Castleconnell Flood Relief Scheme – Natura Impact Statement

Final Report

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Limeric City and County Council
Natura Impact Statement

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Abbreviations

AA	Appropriate Assessment
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
GIS	Geographic Information System
NHA	Natural Heritage Area
NPWS	National Parks and Wildlife Service
OPW	Office of Public Works
pNHA	Proposed Natural Heritage Area
QI	Qualifying Interest
RBMP	River Basin Management Plan
SAC	Special Areas of Conservation
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 Background

JBA Consulting Engineers and Scientists Ltd (hereafter JBA) has been appointed by Limerick City and County Council, to undertake Environmental Consultancy services in relation to the Castleconnell Flood Relief Scheme (FRS) at Castleconnell, Co. Limerick. This includes providing information for the competent authority to assist them to undertake an Appropriate Assessment due to the proximity of Natura 2000 sites to the proposed Scheme.

The proposed development which will be submitted under Part 8 of the Planning and Development Act (2000) as amended, consists of development of a flood relief scheme to minimise the risks currently posed to people, the community, social amenity, environment and landscape.

A Screening for Appropriate Assessment for the development has been carried out (JB Barry, JBA 2024). The assessment concluded that there are potential likely significant effects from the proposed development on Natura 2000 sites within the development's Zone of Influence (ZoI).

The Zone of Influence (ZoI) within which potential impacts from any proposed project must be considered for significance, depends on a variety of factors. This includes the nature, location and extent of the proposed works, the ecological receptors present within the Natura 2000 sites within the area and the potential for in-combination impacts (DoEHLG, 2009).

This Natura Impact Statement provides the results of the assessment conducted for the proposed development, in accordance with Article 6(3) of the Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora).

1.2 Legislative Context

The Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) aims to maintain or restore the favourable conservation status of habitats and species of community interest across Europe.

The requirements of Articles 6(3) and 6(4) of the Habitats Directive have been transposed into Irish legislation by means inter alia the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 / 2011).

Under the Directive a network of sites of nature conservation importance have been identified by each Member State as containing specified habitats or species requiring to be maintained or returned to favourable conservation status. In Ireland the network consists of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), and also candidate sites, which form the Natura 2000 network.

Article 6(3) of the Habitats Directive requires that, in relation to European designated sites (i.e. SACs and SPAs that form the Natura 2000 network), "*any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to* ***appropriate assessment*** *of its implications for the site in view of the site's conservation objectives*".

A competent authority, in this case Limerick City and County Council as a public body, can only grant consent to a plan or project after having determined that it will not adversely affect the integrity of any European site, in light of its conservation objectives and best scientific evidence, either alone or in combination with other plans or projects.

Under article 6(4) of the Directive, if adverse impacts are likely, and in the absence of alternative options, a plan or project must nevertheless proceed for imperative reasons of overriding public interest (IROPI), including social or economic reasons, a Member State is required to take all compensatory measures necessary to ensure the overall integrity of the Natura 2000 site.

1.3 Appropriate Assessment Process

Guidance on the Appropriate Assessment (AA) process was produced by the European Commission in 2002, which was subsequently developed into guidance specifically for Ireland by the Department of Environment, Heritage and Local Government (DEHLG, 2010). These guidance documents identify a staged approach to conducting an AA, as shown in Figure 1-1.

Figure 1-1: The Appropriate Assessment Process

1.3.1 Stage 1 - Screening for AA

The initial, screening stage of the Appropriate Assessment is to determine:
whether the proposed plan or project is directly connected with or necessary for the management of the European designated site for nature conservation
if it is likely to have a significant adverse effect on the European designated site, either individually or in combination with other plans or projects
For those sites where potential adverse impacts are identified, either alone or in combination with other plans or projects, further assessment is necessary to determine if the proposals will have a likely significant effect on the integrity of a

European designated site, in view of the site's conservation objectives (i.e., the process proceeds to Stage 2).

1.3.2 Stage 2 - AA

This stage requires a more in-depth evaluation of the plan or project, and the potential direct and indirect adverse impacts of them on the integrity and interest features of the European designated site(s), alone and in-combination with other plans and projects, taking into account the site's structure, function and conservation objectives. Where required, mitigation or avoidance measures will be suggested.

The competent authority can only agree to the plan or project after having ascertained that it will not adversely affect the integrity of any European site, in light of its conservation objectives and best scientific evidence, either alone or in combination with other plans or projects, after mitigation measures have been applied, and the mitigation measures are certain and capable of being successfully implemented. If this cannot be determined, then alternative solutions will need to be considered (i.e., the process proceeds to Stage 3).

1.3.3 Stage 3 - Alternative Solutions

Where adverse impacts on the integrity of European sites are identified, after mitigation measures have been applied, or the mitigation measures are not certain / capable of being successfully implemented, alternative ways of achieving the objectives of the plan or project that avoid adverse impacts need to be considered. If none can be found, the process proceeds to Stage 4.

1.3.4 Stage 4 - IROPI

Where adverse impacts of a plan or project on the integrity of European sites are identified and no alternative solutions exist, the plan will only be allowed to progress if imperative reasons of overriding public interest (IROPI) can be demonstrated. In this case compensatory measures will be required.

The process only proceeds through each of the four stages for certain plans or projects. For example, for a plan or project, not connected with management of a site, but where no likely significant impacts are identified, the process stops at stage 1. Throughout the process, the precautionary principle must be applied, so that any uncertainties do not result in adverse impacts on a site.

1.3.5 Recent judgements of the Court of Justice of the European Union (CJEU) and how they are used in this assessment

The CJEU issued a ruling on the consideration of avoidance and reduction measures as a result of the case known as People over Wind, Peter Sweetman v Coillte Teoranta (Case C-323/17). This judgement stated that measures intended to reduce or avoid effects on a European site should only be considered within the framework of an AA, and it is not permissible to take into account such measures at the

screening stage. In practice, this means that any activities that are not integral to the project (i.e. the project could conceivably take place without them) and have the effect of avoiding or reducing an impact on a European site, cannot be considered at the screening stage.

The CJEU ruling in the case of Grace & Sweetman [2018] (C-164/17) clarified the difference between avoidance and reduction (mitigation) measures and compensation. Measures intended to compensate for the negative effects of a project cannot be taken into account in the assessment of the implications of a project, and instead are considered under Article 6(4). This means that any project where an effect on the integrity of a European site remains and can only be offset by compensation, would need to proceed under Article 6(4), demonstrating “imperative reasons of overriding public interest”.

The judgements referred to as the Dutch Nitrogen cases [2018] (C-293/17 and C-294/17) have important implications for projects that could potentially impact on sites that are exceeding critical thresholds for input of damaging ammonia (but could also reasonably apply where other nutrients are impacting European sites). The judgements state that the use of thresholds to exclude project impacts is acceptable in principle, and that strategic plans can be used as mitigation but only with consideration of the certainty (or otherwise) of the outcomes of those strategic plans. It clarifies that where the status of a habitat type is already unfavourable the possibility of authorising activities which increase the problem is necessarily limited.

The CJEU ruling in the case of Holohan v An Bord Pleanála (C-461/17) also clarified the importance in AA of taking into account habitat types and species outside the boundary of the European site, where implications of the impacts on those habitat and species may impact the conservation objectives of the European site. In this assessment functionally linked and supporting habitat for species outside of European site boundaries are assessed where they could potentially impact the conservation objectives of any screened in European sites.

The CJEU ruling in response to questions referred by the Irish High Court in the Eco Advocacy case (C-721/21) indicated that an applicant for permission in its AA screening report/and a decision maker in undertaking its AA screening can take into account “standard features”, i.e. all the constituent elements of that project inherent in it/elements that are incorporated into a projects design not with the aim of reducing its negative effects (even where these have the effect of reducing harmful effects on a European site).

1.4 Methodology

1.4.1 Guidance documents

This Natura Impact Statement has been prepared having regard to the Birds and Habitats Directives, the European Communities (Birds and Natural Habitats) Regulations 2011-15 as amended and relevant jurisprudence of the EU and Irish

courts. The following documents have also been used to provide guidance for the assessment:

- DEHLG (2009 rev 2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government (DEHLG, 2009).
- Office of the Planning Regulator (2021) OPR Practice Note PN01 - Appropriate Assessment Screening for Development Management (OPR 2021).
- European Communities (EC) (2019) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission (European Commission 2019).
- EC (2021) Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. (European Commission 2021)
- EC (2022) Guidance document on assessment of plans and projects in relation to Natura 2000 sites. (European Commission. Directorate General for Environment. 2022)
- EC (2002) Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission (European Commission et al. 2002).
- EC (2013) Interpretation manual of European Union habitats. Version EUR 28. (EC 2013).
- EC (2007) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission Management (European Commission, 2007).
- CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland - Terrestrial, Freshwater and Coastal, Second Ed. (Chartered Institute of Ecology and Environmental), updated 2022.
- EC (2007/2012) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. European Commission Management (European Commission, 2007/12).
- NPWS, 2019a. The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill.

- NPWS, 2019b. The Status of EU Protected Habitats and Species in Ireland. Volume 2: Habitats Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill
- NPWS, 2019c. The Status of EU Protected Habitats and Species in Ireland. Volume 3: Species Assessments. Unpublished NPWS report. Edited by: Deirdre Lynn and Fionnuala O'Neill

1.4.2 Desktop Study

A desktop study was conducted of available published and unpublished information, along with a review of data available on the National Parks and Wildlife Service (NPWS) and National Biodiversity Data Centre (NBDC) web-based databases, in order to identify key habitats and species (including legally protected and species of conservation concern) that may be present within ecologically relevant distances from the project as explained below. A baseline habitat assessment was performed using satellite imagery of the site. The data sources below (accessed June 2022) were consulted for the desktop study:

- Aerial photography available from www.osi.ie and Esri World Imagery.
- NPWS website (www.npws.ie) where Natura 2000 site synopses, data forms and conservation objectives were obtained along with Annex I habitat distribution data and status reports.
- River Basin Management Plans (www.wfdireland.ie)
- NBDC species data within a custom polygon covering the study area with an additional 5km buffer
- NBDC Biodiversity Maps (maps.biodiversityireland.ie)
- Catchments (www.catchments.ie)
- Environmental Protection Agency Maps (https://gis.epa.ie/EPAMaps)
- Geological Survey Ireland (GSI) website (www.gsi.ie)
- GSI - Groundwater data viewer (https://dcenr.maps.arcgis.com)
- Planning Applications (myplan.ie)

1.4.3 Ecological Site Surveys

Ecological site surveys were carried out by JBA Ecologists; JBA Arboriculturist and Sub-consultants Dr Joanne Denyer (Denyer Ecology) and Ecofact. Table 1-1 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 2000).

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 (2000). Nomenclature for higher plants principally follows that given in The New Flora of the British Isles 4th Edition (Clive Stace 2019). Identification of Irish plants generally follows that given in Webb's An Irish Flora (Parnell and Curtis, 2012).Details of ecological surveys undertaken within the study area are available in Table 1-1below

Table 1-1 Ecological surveys undertaken in the study area

Survey type	Date	Location of survey	Assessed in NIS or EIAR
Habitat surveys – survey data and subconsultant report included in Appendix B			
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 C			
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

Survey type	Date	Location of survey	Assessed in NIS or 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	
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 D			
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 E			
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	Static detectors set up at Island House, Mahers Pub & Coolbane woods	Impact assessment in EIAR

Survey type	Date	Location of survey	Assessed in NIS or EIAR
	July 2020 12th August- 19th August 2020		
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 F			
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 accompanying this report			
Tree surveys (surveyed by Arborist)	19 & 20 October 2022	Entire scheme	EIAR

1.4.3.1 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 surveys 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 (Smith et al., 2011). 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 (Parnell and Curtis, 2012); while contemporary

nomenclature is in line with The New Flora of the British Isles 4th Edition (Stace, 2019).

1.4.3.2 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 B.

Two habitats listed under Annex I of the E.U. Habitats Directive have been recorded within the study area. 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.

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. It was also checked again in winter 2024 during the repeat Wintering Bird surveys.

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.

1.4.3.3 Bird surveys

Wintering bird surveys, breeding bird surveys and checks for active heron nests were conducted from 2019 to 2023. The full survey report is included in Appendix C.

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)

The surveys conducted are included in the table below.

Table 1-2 Bird Survey

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 & Island House and Mall Road

Survey type	Dates	Locations
	16 January 2024 23 February 2024	
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

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 (Lewis and Tierney 2014), 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 5 months during Winter 2019/2020 by JBA Ecologists at dawn for 2 hours on the following dates:

- 14th Nov 2019
- 17th Dec 2019
- 15th Jan 2020
- 13th Feb 2020
- 11th March 2020

The wintering bird surveys were repeated in 2024 as four years had passed since the original bird surveys carried out in 2019 and 2020. These surveys were carried out on:

- 16th Jan 2024
- 23rd Feb 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 ((Gilbert et al. 2021))

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 (2009) / Breeding Bird Survey (BBS) methodology (BTO, (Heywood et al. 2022)), (Cummins et al. 2010).

Note on age of surveys: The wintering bird surveys were carried out in winter of 2019 to 2020 and therefore the data is 3 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, 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 20223 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 (Gilbert et al., 2021)
- 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 ((NRA 2009b)) / Breeding Bird Survey (BBS) methodology (BTO, (Heywood et al. 2022)), (Cummins et al. 2010).

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, (Bibby, 2000, Cummins et.al 2010).

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.

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.

Heronry

A heronry is located in the trees between Maher's Pub and Island House. At least two trees, a Cedar and a Beech are used by nesting herons. These are around the section of the FRS, Flood Cell E2.

Heron nest counts were carried out from ground level using binoculars (8*42 and 10*42) during wintering bird surveys, and during other site visits. Ground based surveys are not possible during the main growing season as tree foliage obstructs the view. Ground level observations were complemented by a drone survey carried out by a licensed drone operator on 8 September 2022, taking aerial imagery of the suspected nest sites.

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 europaeu*s; and Pygmy Shrew *Sorex minutus* within the surrounding vicinity of the proposed Scheme were noted. The full survey report is included in Appendix D.

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 (2006); Guidelines for the Treatment of Badgers Prior to the Construction of National Road Schemes (2006); and Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes (2006).

Survey of Cloon Stream - Trail camera surveys 2023: As the proposed FRS will be located along the Cloon Stream, further surveys were required to determine use of the stream by Otters was carried out. This involved trail cameras set up along the stream in 6 location in winter and spring.

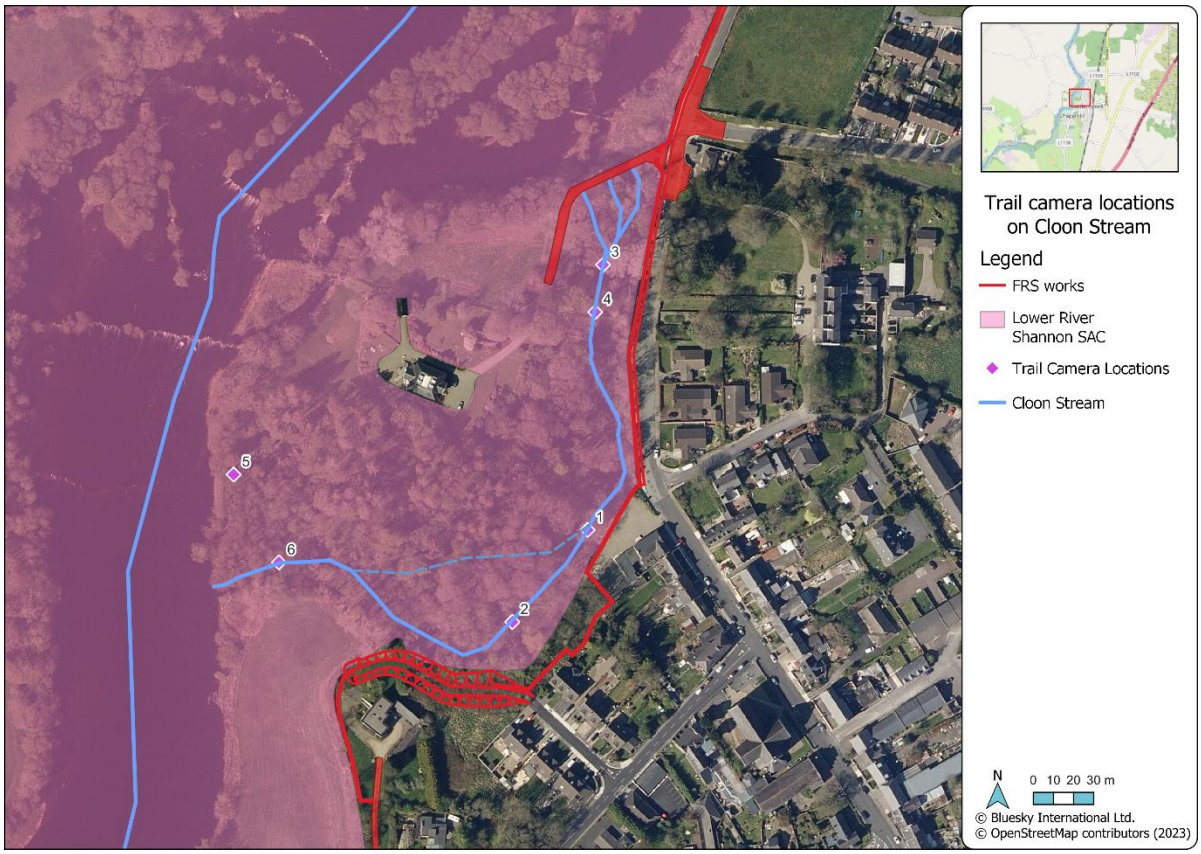

Figure 1-2 Location of trail cameras 1-6 along the Cloon Stream

Table 1-3 Trail Camera Survey

Trail camera	Location	Dates
Winter mammals – set up Trail Camera x 2 cameras	Location 1 & 2	26 January 2023
Trail Camera on Cloon Stream x 2 cams	Location 3 & 4	19th May 2023
Trail Camera on Cloon Stream x 2 cams	Location 5 & 6	1st June 2023

This was done in combination with additional searches for field signs otter in January 2023 while the vegetation was low in the winter, such as prints, slides, couches, dens, and spraints.

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 (Collins, 2016). The full survey report is included in Appendix E.

Table 1-4 Bat Surveys

Survey	Date	Location of survey
Preliminary Bat Roost and Habitat Suitability Surveys	19 September 2019 20 May 2020 & 20 July 2020 (and during other	
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

Preliminary Bat Roost and Habitat Suitability Surveys - Given the presence of a number of mature trees within the site boundary, there was the potential for Bat roosts to be present within or adjacent to the proposed Scheme. The tree survey outlines the potential for trees to contain bat roosts. JBA Ecologists carried out a preliminary Bat roost 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 waling set transect routes within 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 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 2020 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)

The full survey report conducted by Ecofact is included in Appendix F.

Aquatic Habitat Surveys were carried out on the entire study area on the River Shannon, with detailed investigations at a total of 6 survey sites. Survey Site locations are illustrated in Figure 2. The survey was completed with reference to the Environment Agency's "River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003" (EA, 2003) and "A Guide to Habitats in Ireland" (Fossitt, 2000). 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 (Toner et al., 2005). 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 6 site locations in the River Shannon and Cloon Stream were assessed for potential Lamprey and Salmon habitat. An electrical fishing survey was undertaken at the 6 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 Directive - Electric fishing in wadable reaches". A portable electrical fishing unit (Smith Root-LR 24 backpack) was used during the assessments. Fishing was carried out continuously for 5 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 the released alive and spread evenly over the sampling area. No mortalities were recorded. Strict biosecurity measures were followed during all fieldwork (IFI, 2010).

Juvenile Lamprey surveys generally followed the methodology for ammocoetes surveys given in the manual 'Monitoring the River, Brook and Sea Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus' by Harvey & Cowx (2003). Electrical fishing for juvenile lampreys was carried out at three 1m2 habitat patches where available. A total of 3 x 1 m2 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' by Gardiner R (2003).

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. 20 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.

A report of the DNA analysis is included in Appendix G.

Tree survey

Tree surveys were conducted by JBA Arborist on 19 & 20 October 2022. Arboricultural Impact Assessment was written in accordance with BS5837:2012 Trees in relation to design, demolition, and construction. The full survey report accompanies this report

1.4.4 In-combination Assessment

The in-combination impacts are considered only after the assessment of the project alone. Where there is no adverse effect on site integrity, but some adverse effect locally an assessment of this adverse effect in-combination with other plans or projects is carried out. Other plans or projects within this report are in line with those detailed within the accompanying EIAR.
Where other plans or projects are identified then initially a review is made of its AA Screening, or AA, and if the Competent Authority for the plan or project has made a final determination of no effect on the integrity of any European site, either alone or in-combination, this determination is used in this assessment. Where there is not a

full AA, or the findings are unclear or out of date, the plan or project documentation is checked for credible evidence of real (not hypothetical) risk to a European site. Where these are identified then a detailed assessment is carried out. Each of these plans are projects are examined in a pairwise basis first to assess whether there is the potential for cumulative or in-combination effects between the proposed Scheme and the plan or project under examination. Following this an assessment of proposed Scheme and all of the identified plans and projects as a whole are examined, in order to assess whether they all have the capacity to act in a cumulative or in-combination manner.
Potential sources of cumulative impacts were identified based on plans and projects respective ZoIs and the ecology of valued ecological features that are physically linked with Natura 2000 sites, as well as ex-situ supporting habitats, as identified in Section 3.
Plans or projects were searched for using the National Planning Application Database, EIA portal and Myplan.ie databases all accessed online.

1.5 Competent Persons

The assessment has been carried out by Hannah Mulcahy BSc (Hons), MSc ACIEEM. She is a senior ecologist with JBA for 6 years and has undertaken numerous Appropriate Assessment Screening and NIS assessments.

The assessment has been reviewed by JBA Ecology Technical Director Rachael Brady BSc MSc PGCert CEcol MCIEEM with extensive experience in undertaking assessments under the Habitats Directive.

1.6 Consultation

Consultation is ongoing with a number of key stakeholders in relation to 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 Good took place on the 20th 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 updated 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 the extent of the Annex I Alluvial Forest [91E0] within the River Shannon.

Later consultation with Jervis Good, NPWS Ecologist, also took place at the public participation day on the 6th September 2023, on findings of surveys and the proposed Scheme, particularly interactions with the Lower River Shannon SAC.

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.

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

1.7 Limitations and Constraints

In carrying out this NIS, it is inevitably subject to some limitations. These limitations will not affect the conclusion, but the following points are recorded in order to ensure the basis of the assessment is clear:

Information on the works and conditions on site are based on current knowledge at the time of writing. Changes to the site since this report was drafted cannot be accounted for. However, significant changes to the site are unlikely in the time between the submission of the report and likely determination date (2024). Site surveys followed CIEEM guidance provided on suitable lifespan for surveys (CIEEM 2019) Advice note on the lifespan of ecological reports and surveys).

JBA ecologists have been present at the site regularly since 2019 to 2024 when surveys have been undertaken. No differences in species or changes in habitats in relation to the Scheme, has been observed, except in minor instances where noted in the text. The last site visit made by an ecologist for this report was in February 2024. Therefore, it is considered this data is current.

This assessment is based on the design and methodology for proposed works as described in this report. Where changes to design and/or methodology occur, an ecologist will need to be consulted to determine if the changes are likely to alter the ecological impacts and would therefore need reassessment.

The precautionary principle is used at all times when determining potential ecological sensitivity of the site.

2 Castleconnell Flood Relief Scheme Description

2.1 The 'Project'

The proposed flood relief scheme in Castleconnell meets the criteria of a 'Project' as defined in the Habitats Directive and is not directly connected with or necessary to the management of any Natura 2000 site. Therefore, the project is subject to the requirements of the Appropriate Assessment process.

2.2 Project location

The River Shannon is the main river in Ireland, with an estimated catchment area of 15,700 km2. The river begins at Shannon Pot in the Cuilcagh Mountains in County Cavan. The river flows to the south and discharges into the Shannon Estuary. Castleconnell village drains approximately 10,824 km2 of the Shannon catchment and associated flood flow.

Parteen Weir and Lough Derg, which is approximately 6.5 km upstream of Castleconnell village, have a significant impact on the flood flows at Castleconnell.

There is a southerly topographical decline, with road levels adjacent to Rivergrove B&B on the Lacka Road falling to 22.7mOD on Chapel Hill in front of the public carpark.

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

The study area is outlined in red in Figure 2-1.

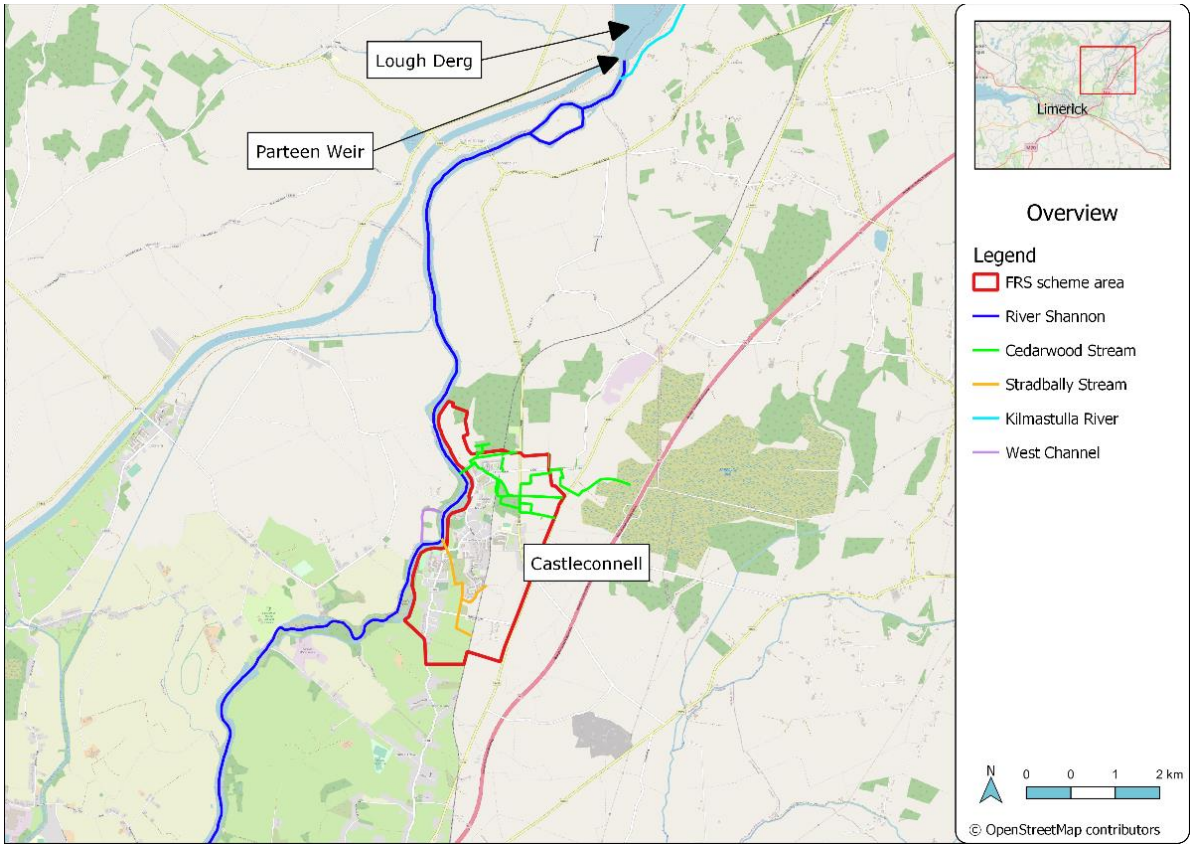

Figure 2-1: Castleconnell FRS Catchment Overview

2.3 Overview of Proposed Development

The proposed development comprises a Flood Relief Scheme with various measures including flood walls, embankments, road raising, demountable flood barriers, and associated works and infrastructural changes. From north to south, the scheme is generally composed of:

- Flood walls and associated interventions between Rivergrove B&B and Mall House.
- Replacement of the existing wall along Mall Road with a new flood wall, set back from the existing wall and the river by c. 1m.
- Road raising at the entrance to Island House and Scanlon Park junction.
- Continuation of the new setback flood wall along Mall Road between the entrance to Island House and Maher's Pub.
- A flood wall running along the back of Maher's Pub and Meadowbrook Estate, merging into a new earth embankment towards Stormont House.
- A new flood wall and road raising along the entrance to Island House.
- Road raising and a demountable flood barrier at the entrance to Coolbane Woods; and
- An embankment running from the entrance to Coolbane Woods, running south and tying in with higher ground.

The location and further description of each element of the FRS is shown on Figure 2-2.

2.4 Detailed Description of Proposed Development

The proposed development comprises the following:

Rivergrove B&B and Grange House

Replacement of the existing wall to the west of Rivergrove B&B with a new flood wall. 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. 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.

Replacement of the existing wall to the west of Grange House 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 views of the river from key areas of the house.

The open section of the Cedarwood Stream adjacent to the Mill Building will remain open, and a new culvert of approximately 60m will be provided from the downstream point of this open section to the 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.

Mall House

Replacement of the wall to the north, west and south of Mall House with a new flood wall. Where the northern face of the house is constructed against the boundary wall, a new plinth wall will be constructed immediately north, in the property of Dunkineely House. Protection is not required to the front of Mall House because the Mall Road is protected.

Provision of a demountable flood barrier to the entrance on Dunkineely House (immediately to the south of Mall House).

Mall Road

Replacement of the existing wall to the west of the Mall Road with a new flood wall which will be set back by c. 1m and constructed outside the SAC and the area of alluvial woodland.

Provision of demountable barrier in the main fisherman access point through the Mall wall.

Island House entrance

Road raising at the entrance to Island House, to the ‘504 event’ 1% AEP flood level (23.70m). Provision for a flood gate on top of this to defend up to the ‘Baseline design event (limitations in operational conditions).’ Raising of c. 50m length of the

driveway to Island House (on the eastern side of the causeway) by c. 200mm to allow for safe evacuation at the onset of a flood event. Raising of Scanlon park junction by c. 100mm

Mall Road (Cont.) & Maher's Pub & Meadowbrook Estate

Replacement of the existing wall between Island House and Maher's pub with a new flood wall, which will be set back by c. 1m for the majority of its length. C. 55m immediately south of the entrance to Island House will be replaced along its existing alignment due to space constraints.

Provision of a new flood wall alongside Maher's Pub car park. It is proposed to set back the wall along the rear (western) boundary by c. 6m to remain outside of the RPZ of the Cedar tree (where herons nest). This flood wall extends along the northern boundary of nr. 7 Meadowbrook Estate, terminating at the front boundary of nr. 6 Meadowbrook Estate. A section of the existing boundary wall at ethe end of the cul-de-sac will be removed, and a gate will be provided through the wall to provide 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.

Meadowbrook Estate & Stormont House

Provision of an embankment along the rear of Meadowbrook Estate, from nr. 7 Meadowbrook Estate and north of Stormont House.

A low-level flood wall along the west of Stormont House, inside the existing castellated wall.

Raising ground levels along the Stormont House entrance road.

A short length of low-level flood wall to tie in with rock at the Castle to the east of the entrance to Stormont House.

Coolbane Woods (entrance)

Road raising to the '504 event' 1% AEP level at the Coolbane Woods junction adjacent to the castle. Provision of a demountable flood barrier to the west of the junction, to defend up to the 'Baseline Design Event (limitations in operational conditions)'.

Coolbane Woods (woodland)

Proposed embankment 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.

Cedarwood Stream

Silt and vegetation removal, replacement of small culvert.

Figure 2-2: Overview of FRS proposal

2.5 Construction Activities

A Draft Buildability Report has been prepared for the proposed FRS which outlines the construction methodology and phasing. This is summarised below and includes information which is relevant to the NIS. The Draft Buildability Report will remain a live document until after the planning application stage, when the finalised detailed design of the scheme is complete.

It is expected that the construction phase will take place over 12 to 18 months.

2.5.1 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. Bunds shall be 110% capacity of the largest vessel contained within the bunded 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.
- A maintenance programme for the bunded areas will be managed by the site environmental manager. The removal of rainwater from the bunded areas will be their responsibility. Records will be maintained of materials taken off site for disposal.
- The site environmental manger will be responsible for maintaining all training records.
- The contents of any tank will be clearly marked on the tank, and a notice displayed requiring that valves and trigger guns be locked when not in use.
- Drainage collection system for washing area to prevent run-off into surface water system; and
- All refuelling of vehicles will be carried out at the fuel stores within the main site compound and only ADR trained personnel will be permitted to operate fuel bowsers.

2.6 Operation

A Maintenance Plan will be put in place whereby Limerick City & County Council will inspect and install the demountable barriers and flood gates once per year to examine them for any defects and to ensure that staff are trained in and familiar in their installation. Annual inspection and installation of demountable barriers and flood gates, and inspection non-return valves and drainage outfall

Annual inspection of Cedarwood Stream and removal of vegetation for improved conveyance if required.

Annual inspections of the embankments will be needed, together with investigations of its performance after each flood event. Monitoring of seepage will be recommended. Inspection of entire scheme following a flood event. Cutting of grass on embankments twice per year.

Responsibility for erection of the demountable flood barriers and flood gates ahead of a flood event will remain with Limerick City & County Council. For this reason, they have all been proposed at publicly accessible locations.

2.7 Zone of Influence

An examination of the construction methods or project description allows sources of impact to be determined. This also allows a zone of influence for the project to be generated based on the size, scale and nature of the works involved. Using the source-pathway-receptor model the pathways for impact are also analysed to see if a functional pathway for impact is present. This report analyses three pathways: surface water, groundwater, and land.

As the works are confined to Castleconnell Village and will largely use existing infrastructure the project will primarily directly affect the site only. However, as the scale of proposed works are considered of 'Project' status, Natura 2000 sites within a 10km range of the proposed development were examined in relation to surface water and groundwater / ground-to-surface water pathways (i.e., local surface water sub-catchments and groundwater bodies / aquifers), with an extended 15km range for those with a downstream hydrological connection.

In respect to the ZoI for air pollution (emissions and dust), Natura 2000 sites within a 500m buffer zone of the development were considered as per the Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction (IAQM, 2014), including ex-situ foraging habitats utilised by QI species associated with local Natura 2000 sites.

Furthermore, a 300m disturbance buffer from boundaries of the proposed development has been incorporated into the ZoI in order to account for QI species potentially foraging within ex-situ habitats. Some wintering bird species (that are QIs of Natura 2000 sites along the Ireland's lakes and rivers and estuaries are known to travel considerable distances on a daily basis for foraging and roosting, with flocks occasionally utilising outlier sites, outside of that of their typical roosting /foraging areas. These flight distances can be beyond what is normally considered the ZoI for

a project. For this reason, any SPAs connected to River Shannon has been included within the ZoI of the proposed development.

This means the final ‘Zone of Influence’ can be a complex shape not easily defined by a simple distance figure, but in this way the assessment includes all relevant sites whilst avoiding unnecessary inclusion of other sites.

3 Natura 2000 sites in proximity to Scheme

3.1 Project AA Screening Summary

Following the ZOI guidance the Natura 2000 (JB Barry, JBA 2024) sites within the range are listed in Table 3-1 below and their location are shown in

Figure 3-2 SPAs in relation to the proposed scheme.

The descriptions of the Natura 2000 sites within the ZoI are given in Table 3-2 (overleaf).

Table 3-1 Natura 2000 sites within ZoI

Natura 2000 site	Site Code	Approximate distance from site
Lower River Shannon SAC	002165	0.0km (partially within site boundary
Glenomra Wood SAC	001013	6.9 km
Clare Glen SAC	00930	7.3 km
Slievefelim to Silvermines Mountains SPA	004165	7.7 Km
Glenstal Wood SAC	001432	9.4 km
River Shannon and River Fergus Estuaries SPA	001432	10.5 Km
Lough Derg (Shannon) SPA	004058	12.4 km
Slieve Bernagh Bog SAC	002312	9.9km
Silvermines Mountains West SAC	002258	14.1km
Danes Hole, Poulnalecka SAC	000030	14.7km

Of the Natura 2000 sites listed in Table 4-1, the Lower River Shannon SAC, Lough Derg (Shannon) SPA and River Shannon and River Fergus Estuaries SPA have hydrological connectivity to the proposed FRS. Due to their proximity the proposed FRS also poses potential impacts via land and air pathways to the Lower River Shannon SAC. The remaining Natura 2000 sites in Table 4-1 are not hydrologically linked to the proposed FRS and given their distance from the project, impacts via land and air pathways are not anticipated. Thus, the Natura 2000 sites within the zone of potential impact of the Scheme are:

- Lower River Shannon SAC,
- River Shannon and River Fergus Estuaries SPA
- Lough Derg (Shannon) SPA

Table 3-2 Location of Natura 2000 sites within ZOI, with information on qualifying interests and impacts determination

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
Lower River Shannon SAC 002165 SAC is overlapping with project site of proposed FRS	Sandbanks which are slightly covered by sea water all the time [1110] Estuaries [1130] Mudflats and sandflats not covered by seawater at low tide [1140] Coastal lagoons [1150] Large shallow inlets and bays [1160] Reefs [1170] Perennial vegetation of stony banks [1220] Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] Salicornia and other annuals colonising mud and sand [1310] Atlantic salt meadows *Glauco-Puccinellietalia maritimae* [1330] Mediterranean salt meadows *Juncetalia maritimi* [1410] Water courses of plain to montane levels with the *Ranunculion fluitantis and*	The proposed FRS is within and adjacent to this SAC. Baseline surveys indicate the following QIs are present in the SAC at Castleconnell and within 100m of the FRS: Water courses of plain to montane levels with the *Ranunculion fluitantis and Callitricho-Batrachion* vegetation [3260] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior Alno-Padion, Alnion incanae, Salicion albae* [91E0] Sea Lamprey *Petromyzon marinus* [1095] Brook Lamprey *Lampetra planeri* [1096] River Lamprey *Lampetra fluviatilis* [1099] Salmon *Salmo salar* [1106] Otter *Lutra lutra* [1355] The proposed FRS footprint is directly within the SAC.	AA required. SAC is overlapping with project site of proposed FRS. Assessed in Section 6 Stage 2 Appropriate Assessment.

