMP / SMR sites and AP sites) will be mitigated by archaeological monitoring, which will include, if necessary, preservation in-situ or full archaeological excavation (preservation by record). The overall predicted impact to archaeological heritage sites will be No effect. While potential impact to setting of the ACAs of Castleconnell is negligible, the public realm plan will further mitigate against this and has the potential to provide a positive effect to these areas. Furthermore, the result of the proposed FRS will be in providing protection for the 1% AEP flood event, protecting the ACA and its character from flood related impacts to built heritage and setting. The overall predicted impact to the ACAs is therefore predicted to be a Slight positive significance of effect.

Sites which are sufficiently removed from the flood relief measures that there will be no construction phase effects but which benefit from the relief of flood events (A.C.M. Community Resource Centre (RPS 1097, 1098), Castle View House (RPS 1091), Spa House (RPS 5059) and Shannon Stores (RPS 5062)) will be positively affected by the proposed scheme with a Slight positive significance of effect.

Although there will be alterations to the grounds of Grange House (including the provision of a higher flood wall, and the replacement of the culvert), the proposed scheme will protect the protected structure (RPS 1075) from significant flooding. The overall positive effect of flood prevention, along with the mitigation measures of glass panels to maintain views and the reused of stone for cladding, will result in a Slight positive significance of effect.

Similarly, the protection of Mall House (NIAH 21807034) and the grounds of Island House (RPS 1085) and Stormont House (BH1) up to the 1% AEP flood event, along with the reuse of stone for cladding, will result in a Slight positive significance of effect.

The Imperceptible effects to Coole (RPS 1074) from the replacement of a culvert will be mitigated by the replacement with reuse of stone resulting in an overall Neutral effect.

Minor alterations are proposed to the causeway to Island House (RPS 5056) to protect the structure and maintain its functionality for exiting the property during flood events. Some of this will comprise material alterations of the structure, but will also include some amount of conservation work in the form of the repointing of masonry. This structure will still be subject to a certain volume and force of water. The overall significance of effect will be Neutral.

Where river walls and stone walls will be replaced by flood walls, stone cladding will be created from the demolished portions of wall where possible. This will reduce the impact by maintaining some of the visual character of these walls. The repair of retained walls where necessary will also be a positive effect. The majority of the proposed flood walls also follow the course of the existing walls, many of which follow the original townland boundaries and riverbank. This will maintain these historic boundaries. The result is that the magnitude of effect is reduced for CH1 and maintained at Imperceptible for CH12 and CH13. However,

the effect to CH6 and CH8 will remain at Slight as the replacement walls will follow new alignments from the historic boundary. As the limestone kerbstones (CH9) will be reinstated, there will be no effect to this feature.

Table 12-9: Predicted residual impacts to cultural heritage receptors – post-mitigation

CH ref.	Significance / Sensitivity Value	Magnitude of Effect	Quality of Effect	Significance of Effect	Duration
ACA1 (Spa-well & Worldsend ACA)	Medium	Low	Positive	Slight	Permanent
ACA2 (Village Core ACA	Medium	Low	Positive	Slight	Permanent
RPS 1074 (Coole)	Medium	N/A	N/A	Neutral	Permanent
RPS 1075 (Grange House)	Medium	Low	Positive	Slight	Permanent
RPS 1085 (Island House)	Medium	Low	Positive	Slight	Permanent
RPS 1091 (Castle View House)	Medium	Low	Positive	Slight	Permanent
RPS 1097 (A.C.M. Community Resource Centre)	Medium	Low	Positive	Slight	Permanent
RPS 1098 (A.C.M. Community Resource Centre)	Medium	Low	Positive	Slight	Permanent
RPS 5056 (Island House Causeway)	Medium	N/A	N/A	Neutral	Permanent
RPS 5059 (Spa House)	Medium	Low	Positive	Slight	Permanent
RPS 5062 (Shannon Stores)	Medium	Low	Positive	Slight	Permanent
NIAH 21807034 (Mall House)	Medium	Low	Positive	Slight	Permanent
BH1 (Stormont House)	Medium	Low	Positive	Slight	Permanent
CH1 (Boundary wall)	Low	Low	Negative	Not significant	Permanent
CH6 (Stone wall)	Low	High	Negative	Slight	Permanent
CH8 (River wall)	Low	High	Negative	Slight	Permanent
CH12 (Stone wall)	Low	Negligible	Negative	Imperceptible	Permanent
CH13 (Stone wall)	Low	Negligible	Negative	Imperceptible	Permanent

12.7 Monitoring

There will be no requirement for monitoring post-construction.

12.8 Reinstatement

The memorial plaque currently embedded in stone wall CH8 and the limestone kerbstones on the Mall (CH9) will be reinstated within the new floodwall and footpath at these locations.

Appropriate reinstatement of the gardens of protected structures should be included in the programme of works. The stream crossing (CH14) to the rear of Coole (RPS 1074) will be reinstated and this should include be sympathetic to the setting and the structure which it is replacing. Similarly, the mature trees in the grounds of Grange House (RPS 1075) that will be removed will be replaced with mature trees and will be sympathetic to the setting.

The cordon proposed around the large masonry fragment of Castle Connell (CH15) in Coolbane Wood, will be removed once construction has been completed.

12.9 Interactions and Potential Cumulative Impacts

12.9.1 Cultural Heritage and Biodiversity

Archaeological testing would have had the potential to have interactions with Ecology, as many of the flood relief measures are in an SAC along the edge of the river. However, the strategy of combining archaeological investigations with the geotechnical site investigations will protect this area from additional impacts related to cultural heritage mitigation.

12.9.2 Cultural Heritage and Landscape and Visual

Interactions with Landscape and Visual comprise the potential for impacts to setting and visual amenity of cultural heritage receptors. Consultations between both disciplines has taken place with regard to potential impacts to the setting of upstanding archaeological monuments and the built heritage of the village. It is agreed that there will be no impact to the setting of the castle (RMP LI001-003) or the church on Cloon Island (RMP LI001-004001). The replacement of existing stone walls with flood walls which will be clad with the same or similar stone is welcome. The use of glass panels to preserve views at Grange House (RPS 1075) also suitably mitigates against potential impacts to setting and visual amenity.

12.10 Cumulative Impacts

The developments listed in Chapter 15 of this EIAR have been reviewed for potential cumulative impacts. No cumulative impacts to cultural heritage have been identified in the proposed scheme.

13 Landscape and Visual Amenity

13.1 Introduction

This chapter of the EIAR was prepared to assess the potential significant effects of the proposed development on landscape and visual amenity. Other effects of lower significance have been included in this assessment to better inform the decision-making process.

This chapter should be read in conjunction with the planning drawings, scheme layouts, and the Options Report, as well as verified photomontages shown in Figures 13.3 to 13.10, and the Biodiversity and Cultural Heritage chapters of this report.

13.2 Assessment Methodology

The landscape and visual amenity chapter examines the potential effects of the proposed development on views of receptors within the Zone of Theoretical Visibility including residential properties and nearby open spaces, in terms of visual intrusion and visual obstruction. It also examines the impact on landscape character areas from the permanent physical changes to the site brought about by the development.

The Landscape and Visual Impact Assessment in the EIAR takes into consideration aerial photography, emerging design drawings, relevant various publications and reports, together with visits to the site and environs of the proposed development. The Assessment is carried out in accordance with:

- Environmental Protection Agency (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Guidelines for Landscape and Visual Impact Assessment (GLVIA) as published by the Landscape Institute (UK) and the Institute of Environmental Management and Assessment (3rd Edition, 2013); and
- Limerick Development Plan 2022-2028 Landscape Character Assessment.

Verified photomontages, largely in accordance with the GLVIA guidance are shown in Figures 13.3 to 13.10 to facilitate the assessment of visual impacts. These photomontages include humans along with the proposed development. The purpose of this inclusion and deviation from the technical guidelines was to make the scale of the proposals more relevant to the non-technical reader of this report. The locations for the photomontages have been agreed following liaison with the local planning authority.

13.2.1 Landscape Impact Assessment Criteria

When assessing the potential impacts on the landscape resulting from a proposed project, the following criteria are considered:

- Landscape character sensitivity;
- Magnitude of likely impacts; and
- Significance of landscape effects.

13.2.2 Sensitivity of the Landscape

The sensitivity of the landscape to change is the degree to which a particular Landscape Character Area (LCA) can accommodate changes or new elements without unacceptable detrimental effects to its essential characteristics.

Landscape Sensitivity, often referred to as 'value', is classified using the following criteria which have been derived from a combination of industry guidelines from the Landscape Institute for Landscape and Visual Impact Assessment and professional judgement.

- Very high - Areas where the landscape character exhibits a very low capacity for change in the form of development. Examples of which are very high value landscapes, protected at an international level

e.g., World Heritage Site, where the principal management objectives are likely to be protection of the existing character;

- High - Areas where the landscape character exhibits a low capacity for change in the form of development. Examples of which are high value landscapes, protected at a national level e.g., National Park, where the principal management objectives are likely to be protection of the existing character;
- Medium - Areas where the landscape character exhibits a medium capacity for change in the form of development. Examples of which are medium value landscapes, protected at a Local or Regional level e.g., Open space areas mentioned within a County Development Plan, where the principal management objectives are likely to be protection of the existing character;
- Low - Areas where the landscape character exhibits a high capacity for change and has very few or no designated landscapes or open space areas; and
- Negligible - Areas of landscape character that include derelict, mining, industrial land or are part of the urban fringe where there would be a reasonable capacity to embrace change or the capacity to include the development proposals. Management objectives in such areas could be focused on change, creation of landscape improvements and/or restoration to realise a higher landscape value.

13.2.3 Magnitude of Likely Landscape Impacts

The magnitude of a predicted landscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the proposed project. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape components and/or a change that extends beyond the boundary of the proposed project that may have an effect on the landscape character of the area.

- Very high - Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality;
- High - Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality;
- Medium - Changes that are modest in extent and scale involving the loss of landscape characteristics or elements that may also involve the introduction of new uncharacteristic elements or features that would lead to changes in landscape character, and quality;
- Low - Changes affecting small areas of landscape character and quality, together with the loss of some less characteristic landscape elements or the addition of new features or elements;
- Negligible - Changes affecting small or very restricted areas of landscape character. This may include the limited loss of some elements or the addition of some new features or elements that are characteristic of the existing landscape or are hardly perceptible;
- Neutral - Changes that do not involve the loss of any landscape characteristics or elements and will not result in noticeable changes to the prevailing landscape character; and
- Positive - Changes that restore a degraded landscape or reinforce characteristic landscape elements.

13.2.4 Significance of Landscape Effects

The significance of the landscape impact will be the combination of the sensitivity of the landscape against the magnitude of the change. This is summarised in Table 13-1 below.