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
	Callitricho-Batrachion vegetation [3260] Molinia meadows on calcareous, peaty or clayey-silt-laden soils *Molinion caeruleae* [6410] Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior Alno-Padion, Alnion incanae, Salicion albae* [91E0] Freshwater Pearl Mussel *Margaritifera margaritifera* [1029] Sea Lamprey *Petromyzon marinus* [1095] Brook Lamprey *Lampetra planeri* [1096] River Lamprey *Lampetra fluviatilis* [1099] Salmon *Salmo salar* [1106] Common Bottlenose Dolphin *Tursiops truncatus* [1349] Otter *Lutra lutra* [1355]	Construction of the proposed flood defence walls will be adjacent to Alluvial woodlands/ within Riparian area of the River Shannon. There will be surface water impacts affecting all QI habitats and species both directly and indirectly from construction. Disturbance impacts are expected to the QI species Otter.	

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
Glenomra Wood SAC 001013 6.2km distance from proposed FRS	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]	This European Site is located 6.2km north of the proposed FRS. There will be no direct effects as the project footprint is located entirely outside the designated site boundary, and the QI is a terrestrial habitat and therefore no pathway for impact exists.	This has no impact pathway, therefore no appropriate assessment is required.
Clare Glen SAC 000930 7km distance from proposed FRS	Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] Killarney Fern *Trichomanes speciosum* [1421]	This European Site is located 7km from the proposed FRS. There will be no direct effects as the project footprint is located entirely outside the designated site boundary, and the QIs are a terrestrial habitat and associated species of flora and therefore no pathway for impact exists.	This has no impact pathway, therefore no appropriate assessment is required.
Slievefelim to Silvermines Mountains SPA 004165 7.4km distance from proposed FRS	Hen Harrier *Circus cyaneus* [A082]	This European Site is located 7.4km distance from the proposed FRS. There is no suitable habitat for hen harrier within the immediate area of the FRS, an no direct effects are anticipated.	This has no impact pathway, therefore no appropriate assessment is required.

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
Glenstal Wood SAC 001432 8.9km distance from proposed FRS	Killarney Fern *Trichomanes speciosum* [1421]	This European Site is located 8.9km from the proposed FRS. There will be no direct effects as the project footprint is located entirely outside the designated site boundary, and the QI is a terrestrial species and therefore no pathway for impact exists.	This has no impact pathway, therefore no appropriate assessment is required.
Slieve Bernagh Bog SAC 002312 9.9k distance from proposed FRS	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030] Blanket bogs (* if active bog) [7130]	This European Site is located 9.9km from the proposed FRS. There will be no direct effects as the project footprint is located entirely outside the designated site boundary, and the QIs are terrestrial habitats and also linked to ground and surface water. These habitats are in an upstream separate catchment and therefore no pathway for impact exists.	This has no impact pathway, therefore no appropriate assessment is required.
River Shannon and River Fergus Estuaries SPA 004077	Cormorant *Phalacrocorax carbo* [A017] Whooper Swan *Cygnus cygnus* [A038] Light-bellied Brent Goose	This European Site is located 10km south of the proposed FRS. Cormorant and Black-headed	AA required. Pathway present with possible impacts on Cormorant [A017] Black-headed Gull [A179] Wetland and Waterbirds

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
10km distance from proposed FRS	*Branta bernicla hrota* [A046] Shelduck *Tadorna tadorna* [A048] Wigeon *Mareca penelope* [A050] Teal *Anas crecca* [A052] Pintail *Anas acuta* [A054] Shoveler *Anas clypeata* [A056] Scaup *Aythya marila* [A062] Ringed Plover *Charadrius hiaticula* [A137] Golden Plover *Pluvialis apricaria* [A140] Grey Plover *Pluvialis squatarola* [A141] Lapwing *Vanellus vanellus* [A142] Knot *Calidris canutus* [A143] Dunlin *Calidris alpina* [A149] Black-tailed Godwit *Limosa limosa* [A156] Bar-tailed Godwit *Limosa lapponica* [A157] Curlew *Numenius arquata* [A160] Redshank *Tringa totanus* [A162]	Gull were recorded during wintering bird surveys in Castleconnell, and these species may be associated with the SPA. This section of the Shannon may provide supporting habitat for these birds. Disturbance impacts are expected to the QI bird species as they are present. The construction element is expected to have surface water impacts which may indirectly affect the QI birds.	[A999]

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
	Greenshank *Tringa nebularia* [A164] Black-headed Gull *Chroicocephalus ridibundus* [A179] Wetland and Waterbirds [A999]		
Lough Derg (Shannon) SPA 004058 11.5km distance from proposed FRS	Cormorant *Phalacrocorax carbo* [A017] Tufted Duck *Aythya fuligula* [A061] Goldeneye *Bucephala clangula* [A067] Common Tern *Sterna hirundo* [A193] Wetland and Waterbirds [A999]	This European Site is located 11.5km distance from the proposed FRS. Cormorant was recorded often during wintering bird surveys in Castleconnell, and this species may be associated with the SPA. This section of the Shannon may provide supporting habitat for these birds. Disturbance impacts are expected to the QI bird species as they are present. The construction element is expected to have surface water impacts which may indirectly affect the QI birds.	AA required. Pathway present with possible impacts on Cormorant [A017]
Silvermines Mountains West SAC 002258	Northern Atlantic wet heaths with *Erica tetralix* [4010] European dry heaths [4030]	This European Site is located 14.1km distance from the proposed FRS. There will be no direct effects	This has no impact pathway, therefore no appropriate assessment is required.

European Site and distance from proposed development	Qualifying Interests of European Sites	Likely Zone of Impact determination	Appropriate Assessment Required?
14.1km distance from proposed FRS	Calaminarian grasslands of the *Violetalia calaminariae* [6130]	as the project footprint is located entirely outside the designated site boundary, and the QIs are terrestrial habitats and also linked to ground and surface water. These habitats are in an upstream separate catchment and therefore no pathway for impact exists.	
Danes Hole, Poulnalecka SAC 000030 14.7km distance from proposed FRS	Caves not open to the public [8310] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] Lesser Horseshoe Bat *Rhinolophus hipposideros* [1303]	This European Site is located 14.7km distance from the proposed FRS. Lesser Horseshoe bat was recorded twice during bat surveys; however it is unlikely the populations of this SAC are linked to this site. Impacts on local bats are assessed in the Biodiversity Chapter of the EIAR. There will be no direct effects to the Oak woods 91A0 Annex Habitat as the project footprint is located 14.7km from the site, and the QI is a terrestrial habitat and therefore no pathway for impact exists.	This has no impact pathway, therefore no appropriate assessment is required. Impacts on local bats are assessed in the Biodiversity Chapter of the EIAR.

3.2 Description of Screened-in European sites

This section provides baseline information on the Natura 2000 sites screened-in in Section 3.1:

- Lower River Shannon SAC, and
- River Shannon and River Fergus Estuaries SPA.
- Lough Derg (Shannon) SPA

3.2.1 Lower River Shannon SAC (002165)

The Lower River Shannon SAC is an extensive site encompassing the Rivers Shannon, Feale, Mulkear and Fergus. The River Shannon within this SAC is largely estuarine and flows through Carboniferous limestone as far as Foynes town and west of Foynes, through mostly Namurian shales and flagstones. The section of the River Shannon which is adjacent to the proposed development site, is part of the of the freshwater section of the river and is not influenced by the tides (NPWS, 2012b).

Baseline surveys indicate the following QIs are present in the SAC at Castleconnell and within 100m of the FRS:

- Water courses of plain to montane levels with the *Ranunculion fluitantis and Callitricho-Batrachion* vegetation [3260]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior Alno-Padion, Alnion incanae, Salicion albae* [91E0]
- Sea Lamprey *Petromyzon marinus* [1095]
- Brook Lamprey *Lampetra planeri* [1096]
- River Lamprey *Lampetra fluviatilis* [1099]
- Salmon *Salmo salar* [1106]
- Otter *Lutra lutra* [1355]

Construction of the proposed flood defence walls will be adjacent to Alluvial woodlands/ within Riparian area of the River Shannon. Alluvial forests are mapped downstream of Castleconnell, but during the surveys have been recorded adjacent to the proposed Scheme also.
There will be surface water impacts affecting all QI habitats and species both directly and indirectly from construction.
The potential impacts on this Natura 2000 site are predominantly through impacts on surface and groundwater quality, alterations to groundwater flows, changes to riparian and instream habitats affecting fish and aquatic invertebrates, all of which may have an indirect impact on the foraging opportunities of designated species of the SAC such as Otter, Lamprey, Salmon. Given the presence of invasive non-native species, namely Giant Hogweed and Himalayan Balsam, there is potential for these to spread and cause further negative impacts on the Natura 2000 site.

Otter has been commonly found in the River Shannon, as have Salmon and Lamprey (NPWS 2013). Surveys indicate these species are present in the Shannon at Castleconnell.

Locations where Opposite-leaved Pondweed and Triangular Club-rush are present on this site are classified as sub-types of the Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitans* and *Calltricho-Batrachion* vegetation (3260). However, neither of these species are present in Castleconnell. The bryophyte-rich sub-type is found in fast flowing water and is not present in Castleconnell. The proposed FRS is within and adjacent to this SAC. This is shown in Figure 3-1 below.

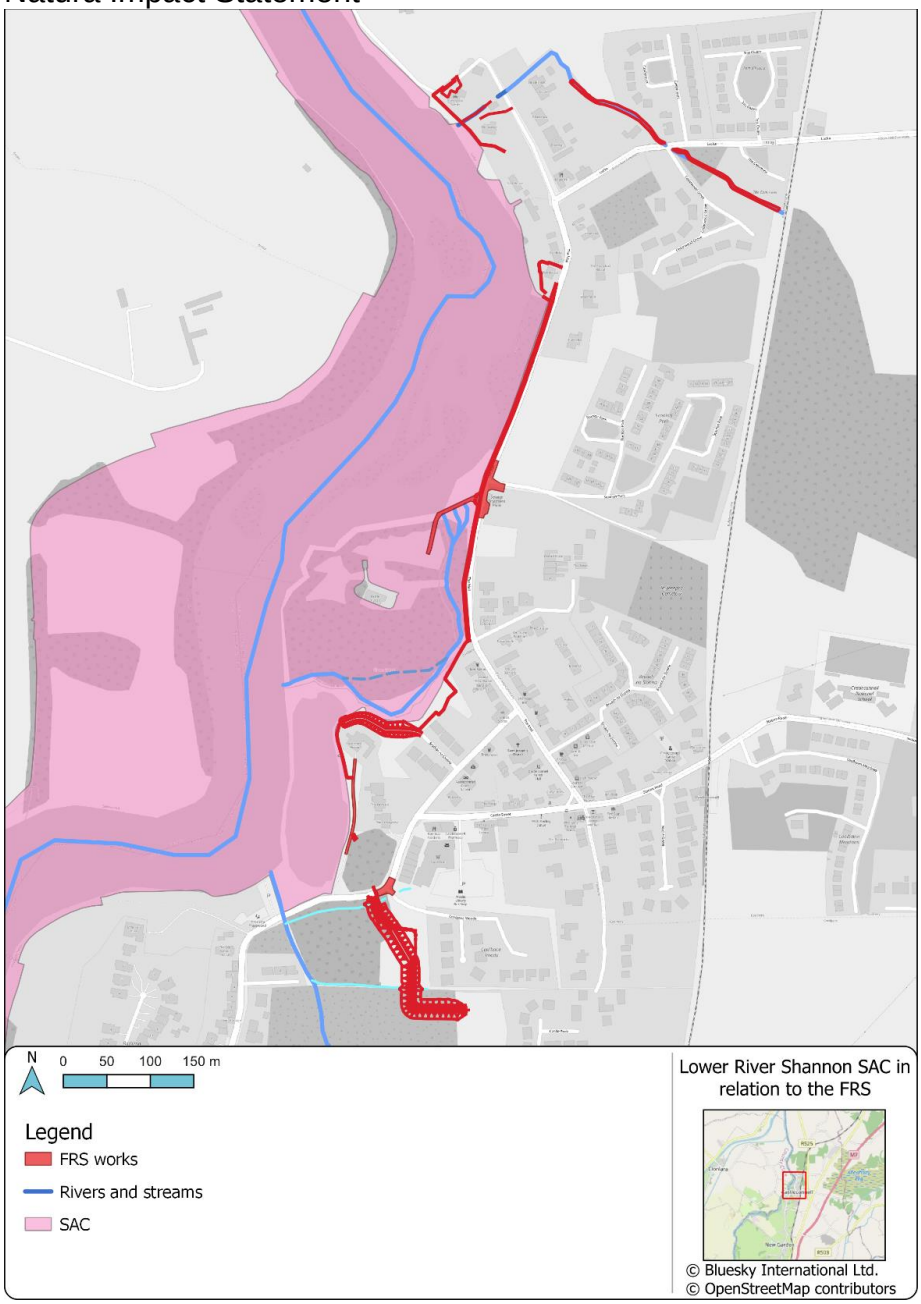

Figure 3-1 Element of the proposed scheme in relation to Lower River Shannon SAC

Qualifying Interests

The site is a SAC selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (* = priority; numbers in brackets are Natura 2000 codes):

- Sandbanks which are slightly covered by sea water all the time [1110]
- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]

- Coastal lagoons [1150]
- Large shallow inlets and bays [1160]
- Reefs [1170]
- Perennial vegetation of stony banks [1220]
- Vegetated sea cliffs of the Atlantic and Baltic coasts [1230]
- Salicornia and other annuals colonising mud and sand [1310]
- Atlantic salt meadows *Glauco-Puccinellietalia maritimae* [1330]
- Mediterranean salt meadows (*Juncetalia maritimi*) [1410]
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils *Molinion caeruleae* [6410]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior Alno-Padion*, *Alnion incanae*, *Salicion albae* [91E0]
- Freshwater Pearl Mussel *Margaritifera margaritifera* [1029]
- Sea Lamprey *Petromyzon marinus* [1095]
- Brook Lamprey *Lampetra planeri* [1096]
- River Lamprey *Lampetra fluviatilis* [1099]
- Salmon *Salmo salar* [1106]
- Common Bottlenose Dolphin *Tursiops truncatus* [1349]
- Otter *Lutra lutra* [1355]

Not all the qualifying features of the SAC occur in the Zone of Influence of the proposed works. Surveys have been conducted to determine the presence of QIs within the River Shannon at Castleconnell as outlined in Section 4. The qualifying features that could be potentially significantly impacted through surface water, groundwater and land and air pathways are.

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]
- Sea Lamprey *Petromyzon marinus* [1095]
- Brook Lamprey *Lampetra planeri* [1096]
- River Lamprey *Lampetra fluviatilis* [1099]
- Salmon *Salmo salar* [1106]
- Otter *Lutra lutra* [1355]

Conservation Objectives

The conservation objectives for the relevant species and habitats of the Lower River Shannon SAC are given in Table 3-3 and are taken from the NPWS Conservation Objectives Document (NPWS 2012b).

Table 3-3: Conservation objectives for relevant qualifying interests at Lower River Shannon SAC (002162) (NPWS, 2012b; NPWS, 2013)

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
To restore the favourable conservation condition of Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-adion, Alnion incanae, Salicion albae*) in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		
Attribute	Measure	Target
Habitat area	Hectares	Area stable or increasing, subject to natural processes, at least c.8.5ha for sites surveyed
Habitat distribution	Occurrence	No decline
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least 25ha in size and “small” woods at least 3ha in size
Woodland structure: cover and height	Percentage and metres	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types
Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy
Hydrological regime: flooding depth/height of water table	Metres	Appropriate hydrological regime necessary for maintenance of alluvial vegetation
Woodland structure: dead wood	m^3 per hectare; number per hectare	At least 30m^3/ha of fallen timber greater than 10cm diameter; 30 snags/ha; both categories should include stems greater than 40cm diameter (greater than 20cm diameter in the case of alder)
Woodland structure: veteran trees	Number per hectare	No decline
Woodland structure: indicators of local distinctiveness	Occurrence	No decline

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
Vegetation composition: native tree cover	Percentage	No decline. Native trees cover not less than 95%
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including alder (*Alnus glutinosa*), willows (*Salix spp*) and, locally, oak (*Quercus robur*) and ash (*Fraxinus excelsior)* and birch (*Betula pubescens*)
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation		
To maintain the favourable conservation condition of Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		
Attribute	Measure	Target
Habitat area	Kilometres Area stable or increasing, subject to natural processes	Kilometres Area stable or increasing, subject to natural processes
Habitat distribution	Occurrence	No decline, subject to natural processes.
Hydrological regime: river flow	Metres per second	Maintain appropriate hydrological regimes
Hydrological regime: tidal influence	Daily water level fluctuations - metres	Maintain natural tidal regime
Hydrological regime: freshwater seepages	Metres per second	Maintain appropriate freshwater seepage regimes
Substratum composition: particle size range	Millimetres	The substratum should be dominated by the particle size ranges, appropriate to the habitat sub-type (frequently sands, gravels and cobbles)
Water Quality; nutrients	Milligrams per litre	The concentration of nutrients in the water column should be sufficiently low to prevent

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
		changes in species composition or habitat condition
Vegetation composition: typical species	Occurrence	Typical species of the relevant habitat sub-type should be present and in good condition
Floodplain connectivity	Area	The area of active floodplain at and upstream of the habitat should be maintained
Riparian habitat	Area	The area of riparian woodland at and upstream of the bryophyte-rich sub-type should be maintained
Sea Lamprey *Petromyzon marinus*		
To restore the favourable conservation condition of Sea Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		
Attribute	Measure	Target
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary
Population structure of juveniles	Number of age/size groups	At least three age/size groups present
Juvenile density in fine sediment	Juveniles/m²	Juvenile density at least 1/m²
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds.
Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.
Brook Lamprey *Lampetra planeri*		
To maintain the favourable conservation condition of Brook Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		
Attribute	Measure	Target
Distribution	% of river accessible	Access to all water courses down to first order streams

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
Population structure of juveniles	Number of age/size groups	At least three age/size groups of brook/river lamprey present
Juvenile density in fine sediment	Juveniles/m²	Mean catchment juvenile density of brook/river lamprey at least 2/m²
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.
River Lamprey *Lampetra fluviatilis*		
To maintain the favourable conservation condition of River Lamprey in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		
Attribute	Measure	Target
Distribution	% of river accessible	Access to all water courses down to first order streams
Population structure of juveniles	Number of age/size groups	At least three age/size groups of river/brook lamprey present
Juvenile density in fine sediment	Juveniles/m²	Mean catchment juvenile density of brook/river lamprey at least 2/m²
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.
Atlantic Salmon *Salmo salar*		
To restore the favourable conservation condition of Salmon in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
Attribute	Measure	Target
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 min sampling
Out-migrating smolt abundance	Number	No significant decline
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA
Otter *Lutra lutra*		
To restore the favourable conservation condition of Otter in the Lower River Shannon SAC, which is defined by the following list of attributes and targets:		

Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) [91E0]		
Attribute	Measure	Target
Distribution	Percentage positive survey sites	No significant decline
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 596.8ha above high water mark (HWM); 958.9ha along riverbanks/ around ponds
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 4,461.6ha
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 599.54km
Extent of freshwater (lake) habitat	Hectares	No significant decline. Length mapped and calculated as 500.1km
Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 125.6ha
Couching sites and holts	Number	No significant decline
Fish biomass available	Kilograms	No significant decline
Barriers to connectivity	Number	No significant increase

Site Vulnerabilities

Threats and pressures to Lower River Shannon SAC are listed in Table 3-4 (NPWS 2013).

Table 3-4: Threats and pressures to Lower River Shannon SAC (NPWS, 2017a)

Code	Threat or pressure	Ranking and Location
I01	Invasive non-native species	L, i
A08	Fertilisation	M, o
A04	Grazing	M, i
H04	Air pollution, air-borne pollutants	M, o
A08	Fertilisation	M, i
E01	Urbanised areas, human habitation	M, o
D01.01	Paths, tracks, cycling tracks	L, i
K02.03	Eutrophication (natural)	M, o

Code	Threat or pressure	Ranking and Location
G01.01	Nautical sports	L, i
B	Sylviculture, forestry	L, i
F01	Marine and Freshwater Aquaculture	L, i
F03.01	Hunting	L, i
C01.01.02	Removal of beach materials	L, i
C01.03.01	Hand cutting of peat	L, i
E03	Discharges	M, o
J02.01.01	Polderisation	M, i
J02.10	Management of aquatic and bank vegetation for drainage purposes	L, i
E03	Discharges	M, i
J02.01.02	Reclamation of land from sea, estuary or marsh	M, o
J02.12.01	Sea defence or coast protection works, tidal barrages	L, i
Location: I = inside, o = outside, b = both Rank: H = high, M = medium, L = low		

3.2.2 River Shannon and River Fergus Estuaries SPA (004077)

This site is located 10km downstream of the proposed FRS. However, the area around Castleconnell may provide supporting habitat for the Qualifying Interests of the SPA.

This site is of great ornithological interest, being of international importance on account of the numbers of wintering birds it supports. It also supports internationally important numbers of three species, i.e., Dunlin, Black-tailed Godwit and Redshank. In addition, there are 16 species that have populations of national importance. For several of the bird species, it is the top site in the country. Also of note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive i.e., Whooper Swan, Golden Plover and Bar-tailed Godwit. The site is most effectively censused from the air and this is carried out most winters (NPWS 2015).

Cormorant and Black-headed Gull were recorded during wintering bird surveys in Castleconnell, and this species may be associated with the SPA. This section of the Shannon may provide supporting habitat for these birds.

Disturbance impacts are expected to the QI bird species as they are present.

The construction element is expected to have surface water impacts which may indirectly impact upon the QI birds SPAs in relation to the proposed scheme.

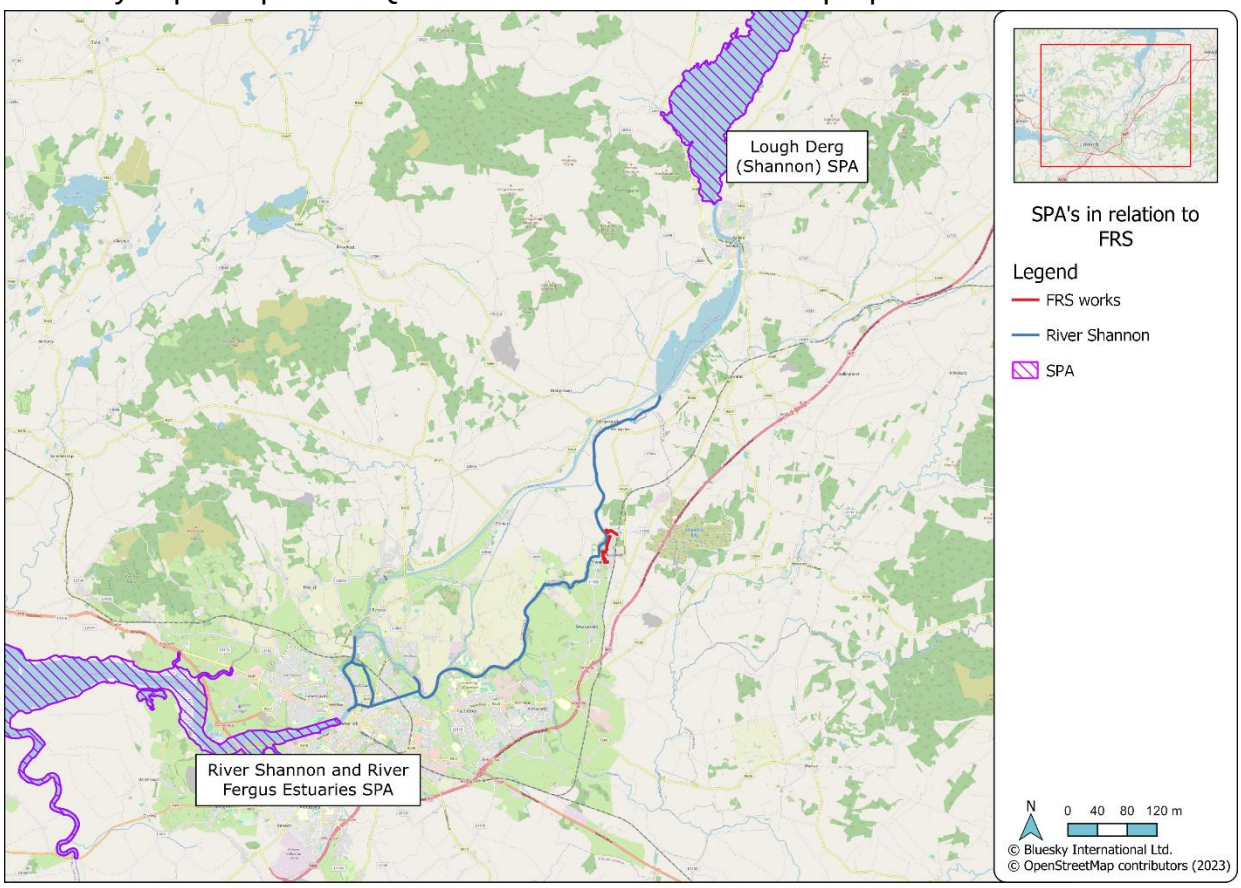

Figure 3-2 SPAs in relation to the proposed scheme

Qualifying Interests

The River Shannon and River Fergus Estuaries SPA is designated for the following Qualifying Interests:

- A017 Cormorant *Phalacrocorax carbo*
- A038 Whooper Swan *Cygnus cygnus*
- A046 Light -bellied Brent Goose *Branta bernicla*
- A048 Shelduck *Tadorna tadorna*
- A050 Wigeon *Mareca penelope*
- A052 Teal *Anas crecca*
- A054 Pintail *Anas acuta*
- A056 Shoveler *Anas clypeata*
- A062 Scaup *Aythya marila*
- A137 Ringed Plover *Charadrius hiaticula*
- A140 Golden Plover *Pluvialis apricaria*
- A141 Grey Plover *Pluvialis squatarola*
- A142 Lapwing *Vanellus vanellus*

- A143 Knot *Calidris canutus*
- A149 Dunlin *Calidris alpina*
- A156 Black-tailed Godwit *Limosa limosa*
- A157 Bar-tailed Godwit *Limosa lapponica*
- A160 Curlew *Numenius arquata*
- A162 Redshank *Tringa totanus*
- A164 Greenshank *Tringa nebularia*
- A179 Black-headed Gull *Chroicocephalus ridibundus*
- A999 Wetlands and Waterbirds

Given the mobile nature of the Qualifying Interests of this SPA, the proximity of the proposed FRS, and the birds recorded during the wintering bird surveys, the following SPA bird species shall be considered in the assessment:

- Cormorant Phalacrocorax carbo
- Black-headed Gull Chroicocephalus ridibundus

Conservation Objectives

The overall Conservation Objectives for the River Shannon and River Fergus Estuaries SPA is to maintain the favourable conservation condition of the Features of Interest for which the SPA has been selected (NPWS 2012c).

The favourable conservation status of a species is achieved 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, and
- 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.

The conservation objectives for birds of River Shannon and River Fergus Estuaries SPA are summarised in Table 3-5. .

Table 3-5 Conservation Objectives for non-breeding birds of River Shannon and River Fergus Estuaries SPA (NPWS 2012c)

Objective 1: To maintain the favourable conservation condition of the non-breeding waterbird Special Conservation Interest species listed for the River Shannon and River Fergus Estuaries SPA, which is defined by the following list of attributes and targets:			
Parameter	Attribute	Measure	Target

Objective 1: To maintain the favourable conservation condition of the non-breeding waterbird Special Conservation Interest species listed for the River Shannon and River Fergus Estuaries SPA, which is defined by the following list of attributes and targets:			
Population	Population Trend	Percentage change as per population trend assessment using waterbird count data collected through the Irish Wetland Bird Survey and other surveys	The long-term population trend should be stable or increasing
Range	Distribution	Range, timing or intensity of use of areas used by waterbirds, as determined by regular low tide and other waterbird surveys	There should be no significant decrease in the range, timing or intensity of use of areas by the waterbird species of Special Conservation Interest other than that occurring from natural patterns of variation
Objective 2: To maintain the favourable conservation condition of the wetland habitat at the River Shannon and River Fergus Estuaries SPA as a resource for the regularly-occurring migratory waterbirds that utilise it, which is defined by the following list of attributes and targets:			
Parameter	Attribute	Measure	Target
Area	Wetland habitat	Area (Ha)	The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 32,261 Ha, other than that occurring from natural patterns of variation.

Site Vulnerabilities

Identified negative threats and pressures on the River Shannon and River Fergus Estuaries SPA are listed in Table 3-6.

Table 3-6: Threats and pressures to River Shannon and River Fergus Estuaries SPA (NPWS, 2017b)

Code	Threat or pressure	Ranking and Location
E02	Industrial or commercial areas	H, o
G01.01	Nautical sports	M, i
E03	Discharges	H, i
D03.02	Shipping lanes	M, i
A08	Fertilisation	H, o
F01	Marine and Freshwater Aquaculture	M, i
E01	Urbanised areas, human habitation	H, o
Location: i = inside, o = outside, b = both Rank: H = high, M = medium, L = low		

3.2.3 Lough Derg (Shannon) SPA

This European Site is located 10km south of the proposed FRS. Lough Derg is of importance for both breeding and wintering birds. The islands in Lough Derg support important breeding colonies of Common Tern and Cormorants. The lake supports nationally important numbers of wintering birds Tufted Duck and Goldeneye.

Cormorant and Black-headed Gull were recorded during wintering bird surveys in Castleconnell, and this species may be associated with the SPA. This section of the Shannon may provide supporting habitat for these birds.

Disturbance impacts are expected to the QI bird's species as they are present.

The construction element is expected to have surface water impacts which may indirectly impact upon the QI birds.

Qualifying Interests

The site is designated for the following Qualifying Interests:

- Cormorant *Phalacrocorax carbo* [A017]
- Tufted Duck *Aythya fuligula* [A061]
- Goldeneye *Bucephala clangula* [A067]
- Common Tern *Sterna hirundo* [A193]

- Wetland and Waterbirds [A999]

Not all the qualifying features of the SPA occur in the Zone of Influence of the proposed works. Surveys have been conducted to determine the presence of QIs within the River Shannon at Castleconnell as outlined in Section 4. The qualifying features that could be potentially significantly impacted are:

- Cormorant *Phalacrocorax carbo* [A017]

3.3 Concluding Statement

Following this screening of the proposed Flood Relief Scheme in Castleconnell, Co. Limerick it can be concluded that likely significant effects are anticipated on the River Shannon SAC and the River Shannon, Lough Derg (Shannon) SPA and River Fergus Estuaries SPA.

It will therefore be necessary to carry out Stage 2 of Appropriate Assessment to determine whether the impacts would have a detrimental effect on site integrity, and if so whether the impacts can be avoided or reduced sufficiently to prevent any impacts.

4 Existing Environment- QI Habitats and Species

This section will summarise the baseline information pertaining to Annex Habitats and Species listed in the EU habitats and birds' directives which are QI features of the screened in SAC and SPAs.

Details of ecological surveys undertaken within the study area are described in Section 1.4.3

4.1 Habitats

Habitat types recorded within the study area are listed in Table 4-1. In this NIS, habitats associated with the Lower River Shannon SAC and Qualifying Interests are assessed only, all other habitats are assessed in the Biodiversity Chapter of the EIAR that accompanies this report.

The table below also contains a heading section for Annex I habitats (associated with Natura 2000 sites) which are linked with specific Fossitt habitats via floral assemblage / quality and/or utilisation by QI faunal species identified from desktop data and/or field survey observations.

Table 4-1 Habitat types recorded in the study area linked to Annex habitats and Species

Fossitt Habitat & Code	Linked Annex Habitat & Species
Wet willow-alder-ash woodland WN6	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0
Riparian woodland WN5	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0
(Mixed) broadleaved woodland WD1	Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)91E0
Upland/eroding rivers FW1 – Cedarwood Stream	Pathway to SAC
Lowland/depositing rivers FW2 – River Shannon & Cloon Stream	Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation [3260] Sea Lamprey Petromyzon marinus [1095]

Fossitt Habitat & Code	Linked Annex Habitat & Species
	Brook Lamprey Lampetra planeri [1096] River Lamprey Lampetra fluviatilis () [1099] Salmon Salmo salar [1106] Lutra lutra (Otter) [1355] Cormorant Phalacrocorax carbo [A017] Black-headed Gull Chroicocephalus ridibundus [A179]
Drainage ditches FW4	Pathway to SAC

4.1.1 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. Details of Annex I habitat surveys and methodology is in Section 1.4.3.2 and details of surveys is included in Appendix B.

Two habitats listed under Annex I of the E.U. Habitats Directive have been recorded within the study area. 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 SAC and will be assessed in the EIAR.

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.

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.

The results of the surveys are described in the sections below.

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 4-1, the Annex I alluvial woodlands are further described in this section. 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 next to Cloon Stream.
- Alluvial Woodland 3- Emerging alluvial forests at Coolbane Woods.
- Affinity to Alluvial Woodland 1- located next to the Mall Road and Cloon Stream (between Island House and Maher's Pub).
- Instream river islands –surveyed in 2019 during initial scoping surveys. Habitat description and ground flora indicated this is Alluvial Forests 91E0.

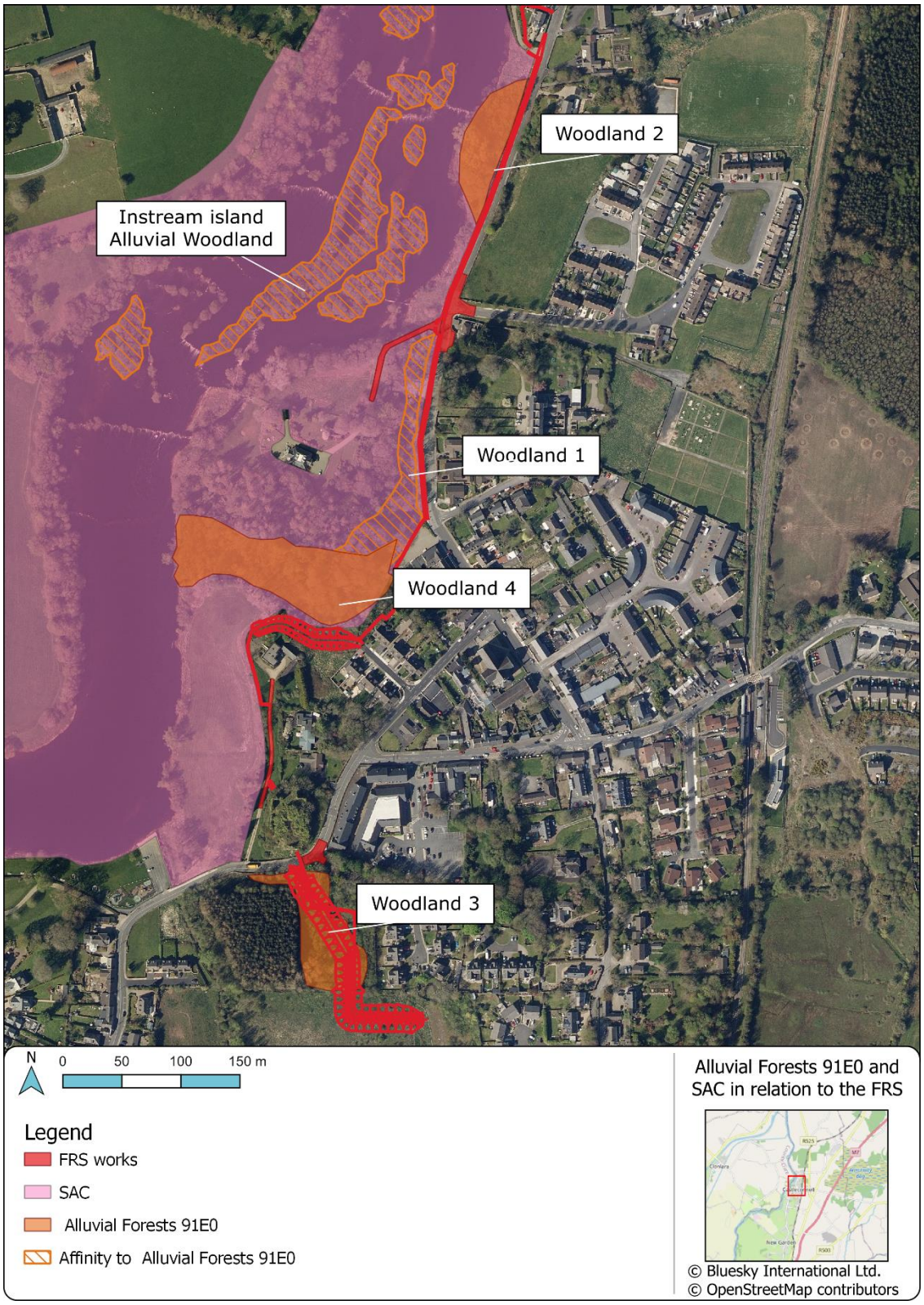

Figure 4-1 Alluvial Forest 91E0 mapped in the scheme area (woodland numbers correspond to survey report by Denyer Ecology, 2022).