Table 13-1: Significance of Landscape and Visual effects based on Magnitude and Sensitivity

	SENSITIVITY				
MAGNITUDE	**Very high**	**High**	**Medium**	**Low**	**Negligible**
Very high	Profound	Very significant	Significant	Moderate	Slight
High	Very significant	Significant	Moderate	Slight	Slight
Medium	Significant	Moderate	Slight	Slight	Imperceptible
Low	Moderate	Slight	Slight	Imperceptible	Imperceptible
Negligible	Slight	Slight	Imperceptible	Imperceptible	Imperceptible
Neutral	Imperceptible	Imperceptible	Imperceptible	Imperceptible	Imperceptible
Positive	Positive	Positive	Positive	Positive	Imperceptible

13.2.5 Sensitivity of Visual Receptors

Unlike landscape sensitivity, the sensitivity of visual receptors has an anthropocentric basis. It considers factors such as the perceived quality and values associated with the view, the landscape context of the viewer, the likely activity they are engaged in and whether this heightens their awareness of the surrounding landscape.

Visual receptors most susceptible to changes in views and visual amenity are:

- Very high – Residents in properties within protected landscapes and travellers on a Scenic route where awareness of views is likely to be heightened;
- High – Residents in properties with predominantly open views from windows, garden or curtilage. People, whether residents or visitors, who are engaged in outdoor recreation including use of public rights of way, whose attention or interest is likely to be focused on the landscape and on particular views, and those on a scenic route where the view is not specifically in the direction of the proposed development;
- Medium – Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience, and communities where views contribute to the landscape setting enjoyed by residents in the area.
- Low – People engaged in outdoor sport or active recreation on a local scale, which does not involve or depend upon appreciation of views of the landscape; and people at their place of work whose attention may be focused on their work or activity, not their surroundings and where the setting is not important to the quality of working life, and people travelling in vehicles where their view is limited to a few minutes at any viewpoint; and
- Negligible – Changes affecting restricted viewpoints.

13.2.6 Magnitude of Visual Impact

The magnitude of a visual effect is determined on the basis of several factors: the relative numbers of viewers, the distance from the viewpoint, the visual dominance of the proposed development within a view and its effect on visual amenity, as follows:

- Very high – The proposal intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. A high degree of visual clutter or disharmony is also generated, strongly reducing the visual amenity of the scene;
- High – The proposal intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual clutter or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene;
- Medium – The proposal represents a moderate intrusion into the available vista, is a readily noticeable element and/or it may generate a degree of visual clutter or disharmony, thereby reducing the visual

amenity of the scene. Alternatively, it may represent a balance of higher and lower order estimates in relation to visual presence and visual amenity;

- Low – The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene; and
- Negligible – The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene.
- Magnitude can also be described as:
- Neutral – Changes that are not discernible within the available vista and have no bearing the visual amenity of the scene; and
- Positive – Changes that enhance the available vista by reducing visual clutter or restoring degraded features.

13.2.7 Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the same significance matrix as used earlier in respect of landscape effects, see Table 13.1.

13.2.8 Impact Classification Terminology

This chapter follows the EPA 2022 Guidance as outlined in Chapter 1 of the EIAR. The term temporary and reversible are considered interchangeable in this report. Impacts that are expected to last less than a year are considered short-term. This deviation from the EPA terminology is in line with the GLVIA (3rd edition)

Each impact is described in terms of its quality, significance, extent, duration and frequency, and type, where possible.

13.2.9 Cumulative Impact Assessment

The cumulative effect of a set of developments is the combined effect of all the developments taken together. Cumulative effects on visual amenity consist of combined visibility and sequential effects. Combined visibility occurs where the observer is able to see two or more developments from one viewpoint.

- Combined visibility may either be in combination (where several developments are within the observer's arc of vision at the same time) or in succession (where the observer has to turn to see the developments).
- Sequential effects occur when the observer has to move to another viewpoint to see different developments. For example, this could be when travelling along roads or paths. The occurrence of sequential effects may range from frequently sequential (the features appear regularly and with short time lapses between, depending on speed of travel and distance between the viewpoints) to occasionally sequential (long time lapses between appearances, because the observer is moving very slowly and / or there are large distances between the viewpoints).

Cumulative landscape effects affect the physical fabric or character of the landscape, or any special values attached to the landscape.

- Cumulative effects on the physical fabric of the landscape arise when two or more developments affect landscape components such as woodland, dykes or hedgerows. Although this may not significantly affect the landscape character, the cumulative effect on these components may be significant – for example, where the last remnants of former shelterbelts are completely removed by two or more developments.
- Cumulative effects on landscape character arise from two or more developments. Housing developments introduce new features into the landscape. In this way, they can so change the landscape character that they can create a different landscape character type. That change need not be negative; some derelict or industrialised landscapes may be enhanced as a result of such a change in landscape character. The cumulative effects on landscape character may include other changes, for example

trends or pressures for change over long time periods, which should form part of any consideration of a particular project.

The area in which the proposals site is located contains other built elements such as walls and therefore there is potential for cumulative effects on landscape and visual amenity.

13.2.10 Relevant Legislation and Guidance

The landscape assessment undertaken is made with regard to the sensitivity of the landscape and its ability to undergo change. The methodology is based on national and local policy guidelines and best practice methodology as outlined in the references below:

- Guidelines on Landscape and Visual Assessment (2002); Irish Landscape Institute (ILI);
- Guidelines for Landscape and Visual Impact Assessment (GLVIA), third edition (2013), Landscape Institute (UK);
- Guidelines on Information to be Contained in Environmental Impact Assessment Reports (2022) Environmental Protection Agency (EPA);
- Environmental Impact Assessment of Projects: Guidelines on the Preparation of the Environmental Impact Assessment Report (EIAR) (2017); European Commission (EC);
- Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (2013) EC;
- Guidelines on Landscape and Landscape Assessment (2000); Department of the Environment, Community and Local Government (DOE);
- National Landscape Strategy 2015-2025 DOE;
- National Biodiversity Action Plan (2017-2021);
- Limerick Development Plan 2022-2028;
- LCA and LVIA of Specified Infrastructure Projects – Overarching Technical Document (Dec 2020); Transport Infrastructure Ireland (TII);
- Visual Representation of Development Proposals, Landscape Institute (UK, 2019); Technical guidance notes for photomontages; and
- Amenity Trees and Woodland: A Guide to their Management in Ireland (2010); Tree Council of Ireland

In addition to the above documents, Ordnance Survey and National Monuments Service historical maps were used to help identify past land uses, landscape components and historic landscape evolution. In a modern context, aerial images from 1995 to the present also informed landscape changes.

13.3 Receiving Environment

13.3.1 Site Context

Castleconnell is situated approximately 10km northeast of Limerick City, along the eastern banks of the River Shannon. It is a large settlement within the commuting belt of Limerick City, with road and rail connections to the City and to Dublin. The River Shannon corridor has a strong influence on the landscape character of the town and the surrounding area.

Several housing areas surround the small core of Castleconnell, which is centred on The Mall Road and Castle Street, with St Joseph's Church and other community and commercial premises in the town centre. The majority of the town sits between the River Shannon to the west and the railway line to the east, with some housing extending beyond the railway line towards the M7.

Landscape Character

The proposed development sits within the Shannon Coastal Zone Landscape Character Area (LCA) for Limerick, and is adjacent to the River Shannon Farmlands LCA for Clare.

The Shannon Coastal Zone LCA encompasses a large portion of northern Limerick and is delimited on one side by the Shannon Estuary and on the other by the gradually rising ground that leads to the agricultural zone and the western hills to the southwest. The estuary is the distinguishing characteristic of the region. In

general, the landscape is of an enclosed agricultural type, with hedgerows serving as the dominant feature. This differs from the other agricultural landscapes of the county in that the field patterns, especially near the estuary, are typically less regular than in other parts of Limerick.

Regarding the River Shannon Farmlands LCA, lowland farming region is dominated by the meandering River Shannon. The Village of O'Briensbridge is crucial for the territory and is designated as an Architectural Conservation Area (ACA). Sliabh Bernagh and the Broadford Hills are framed by undulating lowland farmland in the distance. Other characteristics of the zone are a reduction in farming west of the Shannon and high pressure from quarrying.

The landscape around the development site is dominated by the River Shannon, which is visible from numerous points. The landscape is relatively enclosed, with mature vegetation lining the roads and the River Shannon itself in most places. The study area is low-lying, without connections to the surrounding hills as described in the landscape character assessments.

Visual Amenity

There are no designated protected views which could be impacted by the proposed development, the closest one being approx. 3.3 km to the east. This view is in Co. Tipperary and is oriented west towards the proposed development. However, due to the distance, intervening topography, and vegetation, Castleconnell and the development site are not visible.

Visual amenity is primarily on a local or household scale, with residences in the area enjoying views over the River Shannon and riparian vegetation. Views of the river are also possible along the Mall Road. These views are expected to be impacted during construction or operation by the proposed flood walls, embankments and removal of existing vegetation.

Zone of Theoretical Visibility

A Zone of Theoretical Visibility (ZTV) was produced for the assessment. The ZTV shows the areas that the proposed development could be visible in the surrounding landscape within a radius from the proposed development. This is taken into consideration to form the study area for the assessment of visual impacts. The radius that is considered needs to be proportional to the height and extents of the proposed development. For this proposed development, the ZTV maps show the area with potential visibility within a 1 km radius from the proposed works. The ZTV was based on a viewer eye height of 1.6 m and the proposed defence heights across the scheme. The ZTV is based on a digital terrain model (DTM) and represents a bare ground scenario i.e., with no trees, hedgerow or built features present that would provide screening.