Alluvial woodland 2 – Mall Road

This corresponds to riparian woodland and is a small area of woodland within the flood zone of the River Shannon. The canopy is dominated by Alder and the non-native willow species White Willow. Ash and Rusty Willow *Salix cinerea* subsp. *Oleifolia* are occasional and the hybrid *Salix x reichardtii* (Goat Willow *S. caprea* x Rusty Willow) was recorded. The ground flora is dominated by diverse wetland vegetation (Figure 4-2). In addition to the positive indicator species, the following are frequent: Hemlock Water-dropwort *Oenanthe crocata*, Great Willowherb *Epilobium hirsutum*, Water Horsetail *Equisetum fluviatile*. Giant Hogweed is occasional.

The area of this woodland is approximately 0.3 hectares in size.

Figure 4-2 Alluvial woodland 2 recorded in Castleconnell FRS study area beside Mall Road, corresponding to riparian woodland

Alluvial woodland 4 – Cloon Island/ Stormont House

The second area of alluvial woodland corresponds to wet willow-alder-ash woodland and is adjacent to the River Shannon and there is a river channel to the south which discharges into the River Shannon. This area was viewed from the south of this channel and partially accessed from the northern side. It was not possible to access the whole area due to the deep river channel and scrub. Whilst non-native tree species are present (e.g., Sycamore and conifers), Alder and Ash are also locally frequent, and the ground flora is dominated by wet woodland species (Figure 4-3). The woodland grades into affinity alluvial woodland (WD1 Mixed broadleaved woodland) to the east and contains some areas of non-alluvial woodland.

The area of this woodland is approximately 0.9 hectares in size.

Figure 4-3 Alluvial woodland 4 recorded around the Cloon Stream at Island House & Stormont House; corresponding to wet willow-alder-ash woodland

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 (Figure 4-4) 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. (Denyer Ecology 2022). The area of this woodland is approximately 0.4 hectares in size.

Figure 4-4 Alluvial woodland 3 at Coolbane Woods; corresponding to wet willow-alder-ash woodland

Affinity to Alluvial woodland 1 [WD1 – Mixed broadleaved woodland]
An area of planted woodland in the grounds of a house was identified as having an affinity to alluvial woodland. There is at least one stream channel within the woodland which discharges to the River Shannon. The canopy is dominated by non-native tree species Sycamore and Beech, which are not typical of 91E0. However, in some areas the ground flora has affinity to 91E0 alluvial woodland due to the proximity to the stream and probably winter flooding (Figure 4-5). Non-native species in the ground flora include locally abundant Ground-elder *Aegopodium podagraria*, occasional Giant Hogweed, Snowberry and Winter Heliotrope Petasites pyrenaicus. (Denyer Ecology 2022).The area of this woodland is approximately 0.4 hectares in size.

Figure 4-5 Affinity to alluvial woodland recorded in Castleconnell FRS study area between Island House entrance and Maher's Pub along the Cloon Stream, mixed broadleaved woodland with areas of indicator ground flora

Alluvial Forests 91E0 on Islands – Riparian woodland WN5

Several stands of riparian woodland occur across on in-stream islands in the River Shannon which corresponds to the priority Annex I habitat alluvial woodlands [91E0].

The canopies of these woodlands are often dominated by tree species such as Alder, willow species such as Grey Willow *Salix cinerea* and Crack-willow *Salix x fragilis*, Sycamore and Ash. The ground flora is dominated by Ivy and Nettle; other species include Dock *Rumex* spp., Wood Avens, Yellow Iris, Brome, Cock's-foot and Broad-leaved Helleborine *Epipactis helleborine*.

The woodlands on the Islands were not included in the Annex I habitat survey carried out by Denyer Ecology, as they are not directly affected by the proposed scheme. These islands were surveyed by JBA in 2019. However, the islands and other wooded areas on the banks of the River Shannon at Castleconnell can be considered Annex I Alluvial Woodland 91E0 (Figure 4-6).

Figure 4-6 Example of riparian woodlands recorded on islands within the River Shannon

Floating River vegetation [3260]

The Annex I habitat Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' habitat is designated (QI) within the Lower River Shannon SAC.

During the aquatic survey *Ranunculus*, *Potamogeton* spp. And *Fontinalis antipyretica* were identified. While 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 (Ecofact, 2021).

The protected habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation 'was not recorded on the River Shannon at Castleconnell during the aquatic habitat survey, however this habitat is known to be present just outside the survey boundary, approximately 20m upstream the outfall Conway's Canal, as previously recorded by AECOM ecologists in 2019 (AECOM, 2019). During the survey *Ranunculus*, *Potamogeton* spp. And *Fontinalis antipyretica* were regularly recorded. While *these* species are components of the Annex II 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' habitat, high levels of siltation, filamentous algae and these areas being very localized with high proportion of *Potamogeton* spp.

Means that these areas are not considered to represent this Annex I habitat. Water flowing through the canal is not hydrologically connected to water flowing past Castleconnell.

Full descriptions of encountered habitats and floral assemblages are described in the aquatic baseline report (Appendix F)

Therefore, this habitat was found to not be present in the study area or downstream and is not expected to be impacted.

4.2 Surface Waterbodies within the Scheme Study Area

There are many waterbodies present in the FRS scheme area including the River Shannon (Figure 4-7), as well as three streams. Descriptions of these waterbodies are included as they connect with the Lower River Shannon SAC and contain QI species.

Figure 4-7 Surface waterbodies recorded within the Castleconnell FRS study area

4.2.1 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 stream banks were steep (Figure 4-8). No aquatic vegetation was observed in-stream. This river drains into the SAC.

Figure 4-8 Cedarwood stream is culverted many times, with last culvert at Grange House near where it joins with River Shannon

4.2.2 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 through which flow of water that travels through a headrace towards the Ardnacrusha Hydroelectric station. 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.

Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]' was not recorded at any of the in-stream fisheries survey sites (Ecofact, 2020). It is likely that the background unsatisfactory water quality, channel modifications, and the severe river regulation has made conditions generally unsustainable for this annex habitat.

Annex I habitats Alluvial Forests [91E0] are present on the island and edges of the River Shannon in Castleconnell (Figure 4-9).

Figure 4-9 River Shannon next to proposed scheme

4.2.3 Cloon Stream – Lowland/depositing rivers FW2

The Cloon stream is a side tributary of the River Shannon, which forms Cloon Island (Figure 4-10). This stream is within the Lower River Shannon SAC. 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. The woodlands around the Cloon Stream have been classified as Annex I Alluvial Forests 91E0 and affinity to 91E0 and are located within the SAC (Figure 4-11).

Additionally, River / Brook Lamprey and Sea Lamprey were recorded in the stream during the fisheries surveys. No salmon were recorded in the stream.

Figure 4-10 Cloon Stream – View from causeway at Island House

Figure 4-11 View of Cloon Stream from Maher's Pub Car Park in Winter in normal water conditions (above) and in flood (below)

4.2.4 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 (and SAC) 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 connects with this stream also.

4.2.5 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, however in 2023 this has recently been excavated (Figure 4-12).

Figure 4-12: Drainage ditches in proximity to Coolbane woods

4.3 Protected Fauna (Annex Species)/ QI Features

4.3.1 Desktop survey data

A search was made in National Biodiversity Data Centre (NBDC) records for protected species within 5km of the scheme (full details in Appendix A).

The following species of Qualifying Interest for Screened-in Natura 2000 sites have been recorded in the NBDC database within 5km of the study area:

- European Otter *Lutra lutra*
- Black-headed Gull *Chroicocephalus ridibundus*
- Curlew *Numenius arquata*
- Golden Plover *Pluvialis apricaria*
- Cormorant *Phalacrocorax carbo*
- Lapwing *Vanellus vanellus*
- Whooper Swan *Cygnus cygnus*

Sea Lamprey Petromyzon marinus, a QI species of the Lower River Shannon SAC, has been historically recorded in the stretches of the River Shannon within the study area (records obtained from a sensitive data request from NPWS). These records date as recently as 1995.

These desktop results have been incorporated into the surveys for this Scheme, as detailed in the sections below.

4.3.2 Bird surveys

Wintering bird surveys, breeding bird surveys and checks for active heron nests were conducted from 2019 to 2023. The surveys conducted are included in the table below. Details of bird surveys and methodology is in Section 1.4.3.3 and details of surveys is included in Appendix C.

Qualifying Interest bird records

Cormorant and Black headed Gull are Qualifying Interest features of the River Shannon and River Fergus Estuaries SPA and Lough Derg (Shannon) SPA. Both species were recorded as present in the River Shannon at Castleconnell during the surveys.

Cormorant

Cormorant 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.

A maximum count of eight birds was recorded during the winter bird surveys. Long term trends on a national scale indicate an increasing population, with I-WeBS counts on the Shannon with highs of 66 individuals, and highs of 328 on the Shannon and Fergus estuary (Kennedy et al. 2022).

Black-headed gull

Black-headed gull, a QI of the SPA, were observed to congregate and feed around the Ferry Playground on the amenity grassland, and also in the River Shannon in this area. Black headed gull was observed flying overhead, feeding and resting around the River Shannon. Based on bird surveys and best scientific judgement it is considered that these birds could be part of the populations of wintering waterbirds

which are Qis of the River Shannon and River Fergus SPA and / or Lough Derg (Shannon) SPA.

A maximum count of 39 birds in a single flock flying over was recorded during the winter bird surveys. I-WeBS counts on the Shannon have highs of 225 individuals, and highs of 1484 on the Shannon and Fergus estuary (I-WeBS 2022).

Wintering Black-Headed Gulls were not recorded roosting along the zone of works for the scheme. In winter the birds are likely to be foraging on land. The area covered by the scheme does not present suitable foraging or roosting habitat. Gulls also habituate to the presence of people and machinery and may show fewer signs of disturbance.

The field between Stormont house and the River Shannon may present suitable foraging habitat for the birds. This was confirmed during the 2024 wintering bird surveys, where in flood conditions, Mallard and Greylag geese were roosting and foraging in this meadow.

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.

4.3.3 Otter

Otter *Lutra lutra* is a Qualifying interest of the Lower River Shannon SAC. Details of Mammal surveys and methodology is in Section 0 and details of surveys is included in Appendix D.

A potential otter holt was observed on the right bank of the river in 2019 and otter have been observed feeding in the Shannon during the wintering bird surveys on 13 February 2020. Otter spraints have been recorded along the River Shannon in many locations. 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.

The Otter Survey of Ireland 2004/2005 indicated that Otters were present in 70.53% of sites in the Shannon River Basin District (which included some sites in the vicinity of Castleconnell), compared to 100% from the surveys in 1980/81 (Bailey & Rochford, 2006).

Survey of Cloon Stream – Trail camera surveys 2023
In 2019 & 2020, Otter spraint was recorded on the Island House causeway over the Cloon stream. As the proposed FRS will be located close to 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.

Through January to August 2023, signs of otter were also searched for while the vegetation was low in the winter, such as prints, slides, couches, dens, and spraints.

No signs of otter have been observed around the Cloon Stream downstream of the Island House causeway. Details of these surveys is located in Appendix D.

Otter was not recorded from any of the 6 cameras.

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.

4.3.4 Aquatic Ecology Surveys

Baseline aquatic ecology surveys and a desktop assessment of aquatic ecology was carried out by Sub-consultants Ecofact in August 2021. Details of Fisheries surveys and methodology is in Section 0 and details of surveys is included in Appendix F. A preliminary desktop study gathered information from available online databases/ published documents which informed the field survey effort. Field surveys included an aquatic habitat survey, aquatic macroinvertebrate survey, and electrofishing surveys of general fish stocks (including salmonids) and specific electrofishing efforts to assess juvenile Lamprey presence. Six survey sites were selected in the River Shannon between Doonass Bridge to the south of Castleconnell to an area known as 'Pa's Gap' to the north of Castleconnell. The following sections summarises the findings of the aquatic survey report.

Sea Lamprey *Petromyzon marinus*, River Lamprey, Brook Lamprey *Lampetra planeri*, River Lamprey *Lampetra fluviatilis*, and Salmon *Salmo salar* are all Annex II species, Qis of the Lower River Shannon SAC and are known to be present within the reach of the River Shannon at Castleconnell

Aquatic Fauna

The survey reach was separated into six survey areas. One general fish survey, one kick sampling survey and three juvenile Lamprey surveys were conducted at each survey area. General fish surveys followed standard 5-minute electrical fishing techniques. Separate juvenile Lamprey surveys were carried out using specific electric fishing techniques at three 1 sq. m habitat patches where available. All fisheries surveys were conducted under authorisation from the Department of Environment, Climate and Communications under Section 14 of the Fisheries (Consolidation) Act (1959). A full description of the survey methods, the best practice guidance that was followed and results is described in Appendix F. A map of the survey areas with results is shown in Figure 4-13 overleaf.

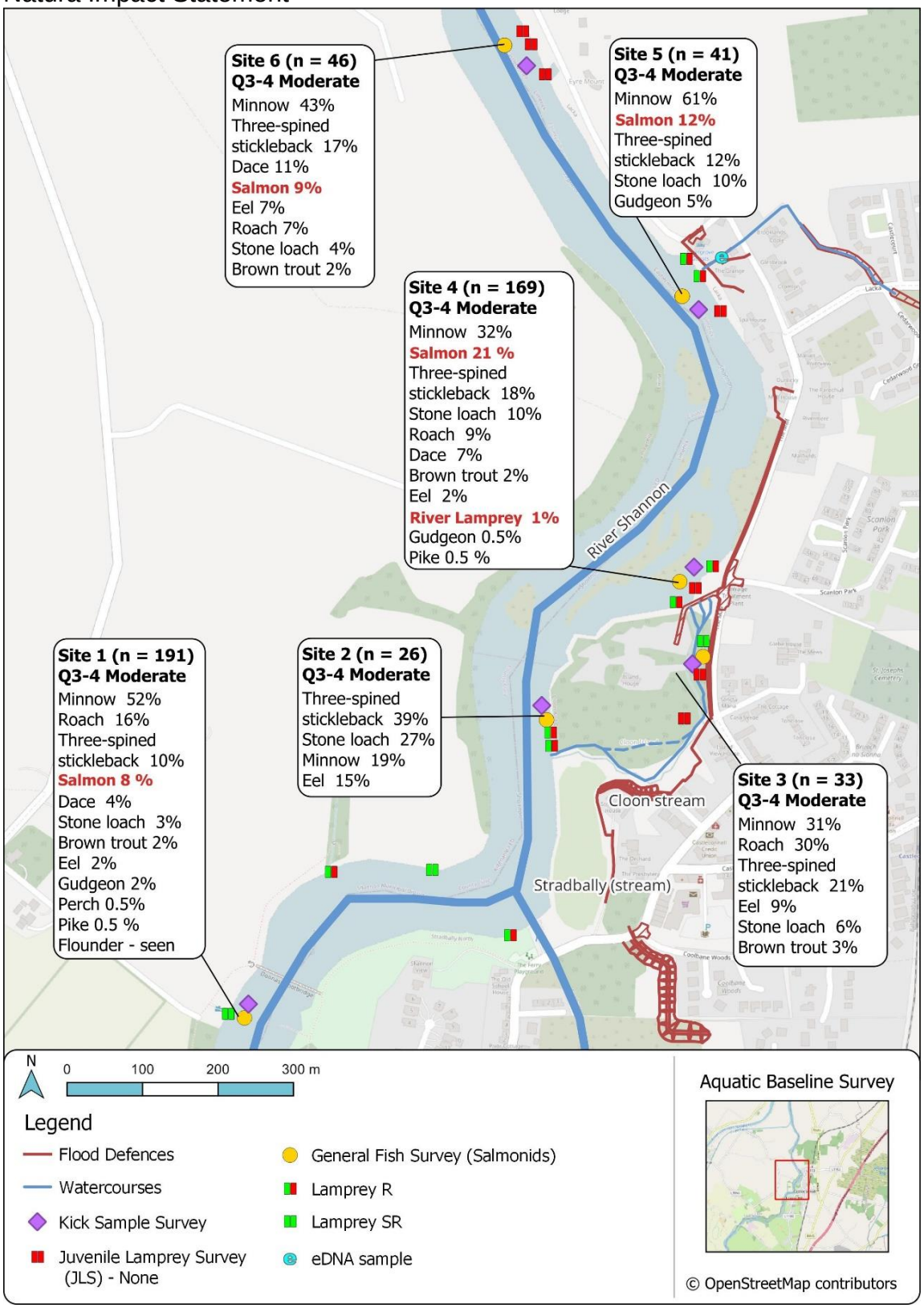

Figure 4-13: Map of aquatic fauna baseline surveys, with recorded Qis of the Lower River Shannon highlighted in yellow

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 77nswer7777*
- Flounder *Platichthys flesus*
- Perch *Perca fluviatilis*
- Pike *Esox 77nswer*
- 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. 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.

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. An outbreak of crayfish plague occurred in the River Maigue in 2017 (LCCC 2022).

The results of these surveys are broken down for each survey area in Table 4-2 overleaf.

Table 4-2: Results of aquatic baseline surveys at each site

Site	Location	Results of electrofishing and macroinvertebrate study – QI species
Site 1	Doonass bridge (River Shannon)	16 Juvenile Atlantic Salmon 35 juvenile Lamprey 2 Sea Lamprey
Site 2	Castlelough / Ferry playground (River Shannon)	No salmonids 11 juvenile Lamprey
Site 3	Cloon Stream	No salmon 4 juvenile Lamprey 1 juvenile Sea Lamprey
Site 4	In River Shannon at Elvers	169 individual fish recorded, comprising of 11 species. 35 Salmon 2 River Lamprey 16 juvenile Lamprey
Site 5	Main River Shannon beside River Grove house	Salmon 13 juvenile Lamprey
Site 6	Pa's Gap (main River Shannon)	Salmon No juvenile Lamprey recorded at Site 6.

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 with ELVs based on most recent available documents. 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. 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 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 area 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 floating river vegetation is also absent. (Ecofact Environmental Consultants 2021)

4.3.5 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 (Figure 4-14). An eDNA sample was taken from an open section of the stream between two culverts, the location of which is outlined in Figure 4-13 above.

Details of eDNA analysis and methodology is in Section 0 and details of results is included in Appendix G.

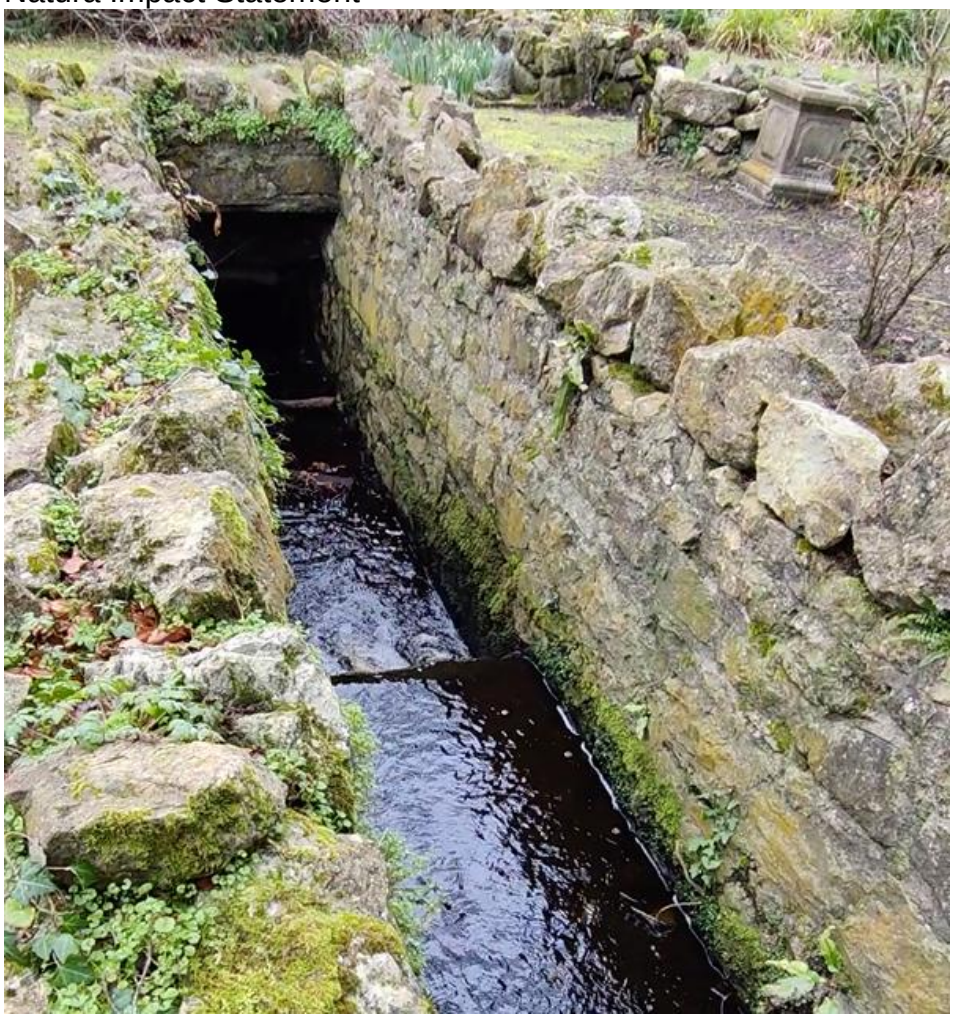

Figure 4-14: Cedarwood Stream, location of eDNA sample.

4.3.6 Cedarwood culvert fish passability analysis

A general desktop passability assessment has been undertaken 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 (2022)Design Guidance For Fish Passage On Small Barriers.

The existing double culvert and weir system 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 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 approximately 0.4m from water level. Another cylindrical culvert (culvert B) is present for approximately 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 presence in the stream was recorded.

4.4 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 A.2. These were sourced from the National Biodiversity Data Centre's biodiversity maps and databases. 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* and Giant Hogweed *Heracleum mantegazzianum* and Zebra Mussel *Dreissena polymorpha*. Quagga mussel *Dreissena bugensis* may also be present in the reaches around Castleconnell.

ESB (2020) 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 2020). 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 (ESB 2020).

4.4.1 3rd Schedule Invasive species

Invasive species were initially recorded in 2019/2020 when surveys began. Third Schedule invasive species including Giant Hogweed (Figure 4-15), Indian Balsam *Impatiens glandulifera* and Zebra Mussel (Figure 4-16) were recorded during ecological site surveys at this time (Figure 4-17). Indian balsam was only noted in the hedges and ditches along Belmont Road which is no longer part of the scheme study area.

Giant Hogweed

There is 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 indication 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 4-15 Giant Hogweed recorded in the riparian vegetation of the River Shannon

Zebra Mussel

Zebra Mussel *Dreissena polymorpha* was recorded at two places in 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 (Ecofact, 2021). 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. 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.

Figure 4-16 Zebra Mussel shells found in the main River Shannon

4.4.2 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 anoma*la (2009) and the Asian Clam *Corbicula fluminea* (2011). As previously noted, the invasive Common Carp was 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.

Figure 4-17 3rd Schedule invasive species recorded within the study area

5 Other Plans and Projects within the study area

This chapter provides a summary of projects in the planning system. The cumulative effects of the proposed development in combination with other relevant existing, planned and permitted projects will be 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. Figure 5-1and Table 5-1 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 and the Screened-in Natura 2000 sites.

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.

None of the associated Environmental reports of the projects 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

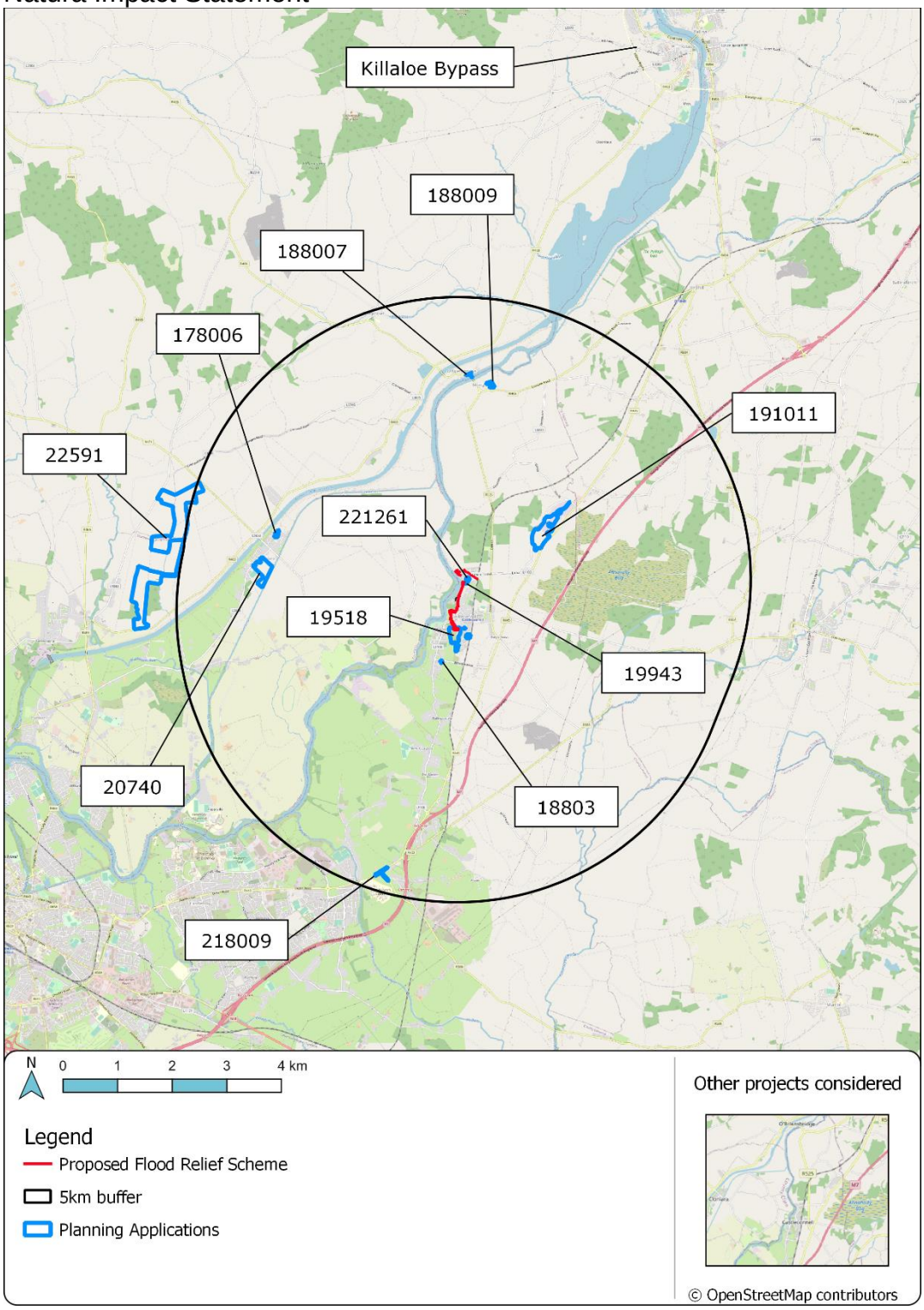

Figure 5-1 Other projects considered

Table 5-1 List of projects considered for cumulative impacts

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 as of October 2023, likely to continue into 2026
178006	Knockbrack Lower, Cloonlara Townland, Clonlara	for the construction of 9 no. dwelling houses with access road, public lighting and all associated ancillary site development works	Permission granted 08/01/2018
188003	St. Patrick's Villas, Stradbally North, Castleconnell Co. Limerick.	(I) provision of 4 no. residential units (3 no. 3 bedroom houses and 1 no. 4 bedroom house (universally accessible unit), (ii) hard landscaping including replacement of existing footpaths, new entranceways, boundary treatments and boundary walls, (iii) upgrading and re-routing of foul sewers and surface water drainage and (iv) all associated site works	Permission granted 13/06/2018

Project name or Reg. Ref.	Location	Description	Status
188007	O'Briensbridge, Co. Clare	for the following development: O'Briens Bridge is a Protected Structure (RPS No. 215) located in the Village O'Briensbridge and carries Regional Road R466 across the River Shannon into Montpelier, Co. Limerick. The trailhead for the Loop Walks is located in the Riverside Park. The walkway under the bridge is closed off at present on safety grounds and the proposed development will allow it to be reopened. The proposed development shall include the following works: 1. Construction of structures on the riverside walk upstream and downstream of O'Brien's Bridge to provide protection from falling masonry from the parapet walls above. The bridge had been struck by 'ehicl's and dislodged masonry had fallen onto the walkwa' belo'. The structures will provide canopies over the walkwa' for ' short distance. 2) Repairs to the surface of the riverside walk in the vicinity of the proposed structures. 3) Provision of traffic signals which will limit traffic to one direction at a time over the bridge. 4) Provision of a traffic detection system consisting of ducting, chambers and loops on the road surface approaching the bridge. 5)Provision of all necessary signs and road markings	Permission granted 09/07/2018
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	Permission granted 02/04/2020. Expires 01/04/2025

Project name or Reg. Ref.	Location	Description	Status
		agricultural use. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) accompany this planning application	
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. Current programme suggests completion in April 2024 (as advised by Torca Homes)
198009	Brookhaven, Montpelier, Co. Limerick.	(a) provision of 12 no. residential units comprising; 3 no. single storey 2-bedroom dwellings; 4 no. two storey 2 bedroom dwellings, 5 no. two storey 3 bedroom dwellings; (b) hard landscaping including roads, footpaths, parking, garden walls, and public lighting; (c) soft landscaping including lawns, trees and hedgerows; (d) provision of new water connections, a foul sewer connection, and a surface water drainage system; (e0 all associated site works	Permission granted 12/12/2019

Project name or Reg. Ref.	Location	Description	Status
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
211348	"The Lodge", Coolbawn, Castleconnell Co. Limerick	the construction of a new single storey family room to the northwest (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.	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,	Permission granted 29/12/2021.

Project name or Reg. Ref.	Location	Description	Status
	Limerick.	improved road markings, new traffic signal control, signage and carriageway resurfacing	
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
22394	Coolbawn Meadows, Coolreiry, Castleconnell Co. Limerick	the construction of 13 houses, which include 1 detached & 12 semi-detached (numbers 18-26 & 29-32), as partial completion of the development approved under planning file reference. p.06/1354 and associated site works	Permission granted 27/10/2022. Expires 26/10/2027 Under construction, likely to be complete before the proposed scheme begins construction

Project name or Reg. Ref.	Location	Description	Status
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	Appealed to ABP. Decision due 17/07/2023
2360808	Coolbawn Meadows, Castleconnell	Montpelier Coolbawn Developments Limited seeks planning permission for development at Coolbane, Castleconnell, Co. Limerick. The development comprises 74 no. residential units comprising: 20 no. 4 bed detached units; 12 no. 4 bed semi-detached units; 18 no. 2 bed terrace units; 6 no. 3 bed terrace units; and 18 no. 3 bed semi-detached units • new estate link road with dedicated cycle lane as an extension to the existing access road serving Coolbawn Estate; • off and on street car parking and bicycle stands; and • all associated site works	Pre-Validation Planning Submission lodged on 06/11/2023.

Project name or Reg. Ref.	Location	Description	Status
		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.	

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

6 Stage 2 Appropriate Assessment

As identified in the Stage 1 AA Screening report and screening summary of this report, it was considered that the proposed scheme could result in likely significant effects on the following Natura 2000 Sites:

- Lower River Shannon SAC
- River Shannon and River Fergus Estuaries SPA
- Lough Derg (Shannon) SPA

From the baseline and desktop surveys, the QI habitats and species present in the immediate surrounds of the proposed FRS, and therefore those likely to be impacted by the works are listed below.

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- Sea Lamprey *Petromyzon marinus* [1095]
- Brook Lamprey *Lampetra planeri* [1096]
- River Lamprey *Lampetra fluviatilis* [1099]
- Atlantic Salmon *Salmo salar*) [1106]
- Otter *Lutra lutra* [1355]

Wintering water birds, but in particular Cormorant *Phalacrocorax carbo* [A017] and Black-headed Gull *Chroicocephalus ridibundus* [A179]

6.1 Construction phase impacts

This section will assess all impacts in relation to the entire scheme and to specific locations of each section of the Flood Relief Scheme. The potential impacts upon each QI will be assessed 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 Maher's Pub.
- Impacts at Meadowbrook Estate
- Impacts at Stormont Property
- Impacts at Coolbane Woods
- Impacts at Cedarwood Stream (at Cedarwood Grove)

6.1.1 Impacts over entire scheme

Some impacts will not be location specific and will potentially impact upon certain QIs throughout the construction phase.

This mainly is related to disturbance and noise impacts, introduction and spread of invasive species, and release of dust and emissions during construction.

Disturbance impacts to Otter (*Lutra lutra*) [1355]

Construction works along the boundary of the Lower River Shannon SAC will generate noise and disturbance as a result of machinery operation and workforce movement during the 18-month construction phase of the project.

Otter, a QI of the Lower River Shannon SAC, has been observed in the main channel. Surveys were carried out from 2022 to 2023 to determine if Otter is present and/or using the Cloon Stream around Island House, and no evidence was found. However, using the precautionary principle, it is likely otter may occasionally commute or forage through the Cloon Stream, but no resting place was found in this area. As the area around Cloon Stream is very overgrown and inaccessible, and a large amount of the scheme is scheduled in here, between the writing of this report and the date of construction (currently scheduled in 2025), otter may be using this area. Therefore, mitigation measures are required to assess the use of the stream by otter within 6 months prior to construction. This is further detailed in the Mitigation section below.

There was a possible holt found on the opposite (left) bank of the River Shannon from where works are proposed (140m away). This is hidden from view by the islands in the main river and the works areas are deemed not close enough for visible to impact any otters that may be using this area. It is not anticipated that otter will be disturbed by noise impacts as the works are being undertaken along a busy village / built environment, and screening from trees will reduce noise disturbance.

Otter that are feeding and commuting up and down the River Shannon at Castleconnell may be disturbed by machinery noise and increased presence of humans and machinery during construction over the 18 months. This may lower their preference to hunt and move past the area of construction. However, the River Shannon is approximately 100m wide with high vegetation cover from the instream island and otter can use the quiet, undeveloped right bank to move through the water and on land. It is not expected the construction works will prevent otter accessing any suitable habitat and/or moving/commuting to and from any watercourses other than the Cloon stream as described above.

Therefore, no significant adverse impacts from disturbance to otters using the River Shannon are anticipated from the construction of the proposed scheme.

Disturbance Impacts to QI birds

Winter and Breeding bird surveys carried out between 2019 and 2023 revealed the presence of a number of bird species using the River Shannon and surrounds in Castleconnell, including two QI birds of the neighbouring SPAs: Cormorant *Phalacrocorax carbo* [A017] and Black-headed Gull *Chroicocephalus ridibundus* [A179].

Black-headed Gull were observed congregating and feeding around the Ferry Playground on the amenity grassland, and also in the River Shannon in this area. They were also observed flying over. Cormorant were observed flying overhead, feeding, and resting around the River Shannon. Based on bird surveys and best scientific judgement it is considered that these birds could be part of the wintering waterbirds populations of the River Shannon and River Fergus SPA and / or Lough Derg (Shannon) SPA.

Construction works along the boundary of the Lower River Shannon SAC will generate noise and disturbance as a result of machinery operation and workforce movement during the 18-month construction phase of the project. These two QI birds may be impacted by the construction of the FRS through noise, disturbance and general increase in human presence and machinery.

Any work within 50m of Black-headed gull and work within 100m of Cormorant will cause disturbance (distances based on Ryan Hanley (2014). The works to be carried out will be along the left bank of the River Shannon and will not directly be related to the habitat the birds use. The works between Rivergrove B&B and Maher's Pub will mainly be buffered by extensive vegetation, and vegetated islands. Furthermore, over 100m north of Rivergrove B&B, rocky outcrops in the river provide resting spots for the birds, ensuring that they have sufficient resting place if disturbed during construction.

Embankment works along from Stormont House will be partly sheltered by light bank vegetation. The embankment itself will be approximately 60m from the water's edge, leaving half the width of the river beyond the disturbance distance.

The Black-headed Gulls were recorded at the southern end of the scheme. Disturbance would be as result of works on the embankment along from Stormont House. Birds using the grassland between Stormont House and the River Shannon would likely be displaced, however the large amount of grassland available on the right bank would provide some temporary displacement habitat. The birds were also recorded around the Ferry playground which is more than 50m away from any construction works. It is not expected the construction works will prevent birds

accessing any suitable habitat and/or moving/commuting to and from any watercourses other than the Cloon stream as described above.

Therefore, no adverse impact to these QI birds is anticipated from disturbance, due to the large receiving environment around the River Shannon that will not be disturbed by the works.

Noise and Vibrations impacts on fish (QIs Sea Lamprey, [1095], Brook Lamprey [1096], River Lamprey [1099] and Salmon [1106]).

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.

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 with swim bladders 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.

Lamprey do not have a swim bladder and have a rudimentary method of hearing which is not particularly sensitive to vibrations. Salmonids (and other species such as cyprinids and Eel) have more complex hearing, these species also possess a swim bladder, although it is not directly connected to the inner ear. Popper et al., 2014 consider species like Salmon as a medium sensitivity species while Lamprey are considered a low sensitivity species.