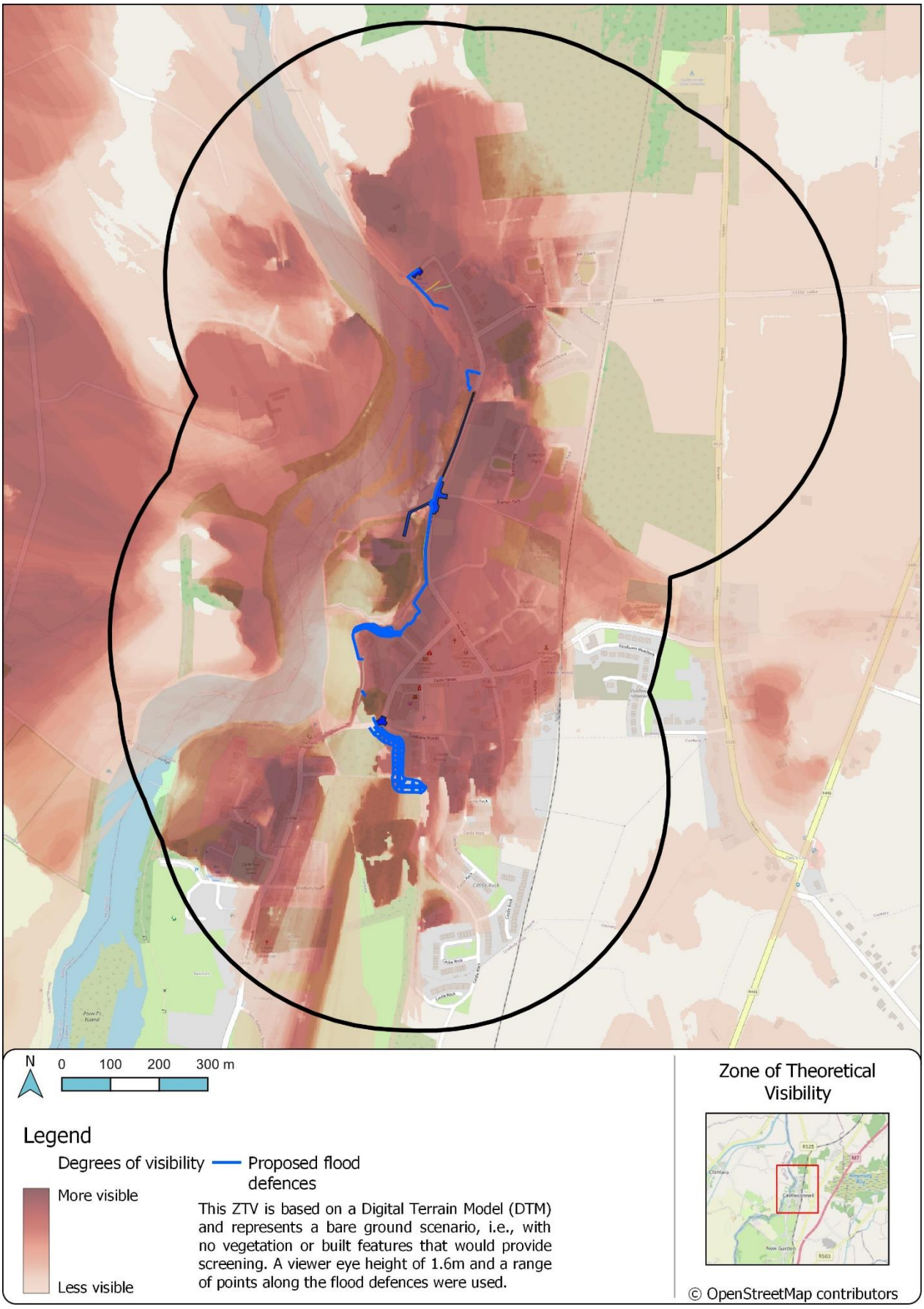

Figure 13-1: Zone of Theoretical Visibility

13.4 Characteristics of the Proposed Development

The full description of the Proposed Development is provided in Chapter 4 of the EIAR.

To facilitate construction works and access, limited vegetation removal will take place, particularly at the Coolbane Woods embankment, Meadowbrook embankment, and the Cedarwood Stream.

The defences are a combination of walls and embankments, with road raising and demountable flood barriers also present. The proposed defence walls are proposed to be finished with the same material as the currently existing walls on site. The proposed embankments will be allowed to be naturally vegetated with grass or herbaceous plants. Trees will not be allowed to grow close to the base of the embankment as this would compromise their structural integrity.

13.5 Potential Impact of the Proposed Development

13.5.1 Predicted Impacts

As described in the methodology, the impacts to the landscape and visual amenity have been assessed based on the sensitivity of the receptor and magnitude of change. This assessment as part of an EIAR is focused on potential significant impacts, and secondarily on impacts of lower significance.

Receptor groups were identified during the initial desktop investigation using aerial imagery and verified on site during the site visit. Receptors were grouped in terms of function, i.e., residential buildings, community buildings, public open space, etc., location and expected significance of impact. See Figure 13-2 for the Visual Receptor Plan which shows the identified receptor groups. These receptor groups are discussed below with an assessment of the effects on their visual amenity.

Eight verified photomontages have been produced showing the expected visual impact of the proposed development from selected points in public locations around the scheme. This provides a sense of the degree of screening and magnitude of change to these views as a result of the proposed development. The compendium of photomontages is presented below in Figure 13-3 to Figure 13-10.

Impact Duration was considered permanent if a receptor had a distinct alteration to the horizon line or if views of a structure would continue to remain visible. During assessment, the landscape was also considered in the context of permanency. For example, retained mature trees were considered permanent, with management and evolution. Naturally colonising vegetation will in the short- to medium-term become a permanent screening feature due to size and density and presence in the vicinity of the proposed development. Deviating from the EPA terminology describing the duration of an impact, the terms *temporary* and *reversible* are used mutually interchangeable in this report to describe an effect that is not permanent.

Type of Impact was considered positive only if the proposals contribute to the character of the locality and would not be detrimental to the landscape or visual amenity. A negative *Type of Impact* might occur if for example, the proposals diluted the character or perception of Castleconnell or had a detrimental impact on views of the River Shannon.

13.5.2 Do-Nothing Impact

Under the do-nothing scenario the landscape character and visual amenity of the area would be unchanged, and Castleconnell would continue to be susceptible to flooding. During flood events, public open spaces and residential areas would continue to flood, resulting in periodic negative impacts on landscape and visual amenity during flood events.

13.5.3 Receptor Descriptions

Landscape

The Landscape Character Assessment for the Limerick Development Plan 2022 – 2028 describes the Shannon Coastal Zone as a large area of land bounded by the River Shannon on one side and “gradually

rising ground" leading on to agricultural zones and higher ground to the west and southwest. The River Shannon and its estuary is the defining characteristic of the LCA. It is under development pressure due to the influence of Limerick City and expansion of settlements such as Castleconnell.

Key characteristics include the geology that favours free draining soils, the mixed, residential, commercial and agricultural use of land. There is a lack of ecological designations, and the hedgerows are overgrown and scrappy. The settlements lack vernacular buildings and most development occurs in the urban fringe.

During construction, the placement of compounds in open spaces, such as at Mall Field, adjacent to the Mall Road, will lead to impacts on the landscape character of these spaces. These impacts will be short-term and temporary.

The location of the proposed development, within Castleconnell Village itself, is expected to limit its potential for impacts on landscape character. The proposed defences such as walls and embankments are placed in areas which already contain built features. Existing pedestrian and vehicular connections to the River Shannon and its riparian zone will be retained. The proposed removal of vegetation along the Cedarwood Stream, and limited tree removal in areas along the Shannon to facilitate the construction of walls and embankments, is expected to impact a distinct element of the existing landscape. This impact is expected to be slight, short-term, temporary negative due to the limited extents of the removal of vegetation and the presence of tall vegetation towards the River Shannon.

The proposed FRS will provide flood protection to existing built properties and road infrastructure; open areas of floodplain will continue to flood, ensuring this aspect of landscape character in the area remains unchanged once the scheme is operational. This will also ensure that existing open spaces in the area around Castleconnell remain as such, as they will not be zoned for development if they sit in a flood zone.

According to the methodology and taking into account the proposed design, the overall impact to the landscape is expected to be **slight, short-term, temporary, negative** during construction and **long-term negative, imperceptible** to **neutral** during the operational stage.

Visual

Receptor groups were identified during the initial desktop investigation using aerial imagery and verified on site during the site visit. Receptors were grouped in terms of function, i.e., residential buildings, community buildings, etc., and location. See Figure 13-2 for the 'Visual Receptor Plan' which shows the identified receptor groups, and Table 13-2 for a summary of visual impact assessment per receptor. These receptor groups are discussed in detail below with an assessment of the effects on their visual amenity.