The impact of sound on fish species in summarised in a technical assessment published by AECOM (2021), which reviews guidelines published by American National Standards Institute (ANSI) (Popper et al. 2014).

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 6-1). 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 6-1: 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	**213dBpeak 219dB SELcum**	**213dBpeak 216dB SELcum**	186dB SELcum	**(N) High (I) Moderate (F) Low**
Medium e.g., Atlantic Salmon	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 Chapter 4 EIAR Noise survey). These sound levels are not exceptionally high and will be temporary in nature. Therefore, no adverse impacts on the QI Atlantic Salmon or the three QI Lamprey Species are expected from noise or vibration.

Dust & emissions

A separate Air Quality report has been carried out for the EIAR (Construction Impacts Chapter 4). 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 also a potential impact that any dust settling in the river or watercourses could introduce pollutants which could impact QI Fish species.

Construction impact for dust has been calculated medium to high risk due to the sensitive ecological receptors that located next to the works. Therefore, mitigation measures are required, which are outlined in Chapter 4 of the EIAR, but a summary is included in the Chapter 7 of this report.

Once operational, no air and climate impacts are expected for this Scheme.

Invasive Non-native Species

Invasive Non-native Species (INNS) have the potential to spread and be introduced during construction works across the entire scheme and impact on habitats including Annex I Alluvial Forest [91E0] habitat. There is also a potential for new INNS to be introduced from machinery, people etc.

Invasive species present within the construction area include Giant Hogweed. Zebra Mussel was found instream during the surveys carried out in the River Shannon; however, none were observed close to the banks or along the Cloon Stream.

The above species are Third Schedule 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 these invasive species. and due diligence must be given to work methods in the vicinity of these invasive non-native species during construction.

Sycamore *Acer pseudoplatanus* is also listed as an impactful non-native species to Alluvial forests and is present in the riparian edges.

Therefore, mitigation measures are required to control the spread of Giant Hogweed during construction of the scheme. General biosecurity measures will be required to ensure no further INNS are introduced.

Impact from Surface Water Upgrade Works

To manage surface water runoff during times of flooding when outfalls are surcharged, a series of high-level overflows will be constructed in select manholes to convey surface water to two temporary pump sumps (one in Maher's Pub car park and another in the lands at Coolbane Woods). A permanent pump will also be constructed at the Scanlon Park junction. In addition to this, alterations in terms of alignments and pipe sizes may be made to select surface water sewers across the study area to convey the necessary flows. This may include increase in pipe sizes, the introduction of sub-surface attenuation, the sealing of existing manholes and the upgrade of outfalls from the system in the Shannon and Cedarwood Stream. The extent of this intervention will be fully developed within the detailed design stage.

The majority of the works associated with the alterations to the existing surface water networks are outside the SAC. Works with the SAC boundary will occur to the upgrade of the existing outfall for the new pumping station at Scanlon Park, but This work is within Annex I habitats of the SAC. This will require mitigation, to protect water quality of the River Shannon SAC.

6.1.2 Impact assessment at Rivergrove B&B and Grange House

The flood relief works at the Rivergrove B&B and the Grange House (Figure 6-1) 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 gravel. 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. The proposed method for constructing the wall 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 and provided advice with regards to mitigation.

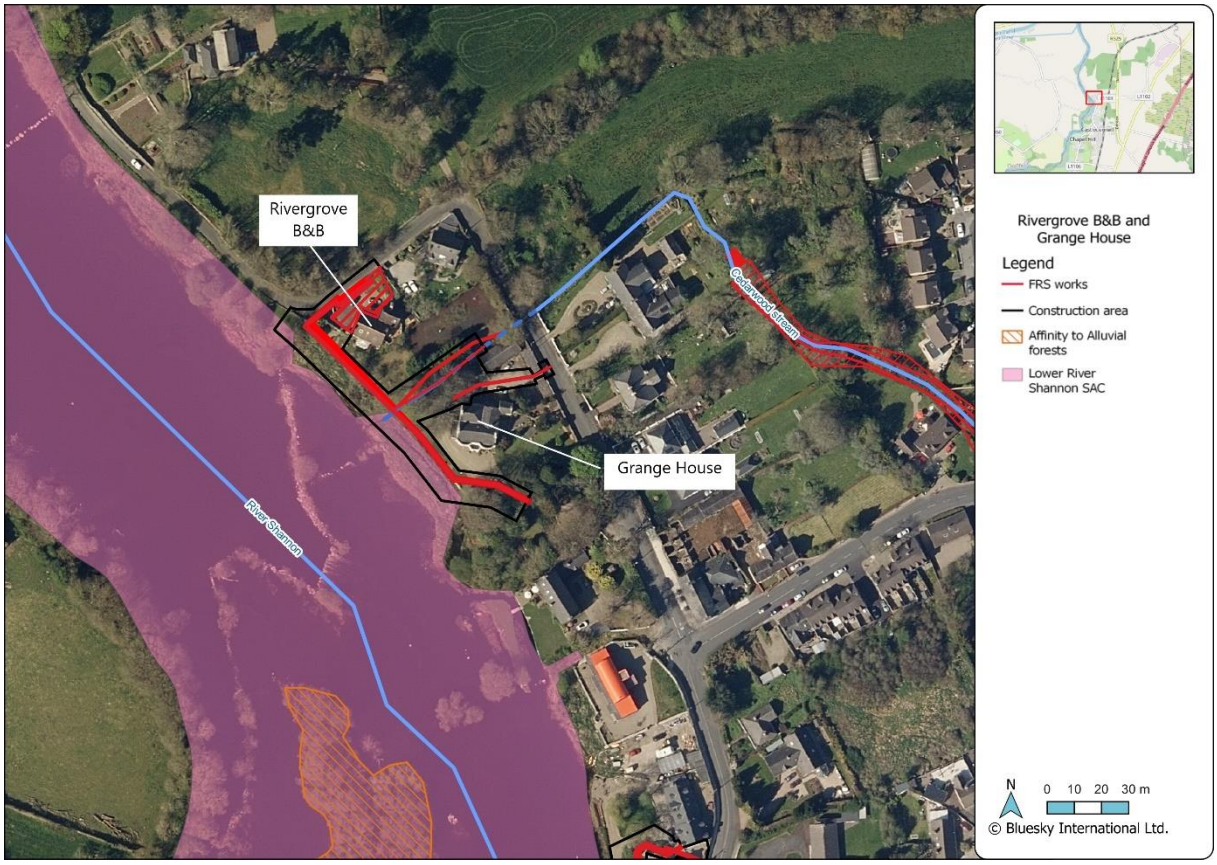

Figure 6-1 FRS works in proximity to Rivergrove B&B

Direct works in SAC boundary

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 and no permanent loss is expected within the SAC. It is anticipated that this is a temporary impact to construct the flood wall only.

Alluvial forests [91E0]

Alluvial woodland is located downstream of the works, in the instream islands (110m away) and the alluvial woodland beside the Mall Road (260m away). No direct impact on this habitat is anticipated.

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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

Release of sediment associated with the bankside and instream works may have an adverse impact on the three Lamprey species and Salmon. Fine silt can settle on Lamprey and Salmon breeding grounds which mainly consist of coarse gravels. 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 works to construct the wall will involve in-situ concrete. Cement within the concrete is highly toxic to Salmon and Lamprey species and can result in mortality where levels are concentrated. Accidental release of hydrocarbons associated with construction machinery can also result in mortality of these QIs.

Mitigation measures will be required to protect Fish QIs from release of pollutants into the watercourse at the River Shannon and Cedarwood Stream.

Cedarwood realignment: The open section of the Cedarwood Stream adjacent to the Mill Building will remain open, and a new culvert will be provided from the downstream point of this open section to outfall to the River Shannon through the proposed flood wall. In order to avoid removal of the open stream feature in the

garden, there will be a minor diversion of the Cedarwood Stream so that the new culvert is constructed to the north of the open stone feature. The discharge point for this culvert will remain the same to avoid any negative impacts on the receiving SAC and hydrophilous tall herb. A pumped water fountain type arrangement will be installed on the open feature to maintain the appearance and sound of flowing water. 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 stream feature.

The existing culvert at Cedarwood has low suitability for fish, with only Eel recorded. It is unlikely Salmon or Lamprey regularly use this stream as it is small, culverted except for 10m open section, and has several weirs. The existing culvert will be maintained for heritage reasons and will have a low level of water in it; however it will no longer be passable by fish. The diversion of the Cedarwood to a new 60m culvert is expected to have a neutral impact to the stream as it will functionally be similar to the existing baseline of the culvert. The new culvert may be designed in a more favourable way for fish passage.

Otter [1355], Cormorant [A017] and Black-headed Gull [A179]

Disturbance of otter and birds is possible but not expected to be significant (see Section 6.1.1.1 and 6.1.1.2).

Indirect impacts to Otter and Cormorant from reduced water quality could result in reduction of prey biomass, as described above for fish, are anticipated without mitigation.

6.1.3 Impact assessment at Mall House

The flood relief works at Mall House (Figure 6-2) 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 6-2 FRS works in proximity to Mall House

Direct works in SAC boundary

Construction access and temporary works will be required directly adjacent to the SAC from the existing built environment of the main road and driveways. No work or access within the riparian area of the SAC is required.

Alluvial forests [91E0]

Alluvial woodland is located 24m from the proposed works. No direct impacts on this habitat from the works around Mall house is anticipated.

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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

Flood wall alignment and construction will not take place instream. As discussed above 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 QIs from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Otter [1355], (Cormorant [A017] and Black-headed Gull [A179])

Disturbance of otter and birds is possible but not expected to be significant (see Section 6.1.1.1 and 6.1.1.2).

Indirect impacts to Otter and Cormorant from reduced water quality could result in reduction of prey biomass, as described above for fish, are anticipated without mitigation.

6.1.4 Impact assessment at Mall Road (phase 1) – Mall house to Island House

The flood relief works along the Mall Road (Figure 6-4) 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.

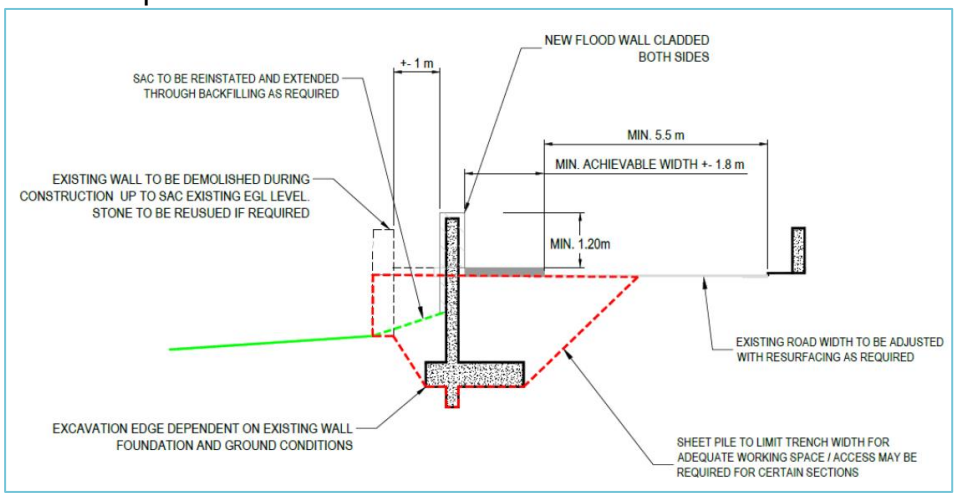

Figure 6-3: Proposed flood wall cross section, showing that it will be constructed within the road area and away from the riparian habitat and SAC

Figure 6-4 FRS works in proximity to Mall Road

Direct works in SAC boundary

Construction of the flood wall will be carried out along the boundary of the SAC The wall will be stepped back by 1.5m from the boundary to avoid damaging the Alluvial Forest adjacent to this area and the scheme has been designed to avoid this woodland and the roost of the trees up to the existing stone wall. The new wall will be outside of the SAC boundary. Construction area within the SAC is designed to be

kept to a minimum to avoid damage to the roots, there may be approximately 1-2m non-intrusive working area (works by hand only) within the river side of the wall. There is not expected to be a permanent loss of habitat.

Alluvial forests [91E0] (Woodland 2)
The proposed flood wall has been designed such that all of the foundation of the new wall will be located within existing built environment. The new flood wall will be stepped back into the roadside by 1.5metres to avoid permanently damaging the Alluvial Forest adjacent to this area. Construction impacts have also been designed to minimise construction area into the Annex I habitat.

No trees will be removed from the Alluvial woodland as there are currently no trees growing immediately adjacent to the wall. Ground flora vegetation in this area is less developed with species of Alluvial Woodland, next to the existing wall, and will likely re-establish quickly post-construction. The area required for construction has been designed to be the smallest footprint possible within this area. To construct the wall, a small construction area of 1m into the Alluvial woodland will be required but no excavation will occur in the woodland. The construction area will be non-intrusive works by hand only. The removal of the existing wall and build the new stepped-back flood wall will occur from the roadside. It is expected that the existing wall will be removed using hand tools, and no large machinery will enter the west side of the wall. The new flood wall excavations will be dug with machinery from the dry side on the Mall Road at all times. Therefore, no direct impacts are anticipated.

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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]
Similarly, to Mall House, the wall running along the Mall Road will not be constructed instream. There is potential for pollutants associated with surface water runoff to enter the River Shannon during the construction phase of the project, as well as potential for pollution events associated with hydrocarbons, all of which can have an adverse effect on the fish QIs. Mitigation measures will be required to protect fish QIs

from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Lightweight concrete will be cast to raise the access level 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 QIs of the Lower River Shannon SAC. Mitigation measures are required to protect water quality.

Otter [1355], (Cormorant [A017] and Black-headed Gull [A179])

Disturbance of otter and birds is possible but not expected to be significant (see Section 6.1.1.1 and 6.1.1.2).

Indirect impacts to Otter and Cormorant from reduced water quality could result in reduction of prey biomass, as described above for fish, are anticipated without mitigation.

6.1.5 Impact assessment at Mall Road (phase 2) - Scanlon Park Junction up to Maher's Pub.

The flood relief works along the Mall Road (Figure 6-5) 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.

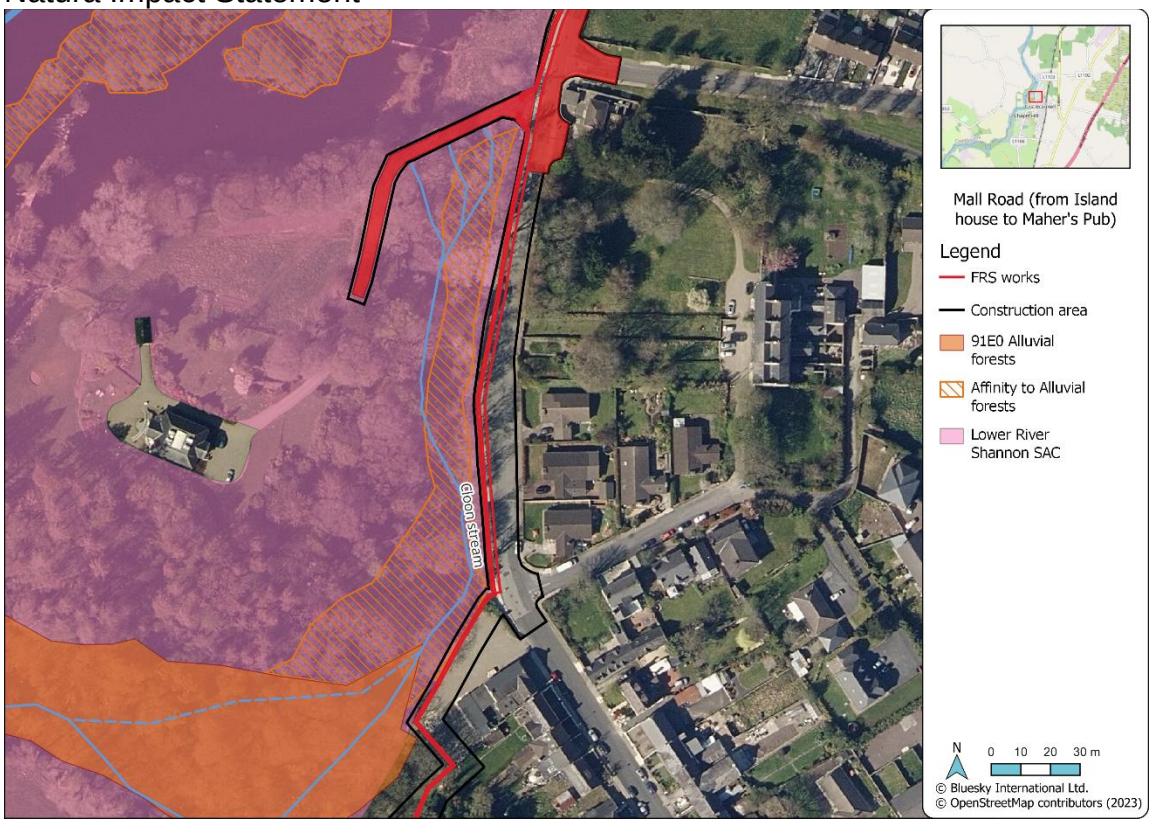

Figure 6-5 FRS works in proximity to the Mall Road

Direct works in SAC boundary

Construction of the flood wall will be carried out within the boundary of the SAC. Approximately 55m of the new flood wall will be constructed within 0.5m of the SAC boundary and the affinity Alluvial woodland from Island House southwards, due to narrowness of the road in this area. The rest of the new flood wall will be stepped back by 1.5m to avoid damaging the affinity to Alluvial Forest habitat adjacent to this area.

Construction area within the SAC is expected to be 1m into the SAC side of the wall.

Alluvial forests [91E0] (Affinity alluvial woodland 4)

At this location, the Annex I habitat present corresponded to Affinity to Alluvial Forests. This was categorised due to the domination by non-native tree species in the canopy, namely Sycamore and Beech, which are not typical of 91E0, but the ground flora has affinity to 91E0 alluvial woodland due to the proximity to the stream and influence of winter flooding. It is considered this habitat has the potential to be of a suitable structure and function of Alluvial Forests. Therefore, as this woodland is in the SAC and connects to Alluvial Forests, it will be treated as Annex I habitat.

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 southwards,

due to narrowness of the road in this area. This will result in removal of approximately 25 trees, notably a large white poplar tree (T092) which is in declining condition will need to be removed. Other trees and flora in this area was mostly non-native trees with understorey of cherry laurel and is not considered good quality alluvial woodland.

The construction of the rest of the new flood wall is similar to Mall road (phase 1). The proposed flood wall has been designed such that all of the foundation of the new wall will be located within existing built environment. The new flood wall will be stepped back into the roadside by 1.5metres to avoid permanently damaging the affinity to Alluvial Forest adjacent to this area.

The area required for construction has been designed to be the smallest footprint possible within this area. To construct the wall, a small construction area of 1m into the Alluvial woodland will be required but no excavation will occur in the woodland. The construction area will be non-intrusive works by hand only. The removal of the existing wall and build the new stepped-back flood wall will occur from the roadside. The existing wall will be removed using hand tools, and no large machinery will enter the SAC side of the wall. The new flood wall excavations will be dug with machinery from the dry side on the Mall Road at all times. Therefore, no direct impacts are anticipated.

It is expected some trees from this woodland will have to be removed to demolish the existing wall and construct the new stepped-back wall. Trees include sycamore and ash trees immediately adjacent to the existing wall. This will result in long-term loss of trees within this woodland however these trees are mostly of non-native origin, except for ash and alder present. Mitigation measures are required to ensure that permanent loss of this habitat is minimised.

Additionally, 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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

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 QIs from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Otter [1355]

The Cloon stream lies adjacent to the scheme at this area, approximately 7m away at the nearest point. Otter may be using the Cloon stream, but surveys along the stream indicated it is likely not an important habitat or commuting route for this mammal. However, as it is a suitable habitat for this species, mitigation measures will be required.

Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

Wintering water birds (Cormorant [A017] and Black-headed Gull [A179])

No impacts anticipated at this location.

6.1.6 Impact assessment at Maher's pub

The flood relief works at Maher's Pub (Figure 6-6) 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.

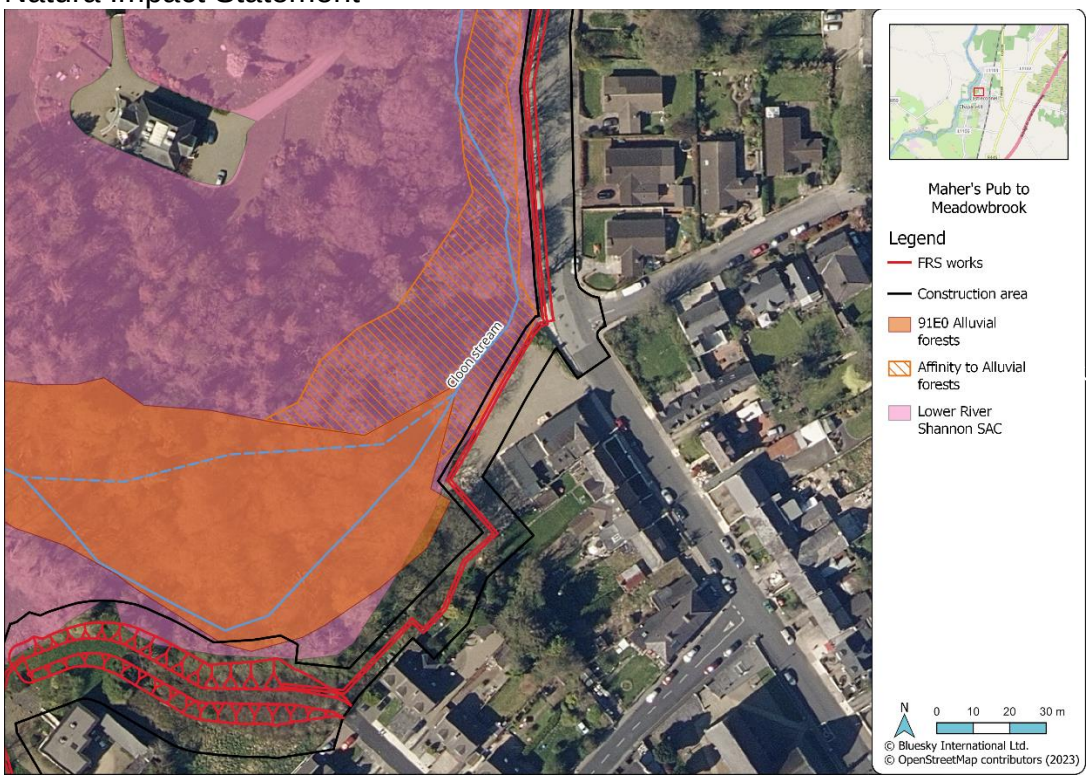

Figure 6-6 FRS works in proximity to Maher's Pub

Direct works in SAC boundary

Construction of the flood wall will be carried out adjacent to the SAC, where the proposed flood wall will be stepped back within the existing built ground of the car park to avoid building in the SAC. There is a 1-2metre drop behind the car park, below which can be considered Alluvial Forest 91E0 (Affinity to 91E0 is also present). No construction is expected within the SAC of the area where the Cloon Stream is present and will be kept within the built environment of the existing car park.

Alluvial forests [91E0]

At this location, the Annex I habitat present corresponded to both Alluvial forests and partially affinity to Alluvial Forests. The edge of Maher's Pub car park is a steep drop off and within this area can be considered Alluvial Forests 91E0.

The FRS wall proposed at the back of Maher's Pub, Meadowbrook and the embankment down to Stormont house, has been designed in such a way as to avoid impacts to the Alluvial Woodland that is present in this area.

Construction of the walls will be very restricted in space in this area, but the works will take place from the dry side at all times from Maher's pub, through the back of the garden of the house next door to the Maher's pub, and around the back to No 7 Meadowbrook. From No. 7 Meadowbrook to Stormont House, the embankment will also be constructed from the dry side, avoiding the Alluvial woodland (discussed in next section below). A large cedar tree with 4-5 heron nests is present here, the flood

wall has been designed to avoid this tree and Root Protection Area (RPA) will be installed to protect this tree from damage, during construction. The Alluvial woodland lies beyond this tree and therefore will be avoided. Therefore, no direct impacts are expected to the Alluvial Woodland at this point.

Sheet piling / cofferdam may be required due to the close proximity of the Cloon Stream to the SAC boundary. Any trees that are near this sheet piling may be impacted as a result of the roots being damaged. Only a few trees are present adjacent to Maher's car park, including Ash and Sycamore. This will require selective tree removal or RPA. Mitigation measures are required if this is undertaken. 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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

The construction of the flood walls at Maher's 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. Lamprey ammocoetes are known to be present within silt beds of the Cloon Stream. The construction of a cofferdam/sheet pilling could result in the disturbance of these juvenile lamprey as well as entrapment and mortality as a result. There is also a possibility of juvenile salmon 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.

As works will take place within or in close proximity to Cloon Stream, mitigation measures will be required to protect fish QIs from impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Otter [1355]

The Cloon stream lies adjacent to the scheme at this area, approximately 7m away at the nearest point. Otter may be using the Cloon stream, but surveys along the stream indicated it is likely not an important habitat or commuting route for this mammal.

However, as it is a suitable habitat for this species, mitigation measures will be required.

Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

Wintering water birds (Cormorant [A017] and Black-headed Gull [A179])

No impacts anticipated at this location.

6.1.7 Impact assessment at Meadowbrook Estate

The flood relief works at Meadowbrook estate (Figure 6-7) 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.

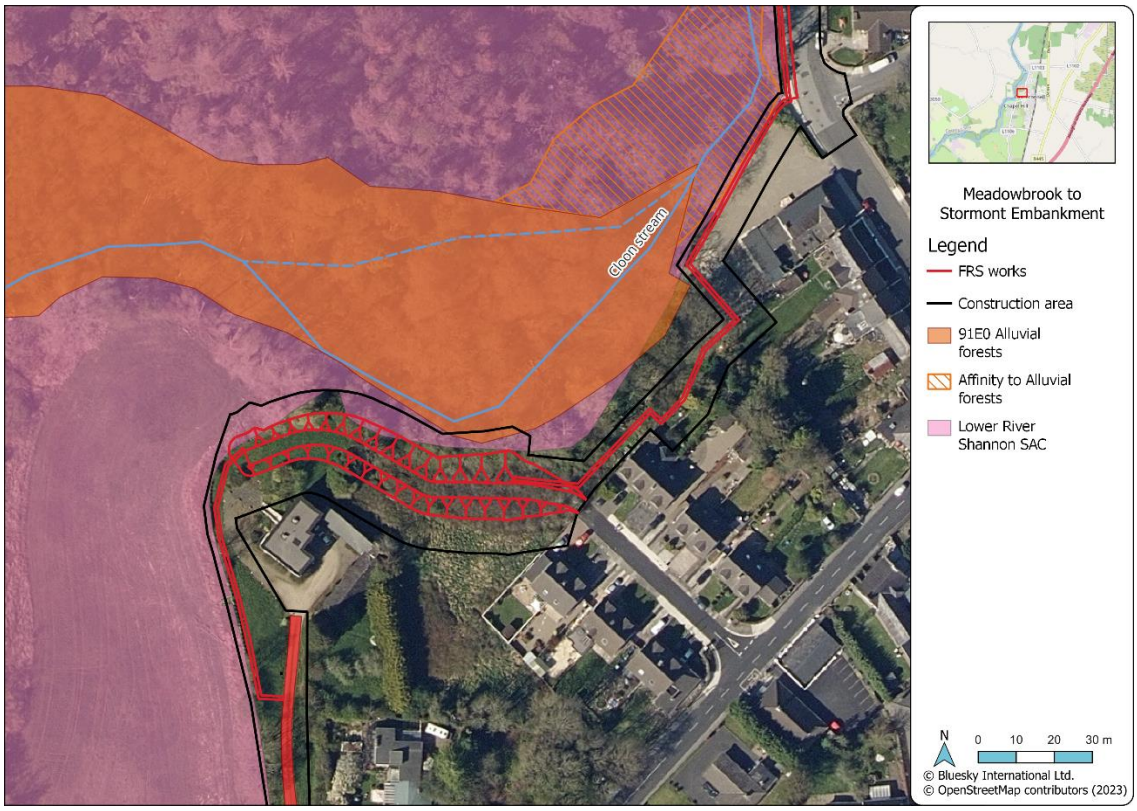

Figure 6-7 FRS works in proximity to Meadowbrook Estate

Direct works in SAC boundary

There is an extremely restricted working zone between the rear gardens and the SAC boundary / riparian area. The Scheme has been designed to ensure construction will be outside of the SAC boundary. There is a 1-2m drop at the edge of the woodland down into the riparian area which serves as a clear delineation for the edge of the Alluvial woodland and no machinery will or can enter this area. The SAC boundary is slightly larger than this riparian area, however all of the Scheme will be built on habitats not linked to the SAC (as described below).

Alluvial forests [91E0]

The FRS wall proposed at the back of Maher's Pub tying into the rear of Meadowbrook estate has been designed in such a way as to avoid the Alluvial Forest and the SAC.

Construction space is very restricted in this area particularly due to the presence of the Alluvial Woodland, as well as a large cedar trees which are to be retained. In response to this, the wall has been designed using sheet piling to form the foundations to reduce the construction area required. The embankment will be constructed from the rear of Meadowbrook estate to the Stormont House garden area, again constructed from the dry side at all times. There is a clear delineation of Alluvial Forest at this point as the woodland begin at a 1-2m bank which falls off into the Cloon Stream. No trees or roots of the Alluvial Woodland will be impacted during the construction of this embankment.

This area is currently composed of scrub which will be removed prior to construction of the embankment. The toe of the embankment will be in line with the 1-2m bank that drops off into the 'wet' side. The top of the bank is considered the edge of the Alluvial woodland, and no removal of trees or vegetation will take place below the top of the bank.

Therefore, no direct impacts are expected to the Alluvial Woodland at this point.

There may be indirect impacts from release of sediments from the excavations and building of the new flood wall and 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.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

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 Cloon stream. Concrete will be used for the concrete capping beam and flood wall on top of the sheet piling.

Mitigation measures will be required to protect fish QIs from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Otter [1355]

The Cloon stream lies adjacent to the scheme at this area, approximately 7m away at the nearest point. Otter may be using the Cloon stream, but surveys along the stream indicated it is likely not an important habitat or commuting route for this mammal. However, as it is a suitable habitat for this species, mitigation measures will be required.

Indirect impacts to Otter from reduced water quality could result in reduction of prey biomass, as described above for fish, are anticipated without mitigation.

Wintering water birds (Cormorant [A017] and Black-headed Gull [A179])

No impacts anticipated at this location.

6.1.8 Impact assessment at Stormont Property

The flood relief works at the Stormont property (Figure 6-8) 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 6-8 FRS work in proximity to Stormont House

Direct works in SAC boundary

The works are outside of the SAC but adjacent to the boundary. All construction machinery will keep outside of the SAC.

Alluvial forests [91E0]

From No. 7 Meadowbrook to Stormont House an embankment has been proposed instead of a wall due to a wider area available for construction. Impacts to Alluvial Forests is described in section above.

The proposed road raising of the access route and the new reinforced flood wall are not expected to have any impact on the Alluvial woodland.

Therefore, no direct impacts are expected to Alluvial Woodland at this location.

There may be indirect impacts from release of sediments from the excavations and building of the new flood walls. 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.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

Construction of the flood relief wall and the raising of the access route 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 will still be taken to ensure there is no impact on fish from a decrease of water quality within the main River Shannon.

Otter [1355]

Otter may be using the Cloon stream, but surveys along the stream indicated it is likely not an important habitat or commuting route for this mammal. However, as it is a suitable habitat for this species, mitigation measures will be required.

Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

Wintering water birds (Cormorant [A017] and Black-headed Gull [A179])

Disturbance to birds using the meadow beside Stormont House is possible but not expected to be significant (see Section 6.1.1.2).

6.1.9 Impact assessment at Coolbane Woods

The flood relief works at the Coolbane Woods (Figure 6-9) 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 6-9 FRS works in proximity to Coolbane Woods

Direct works in SAC boundary

This part of the scheme is not within the SAC Boundary. The works will be 50m away from the SAC. There is a connection with the SAC via existing drainage ditches which drain into the Stradbally stream and into the River Shannon.

Alluvial forests [91E0]

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.

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. However, removal of this woodland will be assessed in the EIAR Biodiversity Chapter due to its conservation value.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106]

Construction of the embankment at Coolbane woods will not have any direct impact on Fish QIs. 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 before entering the River Shannon. Mitigation measures will be required to protect fish QIs from those impacts associated with increased fine sediment load.

Otter [1355], Cormorant [A017]

Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

6.1.10 Impact assessment at Cedarwood Stream (at Cedarwood Grove)

The flood relief works on the Cedarwood stream (Figure 6-10) consists of:

- Vegetation removal from approximately 270m of the stream from Cedarwood Grove downstream.
- Replacement of culvert at one private property Coole House.

Figure 6-10 FRS works along Cedarwood Stream

Direct works in SAC boundary

There are no works within the SAC boundary at this location. The Cedarwood Stream flows into the River Shannon and SAC approximately 165m downstream of the proposed works in this section of the scheme.

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 replacement of the culvert and removal of vegetation and silt from the Cedarwood stream. 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 impacts on water quality.

Fish QIs (Sea Lamprey [1095], Brook Lamprey [1096], River Lamprey [1099], Atlantic Salmon [1106].

The culvert and weir system at the outfall of the Cedarwood Stream restricts Lamprey movement upstream. Therefore, no direct impacts associated with the culvert replacement are anticipated for Lamprey QIs. It is possible that Salmon parr 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. The temporary restriction of movement resulting from stream diversion required to replace the culvert is unlikely to have an adverse impact on this QI.

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 QIs within the River Shannon as described in Section 6.4.2 above. Mitigation measures will be required to protect fish QIs from those impacts associated with increased fine sediment load and/or other pollutants entering the stream in the case of a pollution event occurring.

Otter [1355], Cormorant [A017] and Black-headed Gull [A179])

The Cedarwood Stream is a small stream (approximately 0.5m to 1m wide) with steep sides and is culverted in several sections. It is not considered suitable habitat for Otter or QI birds and therefore no direct impacts are anticipated from the proposed works on the Cedarwood Stream.

Indirect impacts from water quality on prey biomass as described above for fish are anticipated without mitigation.

6.2 Operational impacts

6.2.1 Positive impacts

General positive impacts

Once operational, the FRS will reduce the area at risk of flooding in urban parts of Castleconnell, reducing the likelihood of pollutants being mobilised and entering the River Shannon during flood events.

Point sources which will be protected from flooding include houses, roads, cars, 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 Lower River Shannon SAC and QIs such as Salmon, Lamprey and Otter.

Connection to foul water services

A foul water pipe currently flows into the Cedarwood Stream from Grange House. In its 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 WWTP. This will improve local water quality and is considered a positive impact for Fish QIs.

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 be become obsolete and can be removed from the causeway structure. This will result in the Cloon Stream becoming open and accessible for QI species at all times of the year. Currently, the sluices are closed in high water levels (Figure 6-11) 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 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 6-11 One of three sluice gates at Island House Causeway, shut during winter flooding

6.2.2 Permanent loss of habitat /change within SAC boundary

The alluvial woodland habitat is adjacent to the proposed flood walls on the Mall Road, and also behind Maher's pub / Island House.

The footprint of the entire FRS and flood walls will ultimately be the same as the current built environment or stepped back from the SAC to avoid Alluvial Woodland. It is expected that the Alluvial Woodland will be allowed to expand / self-generate into the additional space of 1.5m created from the stepping back of the new flood wall.

At Island House junction the Mall road wall will encroach 0.5metres into the Affinity to Alluvial Woodland for 55metres due to narrowness of the road. This will be the only area of the Scheme that is permanently within the SAC. However, the woodland is of low quality at this area. Therefore, 27.5m2 of permanent take of land within the SAC is expected.

6.2.3 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. Lamprey are not considered to be using the

stream. The current series of obstacles to fish movement reduce the potential for Salmon 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 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 Lower River Shannon SAC would be in direct contravention of the QIs Conservation Objectives for the Lower River Shannon SAC.

In the absence of appropriate mitigation measures, an improperly designed culvert would have an adverse impact on the QI, Atlantic Salmon [1106].

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 FRS will generally not result in any additional discharges into the River Shannon (Lower River Shannon SAC).

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 QIs present within the stream.

This could have an impact on water quality and sensitive Qualifying Interests Salmon and lamprey species in the Lower Shannon SAC. Mitigation measures are required to ensure annual maintenance of the Scheme will not impact fish species.

6.2.4 Control of Giant Hogweed

Seeds of this plant can remain viable for many years (possibly up to 15 years) 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 the scheme beside the Alluvial woodland which may facilitate the spread of the non-native invasive species.

Mitigation to control germination of Giant Hogweed seeds during operation will be required.

6.2.5 Lighting

No new lighting columns are proposed for the scheme. Where lighting columns have to be removed to construct the new flood walls and embankments, the columns will be replaced on completion of the works. For instance, on the Mall Road, the existing columns will be removed and replaced in line with the new wall.

Therefore, no impacts from lighting are anticipated on any of the QIs such as otter or fish as the lighting regime will remain the same.

6.2.6 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 QIs of the Natura 2000 sites. Therefore, no mitigation is required.

6.3 Do Nothing Impact

If the 'do-nothing' approach is adopted and the development of the Castleconnell FRS does not take place, flooding events will keep occurring within the residential and road/access areas of the village, resulting in reoccurring 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 Natura 2000 sites if they proceed without a coherent and rational approach of a flood relief scheme.

6.4 Overall Impacts on Conservation Objectives

6.4.1 Lower River Shannon SAC

Alluvial forests [91E0]

Conservation objective: to restore the favourable condition of Alluvial Forests 91Eo in the Lower River Shannon SAC

Table 6-2 Tables of impacts on Alluvial forests

Attribute	Measure	Target	Impact
Habitat area	Hectares	Area stable or increasing, subject to natural processes, at least c.8.5ha for sites surveyed	There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location. Some trees within Affinity to Alluvial Woodland 4 will be removed to accommodate the construction of a flood wall. Mitigation is required. 3,880m2 of emerging Alluvial Woodland is anticipated to be lost/impacted outside of the SAC, however this will not cause a reduction in habitat area within the SAC. This is assessed in the EIAR Biodiversity Chapter.
Habitat distribution	Occurrence	No decline	There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location. Some trees within Affinity to Alluvial Woodland 4 will be removed to accommodate the construction of a flood wall. Mitigation is required. 3’880m2 of emerging Alluvial Woodland is anticipated to be lost/impacted outside of the SAC, however this will not cause a reduction in habitat area within the SAC. This is assessed in the EIAR Biodiversity Chapter.
Woodland size	Hectares	Area stable or increasing. Where topographically possible, "large" woods at least	No area of mapped alluvial woodland beside the scheme meets the recommended minimum of 3ha for ‘small’ woods within the SAC. There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be

Attribute	Measure	Target	Impact
		25ha in size and “small” woods at least 3ha in size	permanently lost at Island House to accommodate the flood wall at this location.
Woodland structure: cover and height	Percentage and metres	Diverse structure with a relatively closed canopy containing mature trees; subcanopy layer with semi-mature trees and shrubs; and well-developed herb layer	No change in height or cover of Alluvial Woodlands is anticipated.
Woodland structure: community diversity and extent	Hectares	Maintain diversity and extent of community types	No change in diversity and extent of Alluvial Woodlands anticipated.
Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Seedlings, saplings and pole age-classes occur in adequate proportions to ensure survival of woodland canopy	Scheme not anticipated to effect natural regeneration.
Hydrological regime: flooding depth/height of	Metres	Appropriate hydrological regime necessary	There will be no impacts to the hydrology of the woodland during construction or operation.

Attribute	Measure	Target	Impact
water table		for maintenance of alluvial vegetation	
Woodland structure: dead wood	m^3 per hectare; number per hectare	At least 30m^3/ha of fallen timber greater than 10cm diameter; 30 snags/ha; both categories should include stems greater than 40cm diameter (greater than 20cm diameter in the case of alder)	Deadwood was not assessed; however, it is not expected that the scheme will impact this Attribute. Any wood or trees removed during Construction of scheme (e.g., trimming of branches) will be left in Situ.
Woodland structure: veteran trees	Number per hectare	No decline	No veteran trees were recorded. No impacts to this attribute are anticipated.
Woodland structure: indicators of local distinctiveness	Occurrence	No decline	There were no indicators of local distinctiveness recorded from the alluvial woodland. No decline is anticipated.
Vegetation composition: native tree cover	Percentage	No decline. Native trees cover not less than 95%	Movement of soil may encourage seedlings of native trees but also negative indicator species such as Sycamore or Invasive species. Mitigation required.

Attribute	Measure	Target	Impact
Vegetation composition: typical species	Occurrence	A variety of typical native species present, depending on woodland type, including alder (*Alnus glutinosa*), willows (*Salix spp*) and, locally, oak (*Quercus robur*) and ash (*Fraxinus excelsior)* and birch (*Betula pubescens*)	No change anticipated.
Vegetation composition: negative indicator species	Occurrence	Negative indicator species, particularly non-native invasive species, absent or under control	Spread of non-native invasive species present, notably Giant Hogweed, may be further spread without mitigation. 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.

Otter

Conservation objective: to restore the favourable conservation condition of Otter in the Lower River Shannon SAC

Table 6-3 Impacts on Otter

Attribute	Measure	Target	Impact
Distribution	Percentage positive survey sites	No significant decline	No impact anticipated – scheme will not result in loss of habitat for Otter. Positive result anticipated during Operation as Sluices at Island House causeway will be removed, allowing access to Cloon Stream year-round.
Extent of terrestrial habitat	Hectares	No significant decline. Area mapped and calculated as 596.8ha above high water mark (HWM); 958.9ha along riverbanks/ around ponds	No impact anticipated – scheme will not result in loss of terrestrial habitat for Otter. Scheme is primarily in existing built environment.
Extent of marine habitat	Hectares	No significant decline. Area mapped and calculated as 4,461.6ha	Not applicable.
Extent of freshwater (river) habitat	Kilometres	No significant decline. Length mapped and calculated as 599.54km	Scheme will not reduce the extent of freshwater habitat available to Otter.
Extent of freshwater (lake) habitat	Hectares	No significant decline. Length mapped and calculated as 500.1km	Not applicable.
Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 125.6ha	Not applicable.
Couching sites and holts	Number	No significant decline	Surveys indicate scheme is not impacting any couches or holts.

Attribute	Measure	Target	Impact
			However, using the precautionary principle, dense vegetation around the Cloon Stream section of the Scheme may have otter present in the future. Pre-construction check is advised (detailed in Mitigation section).
Fish biomass available	Kilograms	No significant decline	Impacts on water quality from discharges have the potential to impact on populations of fish and juvenile lamprey and therefore could impact the availability of prey items for Otter. Mitigation required.
Barriers to connectivity	Number	No significant increase	No barriers from Scheme anticipated. Positive result anticipated during Operation as Sluices at Island House causeway will be removed, allowing access to Cloon Stream year-round.
Extent of freshwater (lake/lagoon) habitat	Hectares	No significant decline. Area mapped and calculated as 125.6ha	Not applicable.
Couching sites and holts	Number	No significant decline	Surveys indicate scheme is not impacting any couches or holts. However, using the precautionary principle, dense vegetation around the Cloon Stream section of the Scheme may have otter present in the future. Pre-construction check is advised (detailed in Mitigation section).

Sea Lamprey

Conservation objective: to restore the favourable conservation condition of Sea Lamprey in the Lower River Shannon SAC

Table 6-4 Impacts on Sea Lamprey

Attribute	Measure	Target	Impact
Distribution: extent of anadromy	% of river accessible	Greater than 75% of main stem length of rivers accessible from estuary	No impact from construction or operational phase anticipated.
Population structure of juveniles	Number of age/size groups	At least three age/size groups present	Construction phase: release of pollutants may result in mortality. Mitigation required. Operational phase: None
Juvenile density in fine sediment	Juveniles/m²	Juvenile density at least 1/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Mitigation required. Operational phase: None
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds.	Construction phase: Released fine sediment may settle on spawning beds reducing quality. Mitigation required. Operational phase: None
Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.	Construction phase: Instream piling and/or cofferdams will temporarily reduce juvenile habitat. Mitigation required.

Brook Lamprey

Conservation objective: to maintain the favourable conservation condition of Brook Lamprey in the Lower River Shannon SAC

Table 6-5 Impacts on Brook Lamprey

Attribute	Measure	Target	Impact
Distribution	% of river accessible	Access to all water courses down to first order streams	No impact from construction or operational phase anticipated.
Population structure of juveniles	Number of age/size groups	At least three age/size groups of brook/river lamprey present	Construction phase: release of pollutants may result in mortality. Mitigation required. Operational phase: None
Juvenile density in fine sediment	Juveniles/m²	Mean catchment juvenile density of brook/river lamprey at least 2/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Mitigation required. Operational phase: None
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds	Construction phase Released fine sediment may settle on spawning beds reducing quality. Mitigation required. Operational phase: None
Availability of juvenile habitat	Number of positive sites in 2nd order channels (and greater), downstream of spawning areas	More than 50% of sample sites positive.	Construction phase: Instream piling and/or cofferdams will temporarily reduce juvenile habitat. Mitigation required.

River Lamprey

Conservation objective: to maintain the favourable conservation condition of Brook Lamprey in the Lower River Shannon SAC

Table 6-6 Impacts on River Lamprey

Attribute	Measure	Target	Impact
Distribution	% of river accessible	Access to all water courses down to first order streams	No impact from construction or operational phase anticipated.
Population structure of juveniles	Number of age/size groups	At least three age/size groups of river/brook lamprey present	Construction phase: release of pollutants may result in mortality. Mitigation required. Operational phase: None
Juvenile density in fine sediment	Juveniles/m²	Mean catchment juvenile density of brook/river lamprey at least 2/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Mitigation required. Operational phase: None
Extent and distribution of spawning habitat	m² and occurrence	No decline in extent and distribution of spawning beds	Construction phase Released fine sediment may settle on spawning beds reducing quality. Mitigation required. Operational phase: None

Conservation objective: to restore the favourable conservation condition of Salmon in the Lower River Shannon SAC

Table 6-7 Impacts on Atlantic Salmon

Attribute	Measure	Target	Impact
Distribution: extent of anadromy	% of river accessible	100% of river channels down to second order accessible from estuary	No impact expected.
Adult spawning fish	Number	Conservation Limit (CL) for each system consistently exceeded	Construction phase: Released fine sediment, cement and/or hydrocarbons may adversely impact on fish. Mitigation required. Operational phase: no impact
Salmon fry abundance	Number of fry/5 minutes electrofishing	Maintain or exceed 0+ fry mean catchment-wide abundance threshold value. Currently set at 17 salmon fry/5 min sampling	Construction phase: Released fine sediment, cement and/or hydrocarbons may adversely impact on fish. Mitigation required. Operational phase: No impact

Attribute	Measure	Target	Impact
Out-migrating smolt abundance	Number	No significant decline	Construction phase: Although Cedarwood Stream may provide limited habitat potential to young salmon, abundances are considered low, temporary restriction of movement during construction phase will not adversely impact this conservation objective. Operational phase: The Cedarwood stream is not considered an important habitat for young salmon before migration, however it may provide some supporting habitat for a low abundance of fish. Improper culvert design may result in a very small reduction in migrating smolts in the range of one or two less fish every couple of years. Mitigation required.
Number and distribution of redds	Number and occurrence	No decline in number and distribution of spawning redds due to anthropogenic causes	Construction phase: Release of fine sediment may result in deterioration of spawning redds when fine sediment settles in the main channel. Mitigation required. No operational phase impacts
Water quality	EPA Q value	At least Q4 at all sites sampled by EPA	Construction phase: Released fine sediment, cement and/or hydrocarbons may adversely impact on fish. Mitigation required.

6.4.2 River Shannon and River Fergus Estuaries SPA

Cormorant [A017]

Conservation objective: to restore the favourable conservation condition of Cormorant in River Shannon and River Fergus Estuaries SPA

Attribute	Measure	Target	Impacts
Distribution	Range, timing and intensity of use of areas	Long term population trend stable or increasing	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	No breeding cormorant present. No decline.
Productivity rate	Mean number	No significant decline	No breeding cormorant present. No decline.
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	No breeding cormorant present. No decline.
Prey biomass available	Kilogrammes	No significant decline	Impacts on water quality from discharges have the potential to impact on populations of fish that Cormorant feed on. Reduced prey availability may impact on distribution. Mitigation required.

Attribute	Measure	Target	Impacts
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	FRS will not cause any barrier to cormorant moving up and down the river.
Disturbance at the breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the breeding cormorant population	No breeding cormorant present. No decline.
Population trend	Percentage change	Long term population trend stable or increasing	NA
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by cormorant other than that occurring from natural patterns of variation	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant.

Black-headed Gull [A179]

Conservation objective (CO): to restore the favourable conservation condition of Black-headed Gull in River Shannon and River Fergus Estuaries SPA

Attribute	Measure	Target	Impacts
Population trend	Percentage change	Long term population trend stable or increasing	Scheme not expected to impact population changes.

Attribute	Measure	Target	Impacts
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by black-headed gull other than that occurring from natural patterns of variation	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant.

6.4.3 Lough Derg (Shannon) SPA

There are no site-specific COs listed, however the objective of the SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA, namely Cormorant *Phalacrocorax carbo*, Tufted Duck *Aythya fuligula*, Goldeneye *Bucephala clangula*, Common Tern *Sterna hirundo*. and to maintain or restore the favourable conservation condition of the wetland habitat at Lough Derg (Shannon) SPA as a resource for the regularly occurring migratory waterbirds that utilise it.

Cormorant are assessed following the same CO as for the River Shannon and Fergus estuaries, all other species are assessed following general guidelines to achieve favourable conservation status, as described in the site CO. Broadly, this corresponds to Population size, Distribution, Habitat.

The favourable conservation status of a species is achieved 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, and
- 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.

Cormorant [A017]

To restore/maintain the favourable conservation condition of Cormorant in Lough Derg SPA

Table 6-8 Impacts on Cormorant

Attribute	Measure	Target	Impacts
Distribution	Range, timing and intensity of use of areas	Long term population trend stable or increasing	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant.
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	No breeding cormorant present. No decline.
Productivity rate	Mean number	No significant decline	No breeding cormorant present. No decline.
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	No breeding cormorant present. No decline.
Prey biomass available	Kilogrammes	No significant decline	Impacts on water quality from discharges have the potential to impact on populations of fish that Cormorant feed on. Reduced prey availability may impact on distribution. Mitigation required.
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	FRS will not cause any barrier to cormorant moving up and down the river.
Disturbance at the breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the	No breeding cormorant present. No decline.

Attribute	Measure	Target	Impacts
		breeding cormorant population	
Breeding population abundance: apparently occupied nests (AONs)	Number	No significant decline	No breeding cormorant present. No decline.
Productivity rate	Mean number	No significant decline	No breeding cormorant present. No decline.
Distribution: breeding colonies	Number; location; area (hectares)	No significant decline	No breeding cormorant present. No decline.
Prey biomass available	Kilogrammes	No significant decline	Impacts on water quality from discharges have the potential to impact on populations of fish that Cormorant feed on. Reduced prey availability may impact on distribution. Mitigation required.
Barriers to connectivity	Number; location; shape; area (hectares)	No significant increase	FRS will not cause any barrier to cormorant moving up and down the river.
Disturbance at the breeding site	Level of impact	Human activities should occur at levels that do not adversely affect the breeding cormorant population	No breeding cormorant present. No decline.
Population trend	Percentage change	Long term population trend stable or increasing	NA

Attribute	Measure	Target	Impacts
Distribution	Range, timing and intensity of use of areas	There should be no significant decrease in the range, timing or intensity of use of areas by cormorant other than that occurring from natural patterns of variation	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant.

7 Mitigation to Avoid Impacts

This section describes the avoidance and mitigation measures required to avoid adverse impacts on the Qualifying Interests and their Conservation Objectives (COs) of the Lower River Shannon SAC and River Shannon and River Fergus SPA that will be incorporated into the proposed Castleconnell FRS.

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 ecologist with 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 project ECoW will liaise with IFI for approval of silt reduction measures in advance of any works.

Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 8.3. 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.

Mitigation measures listed below will be included as part of tendering documents and used during preparation and construction phases of the FRS.

A site-specific Construction and Environment Management Plan (CEMP) will be written by the contractor prior to site works commencing. This CEMP will incorporate the mitigation measures listed in this NIS as well as those in the EIAR.

7.1 Construction Mitigation- Habitats and Species

7.1.1 Mitigation for Alluvial forests [91E0]

Woodland 1 & 2
A specific mitigation plan/method statement for works within the vicinity of the SAC woodland will be agreed with and approved by the National Parks and Wildlife Service (NPWS).

Toolbox talk: An Ecological Clerk of Works will be present at the start of any work adjacent to the Alluvial Forests. The ECoW will provide a toolbox talk to the

construction team prior to any ground works taking place, advise on any areas where adjacent to the mapped Alluvial woodlands.

No construction work, storage or dumping of material will be undertaken in the Alluvial Forests 91E0.

As works will be undertaken adjacent and partially within 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. This will be demarcated by the proposed silt mitigation in Section 7.3.1 and approved by ECoW.

Tree root protection: An Arborist has carried out an assessment of works next to trees in Alluvial Forest on the Mall Road. The Arboriculture Report assessed the proposed wall raising and footpath intrusion along The Mall Road and noted that the construction will intrude into the RPA of a number of trees of the Annex I habitat Alluvial Forests. It is considered that no trees will be removed in Woodland 1 and 2. Works are required within the immediate locations of their stems and the construction area may affect the roots of some tree. As this is likely unavoidable, some trees may require trimming prior to the works to reduce the canopy. Many of the trees within the root area are Willows and these are considered resilient trees to some root damage. It is however considered that this will be minimal, and there are sufficient areas outside the affected rooting areas of these retained trees.

Deadwood: During construction work, any deadwood located within the construction area will not be removed from the woodland. Branches and deadwood removed during construction and ongoing maintenance will be placed in various locations within the woodland (as advised by ECoW or ecologist) to increase the dead wood present.

Woodland 3- Compensation for removal of emerging alluvial woodland at Coolbane Woods

The above mitigation measures also apply to this woodland. Further detailed mitigation is outlined in the EIAR Biodiversity Chapter.

Woodland 4 – Affinity to Alluvial woodland (Mall Road phase 2)

The above mitigation measures for Woodland 1 & 2 also apply to this woodland.

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.

7.1.2 Post Construction monitoring of Alluvial Woodland

Post construction monitoring of all Alluvial woodlands will be carried out by an appointed ecologist. This will include a condition assessment of 91E0 woodlands and include removal of negative indicator species, such as Sycamore and invasive species. These species may be more prevalent post-construction due to the movement of soil. This will be undertaken annually 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).

A monitoring and management plan is to be agreed with NPWS.

7.1.3 Mitigation – Otter [1355]

A pre-construction survey for Otter will be carried out within 10 months prior to construction. This should be supplemented by inspection of the FRS construction area immediately prior to site clearance to ensure no holts or couches have been created in the intervening period. This should particularly be undertaken around the Cloon Stream area which is heavily vegetated and is suitable for otter. It is unlikely any holts are to be found, however if the presence of otter is found, appropriate steps will be taken, and a derogation licence will be applied for from NPWS. Any mitigation required will be agreed with NPWS.

Trenching works shall not create confined areas where Otter may get trapped. However, if such areas are created, the area will be fitted with an escape ramp (no more than 45º) to allow trapped animals to escape when the area is not in operation. These areas must be made safe before leaving site each day.

7.1.4 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 take place on the river side of the flood wall. 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 river side of the flood wall 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. The sediment along the banks in this location contains Lamprey ammocoetes which will require translocation to other nearby available habitat, to avoid mortality. Other fish in the area will likely leave through disturbance however if any become entrapped, they will also require removal. The zone of works for translocation efforts is shown in Figure 7-1 below.

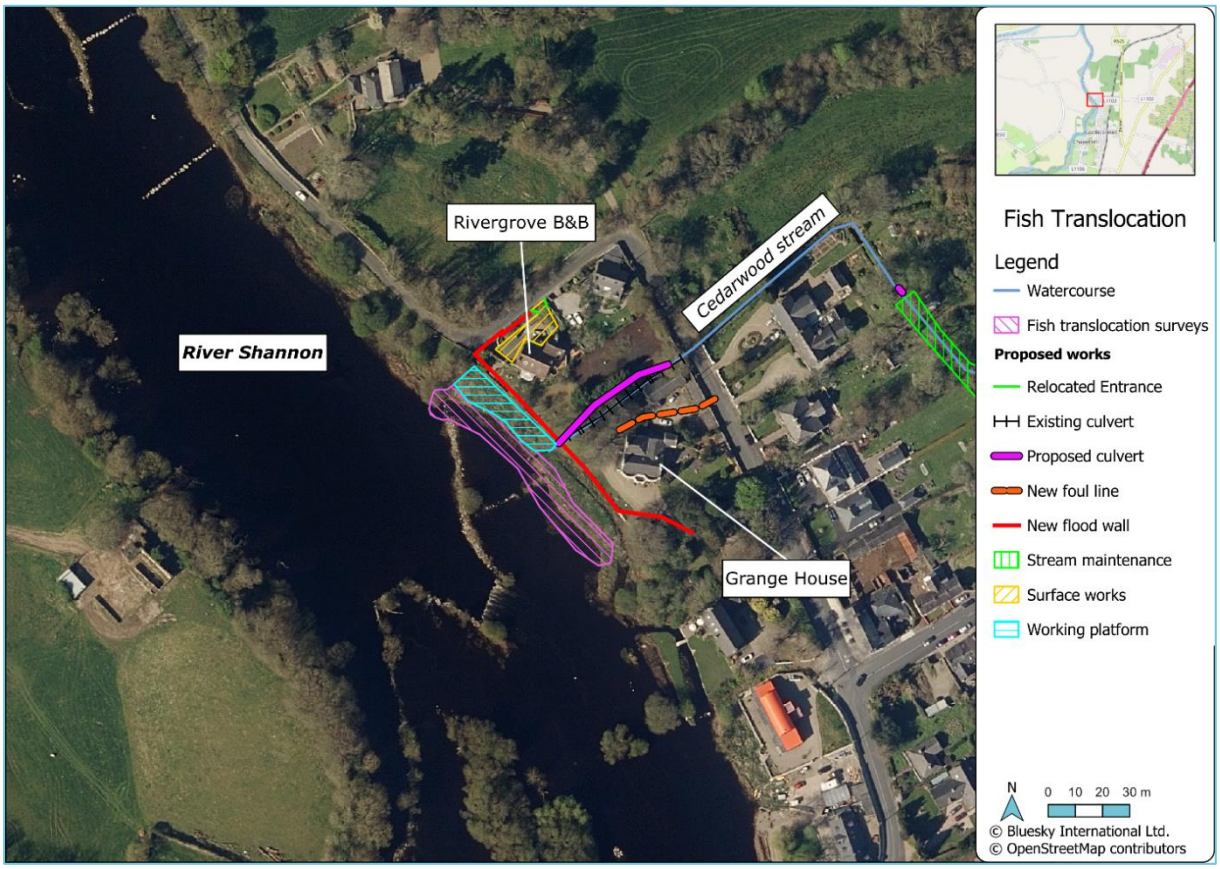

Figure 7-1 Location of fish translocation efforts.

The recovery of Lamprey ammocoetes is a precise and slow process as ammocoetes retreat into their burrows when disturbed. Translocation efforts will follow guidelines for standard electrofishing surveys as set out in Harvey and Cowx (2003). To successfully translocate ammocoetes, this work should be carried out in accordance with the criteria below:

This work will be conducted by an electrofishing team 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 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.

Once all lamprey habitat is surveyed and ammocoetes are translocated, the remaining area should be fished for other species. Fishing efforts should continue until there is successive efforts with no catch return.

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 is 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.

7.1.5 Invasive species

Giant Hogweed is included under this Third Schedule list. As Giant Hogweed is present in the majority of the construction area of the Scheme, there is a duty to ensure this species is not further spread due to construction activities.

A Management and Monitoring Plan for Giant Hogweed should be produced.

Control of Giant Hogweed during Construction

Giant hogweed is a biennial/perennial plant and spreads prolifically by productions of thousands of seeds. Any flowering stalks will be removed immediately by cutting the flower head off. Giant hogweed flowers from approximately May/June/July and set seed from July to August. Hand cutting will only be carried out if the operator is wearing full protective clothing to prevent skin contamination by the sap. Note: removal of flowering heads is already being informally controlled by a local river conservation group.

Any Giant Hogweed that is growing in the location of proposed walls or embankment will 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 300mm 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.

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 will be removed from the site, as this will spread Giant Hogweed to a new location. Any movement of soil created during construction will be stored as close as possible to the original location and placed back where it originated from where possible.

Control of Giant Hogweed during Operation

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 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.

Biosecurity for prevention of spread of IAS

It is important to maintain a good site hygiene when dealing with any non-native species / IAS:

- Where contaminated soil, materials or water are located, fencing and signage should be erected to indicate them.
- Personnel working on or between sites should ensure their clothing and footwear are cleaned where appropriate to prevent spread.
- Tracked vehicles should not be used within the area of infestation.
- All vehicles leaving the infested area and / or transporting infested soil/materials must be thoroughly pressure-washed in a designated wash-down area before being used for other work.
- Where cross-contamination is possible (i.e. from one site to another), consider designating vehicles or machinery to specific sites where possible to prevent spread.
- Material / water left after vehicles have been pressure-washed must be contained, collected, and disposed of appropriately.
- All chemicals used for the control of non-native species should be stored and used in a responsible manner.
- All wash facilities including wastewater from washing vehicles, equipment or personnel should be managed and disposed of at a licenced facility so as not to not cause harm to the environment.

Biosecurity Measures to prevent spread Zebra/Quagga 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, as well as waterborne diseases such as Crayfish Plague, as well as spread of plants and animals in general. 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:

- 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.[1]

7.2 Construction mitigation – Protection of water quality – best practice

Impacts to water quality are expected to impact the following Qualifying Interests during Construction of the Scheme:

- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
- Sea Lamprey *Petromyzon marinus* [1095]
- Brook Lamprey *Lampetra planeri* [1096]
- River Lamprey *Lampetra fluviatilis* [1099]
- Atlantic Salmon *Salmo salar* [1106]
- Otter *Lutra lutra* [1355]
- Cormorant *Phalacrocorax carbo* [A017]

7.2.1 Standard Environmental Best Practice

1 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.

The activities required for the proposed development's construction phase shall remain within the boundary of the proposed site, bar select compound areas, which will be located in adjacent lands for mitigation control reasons. The CEMP will also strictly adhere to best practice environmental guidance including but not limited to the following:

- CIRIA Guidance C532: Control of water pollution from construction sites. Guidance for consultants and contractors. ((Masters-Williams 2001) CIRIA, 2019 - www.ciria.org);
- CIRIA Guidance C741: Environmental good practice on site guide ((Charles and Edwards 2015); CIRIA, 2019 - www.ciria.org);
- CIRIA Guidance C750D: Groundwater control: design and practice ((Preene et al. 2016); CIRIA, 2019 - www.ciria.org);
- CIRIA (C512): Environmental Handbook for Building and Civil Engineering Projects (CIRIA, 2000).
- CIRIA (C697): The SUDS Manual (CIRIA, 2007.
- CIRIA (C649) Control of water pollution from linear construction projects: Site guide (CIRIA 2006a).
- CIRIA (C848): Control of water pollution from linear construction projects: Technical guidance (CIRIA, 2006b (Murnane et al. 2006));
- Inland Fisheries Ireland: Guidance on Protection of Fisheries During Construction Works In and Adjacent to Waters(IFI 2016);
- Inland Fisheries Ireland: 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)

7.2.2 Environmental Management of Site Compounds

The Site compound will be located in the field adjacent to the Mall Road (Figure 7-2).

Figure 7-2 Site compound location in Scanlon Park along the Mall Road

The Principal Contractor will be required to ensure good environmental management within the site compounds set up along the length of the proposed development. The below list of measures will be incorporated into site compound environmental management:

- Site compounds will not be set up within Flood Zone A or B lands in accordance with the OPW 'Planning System and Flood Risk Management Guidelines' (November 2009).
- Site compounds will not be located within core foraging areas utilised by wintering QI bird species.
- Only plant and materials necessary for the construction of the works will be permitted to be stored at the compound location.

Site establishment by the Contractor will include the following:

- Site offices.
- Site facilities (canteen, toilets, drying rooms, etc.).
- Office for construction management team.
- Secure compound for the storage of all on-site machinery and materials.
- Temporary car parking facilities.
- Temporary fencing.
- Site Security to restrict unauthorized entry.
- All sub-contractors will be given induction toolbox talk so that they are aware of material storage arrangements.

- Construction materials within the compound will be stored in a designated area in an organised manner to protect them from accidental damage and deterioration as a result of exposure.
- Bunded storage of fuels and refuelling area. Bunds shall be 110% capacity of the largest vessel contained within the bunded 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.
- A maintenance programme for the bunded areas will be managed by the site environmental manager. The removal of rainwater from the bunded areas will be their responsibility. Records will be maintained of materials taken off site for disposal.
- The site environmental manger will be responsible for maintaining all training records and weekly environmental inspections.
- Drainage collection system for washing area to prevent run-off into surface water system.
- Stockpiling of spoil and spoil-like materials will be appropriately located within the compounds to minimise exposure to prevailing winds.
- All refuelling of vehicles will be carried out at the fuel stores within the main site compound and only ADR trained personnel will be permitted to operate fuel bowsers.

7.3 Construction mitigation - Water Quality 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.

7.3.1 Construction of 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 (Figure 7-3).

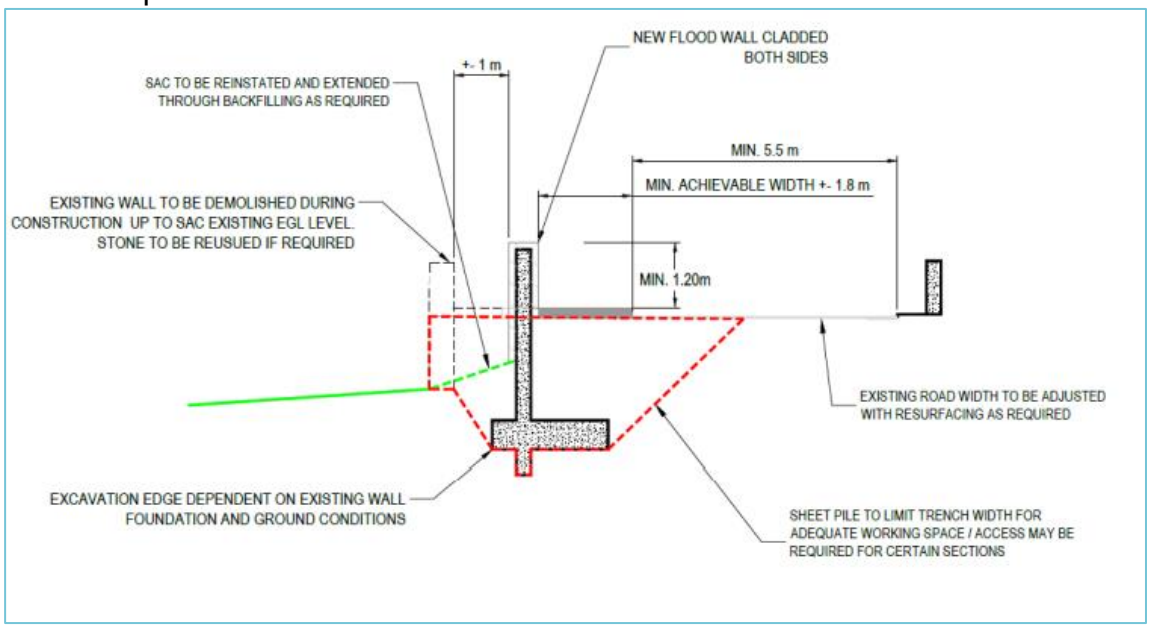

Figure 7-3 Cross section of new proposed wall

Standard trenched silt fencing is not feasible in this location due to the presence of trees nearby. Construction works should take place as follows:

It is expected that demolition of the wall will be required ahead of excavation to mitigate against the risk of collapse. 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/impermeable 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 commence. Once this work 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.

Protection of water from cement leachate: It is expected that the flood wall and foundations will be constructed in-situ using poured concrete however, there may be scope to propose pre-cast concrete units following the detailed design site investigations. The newly excavated space to facilitate the wall foundations should be lined with an impermeable geotextile to create a sealed working space with a fenced buffer between any works involving concrete or cement. Once this area is lined the foundation and wall can be constructed. The wall will then be faced above ground

level on both sides with stone reclaimed from the original stone wall and similar imported stone if needed.

Once the wall is constructed the silt fencing should be carefully removed to prevent any trapped pollutants from entering 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.

7.3.2 Construction of walls and embankments along Cloon Stream Maher's Pub, Meadowbrook, Stormont House

The construction of the new flood wall adjacent to Maher's Pub will be within a few metres (Approximately. 2-5metres) 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 (to be confirmed following further site investigation) of excavation at the foot of the proposed slope which will be backfilled as part of the 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.

7.3.3 Construction of culverts at Cedarwood Stream.

Two culverts are required along the Cedarwood Stream, one at the outfall (approximately 40m long) at Grange House and another approximately 160m upstream at the location of an existing culvert in the rear garden of a private property (approximately 4m long). An assessment has been carried out on the current design of these culverts and weir creates an obstacle to fish passage.

There following section outlines the design of the new culverts such that they do not pose an obstacle to fish passage. Mitigation is required during the installation of the culverts to protect fish and water quality.

7.3.4 Culvert design

The mitigation measures outlined within this section on 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 at 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:

The culvert nearest the outfall will be approximately 60m in length, design measures can 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. This is achievable with the current design.
- Be positioned such that both the upstream and downstream invert shall be 500mm below the upstream and downstream riverbed invert levels respectively. This is achievable with the current design.
- Piped culverts should be avoided wherever possible, with inverted U shape or box culverts over the existing stream bed being the preferred option. The new culvert will be box-shaped.
- 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. This is likely not possible due to lack of space but should be considered in detailed design stage.
- 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. This may not be possible at the downstream side of the culvert as it is natural habitat of riparian vegetation and trees may not survive in this section.
- 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. This is achievable with the current design.

- Head drops should be avoided during detailed design, but if absolutely required a maximum head drop of 0.1m can be permitted. This is achievable with the current design.
- If trash screens are required, they should be adequately spaced to approximately 230mm to allow for fish passage. Mesh screens should be avoided. It is likely trash screens are not required.
- The upstream culvert at Coole House 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.

7.3.5 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 a 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 stream diversion should be constructed in advance of dewatering the stream. The temporary riverbed should be made of compacted soil lined with Terram geotextile which will also extend up the banks. Appropriate gravels and boulders (in line with local bedrock type present in the stream) should be placed overtop the Terram geotextile. Both ends of the temporary diversion should be disconnected from the stream with a geotextile Terram lined sheet piling in advance of connection. The temporary diversion should be opened in tandem with the closure of the works area, described below.

As there is limited space at the smaller upstream culvert, stream diversion may not be possible and over pumping will be required at this location.

Dry works area

In order 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 the installation of a temporary dam using sheet pilings and/or one tonne sandbags, or any other barrier following contractors design specification, 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) and SFCC (2007)should be followed, as well as the following the criteria set out below:

- Silt curtains must be placed in upstream 5m up and downstream of the dry cell piling locations before they are constructed.
- 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 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.

Cedarwood vegetation and silt removal, replacement of culvert at private property (Coole House)

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.

Silt in the Cedarwood stream will also be removed. Mitigation to protect downstream water quality will be required.

Additionally, a culvert over the Cedarwood stream will be replaced. This is located in a private property (Coole House Eircode V94 PY9X).

This work will require the following mitigation:

- Tree and vegetation removal will 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, should be carried out. Further details are included in the EIAR Biodiversity Chapter.
- 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 7.3.3.2.

- ECoW will be present to advise and monitor the works within this sensitive environment.

Rivergrove works from Riparian area

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. This will likely include the following measures as discussed with NPWS:

- A stone platform to be installed for machinery to enter and work in 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.
- Translocation of lamprey should be carried out in this soft mud before the works are started. (further detailed in next section)
- 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).
- Stone used for the platform should be pre-washed aggregate only, to minimise leaching of stone dust into the Shannon.
- ECoW should be present during these work.
- Compaction of soil – 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.

7.3.6 Protection of Stradbally stream from sediment during construction

Two drainage ditches that drain into the Stradbally stream (and thus the Lower River Shannon SAC) are located within the working area of the new embankment to be constructed at Coolbane woods.

Mitigation to prevent sediment release from construction will be put in place to protect the water quality of the local watercourses, and thus QIs such as fish, otter, birds etc.

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.

7.3.7 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 will be protected to prevent any material from falling from 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.
- The ECOW will be present to advise and monitor the works next to this sensitive environment.

7.3.8 Surface Water Management Plan

Work for the upgrading of surface water including new pumping stations at Mahers Pub (discharge to Cloon Stream) and Coolbane Woods (discharge to Stradbally Stream) are also likely to require specific mitigation, particularly relating to the discharge points into existing watercourses. Control measures will also be similar to those outlined in the existing EIAR i.e. measures for sediment control and EcCOW oversight. The ECOW will be present to advise and monitor the works next to this sensitive environment. Standard mitigation measures such as overpumping and working in the dry will be sufficient to protect the water quality within the SAC. Mitigation for the separation of the existing combined network is also likely to be similar to the existing measures.

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.
- Use bio fuels and bio lubricants by machinery
- 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 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 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-sections will provide greater detail on specific locations of these silt fence / trench sections.
- Silt fences will be repaired and/or replaced as necessary by the principal contractor as part of the on-going environmental monitoring programme.

7.3.9 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 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 SAC or QIs. 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 foreperson'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 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. Use of bio-fuels and bio lubricants by machinery is recommended.

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' (NRA, 2008).
- 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.
- Damaged or leaking containers will be removed from use and replaced immediately.

7.3.10 Dust Management Plan

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 provided in the EIAR (Construction Impacts Chapter 4) Section 1.6.2 of the Air Quality and Dust and summarised below pertaining to works next to riparian area of River Shannon where QIs are present:

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 PM10 continuous monitoring and/or visual inspections.

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 track-out.

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 permit.

Access gates to be located at least 10 m from receptors where possible.