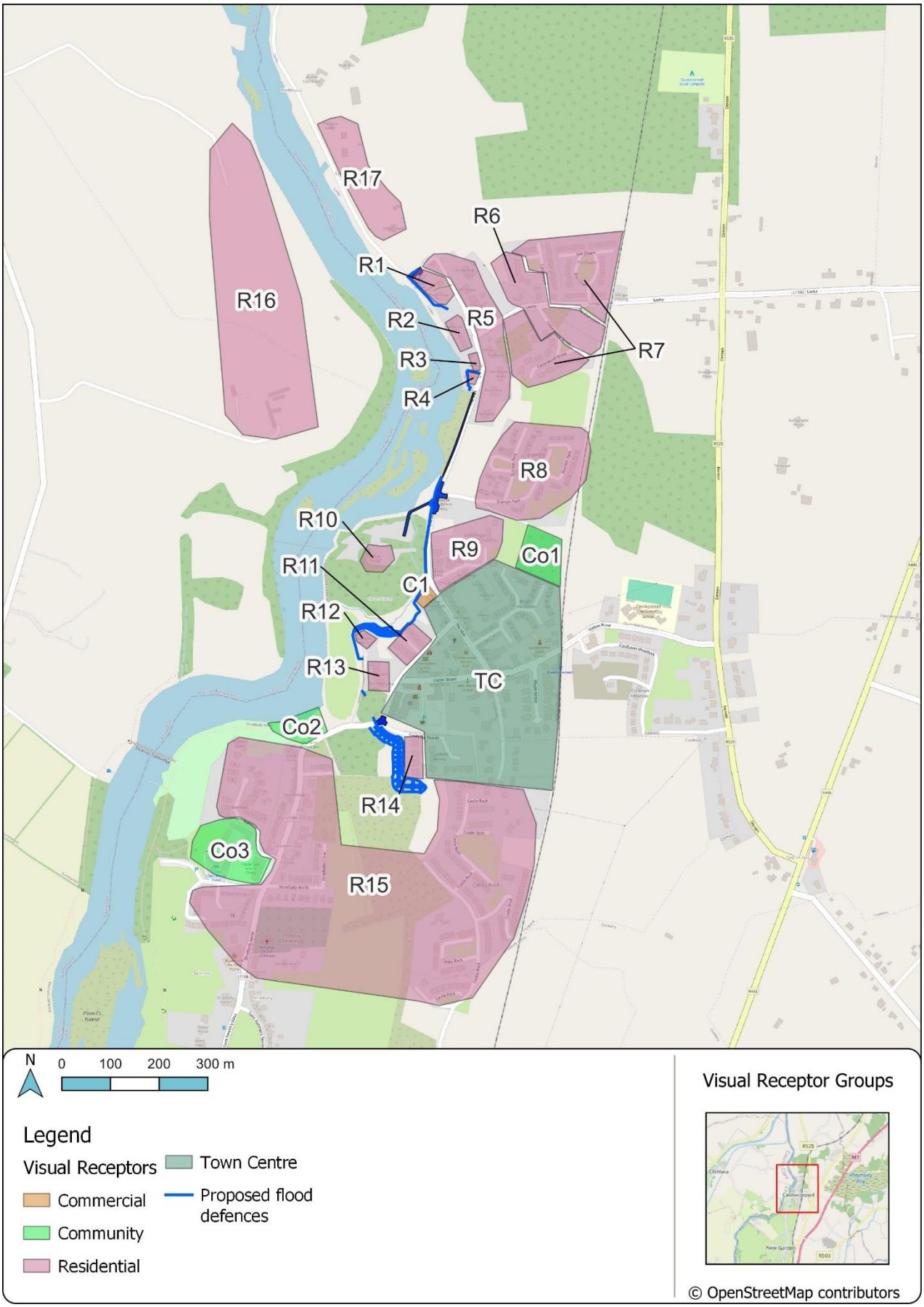

Figure 13-2: Receptor groups

Table 13-2: Visual Receptor Summary Table

Receptor No.	Distance from proposed development	Sensitivity	Magnitude of change	Predicted impact and duration	
				Construction	Operation
R1	0m	High	Medium	*Temporary, moderate, negative*	*Permanent, moderate, negative*
R2	20m	High	Low to Negligible	*Temporary, slight, negative*	*Permanent, slight, negative* to *Imperceptible*
R3	0m	High	Low	*Temporary, slight, negative*	*Permanent, slight, negative*
R4	0m	High	Low	*Temporary, slight, negative*	*Permanent, slight, negative*
R5	30-100m	High	Low to Negligible	*Temporary, slight, negative* to *Imperceptible*	*Permanent, slight, negative* to *Imperceptible*
R6	0m	High	Negligible	*Temporary, slight, negative*	*Permanent, slight, negative*
R7	40-200m	High	Negligible to Neutral	*Temporary, slight, negative* to *Imperceptible*	*Permanent, slight, negative* to *Imperceptible*
R8	80-250m	High	Negligible to Neutral	*Temporary, slight, negative* to *Imperceptible*	*Permanent, slight, negative* to *Imperceptible*
R9	20-150m	High	Low to Negligible	*Temporary, slight, negative*	*Permanent, slight, negative*
R10	50m	High	Negligible to Neutral	*Temporary, slight, negative*	*Imperceptible*
R11	0-50m	High	Low to Negligible	*Temporary, slight, negative*	*Permanent, slight, negative*
R12	0m	High	Low	*Temporary, slight, negative*	*Permanent, slight, negative*
R13	20m	High	Negligible to Neutral	*Temporary, slight, negative*	*Imperceptible*
R14	20m	High	Low to Negligible	*Temporary, slight, negative*	*Permanent, slight, negative*
R15	60-425m	High	Neutral	*Imperceptible*	*Imperceptible*
R16	275-450m	High	Neutral	*Imperceptible*	*Imperceptible*
R17	100-350m	High	Neutral	*Imperceptible*	*Imperceptible*

TC	0-300m	High	Negligible to Neutral	*Temporary, slight, negative* to *Imperceptible*	*Permanent, slight, negative* to *Imperceptible*
C1	0m	Low	Low / Neutral	*Temporary, imperceptible, negative*	*Imperceptible*
Co1	225m	Low	Neutral	*Imperceptible*	*Imperceptible*
Co2	125m	Medium	Negligible	*Temporary, imperceptible, negative*	*Permanent, imperceptible, negative*
Co3	350m	Medium	Neutral	*Imperceptible*	*Imperceptible*

R1 (Rivergrove B&B and Grange House, at the northern end of the scheme) – Distance from land boundary to nearest flood defence measure = 0m.

These two residential buildings are at the northern end of the scheme. Both are detached houses with large gardens wrapping around the buildings. The western boundaries of the gardens are adjacent to the bank of the River Shannon, with views over the river currently available. There are mature trees and other vegetation in the gardens and along the boundaries which provide a moderate level of screening for both houses while allowing views to the river. Three large beech trees in the garden will be removed to facilitate construction.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude Both houses have views over the River Shannon from certain windows and parts of their gardens. It is proposed to build a new flood wall along their western side in place of the existing wall. The proposed wall will range from 1.5m – 2.2m high and will include glass panels to allow particular views of the River to be maintained. The driveway of Rivergrove B&B is also to be rearranged, with a new low level flood wall to be constructed inside the existing wall. A new flood wall will be built across the existing entrance to tie into the existing front wall, and a new entrance will be created at the northeast of the property. Construction will require the clearance of some vegetation along the existing wall on the river side to allow for access, Removal of planting along the northwestern boundary of the property will also be required to facilitate the new entrance. Where possible, this will be translocated to another location in the garden. Views to the flood walls will be direct. The magnitude of change is *Medium*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Moderate, Negative** during construction and **Permanent, Moderate, Negative** during operation.

R2 (2 no. houses along the River Shannon, between Grange House and Dunkineely House) – Distance from nearest flood defence measure = 20m.

This receptor group comprises 2 no. houses adjacent to the River Shannon, with rear windows facing towards the River Shannon and large front and rear gardens.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude The properties are oriented with their rear windows and gardens facing directly onto the River Shannon. The primary views onto the River Shannon and its riparian vegetation will not be affected by the proposed development. Due to tall vegetation to the north of the houses, the flood walls to be built at Rivergrove B&B and Grange House will not be visible from these receptors. The flood walls to be built to

the south will be partially visible through angled views, glimpsed through existing vegetation. The magnitude of change will be *Low* to *Negligible*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

R3 (Dunkineely House) – Distance from land boundary to nearest flood defence measure = 0m.

This receptor group comprises 1 no. house adjacent to the River Shannon, with rear windows facing towards the River Shannon and large front and rear gardens.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude This property is oriented with their rear windows and garden facing directly onto the River Shannon, experienced through a number of trees in their own property. The primary views onto the River Shannon and its riparian vegetation will not be affected by the proposed development. Due to tall vegetation and R2 to the north, the flood walls to be built at Rivergrove B&B and Grange House will not be visible from R3. The flood walls to be built around R4 to the south will be partially visible through angled views, with one low wall to be built along their boundary. The magnitude of change will be *Low*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R4 (Mall House) – Distance from land boundary to nearest flood defence measure = 0m.

This receptor group comprises 1 no. house adjacent to the River Shannon, with rear windows facing towards the River Shannon. The house is at the northern end of The Mall Road. The proposed view of Mall Road, south of Mall House, is shown in Figure 13-3.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude This property is oriented with their rear windows and garden facing directly onto the River Shannon. An existing low wall on the western and northern sides of the property will be demolished and rebuilt as a flood wall, approximately 0.6m higher. This will partially impact views of the River Shannon from the property, however the Shannon will remain visible over the wall. The magnitude of change will be *Low*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R5 (a large group of houses at the northern end of Castleconnell, across the road from receptors R1 to R4) – Distance from nearest flood defence measure = 30-100m.

This receptor group comprises the houses along the eastern side of the Mall Road, from Mallfields in the south to the house across from Rivergrove B&B in the north, and the house beside Rivergrove B&B. These houses mostly face to the west. Any views of the River Shannon from these houses are partially screened by existing vegetation or the houses on the western side of the road (R1-R4). The proposed view of Mall Road, across from the southernmost house in this group, is shown in Figure 13-3.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties currently experience indirect views of the River Shannon, through existing vegetation and partially screened by other buildings, primarily those on the western side of the Mall Road (R1-R4). These views will be slightly impacted by the proposed defences in places, however, the overall character of the views will not be altered as the proposed walls are similar in appearance to the existing walls. The magnitude of change will be *Low* to *Negligible*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

R6 (large group of houses in Cedarwood Grove, The Commons, and Castlecourt, whose gardens are adjacent to the Cedarwood Stream) – Distance from land boundaries to nearest flood defence measure = 0m.

This receptor group comprises the houses, mainly in Cedarwood Grove, The Commons, and Castlecourt estates, whose gardens adjoin the Cedarwood Stream or look onto the stretches of the Cedarwood Stream where works are proposed.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties currently have views towards the Cedarwood Stream, where maintenance works are proposed. These works will comprise vegetation clearance and alterations to a culvert. The stream is currently overgrown with brambles, some of which will be cleared to improve conveyance. Views from these properties to the Cedarwood Stream are possible. The magnitude of change will be *Negligible*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R7 (large group of houses in the northeastern part of Castleconnell, including Inis Cluain and Cedarwood Grove, that are not directly adjacent to Cedarwood Stream) – Distance from nearest flood defence measure = 40-200m.

This receptor group comprises those houses in Cedarwood Grove not part of R6, along with the Inis Cluain housing estate and several other houses in the northeastern part of Castleconnell, which do not directly overlook or adjoin the proposed Cedarwood Stream works.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties are close to the Cedarwood Stream, but are not adjacent to it and are partially to fully screened from it by other existing houses and vegetation. At most, these houses will have an indirect or angled view of part of the works area for the Cedarwood Stream. In this case the magnitude of change will be *Negligible*, and will be *Neutral* otherwise.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

R8 (Scanlon Park) – Distance from nearest flood defence measure = 80-250m.

This is a large receptor group comprising the houses in the Scanlon Park housing estate. They face in a range of directions, with a limited number having direct or angled views towards the Mall Road and the River

Shannon. Most of the receptor group does not have views over the proposed works areas. Figure 13-5 shows the proposed changes to the Scanlon Park/Island House junction, which will be partially visible from some of this receptor group.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude The westernmost properties in Scanlon Park will have angled views of the proposed flood wall along the Mall Road, along with views of the works to the footpath and road raising at the entrance to Island House and Scanlon Park. The riparian vegetation beyond the existing and proposed flood wall will remain partially in view for a number of houses. The new flood wall along the western side of the Mall Road, across from Scanlon Park, will be approx. 300mm higher than the existing wall. The magnitude of change will be *Negligible* to *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

R9 (a group of houses known as The Tontines and Tonville, east of Island House) – Distance from nearest flood defence measure = 20-150m.

This receptor group comprises a group of houses on the eastern side of The Mall Road, with gardens facing onto The Mall Road. Figure 13-7 shows the proposed view of the Mall Road from just south of these houses, and just north of Maher's Pub.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude Three of these properties currently have direct or angled views of the wall along the Mall Road, and the trees on Cloon Island behind that. The construction of a new flood wall in place of the existing wall will slightly impact these views, however the vegetation on Cloon Island will still be visible. The proposed wall will be similar in appearance to the existing wall. The magnitude of change will be *Low* during construction and *Negligible* once operational. The remainder of the houses in this group do not have direct views of the proposed defences.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R10 (Island House) – Distance from nearest flood defence measure = 50m.

This receptor group comprises Island House, which is a large house situated on Cloon Island. The house has a large garden with thick tree coverage to the south and east, and slightly fewer trees to the north and west. Figure 13-5 and Figure 13-6 shows the proposed changes to the entrance to Island House. These will not be visible from the house itself, due to vegetation on Cloon Island. The driveway towards the house will be raised by approx. 200mm, however this will be blended into the adjacent ground. A handrail will also be constructed along the causeway, which while not visible from the house will be visible from parts of the grounds to the north of the house.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude This property is situated on a large plot of land with mature trees providing full screening to the south and east. Partial views of the River Shannon to the west and north are filtered through existing vegetation, and will not be impacted by the proposed development. During construction, machinery and works will be partially visible from the house along the driveway to the northeast. Once operational, this road

raising will have no visual impact. Due to tall mature tree vegetation to the east, the proposed flood walls along Mall Road will not be visible. The magnitude of change will be *Negligible* to *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Imperceptible** during operation.

R11 (Meadowbrook Estate) – Distance from nearest flood defence measure = 0-50m.