Impact and Mitigations Summary

Table 7-1 in overleaf summarises the potential impacts on the attributes of the designated QIs of the Lower River Shannon SAC, and River Shannon and River Fergus SPA, along with the mitigation measures. With mitigation measures in place no adverse effects on the integrity of any Natura 2000 site.

Table 7-1 Summary of impacts and mitigation measures on the attributes of the designated QIs of the Lower River Shannon SAC, and River Shannon and River Fergus SPA,

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
Alluvial forests [91E0] Lower River Shannon SAC	Habitat area	Hectares	There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location.	Avoidance of work in Woodland 1 and 2 has been achieved i.e., mitigation through design. This ensures that there will be no direct impact to the structure and function of the woodlands. Some work in Woodland 4 is unavoidable. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. Some loss of mature trees at the fringes of the woodland is unavoidable, but an overall change in habitat will not occur, and replacement regeneration will be of native composition (via planting or monitoring of natural regeneration).	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				The mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Post-construction monitoring will be required.	
	Habitat area	Hectares	There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location.	Avoidance of work in Woodland 1 and 2 has been achieved i.e., mitigation through design. This ensures that there will be no direct impact to the structure and function of the woodlands. Some work in Woodland 4 is unavoidable. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. Some loss of mature trees at the fringes of the	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				woodland is unavoidable, but an overall change in habitat will not occur, and replacement regeneration will be of native composition (via planting or monitoring of natural regeneration). The mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Post-construction monitoring will be required.	
	Habitat area	Hectares	There will be no direct loss of priority habitat within the boundary of the SAC. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this location.	Avoidance of work in Woodland 1 and 2 has been achieved i.e., mitigation through design. This ensures that there will be no direct impact to the structure and function of the woodlands. Some work in Woodland 4 is unavoidable. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall at this	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				location. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. Some loss of mature trees at the fringes of the woodland is unavoidable, but an overall change in habitat will not occur, and replacement regeneration will be of native composition (via planting or monitoring of natural regeneration). The mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Post-construction monitoring will be required.	
	Habitat distribution	Occurrence	There will be no change in the distribution of habitat within the SAC.	n/a	No adverse effects
	Woodland size	Hectares	No area of mapped alluvial woodland beside the scheme meets the recommended minimum	Some work in Woodland 4 is unavoidable. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
			of 3ha for 'smallwoods within the SAC as outlined in the conservation objectives target (NPWS 2012). There will be no change in woodland sizes within the SAC. No decline.	permanently lost at Island House to accommodate the flood wall at this location. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. Some loss of mature trees at the fringes of the woodland is unavoidable, but an overall change in habitat will not occur, and replacement regeneration will be of native composition (via planting or monitoring of natural regeneration). The mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Post-construction monitoring will be required.	
	Woodland structure: cover and height	Percentage and metres	No change in height or cover of Alluvial Woodlands anticipated at canopy or subcanopy layers.	n/a	No adverse effects
	Woodland structure:	Hectares	No change in diversity and extent of Alluvial	n/a	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	community diversity and extent		Woodlands anticipated.		
	Woodland structure: natural regeneration	Seedling: sapling: pole ratio	Scheme not anticipated to effect natural regeneration	The mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Dust management plan from Section 7.3.9 will protect the overall structure and function of woodland from dust.	No adverse effects
	Hydrological regime: flooding depth/height of water table	Metres	There will be no impacts to the hydrology of the woodland during construction or operation.	n/a	No adverse effects
	Woodland structure: dead wood	m^3 per hectare; number per hectare	Deadwood was not assessed during the Annex I assessment, however it is not expected that the scheme will impact this attribute significantly.	Any wood removed during Construction of scheme (e.g., trimming of branches) will be left in Situ as per Section 7.1.1.	No adverse effects
	Woodland structure:	Number per hectare	No veteran trees were recorded. No impacts to	n/a	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	veteran trees		this attribute is anticipated.		
	Woodland structure: indicators of local distinctiveness	Occurrence	There were no indicators of local distinctiveness recorded from the alluvial woodland. No decline is anticipated.	n/a	No adverse effects
	Vegetation composition: native tree cover	Percentage	Movement of soil may encourage seedlings of native trees but also negative indicator species such as Sycamore or Invasive species. Mitigation required.	Some work in Woodland 4 is unavoidable. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. Some loss of mature trees at the fringes of the woodland is unavoidable, replacement regeneration will be of native composition (via planting or monitoring of natural regeneration). Biosecurity measures outlined in Section 7.1.4 will be adhered to, to prevent introduction of invasive species to the area.	No adverse effects
	Vegetation composition: typical species	Occurrence	No negative change anticipated.	Some loss of mature trees at the fringes of the woodland is unavoidable, but an overall change in habitat will not occur, and replacement regeneration will be of native composition (via planting or monitoring of natural regeneration).	No significant effect

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	Vegetation composition: negative indicator species	Occurrence	Spread of non-native invasive species present, notably Giant Hogweed, may be further spread without mitigation. 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	Adherence to the mitigations outlined in Sub-sections 7.1.1, pertaining to the protection of Alluvial woodland during construction phase. Adherence to Biosecurity measures is outlined in Section 7.1.4. Post-construction monitoring will be required.	No adverse effects
Otter Lower River Shannon SAC	Distribution	Percentage positive survey sites	No impact anticipated – scheme will not result in loss of habitat for Otter.	No otter holts or signs were observed during the baseline surveying. Pre-construction survey for Otter will be required prior to works starting on the Cloon Stream as advised in Section 7.1.3. Positive result anticipated during Operation as Sluices at Island House causeway will be removed, allowing access to Cloon Stream year-round, and reducing a barrier to connectivity.	
		No otter holts or signs were observed during the baseline surveying.			
	Pre-construction survey for Otter will be required prior				

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	to works starting on the Cloon Stream as advised in Section 7.1.3.			Indirect impacts to fish biomass availability will be mitigated via the protection of water quality during construction, as advised in Section 7.3.	
	Positive result anticipated during Operation as Sluices at Island House causeway will be removed, allowing access to Cloon Stream year-round, and reducing a barrier to connectivity.				
	Indirect impacts to fish biomass availability will be mitigated				

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	via the protection of water quality during construction, as advised in Section 7.3.				
		No adverse effects			
Sea Lamprey Lower River Shannon SAC	Distribution: extent of anadromy	% of river accessible	No impact from construction or operational phase anticipated on SAC habitat. The culvert and weir system at the outfall of the Cedarwood stream (ex-situ SAC) restricts Lamprey movement upstream. Therefore, no direct impacts associated with the culvert replacement are anticipated for Lamprey QIs.	n/a	No adverse effects
	Population structure of juveniles	Number of age/size groups	Construction phase: release of pollutants may result in mortality.	Mitigation to prevent sediments and pollutants and dusts from entering watercourses is outlined in Section	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
			Operational phase: None	7.3 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. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	
	Juvenile density in fine sediment	Juveniles/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Operational phase: None	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level knowledge of fisheries to manage works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2).	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				Liaison with IFI.	
	Extent and distribution of spawning habitat	m² and occurrence	Construction phase Released fine sediment may settle on spawning beds reducing quality. Operational phase: None	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	No adverse effects
	Availability of juvenile habitat	Number of positive sites in 3rd order channels (and greater), downstream of spawning areas	Construction phase: Instream piling and/or cofferdams will temporarily reduce juvenile habitat.	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level knowledge of fisheries to manage works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2). Liaison with IFI.	No adverse effects
	Distribution: extent of	% of river	No impact from construction or operational	n/a	No adverse

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	anadromy	accessible	phase anticipated on SAC habitat. The culvert and weir system at the outfall of the Cedarwood stream (ex-situ SAC) restricts Lamprey movement upstream. Therefore, no direct impacts associated with the culvert replacement are anticipated for Lamprey QIs.		effects
	Population structure of juveniles	Number of age/size groups	Construction phase: release of pollutants may result in mortality. Operational phase: None	Mitigation to prevent sediments and pollutants and dusts from entering watercourses is outlined in Section 7.3 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.	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	
Brook Lamprey Lower River Shannon SAC	Distribution	% of river accessible	No impact from construction or operational phase anticipated	n/a	No adverse effects
	Population structure of juveniles	Number of age/size groups	Construction phase: release of pollutants may result in mortality. Operational phase: None	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3 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. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
				management plan (Section 7.3.9) are also in place.	
	Juvenile density in fine sediment	Juveniles/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Operational phase: None	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level knowledge of fisheries to manage works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2). Liaison with IFI.	No adverse effects
	Extent and distribution of spawning habitat	m² and occurrence	Construction phase Released fine sediment may settle on spawning beds reducing quality. Operational phase: None	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3 Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	No adverse effects
	Availability of juvenile habitat	Number of positive sites in 2nd order	Construction phase: Instream piling and/or cofferdams will	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
		channels (and greater), downstream of spawning areas	temporarily reduce juvenile habitat.	knowledge of fisheries to manage works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2). Liaison with IFI.	
River Lamprey Lower River Shannon SAC	Distribution	% of river accessible	No impact from construction or operational phase anticipated	n/a	n/a
	Population structure of juveniles	Number of age/size groups	Construction phase: release of pollutants may result in mortality. Operational phase: None	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3 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.	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	Juvenile density in fine sediment	Juveniles/m²	Construction phase: Instream piling and/or cofferdams may result in entrapment of juveniles and mortality. Operational phase: None	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level knowledge of fisheries to manage works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2). Liaison with IFI.	No adverse effects
	Extent and distribution of spawning habitat	m² and occurrence	Construction phase Released fine sediment may settle on spawning beds reducing quality. Operational phase: None	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are in place.	No adverse effects
	Availability of juvenile habitat	Number of positive sites in 2nd order channels	Construction phase: Instream piling and/or cofferdams will temporarily reduce	Appointment of ECoW with experience in riverine infrastructure works and should have a high-level knowledge of fisheries to manage	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
		(and greater), downstream of spawning areas	juvenile habitat.	works within, or in proximity to the watercourses (Cedarwood Stream, Rivergrove/Grange House Walls). Translocation of ammocetes and entrapped fish as required (Section 7.1.3.1 and 7.3.3.2). Liaison with IFI.	
Atlantic Salmon Lower River Shannon SAC	Distribution: extent of anadromy	% of river accessible	No impact expected.	n/a	No adverse effects
	Adult spawning fish	Number	Construction phase: Released fine sediment, cement and/or hydrocarbons may adversely impact on fish. Operational phase: no impact	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3 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.	No adverse impact
	Salmon fry	Number of fry/5 minutes	Construction phase:	Mitigation to prevent sediments and pollutants from entering	No adverse

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	abundance	electrofishing	Released fine sediment, cement and/or hydrocarbons may adversely impact on fish. Operational phase: No impact	watercourses is outlined in Section 7.3. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	impact
	Out-migrating smolt abundance	Number	Construction phase: Although Cedarwood Stream (ex-situ habitat) may provide limited habitat potential to young salmon, abundances are considered low, temporary restriction of movement during construction phase will not adversely impact this conservation objective. Operational phase: The Cedarwood stream is not considered an important habitat for young salmon before migration, however it may provide some supporting habitat for a	The construction of these culverts should follow best practice guidance including but not limited to: • OPW (2021) 'Design guidance For Fish Passage On Small Barriers'. Fish salvage and translocation efforts will ensure that there will be no entrapment as a result of the dry cell dewatering during works in the Cedarwood.	No significant effect

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
			low abundance of fish. Improper culvert design may result in a very small reduction in migrating smolts in the range of one or two less fish every couple of years.		
	Number and distribution of redds	Number and occurrence	Construction phase: Release of fine sediment may result in deterioration of spawning redds when fine sediment settles in the main channel. No operational phase impacts	Mitigation to prevent sediments and pollutants from entering watercourses is outlined in Section 7.3. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	No adverse effects
Cormorant River Shannon and River Fergus Estuaries SPA And Lough Derg (Shannon) SPA	Distribution	Range, timing and intensity of use of areas	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant	n/a	No significant effect
	Breeding population abundance: apparently occupied nests (AONs)	Number	No breeding cormorant present No decline	n/a	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	Productivity rate	Mean number	No breeding cormorant present No decline	n/a	No adverse effects
	Distribution: breeding colonies	Number; location; area (hectares)	No breeding cormorant present No decline	n/a	No adverse effects
	Prey biomass available	Kilogrammes	Impacts on water quality from discharges have the potential to indirectly impact on populations of fish that Cormorant feed on. Reduced prey availability may impact on distribution.	Indirect impacts to fish biomass availability will be mitigated via the protection of water quality during construction, as advised in Section 7.3. Surface Water Management Plans (Section 7.3.7), and Pollution Control Plans (Section 7.3.8), dust management plan (Section 7.3.9) are also in place.	
	Barriers to connectivity	Number; location; shape; area (hectares)	FRS will not cause any barrier to cormorant moving up and down the River	n/a	No adverse effects
	Disturbance at the breeding site	Level of impact	No breeding cormorant present No decline	n/a	No adverse effects
	Population trend	Percentage change	NA	n/a	No adverse effects

Qualifying Interest	Attribute	Measure	Potential Impacts	Mitigation Measures	Residual Impact
	Distribution	Range, timing and intensity of use of areas	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant	n/a	No adverse effects
Black-headed Gull River Shannon and River Fergus Estuaries SPA	Population trend	Percentage change	Scheme not expected to impact population changes.	n/a	No adverse effects
	Distribution	Range, timing and intensity of use of areas	Noise disturbance from construction may cause temporary displacement but this is not expected to be significant	n/a	No adverse effects

7.4 Cumulative Impact Assessment Summary

The site of the proposed works is situated on a major river (Shannon) in the village of Castleconnell.

Projects within the village environs that could have a cumulative or in-combination impact are listed in Section 5, which generally include new housing developments. None of their associated Environmental reports indicate significant cumulative impacts.

Residual impacts

Residual ecological impacts are those that remain once the development proposals have been implemented. The main aim of ecological mitigation, compensation and enhancement is to minimise or eliminate residual impacts.

The Scheme will result in some loss of trees from Alluvial Woodland 1, 2 and 4, which will be kept as minimal as possible. There-planting with native Alder, and removal of negative indicators such as Sycamore, other non-natives and invasives species should result in no adverse impact to this QI. No other project listed in Chapter 4 is anticipated to remove any Annex I Alluvial Forests and therefore no cumulative impact is anticipated.

During construction there may be water quality impacts. With mitigation measures, outlined in Section 7.3. to protect water quality for Fish QIs and prey biomass for Otter and Cormorant, no significant adverse effect is anticipated from the construction of the Scheme. Upstream of the proposed FRS, the Killaloe Bypass is currently being constructed and could continue up to 2026. An NIS has been carried out for this project. This project is not expected to have cumulative impact 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. No other project listed in Chapter 4 is located upstream with surface water pathway and therefore no cumulative impact is anticipated.

No adverse impacts are anticipated from the Operation of this Scheme.

The remainder of the permitted projects within the locality of the proposed development would have all been in compliance with all applicable planning and environmental approval requirements and be in accordance with the objectives and policies of their respective county / city council development plans. These permitted developments were subject to planning consent, including Appropriate Assessment process, where necessary. By granting permission for these proposed developments, the relevant competent authorities determined that these developments would not lead to adverse temporary or residual impacts on the integrity of any Natura 2000 site, either alone or in-combination with other proposed developments within the locality.

Therefore, there is no potential for these permitted projects and the proposed development to generate adverse cumulative impacts on the Natura 2000 sites within the ZoI, given that mitigation measures that will be in place for the proposed development will ensure no adverse temporary or residual impacts on these designated sites.

8 NIS Conclusion

This Natura Impact Statement provides information for the competent authority to undertake the Stage 2 Appropriate Assessment of the proposed Castleconnell Flood Relief Scheme and in particular to examine the potential direct and indirect impacts on the following Natura 2000 sites:

- Lower River Shannon SAC
- River Shannon and River Fergus Estuaries SPA.
- Lough Derg (Shannon) SPA

A phase 1 Screening for Appropriate Assessment (Section 3) concluded that the potential for significant effects is likely in relation to the above sites. This screening exercise followed a methodology which examines three source > pathway > receptor chains: surface water, land and air, and groundwater pathways.

The proposed FRS works are located directly adjacent to the Lower River Shannon SAC and upstream of River Shannon and River Fergus Estuaries SPA and downstream of Lough Derg SPA. The qualifying interests for Lower River Shannon SAC within the zone of influence are Alluvial forests [91E0], Brook Lamprey *Lampetra planeri* [1096], River Lamprey *Lampetra fluviatilis* [1099], Sea Lamprey *Petromyzon marinus* [1095], Atlantic Salmon *Salmo salar* [1106] and Otter *Lutra lutra* [1355]. Qualifying interests for the River Shannon and River Fergus Estuaries SPA and Lough Derg SPA include wintering birds Cormorant and Black-headed Gull, that forage and rest in the River Shannon and banks around Castleconnell.

Where potentially significant adverse impacts were identified, a range of mitigation and avoidance measures have been recommended. Mitigation measures have been proposed for the area of the proposed development site, including surface water; air (dust), and disturbance mitigations ensuring that the QIs of Natura 2000 sites do not suffer any adverse effects as result of the development.

It is therefore concluded 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:

To confirm this conclusion, a checklist on methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC from (European Commission 2021) has been completed with regards to conservation objectives in Table 8-1.

Table 8-1 Assessing the effects on the integrity of the Natura 2000 site.

Does the plan or project have the potential to:	Yes/No
Hamper or cause delays in progress towards achieving the site's conservation objectives?	No - Following mitigation, no significant adverse residual impacts have been identified that will hamper or delay achievement of the conservation objectives of River Shannon and River Fergus Estuaries SPA, Lower River Shannon SAC and Lough Derg (Shannon) SPA
Reduce the area, or quality, of protected habitat types or habitats of protected species present on the site?	No - Potential adverse impacts on the habitats or protected species of the Lower River Shannon SAC are not expected given the mitigation measures that have been detailed. Some work in Woodland 4 is unavoidable. 27m2 of the edge of Affinity to Alluvial Woodland (4) will be permanently lost at Island House to accommodate the flood wall. This area has affinity to Alluvial forest but does not meet the criteria due to the proportion of non-indicator tree species. However overall, no loss of priority habitat will occur, and the quality to the habitats, following mitigation, is expected to improve.
Reduce the population of the protected species significantly present on the site?	No - Potential impacts to key species of River Shannon and River Fergus Estuaries SPA, Lower River Shannon SAC and Lough Derg (Shannon) SPA are not expected, as impacts can be avoided by implementing the mitigation measures detailed.
Result in disturbance that could affect the population size or density or the balance between species?	No - Potential impacts to key species for which River Shannon and River Fergus Estuaries SPA, Lower River Shannon SAC and Lough Derg (Shannon) SPA are designated are not expected, as impacts can be avoided by implementing the mitigation measures detailed. Population sizes and ecosystem function will be maintained.
Cause the displacement of protected species significantly present on the site and thus reduce the distribution area of those species in the site?	No - Protected species will not be significantly displaced, and the distribution areas of species in the site will be maintained.

Does the plan or project have the potential to:	Yes/No
Result in a fragmentation of Annex I habitats or habitats of species?	No – Potential impacts resulting in fragmentation of species or habitats of the Lower River Shannon SAC are not expected as impacts can be avoided by implementing the mitigation measures detailed.
Result in a loss or reduction of key features, natural processes or resources that are essential for the maintenance or restoration of relevant habitats and species in the site (e.g., tree cover, tidal exposure, annual flooding, prey, food resources)?	No - Potential adverse impacts on key features of River Shannon and River Fergus Estuaries SPA, Lower River Shannon SAC and Lough Derg (Shannon) SPA are not expected, as impacts can be avoided by implementing the mitigation measures detailed. Hydrological flooding regime will be maintained within the SAC, riparian tree cover will be maintained, prey and food resources will not be affected, water quality will not be affected.
Disrupt the factors that help maintain the favourable conditions of the site or that are needed to restore these to a favourable condition within the site?	No - Potential adverse impacts via surface water; land and air; and groundwater pathways identified during the screening process can be mitigated against. The conservation objectives of the Natura sites that allow favourable condition of the site assessed individually, and no adverse effects on the measures of favourable condition will occur.
Interfere with the balance, distribution and density of species that are the indicators of the favourable conditions of the site?	No - Potential impacts to the population size, density or balance of key species are not expected, as impacts can be avoided by implementing the mitigation measures detailed.

Appendices

The following is included in the appendices:

Appendix A – NBDC data- a table of protected species recorded historically within 5km of Castleconnell

Appendix B- Habitat surveys carried out by JBA and sub-consultant report from Dr Jo Denyer on Annex I habitat.

Appendix C- Bird survey results included Wintering bird surveys and Breeding bird survey, as well as results of Heronry surveys.

Appendix D- Mammal survey results including surveys of Cloon Stream for Otter

Appendix E- Bat surveys –

Appendix F – Fisheries survey report conducted by Sub-consultant Ecofact

Appendix E – eDNA results from Cedarwood Stream

Appendices

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Appendix E- Bat surveys –

Appendix F – Fisheries survey report conducted by Sub-consultant Ecofact

Appendix E – eDNA results from Cedarwood Stream

Survey type	Date	Location of survey	Assessed in NIS or EIAR
Habitat surveys – survey data included in Appendix B			
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

Survey type	Date	Location of survey	Assessed in NIS or EIAR
Bird surveys – survey data included in Appendix C			
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	
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 D			
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

Survey type	Date	Location of survey	Assessed in NIS or 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 E			
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 F			
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 accompanies this report			
Tree surveys (surveyed by Arborist)	19 & 20 October 2022	Entire scheme	EIAR

A Habitats

A.1 Protected Species recorded 5km of the site over the last 10 years(NBDC, 2023)

Species name	Date of last record	Dataset	Designation
Amphibians			
Common Frog (Rana temporaria)	09/03/2020	Amphibians and reptiles of Ireland	EU Habitats Directive Annex V || Protected Species: Wildlife Acts
Smooth Newt (Lissotriton vulgaris)	26/03/2020	Amphibians and reptiles of Ireland	Protected Species: Wildlife Acts
Birds			
Barn Owl (Tyto alba)	17/03/2019	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Red List
Barn Swallow (Hirundo rustica)	31/03/2019	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Black-headed Gull (Larus ridibundus)	04/01/2018	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Common Coot (Fulica atra)	22/04/2019	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section II Bird Species, Birds of Conservation Concern - Amber List
Common Kestrel (Falco tinnunculus)	12/05/2019	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Red List
Common Kingfisher (Alcedo atthis)	23/09/2018	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex I Bird Species, Birds of Conservation Concern - Amber List
Common Linnet (Carduelis cannabina)	12/05/2019	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Common Snipe (Gallinago gallinago)	18/01/2017	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section III Bird Species, Birds of Conservation Concern - Red List
Common Starling (Sturnus vulgaris)	07/12/2017	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber

Species name	Date of last record	Dataset	Designation
			List
Common Wood Pigeon (Columba palumbus)	30/12/2017	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section I Bird Species
Eurasian Curlew (Numenius arquata)	09/05/2021	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section II Bird Species, Birds of Conservation Concern - Red List
European Golden Plover (Pluvialis apricaria)	01/03/2018	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex I Bird Species, EU Birds Directive Annex II, Section II & Annex III, Section III Bird Species, Birds of Conservation Concern - Red List
Goldcrest (Regulus regulus)	24/01/2018	Birds of Ireland	Birds of Conservation Concern - Amber List
Great Cormorant (Phalacrocorax carbo)	30/12/2017	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Grey Wagtail (Motacilla cinerea)	23/04/2014	Birds of Ireland	Birds of Conservation Concern - Red List
Greylag Goose (Anser anser)	23/04/2014	Birds of Ireland	Invasive Species Regulation S.I. 477 (Ireland), Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section II Bird Species, Birds of Conservation Concern - Amber List
Hen Harrier (Circus cyaneus)	10/06/2021	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex I Bird Species, Birds of Conservation Concern - Amber List
House Sparrow (Passer domesticus)	07/12/2017	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Mallard (Anas platyrhynchos)	30/08/2022	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section I Bird Species, Birds of Conservation Concern - Amber List
Mute Swan (Cygnus olor)	04/01/2018	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List

Species name	Date of last record	Dataset	Designation
Northern Lapwing (Vanellus vanellus)	01/03/2018	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex II, Section II Bird Species, Birds of Conservation Concern - Red List
Sand Martin (Riparia riparia)	23/04/2014	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Sky Lark (Alauda arvensis)	12/05/2019	Birds of Ireland	Wildlife Acts, Birds of Conservation Concern - Amber List
Whooper Swan (Cygnus cygnus)	02/03/2020	Birds of Ireland	Wildlife Acts, EU Birds Directive Annex I Bird Species, Birds of Conservation Concern - Amber List
Willow Warbler (Phylloscopus trochilus)	22/04/2019	Birds of Ireland	Birds of Conservation Concern - Amber List
Flora			
Yellow Archangel (Lamiastrum galeobdolon)	12/04/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Threatened Species: Least concern
Invertebrates			
Large Heath (Coenonympha tullia)	03/06/2021	Atlas of Butterflies in Ireland 2021	Threatened Species: Vulnerable
Marsh Fritillary (Euphydryas aurinia)	04/06/2018	Irish Butterfly Monitoring Scheme	EU Habitats Directive Annex II, Threatened Species: Vulnerable
Small Heath (Coenonympha pamphilus)	11/06/2020	Atlas of Butterflies in Ireland 2021	Threatened Species: Near threatened
Gooden's Nomad Bee (Nomada goodeniana)	30/04/2021	Bees of Ireland	Threatened Species: Endangered
Large Red Tailed Bumble Bee (Bombus (Melanobombus) lapidarius)	02/08/2020	Bees of Ireland	Threatened Species: Near threatened

Species name	Date of last record	Dataset	Designation
Moss Carder-bee (Bombus (Thoracombus) muscorum)	30/05/2018	Bees of Ireland	Threatened Species: Near threatened
Mammals			
Daubenton's Bat (Myotis daubentonii)	27/08/2013	National Bat Database of Ireland	EU Habitats Directive Annex IV, Wildlife Acts
Eurasian Badger (Meles meles)	31/12/2015	Badger Setts of Ireland Database	Wildlife Acts
Eurasian Pygmy Shrew (Sorex minutus)	24/08/2017	Mammals of Ireland 2016-2025	Wildlife Acts
Eurasian Red Squirrel (Sciurus vulgaris)	03/01/2023	Mammals of Ireland 2016-2025	Wildlife Acts
European Otter (Lutra lutra)	14/10/2012	Roadkill Survey	EU Habitats Directive Annex II & Annex IV, Wildlife Acts
Lesser Horseshoe Bat (Rhinolophus hipposideros)	27/01/2015	National Lesser Horseshoe Bat Database	EU Habitats Directive Annex II & Annex IV, Wildlife Acts
Pine Marten (Martes martes)	18/11/2020	Mammals of Ireland 2016-2025	EU Habitats Directive Annex V, Wildlife Acts
West European Hedgehog (Erinaceus europaeus)	26/06/2021	Hedgehogs of Ireland	Wildlife Acts

A.2 Invasive Soecies Recorded within a 5km Radius over the last 10 years

Species name	Date of last record	Dataset	Designation
Birds			

Species name	Date of last record	Dataset	Designation
Greylag Goose (Anser anser)	23/04/2014	Birds of Ireland	Invasive Species Regulation S.I. 477 (Ireland), Wildlife Acts, EU Birds Directive Annex II, Section I & Annex III, Section II Bird Species, Birds of Conservation Concern - Amber List
Flora			
Butterfly-bush (Buddleja davidii)	27/06/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Medium Impact Invasive Species
Cherry Laurel (Prunus laurocerasus)	18/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species
Giant Hogweed (Heracleum mantegazzianum)	10/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Giant Knotweed (Fallopia sachalinensis)	24/08/2016	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Himalayan Honeysuckle (Leycesteria formosa)	16/07/2019	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Medium Impact Invasive Species
Himalayan Knotweed (Persicaria wallichii)	04/10/2017	National Invasive Species Database	Medium Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Indian Balsam (Impatiens glandulifera)	18/04/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Japanese Knotweed (Fallopia japonica)	10/05/2022	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)

Species name	Date of last record	Dataset	Designation
Rhododendron ponticum	19/06/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Sycamore (Acer pseudoplatanus)	01/07/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Medium Impact Invasive Species
Three-cornered Garlic (Allium triquetrum)	29/03/2021	Vascular plants: Online Atlas of Vascular Plants 2012 Onwards	Medium Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Invertebrates			
Jenkins' Spire Snail (Potamopyrgus antipodarum)	09/08/2018	A national macroinvertebrate dataset collected for the biomonitoring of Ireland's river network, 2007–2018 (EPA)	Medium Impact Invasive Species
Zebra Mussel (Dreissena (Dreissena) polymorpha)	08/08/2018	A national macroinvertebrate dataset collected for the biomonitoring of Ireland's river network, 2007–2018 (EPA)	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Mammals			
American Mink (Mustela vison)	01/06/2015	Atlas of Mammals in Ireland 2010-2015	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)
Bank Vole (Myodes glareolus)	17/11/2010	Atlas of Mammals in Ireland 2010-2015	Medium Impact Invasive Species
Brown Rat (Rattus norvegicus)	09/11/2013	Atlas of Mammals in Ireland 2010-2015	High Impact Invasive Species, Invasive Species Regulation S.I. 477 (Ireland)

Species name	Date of last record	Dataset	Designation
Eastern Grey Squirrel (Sciurus carolinensis)	03/07/2012	Atlas of Mammals in Ireland 2010-2015	High Impact Invasive Species, Invasive Species EU Regulation No. 1143/2014, Invasive Species Regulation S.I. 477 (Ireland)
European Rabbit (Oryctolagus cuniculus)	06/06/2018	Mammals of Ireland 2016-2025	Medium Impact Invasive Species
Greater White-toothed Shrew (Crocidura russula)	02/05/2020	Mammals of Ireland 2016-2025	Medium Impact Invasive Species

B Habitats

B.1 Assessment of Potential Annex 1 habitats

Denyer Ecology report – DE2179_M01a_Castleconnel_FRS_Annex_habitats

B.2 Alluvial Woodland

Denyer Ecology report - DE2179 R01a Castleconnel_FRS_wet woodland

B.3 Tall Herb Swamp

Denyer Ecology report DE2179 R02a Castleconnel_FRS_tall-herb swamp

Memo

To: Declan Egan, JBA Consulting
From: Dr Joanne Denyer (Denyer Ecology)
Cc:
Date: 24 May 2022
Subject: Castleconnel Flood Relief Scheme (FRS) Annex I habitats

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Dr Joanne Denyer was commissioned by JBA Consulting to undertake a survey and assessment of potential Annex I habitats in relation to the Castleconnel Flood Relief Scheme (FRS). Several areas of potential Annex I habitat had been identified within the floodzone of the Lower River Shannon near Castleconnel:

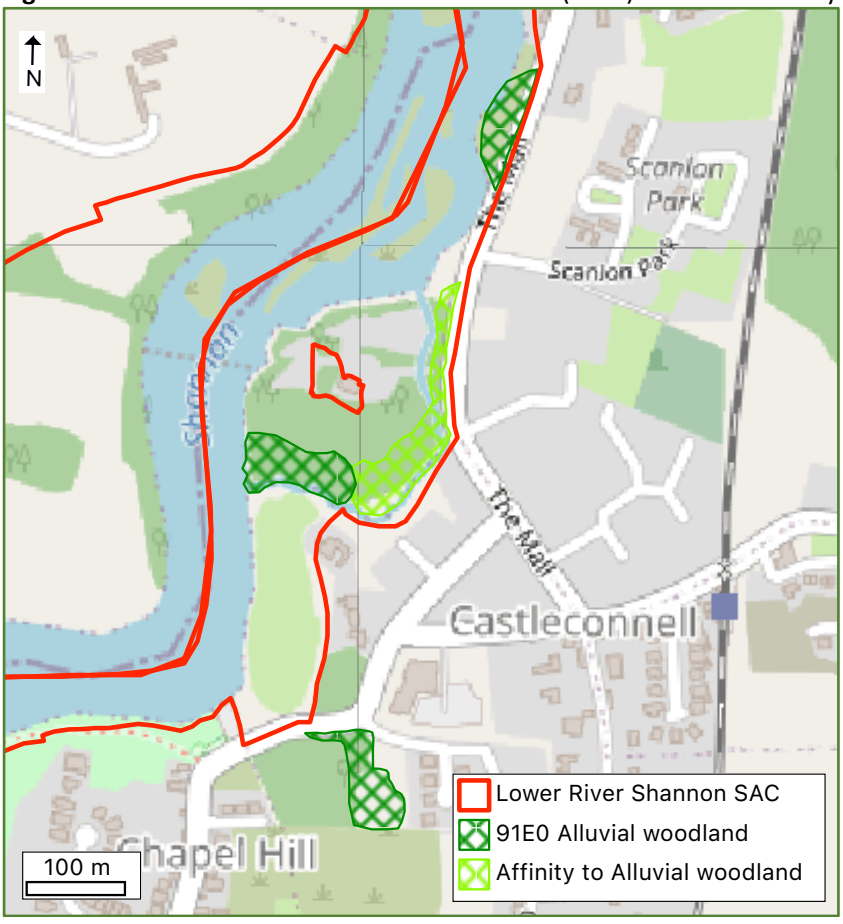
- Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' (Hydrophilous tall-herb fen) [6430]
- Annex I priority habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)' (Alluvial woodland) [91E0]

The site was visited with JBA ecologist Hannah Mulcahy in mid-May 2022. Areas of potential Annex I (priority) habitat were surveyed by walk-over survey. Three areas of **Alluvial woodland (91E0)** were recorded. These are shown on Figure 1. These had a canopy and ground flora dominated by native species typical of alluvial woodland. A detailed 20m x 20m plot was recorded in the northern section (Photograph 1) and 16 positive indicator species for 91E0 were recorded (a minimum of 6 is required for this habitat to pass a condition assessment). In addition, one area of woodland was recorded that was considered to have 'affinity' to alluvial woodland (Figure 1, Photograph 2). This had a canopy dominated by non-native, non-alluvial woodland species (e.g. Sycamore *Acer pseudoplatanus* and Beech *Fagus sylvatica*), but the ground flora had a number of alluvial woodland positive indicator species. Although it is not considered to be an example of alluvial woodland, it is located within the SAC boundary and is sensitive wetland habitat.

Photograph 1. Annex I priority Alluvial woodland in the northern section of the survey area

Photograph 2. Woodland with affinity to 'Alluvial woodland' but with a canopy of non-native tree species

Figure 1.0. Location of Annex I alluvial woodland (91E0) within the survey area



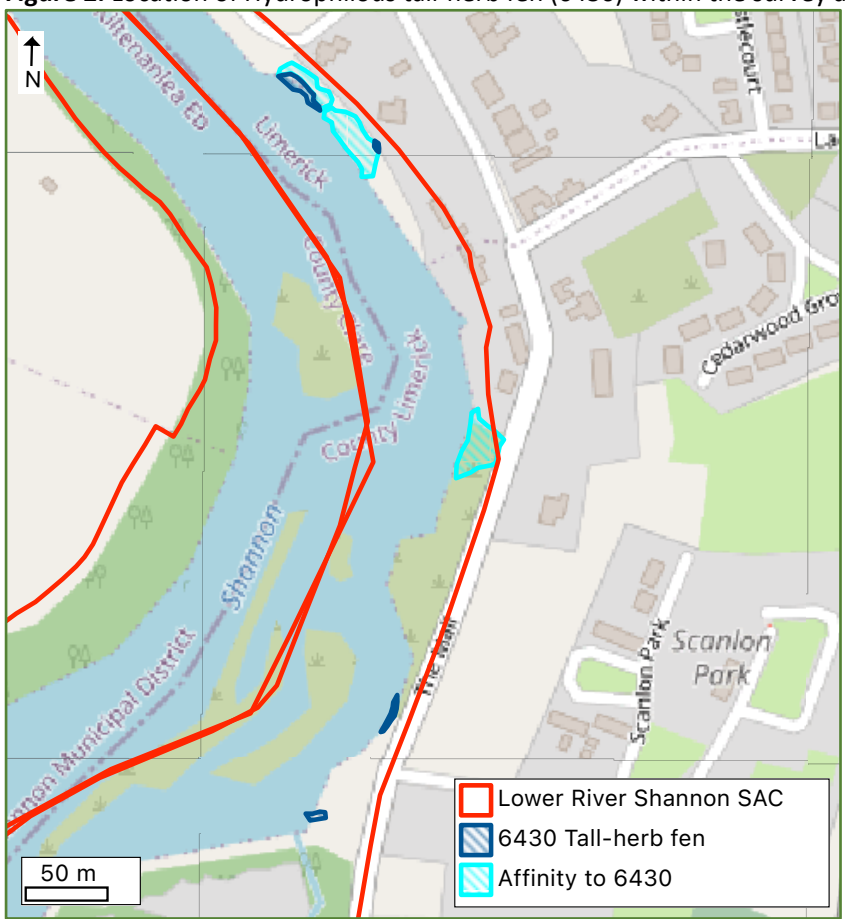
The River Shannon in the survey area frequently has areas of tall-herb swamp along the river margins. In some areas this is considered to be the Annex I habitat **Hydrophilous tall-herb fen (6430)** as it is dominated by positive indicator species for this habitat (Figure 2.0). These tend to be areas located directly adjacent to the river in low-lying areas with high water levels (e.g. Photograph 3). On slightly higher ground, where it is drier, Nettle *Urtica dioica* and Reed Canary-grass *Phalaris arundinacea* are dominant (e.g. Photograph 4). Positive indicator species for Hydrophilous tall-herb fen are present but not dominant. These areas, whilst having 'affinity' to 6430, are not considered to be examples of this Annex I habitat.

However, disturbance should be minimised as they are part of the overall riparian vegetation within the SAC and grade locally into Annex I Hydrophilous tall-herb fen and/ or Alluvial woodland.

Photograph 3. Annex I 'Hydrophilous tall-herb fen in the southern section of the survey area

Photograph 4. Tall-herb swamp with affinity to 'Hydrophilous tall-herb fen'

Figure 2. Location of Hydrophilous tall-herb fen (6430) within the survey area



Summary

- Three areas of Annex I priority Alluvial woodland (91E0) were recorded.
- One area of wet woodland with affinity to Alluvial woodland (91E0) were recorded.
- Four small areas of Hydrophilous tall-herb fen (6430) were recorded.
- Three areas of tall-herb swamp with affinity to Hydrophilous tall-herb fen (6430) were recorded. This habitat is more frequent than shown on Figure 2, as not all areas were mapped (e.g. if they were outside of the FRS direct zone of influence).
- GIS shapefiles of the areas of Annex I habitat (and areas with affinity to Annex I habitat) are included with this survey summary.
- A full survey report will be produced with the details of the survey and assessment for each Annex I/ Annex I priority habitat.

CASTLECONNELL FLOOD RELIEF SCHEME: ALLUVIAL WOODLAND HABITAT SURVEY

July 2022

Report produced by Denyer Ecology for:
JBA Consulting

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CONTENTS

1 INTRODUCTION

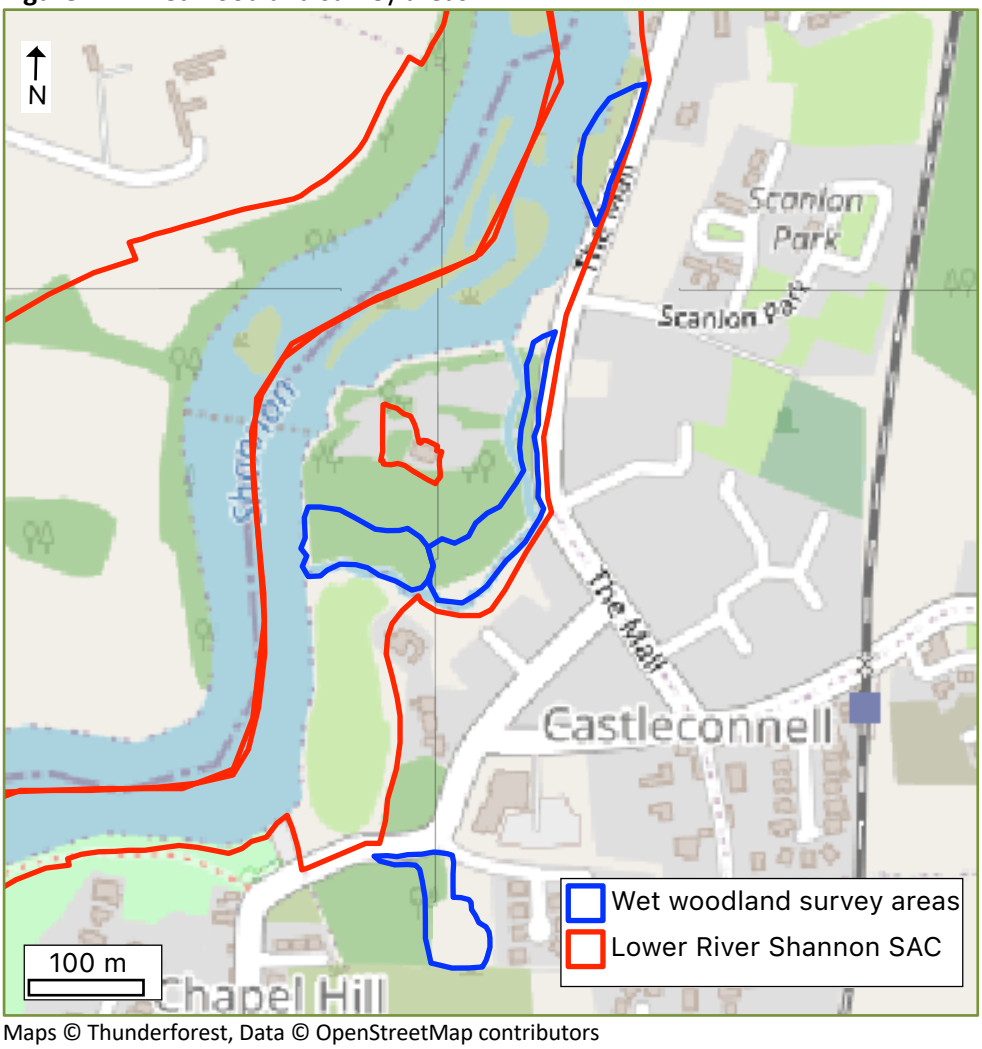
1.1 Background

Dr Joanne Denyer was commissioned by JBA Consulting to undertake a survey and assessment of potential Annex I wetland habitats in relation to the Castleconnel Flood Relief Scheme (FRS). Several areas of potential Annex I priority habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)' (Alluvial woodland) [91E0] had been identified within the floodzone of the Lower River Shannon near Castleconnel. A number of these areas are located within the Lower River Shannon SAC boundary and Alluvial woodland is listed as a Qualifying Interest of this SAC. The aim of the survey was to assess these areas to determine if they are examples of this Annex I priority habitat and to map their extent.

1.2 Site

The survey area is shown in Figure 1.1. It comprises four small areas of wet woodland adjacent to the River Shannon. The site in the south (Figure 1.1) is located outside of the SAC boundary.

Figure 1.1. Wet woodland survey areas



Maps © Thunderforest, Data © OpenStreetMap contributors

2 METHODOLOGY

2.1 Desktop information

The following resources were consulted:

- GIS boundaries of designated site data (data accessed via NPWS website).
- *Conservation Objectives: Lower River Shannon SAC 002165*. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht (2012)
- Lower River Shannon SAC Site synopsis (Revision 13, 16.12.13)
- *Lower River Shannon SAC (site code 2165) Conservation objectives supporting document-woodland habitats* (Version 1, 2012)
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2.2 Habitat survey

The areas of potential Annex I (priority) habitat were surveyed by walk-over survey by two experienced botanists (Dr Joanne Denyer and Hannah Mulcahy The woodland habitat types were classified using 'Guide to Habitats in Ireland' (Fossitt, 2000) and the Irish Vegetation Classification. Within each habitat dominant and abundant plant species, 91E0* indicator species and/or species of conservation interest were recorded.

2.3 Plant species nomenclature

Vascular plant nomenclature follows that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). The bryophyte nomenclature adopted by Blockeel et al. (2021) is used.

3 RESULTS

Three areas of Annex I priority **Alluvial woodland (91E0)** were recorded (Areas 2, 3 and 4; Figure 3.1). These had a canopy and ground flora dominated by native species typical of alluvial woodland. In addition, one area of woodland (Area 1; Figure 3.1) was considered to have 'affinity' to alluvial woodland, but had a canopy dominated by non-native, non-alluvial woodland species. The key features and Annex I assessment of the four woodland areas are shown in Tables 3.1 and 3.2.

Figure 3.1. Location of Annex I priority wet woodland areas

Table 3.1. Description of woodland areas and vegetation community

Woodland area	Photograph	Description	Fossitt Habitat level 3	IVC woodland type
1		An area of planted woodland in the grounds of a house. There is at least one stream channel within the woodland which discharges to the River Shannon. The canopy is dominated by non-native tree species Sycamore *Acer pseudoplatanus* and Beech *Fagus sylvatica,* which are not typical of 91E0. However, in some areas the ground flora has affinity to 91E0 alluvial woodland due to the proximity to the stream and probably winter flooding. Non-native species in ground flora include locally abundant Ground-elder *Aegopodium podagraria,* occasional Giant Hogweed Snowberry *Symphoricarpos albus* and Winter Heliotrope *Petasites fragrans.*	WD1 Mixed broadleaved woodland	Affinity to WL3c *Fraxinus excelsior – Iris pseudacorus* woodland, but with abundant *Fagus sylvatica* in canopy
2		This is a small area of woodland within the flood zone of the River Shannon. The canopy is dominated by Alder *Alnus glutinosa* and the non-native willow species White Willow *Salix alba*. Ash *Fraxinus excelsior* and Rusty willow *Salix cinerea* subsp. *oleifolia* are occasional and the hybrid *Salix* x *reichardtii* (Goat Willow *S. caprea* x Rusty Willow) was recorded. The ground flora is dominated by diverse wetland vegetation. In addition to the positive indicator species, the following are frequent: Hemlock Water-dropwort *Oenanthe crocata,* Great Willowherb *Epilobium hirsutum,* Water horsetail *Equisetum fluviatile*. Giant Hogweed *Heracleum mantegazzianum* is occasional.	WN5 Riparian woodland	WL3D *Salix cinerea – Urtica dioica* woodland, *Salix fragilis – Calystegia sepium* sub-community (WL3Di)

Woodland area	Photograph	Description	Fossitt Habitat level 3	IVC woodland type
3		A small area of woodland 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 *Carex pendula* is also locally frequent.	WN6 Wet willow-alder-ash woodland	WL3E *Salix cinerea – Galium palustre* woodland
4		This area is located to the west of area 1. It is adjacent to the River Shannon and there is a river channel to the south which discharges into the River Shannon. This area was viewed from the south of this channel and partially accessed from the northern side. It was not possible to access the whole area due to the deep river channel and scrub. Whist non-native tree species are present (e.g. Sycamore and conifers), Alder and Ash are also locally frequent and the ground flora dominated by wet woodland species. The woodland grades into area 1 (WD1 Mixed broadleaved woodland) to the east and contains some areas of non-alluvial woodland.	WN6 Wet willow-alder-ash woodland/	WL3c *Fraxinus excelsior – Iris pseudacorus*

Table 3.2. Assessment of Annex I priority habitat features within woodland areas

Woodland area	91E0* positive indicator species	Number of 91E0 positive indicator species in 20m x 20m plot(s)[1]	Proportion of 91E0* target species in canopy[2]	Negative indicator species	Cover of negative species [3]	Annex I priority woodland 91E0*
1	**Target species:** *Alnus glutinosa, Fraxinus excelsior* **Other woody:** *Crataegus monogyna* **Herbs & ferns:** *Agrostis stolonifera, Carex remota, Filipendula ulmaria, Iris pseudacorus, Mentha aquatica, Ranunculus repens, Urtica dioica* **Mosses & liverworts:** n/a	5	<5%	**Non-native trees:** *Acer pseudoplatanus, Fagus sylvatica,* **Non-native shrubs:** *Symphoricarpos albus*	>60%	No
2	**Target species:** *Alnus glutinosa, Fraxinus excelsior, Salix cinerea, Salix alba, Salix* x *reichardtii, Salix viminalis* **Other woody:** n/a **Herbs & ferns:** *Agrostis stolonifera, Angelica sylvestris, Carex remota, Filipendula ulmaria, Galium palustre, Iris pseudacorus, Lycopus europaeus, Mentha aquatica, Phalaris arundinacea, Ranunculus repens, Rumex sanguineus, Urtica dioica* **Mosses & liverworts:** n/a	16	80%	**Non-native trees:** *Acer pseudoplatanus* **Non-native shrubs:** n/a	<1%	Yes
3	**Target species:** *Salix cinerea* **Other woody:** *Betula pubescens* **Herbs & ferns:** *Agrostis stolonifera, Angelica sylvestris, Carex remota, Filipendula ulmaria, Iris pseudacorus, Ranunculus repens, Rumex sanguineus, Urtica dioica* **Mosses & liverworts:** n/a	6	100%	**Non-native trees:** n/a **Non-native shrubs:** n/a	0%	Yes
4	**Target species:** *Alnus glutinosa, Fraxinus excelsior* **Other woody:** *Crataegus monogyna* **Herbs & ferns:** *Agrostis stolonifera, Angelica sylvestris, Carex remota, Filipendula ulmaria, Iris pseudacorus, Ranunculus repens, Rumex sanguineus, Urtica dioica* **Mosses & liverworts:** n/a	6	90% (where 91E0)	**Non-native trees:** *Acer pseudoplatanus,* conifers **Non-native shrubs:** n/a	5% (where 91E0)	Yes, but contains some areas of WD1 which is non-91E0

[1]Target for 91E0 is 6 species per 20m x 20m plot, including at least one target (canopy) species
[2]Target for 91E0 is ≥50% proportion of target species in the canopy
[3]Target for 91E0 is ≤10%

4 DISCUSSION AND SUMMARY

Three areas of Annex I priority alluvial woodland [91E0*] were recorded (Figure 3.1, Tables 3.1 and 3.2).

- Area 2: Riparian woodland, WL3D *Salix cinerea – Urtica dioica* woodland, *Salix fragilis – Calystegia sepium* sub-community (WL3Di)
- Area 3: WN6 Wet willow-alder-ash woodland; WL3E *Salix cinerea – Galium palustre* woodland
- Area 4: WN6 Wet willow-alder-ash woodland; WL3c *Fraxinus excelsior – Iris pseudacorus* woodland

Information on wet woodland within the SAC (SAC site synopsis and *Conservation objectives supporting document- woodland habitats* (see Section 2.1) state that the two main types of wet woodland within the SAC are:

- Gallery woodland (*Salicion albae*) dominated by White Willow and Alder and occurring in small narrow stands on riverbanks (e.g., area 2); and,
- Wet willow-alder-ash woodland dominated by Alder and Rusty Willow with Ash and occurring in valley bottoms and slopes (e.g., areas 3 and 4).

It is noted that Sycamore is the principal invasive alien tree species present, and that Giant Hogweed is frequent.

This is consistent with the three areas of wet woodland recorded and mapped during this survey, within and adjacent to the Lower River Shannon SAC.

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CASTLECONNELL FLOOD RELIEF SCHEME:
TALL-HERB SWAMP HABITAT SURVEY

July 2022

Report produced by Denyer Ecology for:
JBA Consulting

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CONTENTS

1 INTRODUCTION

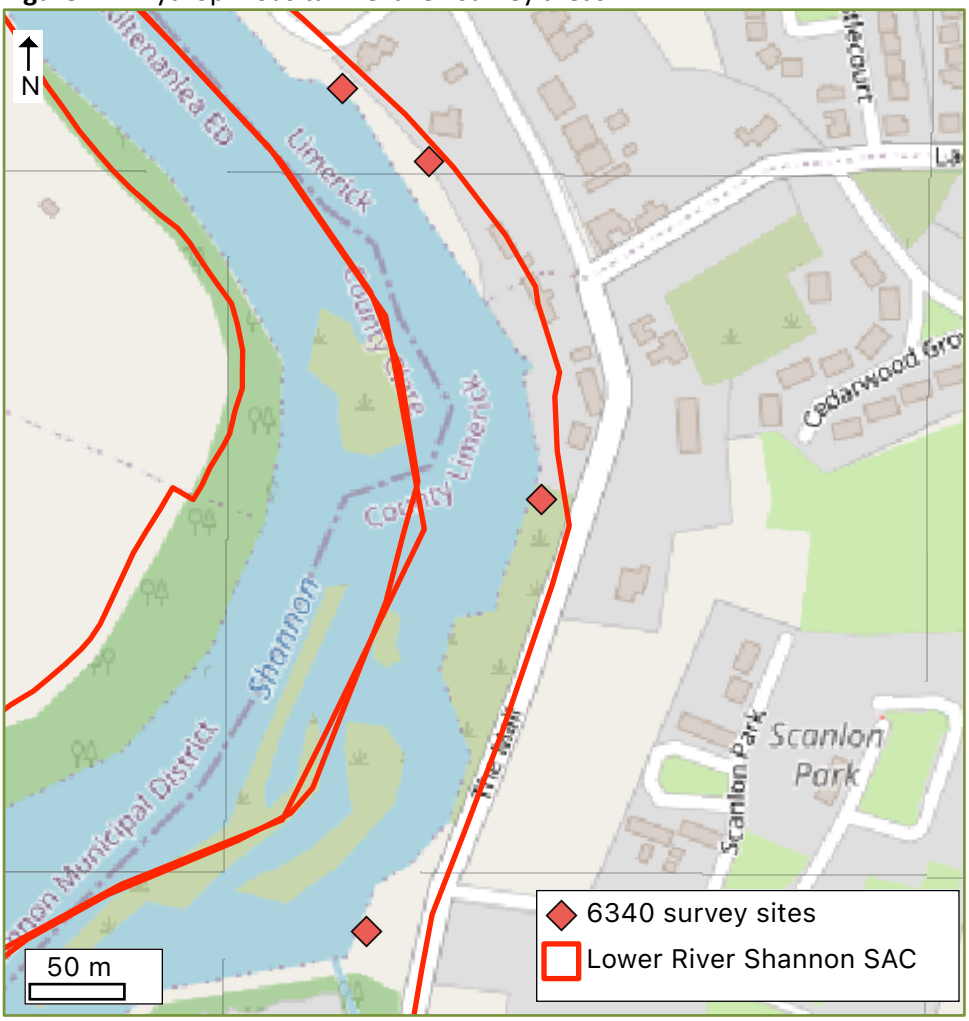
1.1 Background

Dr Joanne Denyer was commissioned by JBA Consulting to undertake a survey and assessment of potential Annex I wetland habitats in relation to the Castleconnel Flood Relief Scheme (FRS). Several areas of potential Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels)' (Hydrophilous tall-herb fen) [6430] had been identified adjacent to the Lower River Shannon near Castleconnel. These areas are located within the Lower River Shannon SAC boundary. This Annex I habitat is not (currently) listed as a Qualifying Interest of this SAC. The aim of the survey was to assess these areas to determine if they are examples of this Annex I habitat and to map their extent.

1.2 Site

The survey area is shown in Figure 1.1. It comprises four sections of riparian vegetation adjacent to the River Shannon within the SAC boundary.

Figure 1.1. Hydrophilous tall-herb fen survey areas



Maps © Thunderforest, Data © OpenStreetMap contributors

2 METHODOLOGY

2.1 Desktop information

The following resources were consulted:

- GIS boundaries of designated site data (data accessed via NPWS website).
- *Conservation Objectives: Lower River Shannon SAC 002165*. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht (2012)
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- Irish Vegetation Classification (accessed online https://biodiversityireland.ie/projects/ivc-classification-explorer/)

2.2 Consultation

The NPWS grassland specialist was consulted in relation to the latest definition of 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.

2.3 Habitat survey

The areas of potential Annex I (priority) wetland habitat were surveyed by walk-over survey by two experienced botanists (Dr Joanne Denyer and Hannah Mulcahy The vegetation and habitat types were classified using 'Guide to Habitats in Ireland' (Fossitt, 2000) and the Irish Vegetation Classification. Within each habitat dominant and abundant plant species, 6430 indicator species and/or species of conservation interest were recorded.

2.4 Plant species nomenclature

Vascular plant nomenclature follows that of the *New Flora of the British Isles*. 4th Edition (Stace, 2019). The bryophyte nomenclature adopted by Blockeel et al. (2021) is used.

3 RESULTS

Four areas of Annex I Hydrophilous tall-herb fen (Figure 3.1) were identified. In addition there were three areas that had some affinity to Annex I Hydrophilous tall-herb fen, but did not have sufficient cover or number of positive indicator species. The key features and Annex I assessment of the seven wetland areas are shown in Tables 3.1 and 3.2.

Figure 3.1a. Location of areas of Hydrophilous tall-herb fen and similar habitat (southern area)

Figure 3.1b. Location of areas of Hydrophilous tall-herb fen and similar habitat (northern area)

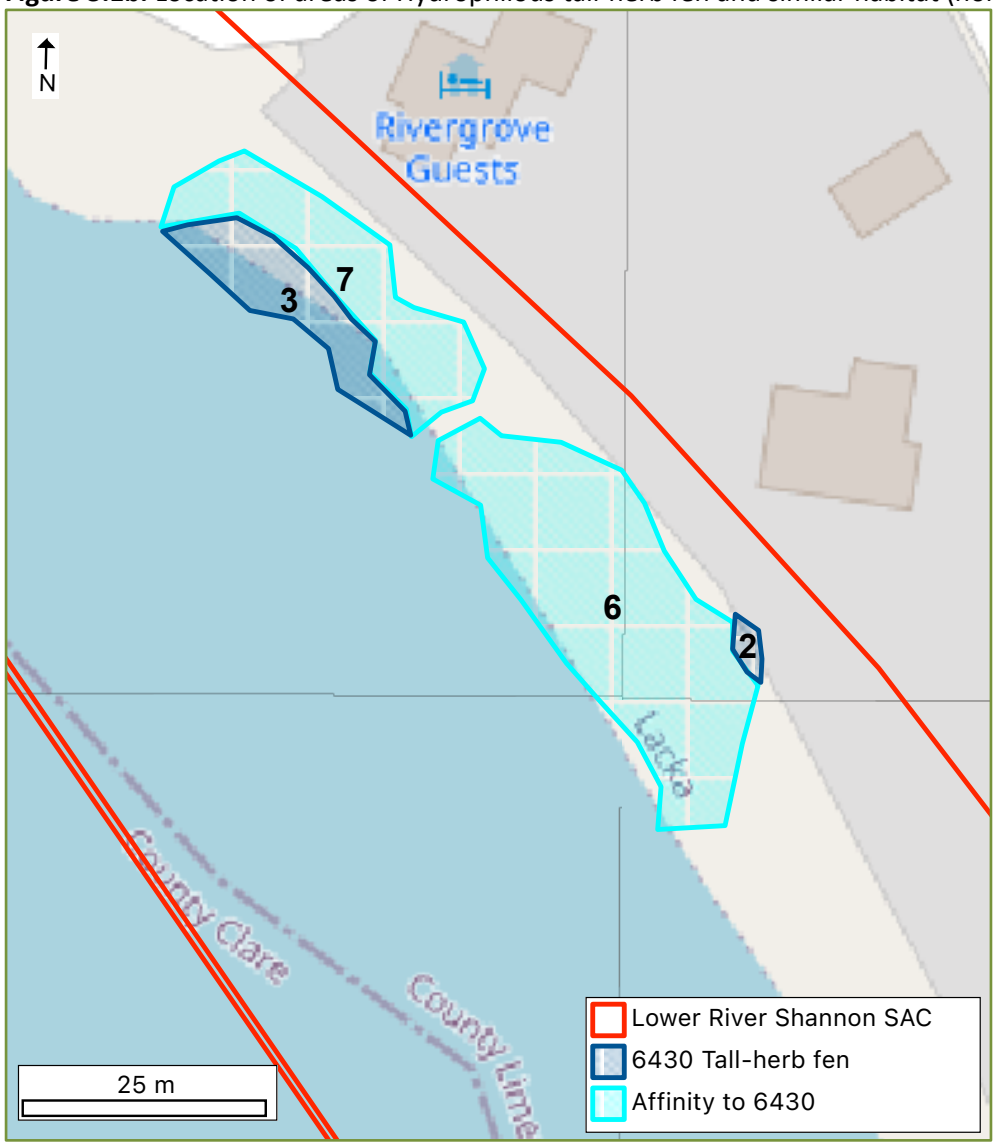

Table 3.1. Description of woodland areas and vegetation community

Wetland area	Photograph	Description	Fossitt Habitat level 3	IVC
1		A small strip of vegetation where a side channel meets the main river. There is a wall to the south and east. A small area is forb dominated. To the east it is drier and Nettle *Urtica dioica* becomes dominant. The main species present are Great Willowherb *Epilobium hirsutum,* Hemlock Water-dropwort *Oenanthe crocata,* Angelica *Angelica sylvestris,* Water Mint *Mentha aquatica,* Marsh Marigold *Caltha palustris,* Hemp-agrimony *Eupatorium cannabinum,* Meadowsweet *Filipendula ulmaria,* Yellow Flag *Iris pseudacorus* and Nettle.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)
2		A small area of vegetation adjacent to the wall of a property to the east (indicated by red arrow). There is a ditch in this location and this small section of vegetation is wetter than adjacent areas, which are Nettle and Reed Canary-grass *Phalaris arundinacea* dominated. The small area of 6430 is forb dominated with Water Mint, Angelica, Marsh Marigold, Great Willowherb, Meadowsweet, Water Horsetail, Hemlock Water-dropwort, Water Figwort *Scrophularia auriculata,* Tufted Vetch *Vicia cracca* and Reed Canary-grass.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)

Wetland area	Photograph	Description	Fossitt Habitat level 3	IVC
3		An area of wetland vegetation at the edge of the River Shannon and partially submerged. To the east the ground rises (right of the photo) and Nettle becomes dominant. In the wetland area Water Horsetail is abundant with Bur-reed *Sparganium* sp. (not flowering). Where these are dominant it could be classified as Reed and large sedge swamp. However forbs are locally abundant with Water Mint, Hemlock Water-dropwort, Great Willowherb and other wetland species.	FS1 Reed and large sedge swamps/ FS2 Tall-herb swamps	Affinity with both FW3G *Equisetum fluviatile – Eleocharis palustris* swamp and FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp
4		Strip of wetland vegetation between the River Shannon to the west, a wall to the east and area of wet woodland to the north. This area is forb dominated and the vegetation is similar to that found in the ground flora of the wet woodland area. Species present include Great Willowherb, Hedge Bindweed *Calystegia sepium,* Tufted Vetch *Vicia cracca,* Water Horsetail *Equisetum fluviatile,* Hemlock Water-dropwort, Water Mint, Reed Canary-grass and Nettle.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)

Wetland area	Photograph	Description	Fossitt Habitat level 3	IVC
5		An area of riparian vegetation to the north of a wet woodland area (which divides this section from area 4). The River Shannon lies to the west and a wall to the east and north. The vegetation has species typical of 6430, but Nettle and Reed Canary-grass are dominant and it is species-poor overall. Additional species include Hedge Bindweed, Yellow Flag, Water Horsetail and Hemlock Water-dropwort.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)
6		A large area of Nettle dominated vegetation between property walls to the east and the River Shannon to the west. This area occupies slightly higher ground and is above the summer level of the river. Nettle is dominant over most of the area, with Reed Canary-grass, except where it grades into the wet ditch (area 2) closer to the wall to the SE. Other wetland species such as Great Willowherb, Water Mint, Hemlock Water-dropwort and Water Figwort are present but of low frequency and cover.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)

Wetland area	Photograph	Description	Fossitt Habitat level 3	IVC
7		A large area of Nettle dominated vegetation between property walls to the east and the River Shannon to the west (similar to area 6). Giant Hogweed *Heracleum mantegazzianum* is present occasionally. This area occupies slightly higher ground and is above the summer level of the river. Nettle is dominant over most of the area, with Reed Canary-grass, except where it grades into wetter areas at the river edge (area 3). Other wetland species such as Great Willowherb, Water Mint, Hemlock Water-dropwort, Tufted Vetch, Hedge Bindweed are present but of low frequency and cover. In the northern area, to the east (nearest the wall) the vegetation becomes drier with Bramble *Rubus fruticosus* agg. and dumped hedge cuttings.	FS2 Tall-herb swamps	FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)

Table 3.2. Assessment of Annex I habitat features within wetland areas

Woodland area	6430 positive indicator species	Number of 91E0 positive indicator species in 2m x 2m plot[1]	Proportion of 6430 target species in sward[2]	Negative indicator species	Cover of negative species[3]	Annex I priority tall-herb fen 6430
1	*Angelica sylvestris, Epilobium hirsutum, Eupatorium cannabinum, Filipendula ulmaria, Iris pseudacorus Mentha aquatica*	4-5	40%	*Phalaris arundinacea*	<10%	Yes
2	*Angelica sylvestris, Epilobium hirsutum, Equisetum fluviatile, Eupatorium cannabinum, Filipendula ulmaria, Iris pseudacorus Mentha aquatica, Vicia cracca*	4-5	50%	*Phalaris arundinacea*	<10%	Yes
3	*Epilobium hirsutum, Equisetum fluviatile, Mentha aquatica*	3-4	60%	*Phalaris arundinacea*	<5%	Yes
4	*Calystegia sepium, Epilobium hirsutum, Equisetum fluviatile, Mentha aquatica, Vicia cracca*	3-4	40%	*Phalaris arundinacea*	<20%	Yes
5	*Calystegia sepium, Equisetum fluviatile, Iris pseudacorus*	2	5%	*Phalaris arundinacea*	>60%	No
6	*Epilobium hirsutum, Mentha aquatica*	1-2	5-10%	*Phalaris arundinacea*	5-10%	No

Woodland area	6430 positive indicator species	Number of 91E0 positive indicator species in 2m x 2m plot[1]	Proportion of 6430 target species in sward[2]	Negative indicator species	Cover of negative species[3]	Annex I priority tall-herb fen 6430
7	*Calystegia sepium, Epilobium hirsutum, Mentha aquatica, Vicia cracca*	1-2	5%	*Phalaris arundinacea*	5-50%	No

[1]Target for 6430is ≥3 species per 2m x 2m plot. Tufted Vetch has been added to the indicator list (NPWS, pers. comm.)

[2]Target for 6430 is ≥40% proportion of positive indicator species in the sward

[3]Target for 6430 is ≤33% collective cover. Nettle is not currently a negative indicator species (but does reduce the proportion of positive indicator species).

4 DISCUSSION AND SUMMARY

Four areas of Annex I Hydrophilous tall-herb fen [6430] were recorded (Figure 3.1, Tables 3.1 and 3.2).

- Area 1: FS2 Tall-herb swamps; most affinity with FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)
- Area 2: FS2 Tall-herb swamps, most affinity with FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)
- Area 3: FS1 Reed and large sedge swamps/ FS2 Tall-herb swamps; affinity with both FW3G *Equisetum fluviatile – Eleocharis palustris* swamp and FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp
- Area 4: FS2 Tall-herb swamps, most affinity with FW3F *Filipendula ulmaria – Valeriana officinalis* tall-herb swamp (although *Phragmites australis* rare)

Three additional areas had similar vegetation but Nettle and/ or Reed Canary-grass were dominant. These are not examples of Annex I Hydrophilous tall-herb fen [6430] as they do not have 3 positive indicator species per 2m x 2m area and positive indicator species are not 40% cover or over. These tend to occupy area that are slightly elevated above the river level and therefore drier. All areas (Annex and non-Annex) are located within the Lower River Shannon SAC.

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C Bird Survey Result

This appendix contains data collected during the bird surveys carried out within the footprint of the scheme. Records of bird data are collected and collated from specific wintering bird surveys, breeding bird surveys, records collected during nonspecific site visits, bird recorded on camera traps, as well as data collected by local residents from sound and observation surveys, and other casual records.

C.1 Wintering Bird Survey

The wintering bird surveys recorded 30 species, with a mix of common woodland and garden bird species, as well as designated species. Two species listed as Qualifying Interests of the River Shannon and River Fergus Estuaries SPA, Cormorant *Phalacrocorax carbo,* Black-headed Gull *Chroicocephalus ridibundus and five species listed in the* Annexes of the Birds Directives, Cormorant *Phalacrocorax carbo,* Mallard *Anas platyrhynchos,* Greylag Goose *Anser anser,* Kingfisher *Alcedo atthis and* Black-headed Gull *Chroicocephalus ridibundus were also recorded.*

Figure 8-1 Wintering bird surveys sites & vantage points

C.1.1 Wintering bird Survey 1 – Island House VP

Date of Survey	14/11/2019		
Surveyor	Hannah Mulcahy		
Survey start	8.30am Survey end	10am	
Weather beaumont	Clear, cold, bright Temp	3-4 degrees wind	4-5

Species	No.	Time	behaviour	location/direction
Cormorant	1	before survey began	fly over	down river
Mallard (male)	1	before survey began	foraging	down river
Greylag Goose	2	8.34	foraging, resting, swimming	down river
Mute Swan	1	8.34	swim	down river
Mallard (male)	1	8.4	fly over	up river
Magpie	1	8.45	fly over	to field to east
Collared Dove	1	8.49	fly over	down river
Mallard	2	8.55	resting	down river
Jackdaw	2	8.55	fly over	to field to east
Mute Swan	2	9	foraging, swimming	up river
Cormorant	1	9.01	fly over	down river
Wood Pigeon	1	9.01	fly over	up river
Hooded Crow	1	9.12	fly over	down river
Kingfisher	1	9.16	fly over, close to water	down river
Chaffinch (female)	1	9.2	moving from tree to tree	up river, stayed by left bank
Grey Wagtail	1	9.23	fly over	down island house stream
Rook	1	9.4	fly over	up river

C.1.2 Wintering bird Survey 1 -Ferry Playground VP

Date of Survey 14/11/2019

Surveyor Colm O'Leary

Survey start 8.30am Survey end 10am

Weather Clear, cold, bright Temp 3-4 degrees wind 4-5 beaumont

Species	No.	Time	behaviour	location/direction
Mute Swan	2	8.35	feeding	centre of river
Cormorant	1	8.36	basking	up river
Mallard	5		fly over	down river
Black-headed Gull	3		fly over	
Mallard	3	8.47	swimming	right bank
Grey Heron	1		foraging	right bank

Species	No.	Time	behaviour	location/direction
Grey Heron	2		foraging	right bank
Grey Heron	1		foraging	down river
Black-headed Gull	8	9.01	resting	right bank
Black-headed Gull	1		fly over	down river
Mallard	2		fly over	down river
Small black-head diver no ID	1	9.2	fly over	down river
Mallard	3		swimming	across river
Cormorant	1		foraging	centre of river
Black-headed Gull	1	9.32	fly over	down river
Black-headed Gull	5		fly over	down river
Mute Swan	1		fly over	down river
Black-headed Gull	7		fly over	up river
Cormorant	1		fly over	down river
Mallard	2	10	foraging	down river

C.1.3 Wintering bird Survey 2 -Ferry Playground VP

Date of Survey 17/12/2019

Surveyor Hannah Mulcahy

Survey start 8.30am Survey end 10am

Weather Clear, cold, bright, Temp 1-2 degrees, no wind

Species	No.	Time	behaviour
Black-headed Gull	15	8.40am	flying
Grey Heron	1		hunting
Mute Swan	2		foraging
Mallard	2		swimming
Wren	1		foraging
Robin	1		foraging
Blackbird	4		foraging
Greylag Goose	2		swimming/flying
Mallard	2		swimming
Rook	4		roosting
Wood Pigeon	2		roosting
Greylag Goose	4	9am	swimming/flying
Mallard	5	9.15am	swimming
Grey Heron	1	9.30am	hunting/flying
Goldfinch	2		foraging

Species	No.	Time	behaviour
Blue Tit	2		foraging
Great Tit	2		foraging
Cormorant	2	9.40am	flying
Moorhen	1		swimming
Song Thrush	1		forgaing
Wagtail	1		forgaing
Grey Wagtail	1		forgaing
Cormorant	1	9.58am	flying
Grey Heron	1		hunting/flying
Treecreeper	2	10am	foraging

C.1.4 Wintering bird Survey 2 -Island House entrance VP

Date of Survey 17/12/2019

Surveyor Colm O'Leary

Survey start 8.30am Survey end 10am

Weather Clear, cold, bright Temp 1-2 degrees wind no wind

Species	No.	Time	behaviour	location/direction
Mallard	3	8.54		
Grey Heron	1	8.54	flying	downstream
Greylag Goose	2	8.54	swimming	north of IH
Mallard	1	9.04	swimming	
Mallard	3	9.26	swimming	
Black-headed Gull	1	9.26	flying	north of IH
Black-headed Gull	1	9.29	flying	
Cormorant	1	9.31	flying	downstream
Grey Heron	1	9.33	flying	upstream
Grey Heron	1	9.34	flying	downstream
Cormorant	1	9.34	flying	downstream
Mute Swan	1	9.43	foraging	
Mallard	1	9.53	swimming	downstream

C.1.5 Wintering bird Survey 3 -Ferry Playground VP

Date of Survey 15.01.2020

Surveyor Colm O'Leary

Survey start 8.30am Survey end 10am

Weather Clear, cold, bright Temp 4 degrees wind small breeze

Species	No.	Time	behaviour	location/direction
Mute Swan	2	8.35	feeding	
Greylag Goose	2		feeding	
Mallard	4		feeding	
Black-headed Gull	17		feeding	
Grey Heron	1	8.37	feeding	opp. Bank
Mallard	2		swimming	
Kingfisher	1	8.38	perched by car park	
Grey Heron	1	8.43	feeding	near bank
Mallard	12	8.47	swimming	upstream
Moorhen	1		flying	downstream
Greylag Goose	5	8.52	flying	upstream
Cormorant	1		flying	downstream
Greylag Goose	56	8.57	flying, landing on water	
Mallard	2		flying	upstream
Greylag Goose	3	9am	flying	downstream
Mute Swan	1		flying	downstream
Mallard	2	9.05	swimming	upstream
Mallard	3		swimming	downstream
Black-headed Gull	1	9.14	swimming	
Black-headed Gull	4		swimming	
Black-headed Gull	2	9.22	swimming	
Greylag Goose	2	9.26	swimming	
Mallard	2	9.29	swimming	
Cormorant	1		flying	downstream
Greylag Goose	1		flying	
Greylag Goose	3	9.31	flying	upstream
Cormorant	1		flying	upstream
Cormorant	1		flying	downstream
Greylag Goose	8	9.37	flying	
Mallard	1		flying	downstream
Greylag Goose	2	9.45	flying	upstream

Species	No.	Time	behaviour	location/direction
Cormorant	1	9.45	flying	downstream
Cormorant	1	9.55	flying	upstream

C.1.6 Wintering bird Survey 3 -Island House entrance VP

Date of Survey 15.01.2020

Surveyor Hannah Mulcahy

Survey start 8.30am Survey end 10am

Weather Clear, cold, bright Temp 4 degrees wind no wind

Species	No.	Time	behaviour	location/direction
Mallard	7	8.4	took flight from water, flushed by surveyor	downriver
Grey Heron	2		circling above river, calling	downriver
Greylag Goose	3	8.55	foraging	near eelery houses
Moorhen	1		foraging	near eelery houses
Greylag Goose	10	8.57	flying in a flock	upriver
Mute Swan	4	9am	foraging	upriver
Greylag Goose	1		flying	downriver
Mallard	3		swimming	downriver
Black-headed Gull	1	9.05	flying	downriver
Mallard	4	9.07	flying/ landing	downriver, behind island
Grey Wagtail	1	9.15	foraging edge of water	
Grey Heron	1	9.2	flying	upriver
Cormorant	1	9.28	flying	downriver
Greylag Goose	2	9.31	flying	upriver
Cormorant	1	9.35	flying	downriver

C.1.7 Wintering bird Survey 4 -Island House entrance VP

Date of Survey 13.02.2020

Surveyor Colm O'Leary

Survey start 07:55 Survey end 09:20

Weather Cold, Clear sky, River in flood, Temp 5, wind low

Species	No.	Time	behaviour	location/direction
Grey Heron	1	08:02		In Island house garden
Moorhen	1	08:04	Flying	Downstream
Otter	1	08:08	Swimming	Downstream
Black-headed Gull	2	08:10	Flying	Downstream
Black-headed Gull	16	08:11	Flying	Downstream
Mallard	2	08:19	Feeding	In reed bed just north of Islandhouse
Grey Heron	1	08:27	Flying	Upstream
Mallard	4	08:30	Flying	Downstream
Grey Heron	1	08:32	Flying	Carrying nest material. Possible nest somewhere near Island House
Grey Wagtail	1	08:35		
Grey Heron	1	08:38	Flying	Carrying nest material.
Little Egret	1	08:54	Flying	Downstream
Grey Heron	1	08:55	Flying	Downstream
Grey Heron	1	08:56	Flying	Upstream
Grey Heron	1	09:00	Flying	Downstream
Mallard	2	09:03	Feeding	
Mallard	1	09:10	Feeding	
Greylag Geese	3	09:11	Flying	Downstream
Mallard	2	09:13	Feeding	In alluvial woodland along road

C.1.8 Wintering bird Survey 4 -Ferry Playground VP

Date of Survey 13.02.2020

Surveyor Joe Freijser

Survey start 07:45 Survey end 09:19

Weather Clear, Sunny Temp5 wind none

Species	No.	Time	behaviour	location/direction
Mute Swan	2	07:45	Feeding	NW parking
Black-headed Gull	1	07:48	Flying	NW parking
Mallard	2	07:59	Swimming	NW parking
Grey Heron	1	08:07	Flying	west

Species	No.	Time	behaviour	location/direction
Mallard	1	08:08	Swimming	NE parking
Dipper	1	08:19	Perching	Under bridge
Dipper	1	08:25	Feeding	Middle of river under bridge
Dipper	2	08:30	Flying	100m ahead of bridge, flying west
Greylag Goose	2	08:36	Foraging	on r-bank opposite playground
Moorhen	1	08:37	Swimming	on r-bank opposite playground
Black-headed Gull	1	08:45	Swimming	on r-bank opposite playground
Tree Sparrow	~50	08:46	Feeding	On floating debris next to park
Long-tailed Tit	1	08:50		
Grey Heron	1	08:54	Flying	East, North of park
Black-headed Gull	2	09:06	Sitting	on bank playground
Mallard	2	09:08	Flying	
Greylag Goose		09:08		on water
Mute Swan		09:08		on water

C.1.9 Wintering bird Survey 5

Date of Survey 11.03.2020

Surveyor Colm O'Leary & Hannah Mulcahy

Location Island House, Tom Maher's Pub carpark, and Ferry playground

Survey start 07:10 Survey end 08:30

Weather Drizzle, some wind, River in flood but receding and flowing fast. Temp 7 wind 03-Jan

NOTE: The survey areas were in flood conditions, and as such this survey was not carried out in the usual VPs

VP Survey from island house to Mall house.