This receptor group comprises the houses of Meadowbrook Estate. The houses are oriented in a southeast-northwest direction, facing inwards to each other, with small front and rear gardens. Figure 13.8 shows the proposed view from Meadowbrook Estate, showing proposed flood wall, access gate and tree removal to facilitate the embankment.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude The properties are oriented facing away from the proposed flood embankment immediately to the west. The proposed embankment will be partially visible through angled views from upstairs windows, and once operational will be vegetated with grass. The proposed embankment will not be visible from ground level. A small number of trees will be removed to facilitate the construction of the embankment. This will open up views to the west slightly, however the majority of trees on Cloon Island will remain in place and visible. A new flood wall will be constructed between Maher's Pub and the cul-de-sac in Meadowbrook Estate, with a new access gate in the wall to facilitate maintenance of the embankment behind. The new wall will be visible from the side of No. 7 Meadowbrook Estate. The magnitude of change will be *Negligible* for most of these elements and will be *Low* due to the new flood wall at No. 7.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R12 (Stormont House) – Distance from land boundary to nearest flood defence measure = 0m.

This receptor group comprises Stormont House, a detached house on a large plot of land adjacent to the River Shannon.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude This property has wide views over the River Shannon to the west and southwest, with mature tree vegetation to the north on Cloon Island. The proposed flood embankment will partially impact views of the trees to the north but will have minimal impact on views of the Shannon. The proposed low-level flood wall will be in the foreground of views of the River Shannon, and will obscure views of the existing castellated low wall. The magnitude of change will be *Low*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R13 ("The Orchard" and "The Presbytery", 2 no. houses southeast of Stormont House, with rear windows facing west towards the River Shannon) – Distance from nearest flood defence measure = 20m.

This receptor group comprises 2 no. houses adjacent to the River Shannon, with rear windows facing towards the River Shannon and large front and rear gardens.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties have glimpse views towards the River Shannon, which are partially filtered by existing deciduous and evergreen vegetation along the driveway to Stormont House, and existing rear boundary walls. Proposed flood defences will not be visible from the houses, and visual impacts will be experienced during the construction stage. The magnitude of change will be *Negligible* to *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

R14 (4 no. houses in Coolbane Woods, with rear gardens facing towards a proposed embankment) – Distance from nearest flood defence measure = 20m.

This receptor group comprises 4 no. houses in the Coolbane Woods housing estate. The houses have large back gardens which face towards the proposed flood embankment at Coolbane.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties have back gardens which face west over a green field and tree planting. The proposed flood embankment to be built west of these houses will be lower than their garden wall, however will require some tree removal. This will affect their views to the west, but trees beyond the embankment will remain in view. The magnitude of change will be *Low* to *Negligible*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** during construction and **Permanent, Slight, Negative** during operation.

R15 (large group of houses south of the centre of Castleconnell) – Distance from nearest flood defence measure = 60-425m.

This is a large receptor group comprised of the houses south of the proposed flood defences, in Stradbally North, Castle Rock, Chapel Hill and Rathlinn. None of the houses are directly adjacent to any proposed flood defences.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties mainly experience views of an urban nature (i.e., towards other houses or built elements) or overlook green fields or agricultural land. These views will not be impacted by any flood defence measures due to sufficient vegetation providing screening, or the topography providing screening. The magnitude of change will *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Imperceptible** during both construction and operation.

R16 (4 no. houses on the west bank of the River Shannon, across the river from Castleconnell) – Distance from nearest flood defence measure = 275-450m.

This receptor group comprises 4 no. detached houses on farmland or green fields on the western bank of the River Shannon, across the river from Castleconnell.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties are situated largely in open spaces, with screening vegetation along field boundaries. The River Shannon is to their east, and has thick vegetation running along its length, which prevents views towards Castleconnell. The magnitude of change will be *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Imperceptible** during both construction and operation.

R17 (group of houses along the River Shannon, at World's End, north of Rivergrove B&B) – Distance from nearest flood defence measure = 100-350m.

This receptor group comprises 2 no. houses adjacent to the River Shannon, with rear windows facing towards the River Shannon and large front and rear gardens.

Sensitivity Receptors would be residents at home. Sensitivity is *High*.

Magnitude These properties, due to screening vegetation along their boundaries and between Rivergrove B&B and themselves, and due to the intervening topography and bend in the River Shannon, will not experience any views of the proposed flood defences. The magnitude of change will be *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Imperceptible** during both construction and operation.

TC (Castleconnell Town Centre) – Distance from nearest flood defence measure = 0-300m.

The centre of Castleconnell has been grouped as a receptor. This receptor group includes a large number of houses, along with community facilities, such as a church, post office, health centre, Garda Station, etc., and commercial premises. The area is centred around The Mall and Castle Street.

Sensitivity Highest sensitivity receptors would be residents at home. Highest sensitivity is *High*.

Magnitude Most views from receptors in Castleconnell Town Centre are focused on the streetscape and surrounding buildings, with street trees and boundary treatments providing partial filtering to longer views. Any views of the proposed defences will be limited to glimpse views along the Mall towards the proposed flood wall, and views towards the proposed road raising at the entrance to Coolbane Woods. The primary views of the Castleconnell streetscape will not be affected by the proposed development, and most receptors in the eastern parts of the town centre will experience no visual impacts. The magnitude of change will be *Negligible* to *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Slight, Negative** to **Imperceptible** during construction and **Permanent, Slight, Negative** to **Imperceptible** during operation.

C1 (Maher's Pub) – Distance from land boundary to nearest flood defence measure = 0m

Maher's Pub at the northern end of Castleconnell Town Centre has been included as an individual receptor (instead of including it within the rest of Castleconnell Town Centre, TC above) due to the proposed flood wall along its boundary.

Sensitivity Receptors would be staff and customers at the pub. Sensitivity is *Low*.

Magnitude The proposed flood wall along the boundary of the car park will be constructed in view of the pub. The proposed wall will be similar in construction to the existing wall along The Mall, and will formalise the boundary between the car park and the woodland beyond it, and will be set into the car park by approx. 6m. The magnitude of change will be *Low* during construction and *Neutral* once operational.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Imperceptible, Negative** during construction and **Imperceptible** once operational.

Co1 (St Joseph's Cemetery) – Distance from nearest flood defence measure = 225m

St Joseph's Cemetery is situated just to the north of Castleconnell Town Centre, and just south of Scanlon Park. The cemetery is roughly rectangular and located on open ground.

Sensitivity Receptors are visitors to the cemetery. Sensitivity is *Low*.

Magnitude Visibility of the development site from the cemetery is fully screened by houses and mature vegetation to the west of the cemetery. The magnitude of change will therefore be *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Imperceptible** during both construction and operation.

Co2 (The Ferry Playground and open space) – Distance from nearest flood defence measure = 125m

The Ferry Playground is located at the southern end of Castleconnell, adjacent to the River Shannon. The playground and open space around it has expansive views of the Shannon. Stormont House (R12) is also visible from the car park.

Sensitivity Receptors are visitors to the playground and open space. Sensitivity is *Medium*.

Magnitude Visibility of the development site from the playground and adjacent open space is partially screened by vegetation to the east and northeast, with the low flood wall and raised driveway at Stormont House (R12) the most visible from this receptor. The trees are a mix of deciduous and evergreen, so visibility through gaps will be clearer in the winter. Where visible, defences will not impact views of the River Shannon or impact significantly on visual amenity. The magnitude of change will be *Negligible*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Temporary, Imperceptible, Negative** during construction and **Permanent, Imperceptible, Negative** once operational.

Co3 (Castle Oaks Hotel and Leisure Centre) – Distance from nearest flood defence measure = 350m

Castle Oaks Hotel and Leisure Centre is on a large plot of land and is largely screened by mature trees and the existing housing at Rathlinn and Chapel Hill.

Sensitivity Receptors are staff and visitors to the hotel and facilities. Sensitivity is *Medium*.

Magnitude Visibility of the development site from the hotel and leisure centre is fully screened by houses and mature trees along its boundary. The magnitude of change will be *Neutral*.

Effect In accordance with Table 13-1, the significance of the visual effect will be **Imperceptible** during both construction and operation.

Castleconnell Flood Relief Scheme | View from The Elvers Lookin South | VRP No. 1

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566192.50, 663144.53 Camera Level (Metres Above Ordnance Datum): 25.7 Date & Time: 09/08/2023, 11:55am	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-3: Photomontage VRP No. 1

Castleconnell Flood Relief Scheme | View from The Mall Looking North at entrance to Scanlon Park | VRP No. 2

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566104.02, 662902.56 Camera Level (Metres Above Ordnance Datum): 25.0 Date & Time: 09/08/2023, 12:08pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Castleconnell Flood Relief Scheme | View from The Mall Looking North at entrance to Scanlon Park | VRP No. 2

Figure 13-4: Photomontage VRP No. 2

Castleconnell Flood Relief Scheme | View from The Mall Looking South at entrance to Scanlon Park | VRP No. 3

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566109.38, 662916.83 Camera Level (Metres Above Ordnance Datum): 24.9 Date & Time: 09/08/2023, 12:16pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-5: Photomontage VRP No. 3

Castleconnell Flood Relief Scheme | View from The Mall at entrance to Island House | VRP No. 4

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566103.42, 662883.28 Camera Level (Metres Above Ordnance Datum): 24.7 Date & Time: 09/08/2023, 12:20pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-6: Photomontage VRP No. 4

Castleconnell Flood Relief Scheme | View from Tonville looking towards Mahers Car Park | VRP No. 5

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566101.70, 662736.84 Camera Level (Metres Above Ordnance Datum): 25.2 Date & Time: 09/08/2023, 12:35pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-7: Photomontage VRP No. 5

Castleconnell Flood Relief Scheme | View from entrance to Meadowbrook looking North West | VRP No. 6

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566064.29, 662593.21 Camera Level (Metres Above Ordnance Datum): 24.5 Date & Time: 09/08/2023, 2:22pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-8: Photomontage VRP No. 6

Castleconnell Flood Relief Scheme | View from Chapel Hill looking East | VRP No. 7

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 565936.30, 662431.79 Camera Level (Metres Above Ordnance Datum): 24.0 Date & Time: 09/08/2023, 2:06pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

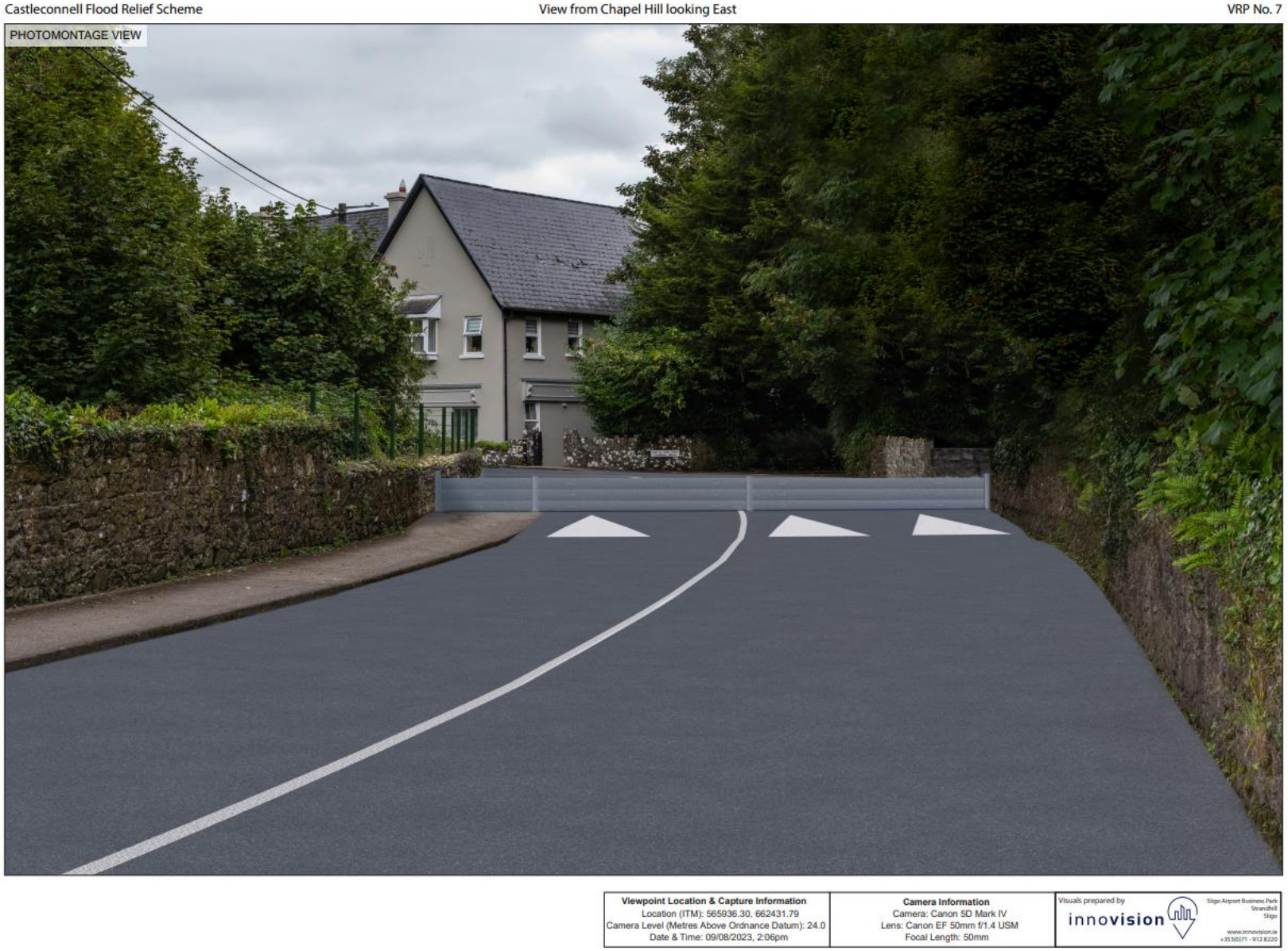

Figure 13-9: Photomontage VRP No. 7

Castleconnell Flood Relief Scheme | View from Coolbane Wood looking South | VRP No. 8

Viewpoint Location & Capture Information	Camera Information	Visuals prepared by
Location (ITM): 566004.26, 662436.42 Camera Level (Metres Above Ordnance Datum): 24.6 Date & Time: 09/08/2023, 1:58pm	Camera: Canon 5D Mark IV Lens: Canon EF 50mm f/1.4 USM Focal Length: 50mm	innovision Sligo Airport Business Park Strandhill Sligo www.innovision.ie +353(0)71 - 912 8220

Figure 13-10: Photomontage VRP No. 8

13.6 Mitigation Measures

13.6.1 Construction Phase Mitigation

No significant landscape nor visual impacts are expected during construction. Despite that, less visually intrusive hoarding with viewing windows towards the Shannon where appropriate is proposed to reduce visibility of moving plant from outside the site while allowing for visual connectivity when required.

13.6.2 Operational Phase Mitigation

No significant landscape nor visual impacts are expected during the operational phase. Nonetheless, the proposed development design includes limited removal and widely retention of trees and vegetation throughout the scheme extent that will help to mitigate against some of the less significant landscape and visual impacts on receptors most affected.

The design of the proposed flood wall along the Mall will be similar to that of the existing wall, and will use the same materials from the existing wall where possible. Where this is not possible, a similar looking finish will be used. This will further mitigate visual impacts of the proposed wall to views facing towards it.

13.7 Residual Impacts

The proposed development is not expected to significantly reduce the landscape and visual qualities of the impacted area. Therefore, no mitigation is required, and no residual impacts are expected.

13.8 Interactions

The EIAR must also consider in-combination effects, or the interactions between the different factors discussed.

Landscape and Visual Amenity and Biodiversity

Effects on biodiversity, such as the removal of trees or trimming of other vegetation to allow for construction access, can have further effects on landscape and visual amenity. Limited tree removal is proposed, which will have an impact on visual amenity and landscape as discussed above. This will have further impacts as discussed in Chapter 8 Biodiversity. Mitigation measures included in the Biodiversity chapter, such as the use of root protection zones and additional tree planting, will help to further mitigate impacts on visual amenity and landscape.

Landscape and Visual Amenity and Cultural Heritage

The setting of parts of Castleconnell will be altered by the proposed Flood Relief Scheme. This will lead to effects on cultural heritage, discussed in Chapter 12. The construction of flood walls at Rivergrove B&B, Grange House, Mall House, and along the Mall Road, and changes to the entrance and driveway of Island House, will impact the setting of these structures and their views of the River Shannon and surrounding landscape. The proposed flood walls will incorporate stone from the existing walls or of a similar type, reducing these negative impacts on setting and visual amenity. The interaction between landscape and visual amenity and cultural heritage will be imperceptible.

13.9 Cumulative Impacts

Cumulative effects are the result of several minor effects combining to create one major effect. The assessment of cumulative effects considers existing stresses on the water environment as well as developments that are in planning or are underway.

The projects considered for potential cumulative effects with the proposed development are listed in Chapter 15. These projects were considered and assessed in terms of their potential impact on landscape and visual amenity and their potential to be experienced cumulatively with the proposed development.

It is possible that the construction period of the proposed development will overlap with that of several developments in Castleconnell. This would result in a temporary slight negative cumulative effect, for the duration of the overlapping construction period. A significant impact would not occur in this scenario.

Due to the nature of the proposed development and the nature of the projects listed in Chapter 15, cumulative effects during the operational phase are expected to be imperceptible.

14 Interactions

The EIA Directive (2014/52/EU) requires a description of:

> '*the interaction between any of the foregoing aspects'.*

Interactions can occur when a predicted impact causes interaction or dependency with other environmental aspects. This section discusses the interactions between aspects and assesses them as positive, negative or neutral (as having no interaction or interdependency).

The interactions of environmental effects were considered throughout the design development for the proposed flood relief scheme and adjustment were made to the design of the layout to mitigate impacts arising from these interactions. Interactions between certain environmental aspects are discussed in the sections below. The interactions of environmental effects were considered throughout the EIA process for the proposed development and adjustments were made to the design of the layout to mitigate impacts arising from these interactions. In Table 14-1 interactions between environmental aspects are marked with a 'Y' and discussed in the text below.

Table 14-1: Summary of environmental impacts interactions

	Air Quality and Dust	Climate	Noise and Vibration	Population and Human Health	Biodiversity	Land and Soil	Water	Cultural Heritage
Population and Human Health	**Y**		**Y**					
Biodiversity	**Y**							
Land and Soil	**Y**	**Y**			**Y**		**Y**	
Water	**Y**			**Y**	**Y**	**Y**		
Material Assets				**Y**		**Y**	**Y**	
Cultural Heritage								
LVIA	**Y**				**Y**			**Y**

14.1 Air Quality and Dust – Population and Human Health

Significant quantities of dust or impacts to air quality could lead to negative effects for population and human health in Castleconnell. The potential for impacts to population and human health was assessed in Chapter 6 Construction Impacts. There are no significant negative interactions expected, as the effect from air quality and dust as outlined in the Construction Impacts chapter will be negligible.

14.2 Air Quality and Dust – Biodiversity

During construction works, the potential for dust generation and emissions, or impacts on air quality could lead to indirect effects on biodiversity on site or in the surrounding areas. The Biodiversity chapter considered this potential and that mitigation measures outlined in Chapter 6 Construction Impacts would be put in place. The effect of dust generation on any biodiversity receptors will be negligible.

14.3 Air Quality and Dust – Land and Soil

The movement and excavation of soils during construction could lead to increases in dust generation and movement. This has been considered in the air quality and dust chapter, and the impact of works to land and soil will not lead to a significant interaction with air quality and dust. Furthermore, mitigation measures described in Chapter 6 of the EIAR, and in the CEMP, will further reduce any potential for interactions between land and soil and air quality and dust.

14.4 Air Quality and Dust – Water

Earthworks during the construction phase could give rise to impacts on water quality due to dust impacts. The Water chapter considered this potential and found that impacts due to dust are not expected to be significant. In addition to this, mitigation measures for the control of dust during construction are described in Chapter 6 of the EIAR, and in the CEMP. These mitigation measures will further reduce any potential for impacts on water due to dust deposition.

14.5 Air Quality and Dust – Landscape and Visual Amenity

Large depositions of dust could have a negative impact on landscape or visual amenity for receptors in Castleconnell. This is not expected to occur due to the predicted impact of dust being negligible, and mitigation measures outlined in the Construction Impacts chapter.

14.6 Population and Human Health – Noise and Vibration

Excessive noise or vibration during construction could interact negatively with population and human health in Castleconnell or the surrounding area. Mitigation measures outlined in the Construction Impacts chapter will ensure that the impact of noise and vibration on population and human health will not be significant.

14.7 Population and Human Health – Water

Impacts to water quality could negatively interact with population and human health, due to either impacts to drinking water, or the amenity value of the River Shannon at Castleconnell. Negative interactions with population and human health are not expected to occur, due to the mitigation measures to be put in place for the protection of water, and residual impacts to water being slight negative to imperceptible.

14.8 Material Assets – Population and Human Health

Impacts to material assets, in particular to utilities or roads, traffic, and transport, could lead to interactions with population and human health if significant or allowed to go on for a long time. They have the potential to affect the population of Castleconnell and their daily activities during the construction phase, and during operation when the demountable flood barriers are in place.

During construction, there will be short disruptions to utilities which will inconvenience a small number of people in Castleconnell. These will be communicated to residents in advance and will be kept to the shortest time possible. The overall impact of these disruptions, with mitigation measures in place as outlined in Chapter 11, will be temporary and imperceptible.

During construction, temporary disruptions to traffic and access due to both full and partial road closures will occur. This will lead to temporary negative impacts for residents and people passing through Castleconnell, as outlined in Chapter 11. With mitigation measures in place as outlined in Chapter 11, the overall negative impact on population and human health due to interactions with roads, traffic, and transport will be temporary, slight, negative.

Once operational, there will be an intermittent impact on roads, traffic and transport due to the use of demountable flood barriers during flood events in Castleconnell. When the demountable flood barriers are in place, there will be a slight negative interaction with population and human health. This will be mitigated against by advance warning systems, and the availability of alternative routes.

14.9 Land and Soil – Biodiversity

Interactions between soils, geology, and biodiversity can occur through surface, groundwater, and air pathways. The proximity of the Lower River Shannon SAC poses a risk for the entry of contaminants via surface water run-off, dewatered groundwater, and soil erosion. Introduction of contaminants and suspended solids could lead to habitat degradation of the adjacent SAC or downstream groundwater or surface water receptors. With the implementation of mitigation measures potential impacts through interaction would be short-term, imperceptible, not significant.

14.10 Land and Soil – Water

Soils and geology share direct links with groundwater. Hydrogeology is further linked with surface water networks. Soil quality and condition affects the rate of recharge, infiltration, percolation, and drainage for groundwater bodies. Similarly, surface water run-off can directly affect soil quality and condition through deposition or withdrawal of chemicals, suspended solids, and nutrients. During construction eroded material can enter the surface and ground water causing influx of sediments. During operation there will be an initial flush of loose material during the next heavy rainfall event following construction of the earthen embankments. This has the potential to increase suspended sediments. Through implementation of mitigation measures outlined in Chapters 9 and 10 of the EIAR, the potential impact through interaction is reduced to short-term, slight, negative.

14.11 Land and Soil – Material Assets

Land and soils impacts interact with material assets through use of the local road network, import and export of materials and equipment, and disruption or diversion of utilities.

Diversion of several utilities will be required to accommodate the flood wall proposed along Mall Road, including a gas main, surface water and sewer networks, overhead electricity cables, and underground broadband cables. Works for the Mall Road will be carried out in two phases, whereby diversion and relocated of utilities will be carried out in phase one, while flood defence measures will be constructed in phase 2. Through implementation of mitigation measures the overall potential impacts from interaction with material assets will be temporary, slight, negative.

14.12 Land and Soil – Climate

Works where excavation of soil is proposed occur in some areas of seasonal waterlogging and peat. Anaerobic conditions in soils can lead to an increase in carbon dioxide. Excavation of material across the scheme area will release sequestered carbon increasing greenhouse gas levels in the air. These effects are further discussed in the Climate section of the Construction Impacts chapter. The interaction of these effects will be long-term, imperceptible, not significant.

14.13 Landscape and Visual Amenity – Biodiversity

Effects on biodiversity are linked with landscape and visual amenity. The removal of trees and/or trimming of other vegetation to allow for construction access, can have further effects on landscape and visual amenity. Limited tree removal is proposed, which will have an impact on visual amenity. Mitigation measures included in the biodiversity chapter, such as the use of root protection zones and additional tree planting, will help to further mitigate impacts on visual amenity and landscape. Impacts due to interactions between landscape and visual amenity and biodiversity will not be significant.

14.14 Landscape and Visual Amenity – Cultural Heritage

The setting of parts of Castleconnell will be altered by the proposed Flood Relief Scheme. This will lead to effects on cultural heritage. The construction of flood walls at Rivergrove B&B, Grange House, Mall House, and along the Mall Road, and changes to the entrance and driveway of Island House, will impact the setting of these structures and their views of the River Shannon and surrounding landscape. The proposed flood walls will incorporate stone from the existing walls or of a similar type, reducing these negative impacts on setting and visual amenity. The interaction between landscape and visual amenity and cultural heritage will be imperceptible.

14.15 Water – Biodiversity

The Lower River Shannon SAC is a valuable habitat for a number of significant and protected species. Impacts on waterbodies (i.e., the River Shannon itself or its tributaries) could affect the SAC or aquatic habitats and species. The main potential impacts identified in the Biodiversity chapter include accidental sediment release or pollution due to spills or leaks, or disruption to habitats due to instream or bank-side works. Mitigation measures included in the Water chapter and the Biodiversity chapter will ensure that no significant interactive effects occur.

14.16 Water – Material Assets

Construction vehicles moving on site during the construction phase could result in hydrocarbons entering the surface water drainage system, leading to effects downstream. This is mitigated against by measures included in the Water chapter for the prevention of pollution or increased sedimentation. The mitigation measures are also included in a preliminary Construction Environmental Management Plan (CEMP), which outlines the site compound locations and require all vehicles to be maintained frequently and to carry spill kits at all times. Without mitigation in place, this could lead to a temporary significant negative effect. However, with the measures outlined in Chapters 10 and 11, the interaction between these will be temporary, imperceptible, neutral.

There is also the potential for a flood event to occur during construction. With mitigation measures in place, interactions between these effects are not expected to be significant.

15 Cumulative Impacts

This chapter provides a summary of the potential cumulative effects assessed throughout this EIAR. The cumulative effects of the proposed development in combination with other relevant existing, planned and permitted projects have been assessed to determine whether these would give rise to significant effects on the environment.

Any predicted cumulative effects arising from the proposed development in combination with other existing, planned and permitted projects are set out in the various chapters throughout this EIAR. Figure 15.1 and Table 15-1 below provide summary details of the projects/developments that have the potential to impact resources, traffic, or the local area, and so could have potential cumulative effects with the proposed flood relief scheme.

Only those projects whose duration of permission overlaps with the likely construction period of the proposed development (i.e., 2025 onwards) are included. Small developments such as house extensions and alterations, or the construction of a single dwelling or structure, have been excluded as the likely effects of such developments will not be significant, except where they are taking place adjacent to or in close proximity to the proposed defences.

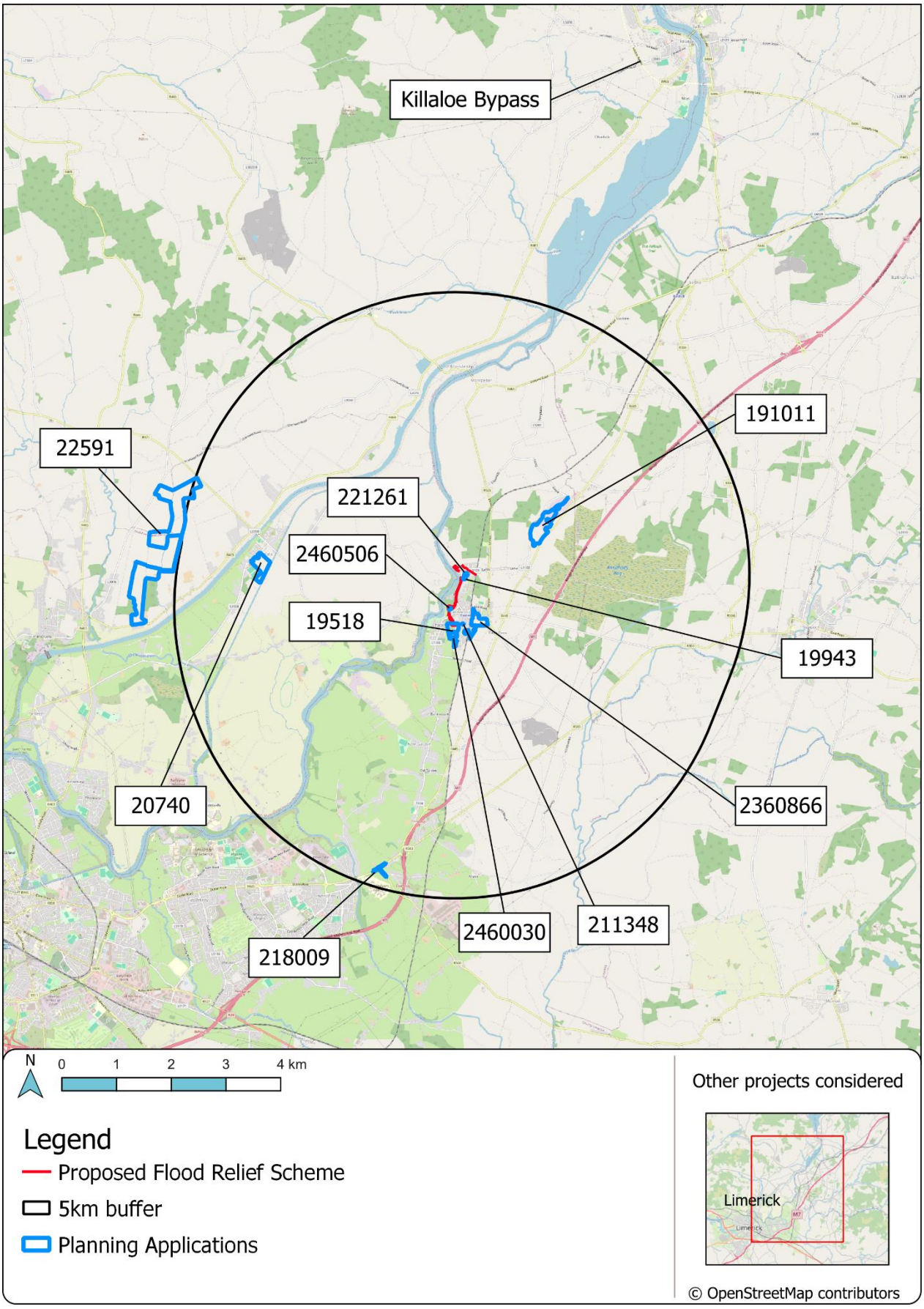

Figure 15-1: Other projects considered

Table 15-1: List of projects considered for Cumulative Effects

Project name or Reg. Ref.	Location	Description	Status
Killaloe Bypass/Shannon Bridge Crossing/R494 Upgrade	Killaloe, Co. Clare	The proposed scheme has been broken down into three sections as follows: - Killaloe Bypass: This part of the scheme aims to create a western bypass around the town of Killaloe which will connect the R463 to the north of town with the proposed Shannon Bridge Crossing section and R463 to the south of the town. - Shannon Bridge Crossing: This section of the scheme will cross the River Shannon approximately 1km south of the existing Killaloe Bridge and will connect the proposed Killaloe Bypass with the R494. - R494 Upgrade: This section will involve widening, regrading and local realignment of the R494 from its junction with the R496 and proposed Shannon Bridge Crossing south of Ballina, as far as the junction with the R445 (previously known as N7) north of Birdhill.	**Construction progressing with latest public update released in December 2023, likely to continue into 2026**
191011	Gooig, Castleconnell, Co. Limerick.	Removal of the intervening aggregate reserve (c. 1.47ha. and 80,000m cubed aggregate in volume) currently dividing the registered quarries at Gooig (Ref. No. 05/7026 and 05/7037). The restoration of the combined quarries through importation if uncontaminated soils and stones (c. 12.2ha. and 1,250,000m cubed). The provision and operation of a wheel wash facility and use of the site access and infrastructure of existing permitted Roadstone manufacturing operations to fully restore the land to agricultural use. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) accompany this planning application	Permission granted 02/04/2020. Expires 01/04/2025
19518	Coolbane, Castleconnell, Co. Limerick.	The provision of a total of 52 no. dwellings as follows - 12 no. 2.5 storey 4 bed units, 20 no. 2 storey terraces/semi-detached 3 bed units, 16 no. 2.5 storey semi-detached 4 bed units and 4 no. 2 storey semi-detached 4 bed units together with all associated landscaping and site works and connection to existing services. The proposed development also includes for a crèche with a gross floor area of 467.7 square metres and all associated works. The planning application is also accompanied by a Nature Impact Statement	Permission granted 03/10/2019. Expires 20/12/2025 **Under construction – nearing completion.**
19943	The Parochial House, The Mall, Castleconnell Co. Limerick.	A driveway and entrance to parochial house 2 and alter existing entrance to parochial house 1 and erect a fence/concrete block wall between houses 1 and 2 and carry out associated site works	Permission granted 30/06/2020. Expires 29/06/2025
20740	Clonlara, Co Clare	For the construction of a total of 70 Dwellinghouses (including 14 no. Detached 4 Bed houses, 4 No. split level 4 Bed houses, 12 No. Semi-Detached 4 Bed houses, 36 No. Semi-Detached 3 Bed houses, 4 No. Semi-Detached 2 Bed houses) and for new connections to public services including water & foul sewerage including pumping station, rising main and associated plant. PERMISSION is also sought for vehicular and pedestrian entrances, access roads, footpaths, landscaping works, parking areas, boundary treatments & all ancillary site works. A Natura Impact Statement (NIS) shall be submitted to the Planning Authority as part of this application.	Permission granted 29/09/2021. Expires 28/09/2026 **Under construction.**

211348	"The Lodge", Coolbawn, Castleconnell Co. Limerick	The construction of a new single storey family room to the north west (rear) corner of our existing house, the provision of a ground floor utility and shower room within the existing footprint of the house at ground floor level also, minor alterations to the entrance way, and all ancillary site	Permission granted 17/11/2021. Expires 13/04/2027
218009	Cappamore Road(R506) & Dublin Road(R445) Junction, Garraunykee & Woodstown, Co. Limerick.	Junction improvement works on the R445(Dublin Road)/R506(Cappamore Road), Limerick. The proposed works will include the construction of new footpaths, new cycle lanes, new junction slip lanes, new controlled pedestrian crossings, new public lighting scheme, new surface water drainage system, improved road markings, new traffic signal control, signage and carriageway resurfacing	Permission granted 29/12/2021.
221261	The Commons, Cloon & Commons, Castleconnell	1 no. detached dwelling house, connection to main drainage, adjustment of existing boundary to existing dwelling to provide access to new dwelling house & associated site works	Permission granted 06/03/2023. Expires 05/03/2028
22591	Ballyglass Coolderry Dromintobin North Reanabrone, and Oakfield (townlands) Ardnacrusha, Co Clare	For a 10-year planning permission for a solar array at Ballyglass, Coolderry, Dromintobin North, Reanabrone, and Oakfield (townlands) Ardnacrusha, Co Clare. The development will consist of c265,000 m2 of solar panels on ground mounted frames, 8 no. single storey control cabins with associated electrical transformer units and hardstand areas, 2 no. ring main units, underground cabling within the solar array site and within the L70382 public road to connect solar array field parcels, security fencing, CCTV, access tracks (upgrade of existing and new), upgrades to four existing agricultural field entrances on the R463, l3046 and L70382 and creation of new entrance on L70382, temporary construction compound, landscaping and all associated ancillary apparatus and development works. The solar array will connect to the national grid and will have an operational lifespan of 35 years. A Natura Impact Statement (NIS) has been prepared in respect of the proposed development and will be submitted to the planning authority with the application	Permission granted by An Bord Pleanála 21/11/2023
2360866	Coolbawn Meadows, Castleconnell	An extension to the existing Coolbawn Estate in the townlands of Coolbane and Coolreiry at Castleconnell, Co. Limerick. The development comprises (i) 74 no. residential units comprising (a) 20 no. 4 bed detached units; (b) 12 no. 4 bed semi-detached units; (c) 12 no. 2 bed terrace units; (d) 12 no. 3 bed terrace units; and (e) 18 no. 3 bed semi-detached units (ii) new estate link road with dedicated cycle lane as an extension to the existing access road serving Coolbawn Estate; (iii) off and on street car parking and bicycle stands; and (iv) all associated site works including pumping station and emergency storage; and 2 no. attenuation tanks. The existing temporary construction access from Station Road / Railway Road shall continue to be used to facilitate construction of the development. A Natura Impact Statement has been prepared in respect of the proposed development and accompanies the planning application	Planning Submission lodged on 24/11/2023. Further information requested 25/01/2024, due 6 months from this date.

2460030	Coolbane, Castleconnell, County Limerick	The provision of 7 no. 2 bed 3 person dwellings, 7 no. 2 bed 4 person dwellings for senior living and 2 community dwellings each with 4 bedrooms plus 1 carer bedroom and communal areas for senior living, together with modifications to existing site levels and all associated landscaping and site works and connection to existing services	Planning submission lodged 18/01/2024. Decision due 13/03/2024.
2460506	Stormont House, Coolbawn, Castleconnell, Co. Limerick, V94 RP7Y	the development that will consist of the demolition of an existing derelict coach house and external store and the construction of a replacement one and a half storey guest accommodation with a dormer window to the rear including landscaping and ancillary site works	Planning submission lodged 27/05/2024. Further information requested 18/07/2024, due 6 months from this date.

15.1 Air Quality and Dust

In relation to the in-combination construction and/or operational impact of the proposed development with other proposed schemes in the area, the list of schemes in Table 15-1 has been reviewed. None of these schemes will result in any significant additional construction and/or operational Air Quality & Dust impact.

In Section 6.1.4 Mitigation Measures above it states:

- If applicable, hold regular liaison meetings with other high risk construction sites within 500 m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.

Planning Ref. 191011 is considered a medium/high risk site, and as such regular liaison meetings should be held if the construction periods of both developments overlap, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised.

15.2 Climate

No potential cumulative impacts were identified with regard to climate.

15.3 Noise and Vibration

No potential cumulative impacts were identified with regard to noise and vibration.

15.4 Population and Human Health

If the construction phases of developments listed in Table 15-1 coincide with the construction phase of the proposed development then there is the potential for cumulative impacts arising from the presence of widespread construction works, disruptions, and diversions throughout the Village and surrounding areas. These effects will be temporary and not significant given the size and nature of other developments in Castleconnell.

Once operational, the proposed FRS, when considered cumulatively with the above developments, will have a positive impact on population and human health.

15.5 Biodiversity

15.5.1 Killaloe Bypass / Shannon Bridge Crossing / R494 Upgrade

The proposed Killaloe Bypass is situated upstream of Castleconnell adjacent to the River Shannon. Construction is currently ongoing and is projected to continue into 2026. This will likely result in an overlap with the construction phase of the proposed scheme. Without mitigation measures there is the potential for impacts to water quality and aquatic habitats in proximity to and downstream of the project. An NIS and EIAR have been submitted to Clare County Council as part of the planning application which found no significant effects on biodiversity as a result of the development. Considered with this development, potential cumulative impacts are not expected owing to several factors including distance, dilution, and restriction of water movement between each project due to Parteen Weir.

15.5.2 Planning Ref. 191011

Planning permission was granted in 2020 for the restoration of several combined quarries within a site located northeast of the proposed scheme. Formerly known as ‘Gooig Pit’, the development will involve the importation of uncontaminated soils and stones and associated works to restore the site for agricultural use. An NIS and EIAR have been submitted as part of the planning application. No pathways between this development and the proposed scheme were identified and therefore no cumulative impact is expected.

15.5.3 Planning Ref. 22591

A 10-year planning permission was granted by Clare County Council for the construction of a solar array at Ballyglass. The construction phase will overlap with the construction period of the proposed scheme. However, due to the distance and lack of connectivity between these proposed developments, cumulative impacts arising from their concurrent construction phases are not anticipated.

15.5.4 Planning Ref. 19943, 211348, and 221261

Three small scale developments are located directly adjacent to the scheme which are also proximal to the Lower River Shannon SAC. Due to their location, the potential for cumulative impacts arising from coinciding construction phases was considered. Due to the minimal construction works required for each of these developments it was determined that no cumulative impacts were anticipated.

15.6 Land and Soil

The two largest developments listed in Table 15-1 that have the potential to impact soils and geology in the are the solar array at Ballyglass (Ref. 22591) and the quarry restoration at Gooig (Ref. 191011). While the construction periods for each development are likely to overlap, due to the distance from Castleconnell town cumulative impacts are not anticipated to be significant. Once operational, the quarry restoration will have a positive impact on soils and geology.

Planning permission for 52 no. residential units south of Coolbane Woods (Ref. 19518) was granted in 2020 and construction is currently ongoing. An area allocated for open space in the Masterplan encroaches onto an area designated for embankments under the proposed scheme. Construction in this section of the proposed scheme is likely to commence after construction of the residential development has been completed, and therefore, cumulative effects from construction will not be significant. Following completion of both schemes the land use infiltration and run-off rates at the intersection will not be significantly changed. The combined effects will be imperceptible.

Permission has been granted for several other small to medium residential developments and commercial extensions within the town. Due to the size and nature of these developments they are not expected to result in significant cumulative effects on soils and geology. Overall, ensuring relevant legislation and proposed mitigation measures are adhered to and implemented, the cumulative effects associated with developments in the area are long-term with an imperceptible impact on land, soils, and geology.

15.7 Water

The Killaloe Bypass / Shannon Bridge Crossing / R494 Upgrade improvement scheme has the potential to interact with the surface and groundwater environment of Castleconnell FRS.

An Environmental Impact Statement was prepared to assess the impact of the Scheme. In the report, the worst residual impact considered is classified from minor to insignificant. Any potential cumulative impacts to surface water quality as a result of the Killaloe Bypass construction (i.e., suspended solids entering the Shannon through surface water runoff) would have appropriate mitigation measures in place.

Other projects will not have a significant cumulative impact with the proposed development, due to their small size, lack of complex likely effects, and surface or groundwater connection.

15.8 Material Assets

The list of projects outlined in Table 15-1 has been consulted; no significant negative impacts on Material Assets are expected.

The removal of 80,000m^3 of aggregate and import of 1,250,000m^3 at Gooig, Castleconnell, will result in a large number of trucks due to the volume of material to be removed. If that work coincides with the

construction phase of the proposed development, the number of additional trucks on the roads would result in negative impacts. However, due to the location of the aggregate reserve, trucks leaving there will not need to pass through Castleconnell.

Road closures and diversions north of Castleconnell as part of the Killaloe Bypass have the potential to increase traffic along other roads in the surrounding area. This could lead to a temporary strain on the road network around Castleconnell. Once operational, the bypass will have a positive impact on traffic around Killaloe and the wider area including Castleconnell.

If other projects listed above go ahead at the same time as the proposed development, there could be a cumulative impact on roads due to increased construction traffic. However, given the size of the proposed development and the other developments in the area, no significant cumulative effect is expected.

15.9 Cultural Heritage

No potential cumulative impacts were identified with regard to cultural heritage.

15.10 Landscape and Visual Impact

The projects listed in Table 15-1 were considered and assessed in terms of their potential impact on landscape and visual amenity and their potential to be experienced cumulatively with the proposed development.

It is possible that the construction period of the proposed development will overlap with that of several developments in Castleconnell. This would result in a temporary slight negative cumulative effect on the local visual amenity and landscape for the duration of the overlapping construction period. A significant impact would not occur in this scenario.

Due to the nature of the proposed development and the nature of the other projects listed, cumulative effects during the operational phase are expected to be imperceptible.

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