Species	No.	Time	behaviour	location/direction
Heron	1	07:19	flying with twig	to island house
Treecreeper	1	07:19	foraging on tree	
Greylag goose	2	07:24	swimming	in flooding alder woodland (current is strong)

Species	No.	Time	behaviour	location/direction
Greylag goose	2	07:26	resting on bank by flood water next to	mall house

VP Survey at Ferry Playground and downriver to bridge

Species	No.	Time	behaviour	location/direction
Greylag goose	2	07:37	grazing on bank by flood water next to	playground carpark
Greylag goose	2	07:37	grazing on bank by flood water next to	opposite bank from carpark
Greylag goose	2	07:37	flying downriver	
Greylag goose	2	07:40	flying upriver	
Heron	1	07:40	flying to trees behind castle	
Black headed gull	1	07:44	resting at ferry playground	
Cormorant	1	07:45	flying low upriver	
Black headed gull	25	07:46	flying high downriver	
Greylag goose	4	07:46	flying upriver and landing to avoid rapids	
Black headed gull	39	07:47	flying high downriver	
Cormorant	1	07:47	flying low upriver	
Greylag goose	2	07:50	flying upriver and landing to avoid rapids	

Survey of heronry on island house trees from Tom Mahers pub carpark from 8.10-8.30am

Heron	3	08:10	three active nests observed being built in two conifers and a beech R 66087 62687
sparrowhawk	1	08:20	flying through trees in same area, maybe hunting or possibly nesting.

C.1.10 Wintering bird Survey 6 – VP Ferry playground to footbridge

Updated surveys in 2024 to supplement data

Date of Survey	16.01.2024		
Surveyor	Hannah Mulcahy		
Survey start	8.40am	Survey end	10.30am
Weather	calm, no wind, clear,	Temp	minus 3c

Species	No.	Time	behaviour
Ferry Playground			

Species	No.	Time	behaviour
Blackheaded Gull	6	08:40	Flying and resting
Jackdaw	1	08:41	Next to stradbaly stream
Redwing	1	08:42	Flying north
Bluetit	1	08:43	In trees
Heron	2	08:44	Flying towards Island House
Song Thrush	1	08:45	In trees
Chaffinch	1	08:46	In trees
Mallard	3	08:47	By Stradbally stream
Great tit	1	08:48	in trees
Mute Swan	3	08:49	Upstream foraging by islands
Rook	1	08:50	in trees
Mute swan	2	09:11	swans swam over to left bank
Heron	2	09:12	1 heron landed on right bank and then both took off to island house
Greenfinch	1	09:13	in trees
Chaffinch	1	09:14	in trees
Song thrush	1	09:15	in trees
Mallard	3	09:16	flying upstream
Blackheaded gull	11	09:17	gathering around ferry playground
Goldfinch	10	09:18	large flock on right bank in trees
Wren	1	09:19	
Mallard	3	09:20	
Kingfisher	1	09:30	Flying up Stradbally stream, possibly roosting under or near road bridge
Cormorant	2	10:30	resting on weirs
Footbridge additional species			
Mallard	8	08:51	feeding around weirs
Greylag goose	35	08:52	resting on weirs, confluence of small stream on right bank
Dipper	2	08:53	at bridge, on weirs
Grey wagtail	1	08:54	at bridge, on weirs
Chaffinch	1	08:55	In trees
Starling	1	08:56	In trees
Goldfinch	1	08:57	In trees
Mute Swan	2	08:58	feeding on right bank

C.1.11 Wintering bird Survey 6 – Island House and Mall Road VP

Updated surveys in 2024 to supplement data

Date of Survey 16.01.2024

Surveyor Dominic Tilley

Survey start 8.40am Survey end 10.30am

Weather calm, no wind, clear, Temp minus 3c

Species	No.	Time	behaviour
Island House entrance – Mall Road			
Moorhen	1	08:40	foraging
Greylag	4		roosting
Lotti	6		foraging
Mallard	4		foraging
Chaffinch	6		foraging
Grey wagtail	1		on weir
Fieldfare	5		island house trees
Chaffinch	3		on island
Pied wagtail	1	08:50	flying west
Mallard	3		foraging
Greylag	3		flew in from south, circled and flew back south
Mute swan	2	09:17	flying north
Greylag	2	09:30	flying south
Tom Maher Pub			
Redwing	50	09:40	in tree tops
Heron			in heron tree
Heron			in beech
Rivergrove B&B			
Mallard	2	10:20	
Swan	3		1 juvenile foraging

C.1.12 Wintering bird Survey 7– Updated surveys in 2024 to supplement data

Date of Survey 23.02.2024

Surveyor Hannah Mulcahy

Survey start 7.40am Survey end 9.30am

Weather calm, slight wind, drizzle. River was in flood condition-
Temp 3 degrees

NOTE: River in flood conditions, fast moving, flooded islands and alluvial woodland. Instream islands flooded and birds not able to roost. Some birds such as Greylags and Mallards are resting and foraging in Stormont House wet meadows.

Species	No.	Time	Behaviour / location
Island House / Mall Road			
Blackbird	1	07:40	
Jackdaw	1	07:40	flying over
Herons	1	07:44	
Wood pigeon	1	07:45	calling in heron tree
Mute swan	1	07:46	
Moorhen	1	07:46	in alluvial woodland and amongst island in centre of the channel
Wren	1	07:47	
Chaffinch	1	07:50	
Ferry Playground			
Mallards	3	08:20	are flying around a lot, makes chasing females
mallard	3	08:20	on top of castle wall
Mallard	2	08:20	resting at mouth of stradbally stream
greylag	3	08:30	resting at mouth of stradbally stream
2 greylag geese	2	08:30	flying upriver 8.10
2 greylag geese	2	08:30	flying upriver 8.15
Mute swan	2	08:30	resting at stormont house - meadow flooded
5 greylag geese r	5	08:30	resting at stormont house - meadow flooded
Mallard	3	08:30	resting at stormont house - meadow flooded
Chaffinch, Wren, starling, great tit, robin, dunnock, goldfinch, wood pigeon, song thrush, Bullfinch, blackbird	1	09:00	
goldcrest	3	09:00	
Greylag	1	09:00	flying in to area next to ferry p,ayground
Greylag	1	09:00	also roost and feeding in grass/lawn of ferry playground
Grey heron	1	9.30	flushed from trees by park bank

A Summary table of the protected, red listed or amber listed birds recorded during the Wintering Bird Surveys from 2019 to 2023, as well as notable species.

Latin name	Common name	14/11/19	17/12/19	15/01/20	13/02/20	11/03/20	16/01/24	23/02/24
Accipiter nisus	Sparrowhawk	0	0	0	0	1	0	0
Anas platyrhynchos *	Mallard	17	17	42	16	0	18	13
Anser anser	Greylag Goose	2	6	40	6	18	43	11
Cygnus olor *	Mute swan	6	3	3	3	0	7	3
Chroicocephalus ridibundus *	Black-headed Gull	13	17	0	22	65	17	0
Alcedo atthis *	Kingfisher	1	0	1	0	0	1	0
Gallinula chloropus	Eurasian moorhen	0	1	2	2	0	0	1
Cinclus cinclus	Dipper	0	0	0	4	0	1	0
Motacilla cinera **	Grey Wagtail	1	1	1	1	0	0	0
Passer montanus *	Eurasian Tree sparrow	0	0	0	50	0	0	0
Ardea cinerea	Grey heron	5	6	5	9	2	0	2
Egretta garzetta	Little Egret	0	0	0	1	0	0	0
Phalacrocorax carbo *	Great Cormorant	5	5	8	0	2	0	0
Turdus iliacus **	Redwing	0	0	0	0	0	51	0
Turdus pilaris	Fieldfare	0	0	0	0	0	5	0
Symbol * = Amber listed bird under BoCCI, ** = Red listed								

C.2 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 3-2).

The trees to the back of Mahers Pub, and adjacent to Island House, hold a significant rookery, as well as a heronry.

Species recorded during nesting bird survey

Latin name	Common name	Breeding?	29/07/2022	04/05/2023	01/06/2023
*Anas platyrhynchos**	Mallard	Yes	2	3	3
Anser anser	Greylag Goose	Yes	6	5	4
*Cygnus olor**	Mute Swan	Yes	2	3	0
*Alcedo atthis**	Kingfisher	No	1	0	0
Cuculus canorus	Cuckoo	No	1	0	0
Falco peregrinus	Peregrine Falcon	No	0	1	0
*Falco tinnunculus***	Eurasian Kestrel	No	0	2	0
Gallinula chloropus	Eurasian Moorhen	Yes	0	2	1
Aegithalos caudatus	Long-tailed tit	Yes	0	1	1
Carduelis carduelis	European Goldfinch	No	0	1	0
Cinclus cinclus	Dipper	No	1	0	0
Columba palumbus	Common Wood-pigeon	No	0	5	3
Corvus frugilegus	Rook	Yes	0	8	4
Corvus monedula	Eurasian Jackdaw	Yes	0	2	2
Cyanistes caeruleus	Eurasian Blue Tit	Yes	0	6	11
Erithacus rubecula	European Robin	Yes	6	4	3
Fringilla coelebs	Common Chaffinch	Yes	0	8	6
Garrulus glandarius	Eurasian Jay	No	0	1	0
*Hirundo rustica**	Barn Swallow	Yes	0	4	3

Latin name	Common name	Breeding?	29/07/2022	04/05/2023	01/06/2023
Motacilla alba	Pied Wagtail	Yes	0	1	2
*Motacilla cinera***	Grey Wagtail	Yes	2	0	1
Parus major	Great tit	Yes	1	5	4
*Passer domesticus**	House sparrow	Yes	0	2	1
Periparus ater	Coal tit	Yes	0	1	0
Phylloscopus collybita	Common Chiffchaff	Yes	0	2	2
*Phylloscopus trochilus**	Willow warbler	Yes	2	2	3
Pica pica	Eurasian Magpie	Yes	0	3	3
Prunella modularis	Dunnock	No	0	0	1
Pyrrhula pyrrhula	Bullfinch	Yes	0	4	4
*Regulus regulus**	Goldcrest	Yes	1	2	1
Streptopelia decaocto	Eurasian Collared-Dove	No	0	2	1
Sturnus vulgaris	European Starling	Yes	0	4	4
Sylvia atricapilla	Eurasian Blackcap	Yes	0	3	5
Troglodytes troglodytes	Eurasian Wren	Yes	1	11	10
Turdus merula	Eurasian Blackbird	Yes	0	17	6
Turdus philomelos	Song thrush	Yes	0	2	5
Turdus viscivorus	Mistle thrush	No	0	2	0
Ardea cinerea	Grey heron	Yes	1	3	2
*Phalacrocorax carbo**	Great Cormorant	No	1	2	2
Symbol * = Amber listed bird under BoCCI, ** = Red listed					

C.3 Additional bird records

C.3.1 Trail camera

Camera traps deployed in the wooded area around Island house, to record mammals also detected bird species. The species recorded were all common woodland and garden birds.

- Eurasian Treecreeper Certhia familiaris
- Eurasian Blue Tit Cyanistes caeruleus
- Common Chaffinch Fringilla coelebs
- Great tit Parus major
- Eurasian Wren Troglodytes troglodytes
- Eurasian Blackbird Turdus merula
- Song thrush Turdus philomelos

C.3.2 Sound records

Casual sound recording carried out in the grasslands and woodland areas of Island House recorded the presence of common woodland and garden bird species;

- Mallard Anas platyrhynchos*
- Greylag Goose Anser anser
- Sedge Warbler Acrocephalus schoenobaenus
- Long-tailed Tit Aegithalos caudatus
- Eurasian Treecreeper Certhia familiaris
- Common Wood-pigeon Columba palumbus
- Hooded crow Corvus cornix
- European Robin Erithacus rubecula
- Common Chaffinch Fringilla coelebs
- Grey Wagtail Motacilla cinera **
- Great tit Parus major
- Coal tit Periparus ater
- Common Chiffchaff Phylloscopus collybita
- Goldcrest Regulus regulus *
- Eurasian Siskin Spinus spinus
- Eurasian Blackcap Sylvia atricapilla
- Eurasian Wren Troglodytes troglodytes
- Eurasian Blackbird Turdus merula
- Song Thrush Turdus philomelos

D Mammal / Otter Surveys

In 2019 & 2020, an Otter spraint was recorded on the Island House causeway over the Cloon stream. As the proposed FRS will be located close to 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 location in winter and spring 2023 (**Error! Reference source not found.**).

In January 2023, signs of otter were also searched for 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.

Casual observations have been undertaken over the course of all other surveys in this area since 2019 for otter. Otter has been observed in main River Shannon near the islands during the wintering bird surveys. No other signs of otter has been observed in Cloon Stream.

Summary of six Trail Camera records

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 picked up
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*

Otter was not recorded from any of the 6 cameras along the Cloon stream. The trail cameras picked up other species such as Heron and Foxes *Vulpes vulpes* many times.

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.

Detailed results of 6 trail cameras included below.

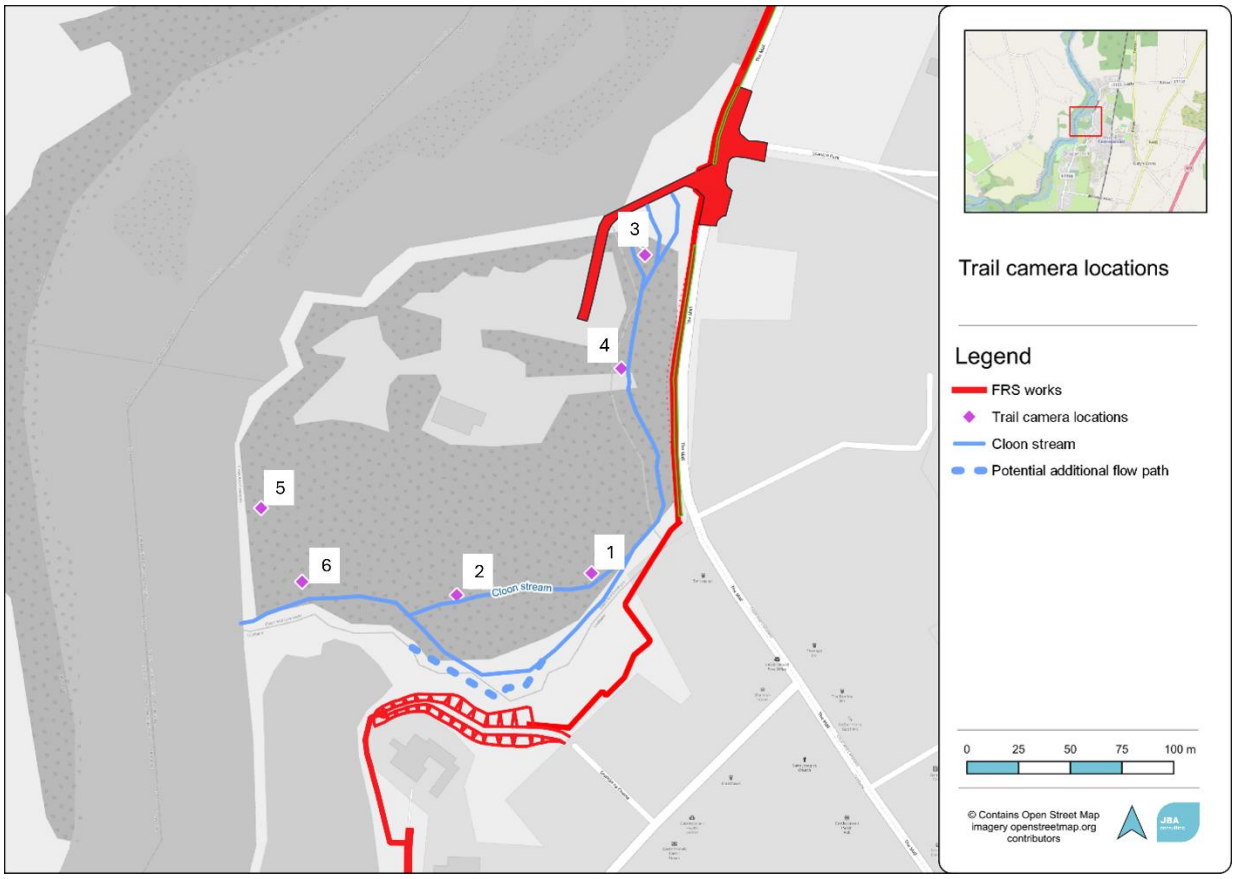

Figure 8-2 Camera traps location

Trail cam Location 1 and 2 (Camera trap behind Mahers along Cloon Stream) in January 2023

Date	Location 1 Results	Location 2 Results
23/01/23	Fox	No data – camera fault
24/01/23	Fox	No data – camera fault
25/01/23	Fox and House cat	No data – camera fault
26/01/23	Fox	No data – camera fault
29/01/23	Fox	No data – camera fault
30/01/23	Fox	No data – camera fault
01/02/23	Fox	No data – camera fault
02/02/23	Fox	No data – camera fault

Date	Location 1 Results	Location 2 Results
04/02/23	Grey Heron and Fox	No data – camera fault
05/02/23	Grey Heron and Fox	No data – camera fault
06/02/23	Fox	No data – camera fault

Location 3 and 4 along Cloon stream next to Island House causeway in May 2023

Date	Location 3 Results	Location 4 Results
19/05/2023	No data – no species	No data – no species
20/05/2023	No data – no species	No data – no species
21/05/2023	No data – no species	No data – no species
22/05/2023	No data – no species	Magpie
23/05/2023	No data – no species	No data – no species
24/05/2023	No data – no species	No data – no species
25/05/2023	No data – no species	Bullfinch
26/05/2023	No data – no species	No data – no species
27/05/2023	No data – no species	No data – no species
28/05/2023	No data – no species	No data – no species
29/05/2023	No data – no species	No data – no species

Trail cam results along Cloon Stream (in Alluvial woodland) and in woodland along trail in June 2023

Date	Location 5 results	Location 6 Results
01/06/23	Blackbird and Fox	No data – no species
02/06/23	Blackbird	No data – no species
03/06/23	Blackbird	No data – no species
04/06/23	Blackbird and Fox	No data – no species
05/06/23	Great Tit, Fox, Chaffinch	No data – no species
06/06/23	Great Tit, Blue Tit, Blackbird, Song Thrush and Fox	No data – no species
07/06/23	Fox and Great Tit	No data – no species
08/06/23	Fox and Blackbird	No data – no species
09/06/23	Great Tit and Wren	No data – no species
10/06/23	Fox and Song Thrush	No data – no species
11/06/23	Fox, juvenile Blue Tit and Song Thrush	No data – no species
12/06/23	Blackbird, Great Tit and Brown Rat	No data – no species
13/06/23	Blackbird	No data – no species

Date	Location 5 results	Location 6 Results
14/06/23	Treecreeper	Wood pigeon
15/06/23	Wren	No data – no species
18/06/23	Juvenile fox	No data – no species
20/06/23	Blackbird, juvenile Blue Tit and Great Tit	No data – no species

E Bat Surveys

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

E.1 Bat Survey Transect Island House to Castleconnell Castle 20th May 2020

Bat Survey Transect Island House to Castleconnell Castle 20th May 2020			
Name	Hannah Mulcahy and Colm O'Leary	Temp	Start: 17 oC Finish: 15 oC
Date	20.05.2020	Start time	21.30
Site	Castleconnell FRS	End time	23.30
Survey point	Island house to Castle Transect Survey	Weather	Mild, clear, low cloud cover, but wind and cloud increased towards end of survey
Type of survey	Transect		
Static detector placed behind Maher's Pub and Static detector placed in scrub behind Coolbane Wood			
Location		Species	Comments

Bat Survey Transect Island House to Castleconnell Castle 20th May 2020		
Island House to Mahers Pub	Soprano Pipistrelle, Common Pipistrelle	Island house by River Shannon very busy with bats – continuous feeding.
Mahers pub to Post Office	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Static set up on Ash tree in Mahers pub car park.
Post Office to Castle	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Castle lit up brightly
Castle to Stormont House	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Limited bat activity
Coolbane Woods	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Cpip in clearing in scrub. Static bat detector set up in this scrub. Lots of activity at entrance to Coolbane Woods

Bats recorded by Anabat Walkabout Dectector during 20th May 2020 transect

Bats	Call Count
Brown Long-eared (Plecotus auratus)	1
Common Pipistrelle (Pipistrellus pipistrellus)	49
Leisler's Bat (Nyctalus leisleri)	8
Myotis sp.	1
Soprano Pipistrelle (Pipistrellus pygmaeus)	151
Island House to Castleconnell Castle Total	210

Data from Static Detector placed along Cloon Stream behind Mahers Pub 20-24th May 2020

Static- Mahers Pub	Date				
Bat Species	20/05	21/05	22/05	23/05	24/05
Common Pipistrelle	49	8	174	165	139
Leisler's Bat	139	17	86	230	124
Soprano Pipistrelle	159	29	564	497	315
Myotis sp.	6	0	8	9	32
Total	353	54	832	901	610

E.2 Bat Survey Transect Island House to Castleconnell Castle 20th July 2020

Bat Survey Transect Island House to Castleconnell Castle 20th July 2020			
Name	Colm O'Leary, Hannah Mulcahy	Temp	Start: 15 oC Finish: 15 oC
Date	20.07.2020	Start time	21.45
Site	Castleconnell	End time	23.40
Survey point	Island House to Castleconnell Castle	Weather	80% cloud, very light breeze, warm
Type of survey	Transect		
Static detector placed behind Maher's Pub and Static placed detector in scrub behind Coolbane Wood			

Location	Species	Comments
Island House to Mahers Pub	Soprano Pipistrelle, Common Pipistrelle Daubentons Bat	Island house by River Shannon very busy with bats – continuous feeding.
Mahers pub to Post Office	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Static set up on in car park.
Post Office to Castle	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	
Castle to Stormont House	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	

Bat Survey Transect Island House to Castleconnell Castle 20th July 2020		
Coolbane Woods	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	Spip and Cpip Roost located at (52.712135, -8.503112), approximately 20 - 40 Spip and Cpip emerging from roof fascia of building near Coolbane Meadows

Figure 8-3 Roost of 20-40 Pipistrelles emerging from this building in Coolbane Meadows

Bats recorded by Anabat Walkabout Detector during 20th July 2020 transect

Bats	Call Count
Brown Long-eared (Plecotus auratus)	1
Common Pipistrelle (Pipistrellus pipistrellus)	4
Leisler's Bat (Nyctalus leisleri)	57
Soprano Pipistrelle (Pipistrellus pygmaeus)	31
Island House to Castleconnell Castle Total	93

Data from Static Detector placed along Cloon Stream behind Mahers Pub 20-28 July 2020

Static-Mahers Pub	Date							
Bat Species	20/07	21/07	22/07	23/07	24/07	25/07	26/08	27/07

Static-Mahers Pub	Date							
Common Pipistrelle	236	164	69	156	96	176	4	159
Leisler's Bat	265	401	366	381	465	335	222	351
Soprano Pipistrelle	494	436	301	414	267	291	159	419
Myotis sp.	6	4	5	7	3	0	0	2
Brown Long-eared Bat	1	0	2	0	0	0	0	0
Total	1002	1005	743	958	831	802	385	931

Data from Static Detector placed along Cloon Stream behind Coolbane Woods in Scrub Area 20-28 July 2020

Static-Coolbane Woods Willow Scrub	Date							
Bat Species	20/07	21/07	22/07	23/07	24/07	25/07	26/07	27/07
Common Pipistrelle	2	2	0	1	3	3	0	3
Leisler's Bat	42	44	39	42	35	28	10	25
Soprano Pipistrelle	39	112	82	85	161	132	73	73
Myotis sp.	2	4	2	3	4	3	1	0
Lesser Horseshoe Bat	0	0	0	1	0	0	0	0
Total	85	162	123	135	203	166	84	101

E.3 Static Bat detector data August 2020

A transect was not carried out for August 2020 however static detectors were placed in Coolbane Woods and Mahers pub for a week in August.

Data from Static Detector placed along Cloon Stream behind Mahers Pub 12-18th August 2020

	Date						
Bat Species	12/08	13/08	14/08	15/08	16/08	17/08	18/08

	Date						
Common Pipistrelle	58	15	19	12	15	0	54
Leisler's Bat	750	535	493	624	606	7	621
Soprano Pipistrelle	466	376	396	343	472	0	657
Myotis sp.	13	38	30	10	25	0	14
Total	1241	964	938	989	1118	7	1346

Data from Static Detector placed along Coolbane Woods 12-18th August 2020

	Date				
Bat Species	12/08	13/08	14/08	15/08	16/08
Common Pipistrelle	3	6	2	6	5
Leisler's Bat	134	193	139	66	160
Myotis sp.	1	1	1	0	1
Soprano Pipistrelle	29	86	49	58	69
Total	167	286	191	130	235

E.4 Bat Survey Grange House 8th September 2022

An additional survey was carried out at Grange House in 2022 as this area was added to the scheme after the original bat surveys were carried out. This included an emergence survey of two mature Beech trees in Grange House, which will be removed as part of the Scheme.

Bat Survey Grange House 8th Sept 2020			
Name	Johanna Healy	Temp	Start: 17 oC Finish: 15 oC
Date	8.09.2022	Start time	20.10
Site	Grange House	End time	22.15
Survey point	Hollow beech by river wall	Weather	Clear, warm, no rain
Type of survey	Activity & emergence		
Location	Species	Comments	

Bat Survey Grange House 8th Sept 2020		
Grange house – Beech trees emergence surveys	Leislers Bat	Possible emergence from beech tree at 20.35
Grange House activity over River Shannon	Soprano Pipistrelle, Common Pipistrelle Leislers Bat	High foraging activity over river

Bats recorded by Anabat Walkabout Detector during 8th September 2022 transect

Bats	Call Count
Common Pipistrelle (Pipistrellus pipistrellus)	306
Leisler's Bat (Nyctalus leisleri)	187
Myotis sp.	55
Soprano Pipistrelle (Pipistrellus pygmaeus)	219
Grange House Total	767

E.5 Bat survey conducted 27th September 2019 for development of Options for Castleconnell FRS

Transect Surveys were conducted at Island House and along the Mall Road, and another survey conducted at Stradbally (this area was later removed from the scope).

E.6 Island House transect survey

Bats were recorded along Island House from 20:03 to 21:39, a total of 44 recordings were made by surveyors. In section A, many bats were recorded and seen flying through the wooded area, the main species here were Soprano and Common Pipistrelles 25+, Leisler's and at least two species which could not be identified in the field. In section B along the water 10+ Daubenton's were seen and recorded over water and 2+ Leisler's bats were recorded overhead. In section C, 1+ Daubenton's and Leisler's were recorded, this section was within a beech treeline. In Section D and E smaller numbers of Common and Soprano Pipistrelle, Daubenton's, Leisler's and unidentified species were recorded. Many flying insects were observed during the evening. Foraging behaviour was the most frequently recorded behaviour during the survey period. Some commuting behaviour was also observed.

Overall, approximately 40-50 occurrences of Pipistrelles, and 15 Leisler's bat, Pipistrelle occurrences were recorded. The fact that Leisler's bats were observed early in the evening means that they are roosting nearby to the site, and as there was

such a high number of Leisler's bats recorded, we can conclude this nearby population may be part of a maternity roost.

657 bats were recorded by the static bat detector during the transect survey. **Error! Reference source not found.** (below) shows the species of bat and the number of bat calls recorded during the Island House transect survey. See **Error! Reference source not found.** for location of the static detector.

Species and number of bat calls recorded during the transect survey

Bat species	Call Count
Common pipistrelle (Pipistrellus pipistrellus)	198
Daubenton's Bat (Myotis daubentonii)	23
Leisler's Bat (Nyctalus Leisleri)	353
Soprano pipistrelle (Pipistrellus pygmaeus)	83
Island House Total	657

E.6.1 Stradbally survey

In Stradbally (**Error! Reference source not found.**) bats were recorded between 08:01 and 09:30. A total of 17 recordings were made by surveyors. Species recorded were Soprano and Common Pipistrelles, Leisler's and unidentified Myotis sp. Overall there were 123 bats recorded during the transect by Anabat walkabout bat detector. **Error! Reference source not found.** (below) shows the species of bat and number of bat calls recorded during the Stradbally transect survey.

Species and number of bat calls recorded during the Stradbally transect survey

Bats	Call Count
Common pipistrelle (Pipistrellus pipistrellus)	5
Leisler's Bat (Nyctalus Leisleri)	92
Myotis sp.	4
Soprano pipistrelle (Pipistrellus pygmaeus)	22
Stradbally Total	123

E.6.2 Static detector survey results

An Anabat static bat detector was deployed for 7 nights close to the River Shannon within the Island House woodland. See **Error! Reference source not found.** for location of the static detector near the Island house. The detector was placed in a

secluded area away from the road to reduce the amount of background noise picked up by the detector.

Over the 7 nights the weather was fair with a few showers. Temperatures ranged from highs of 20 to lows of 10 degrees. This represents ideal conditions for bat activity. **Error! Reference source not found.** shows the location where the static bat detector was positioned.

Error! Reference source not found. shows the bat species and the number of bat calls recorded from the 19th to the 26th of September.

Species of bat and number of bat calls recorded during the seven days the static detector was deployed

Bat species	19/09	20/09	21/09	22/09	23/09	24/09	25/09	26/09	Total
Common pipistrelle (Pipistrellus pipistrellus)	157	1	0	348	0	25	0	0	531
Leisler's Bat (Nyctalus Leisleri)	109	21	17	57	10	14	4	10	242
Lesser Horseshoe Bat (Rhinolophus hipposideros)	0	1	0	0	0	0	0	0	1
Myotis sp.	15	15	15	47	18	7	14	9	140
Soprano pipistrelle (Pipistrellus pygmaeus)	607	440	62	1840	1190	646	609	968	6362
Total	888	478	94	2292	1218	692	627	987	7276

The exceptionally high bat activity at both sites, particularly at Island House, indicates that these sites are important foraging sites for the bat species recorded using the site. It also suggests that there may be several bat roosts in the vicinity of the site, particularly due to the high bat activity noted very early in the night, indicating that a large number of bats are emerging from roosts close by.

F Fishery Survey

Survey report carried out by Ecofact in 2021 for this FRS.

Proposed Flood Relief Scheme, Castleconnell, Co. Limerick

Baseline Aquatic Ecology Survey

Version (23-11-21) DRAFT

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TABLE OF CONTENTS

1. INTRODUCTION

Ecofact Environmental Consultants Ltd. were commissioned by JBA Consultants Ltd. and Limerick City and County Council to undertake a baseline aquatic ecology survey of the River Shannon in Castleconnell, Co. Limerick. This document describes the existing baseline in the study area for aquatic habitats, aquatic ecological communities and individual aquatic species.

There is a proposal to carry out flood relief works on selected areas in Castleconnell, on a section of the Old River Shannon, as can be seen in Figure 1. The proposal includes for flood walls, embankments, road raising, culverts, flood gates and low level plinth walls. Flood walls are proposed along the eastern bank of the River Shannon, on the boundary of Castelconnell town, along Coolbawn meadows road and main street. Embankments are also proposed along the eastern bank of the shannon, as well as along an existing drain near Chapel Hill road. Road raising works are proposed near the junction of Chapel hill road, Coolbawn meadows road and Coolbane wood road, adjacent to Castleconnell castle. A flood gate is also proposed at this junction. Culverting works are proposed in the north of the town near Rivergrove House BnB, along with a low level plinth wall. Road raising, flood gates and an embankment are also proposed along the junction between Scanlon road and The Elvers road on the eastern bank of the River Shannon.

The aims of the current report are to carry out a desktop study and a baseline aquatic ecological survey of the study area, in order to provide a detailed description and evaluation of the receiving environment proposed flood relief scheme. Field survey work, to inform the current assessment, included habitat surveys, kick/sweep sampling for aquatic macroinvertebrates as well as a general fish stock assessment and juvenile lamprey survey. The surveys were completed during August 2021.

Castleconnell village and the proposed flood scheme is located the “old” River Shannon channel. This was the former main channel of the Shannon before the Shannon hydroelectric scheme. This section of river is now affected by extreme water abstraction and regulation – with up to 97% of the flow in the Lower River Shannon SAC abstracted at Parteen Regulating Weir. Parteen Regulation Weir is located approximately 4km upstream of Castleconnell village, within the Lower River Shannon SAC. Here the river is diverted via a 12.6km headrace to the 86MW hydroelectric generating station at Ardnacrusha. Downstream of Ardnacrusha hydroelectric station water is discharge via a 2.1km long the tailrace canal and joins with the River Shannon just upstream of Limerick City. A statutory minimum “compensation flow” for the “old” River Shannon was set in 1935 and has not been reviewed since. The compensation flow is 10 cubic meters per second (cumecs) - which is less than the n99%ile flow prior to the Shannon scheme. This minimum flow is only exceeded when the flows in the river are in excess of the turbine capacity at Ardnacrusha (400 cumecs). Therefore for the majority of the time the “old” river channel only has the absolute minimum compensation flow. This extreme abstraction and regulation has had a profound effect on the ecology and hydromorphology of the river. A map of the Lower River Shannon showing the location of the hydroelectric scheme and the proposed flood scheme area is provided in Figure 1.

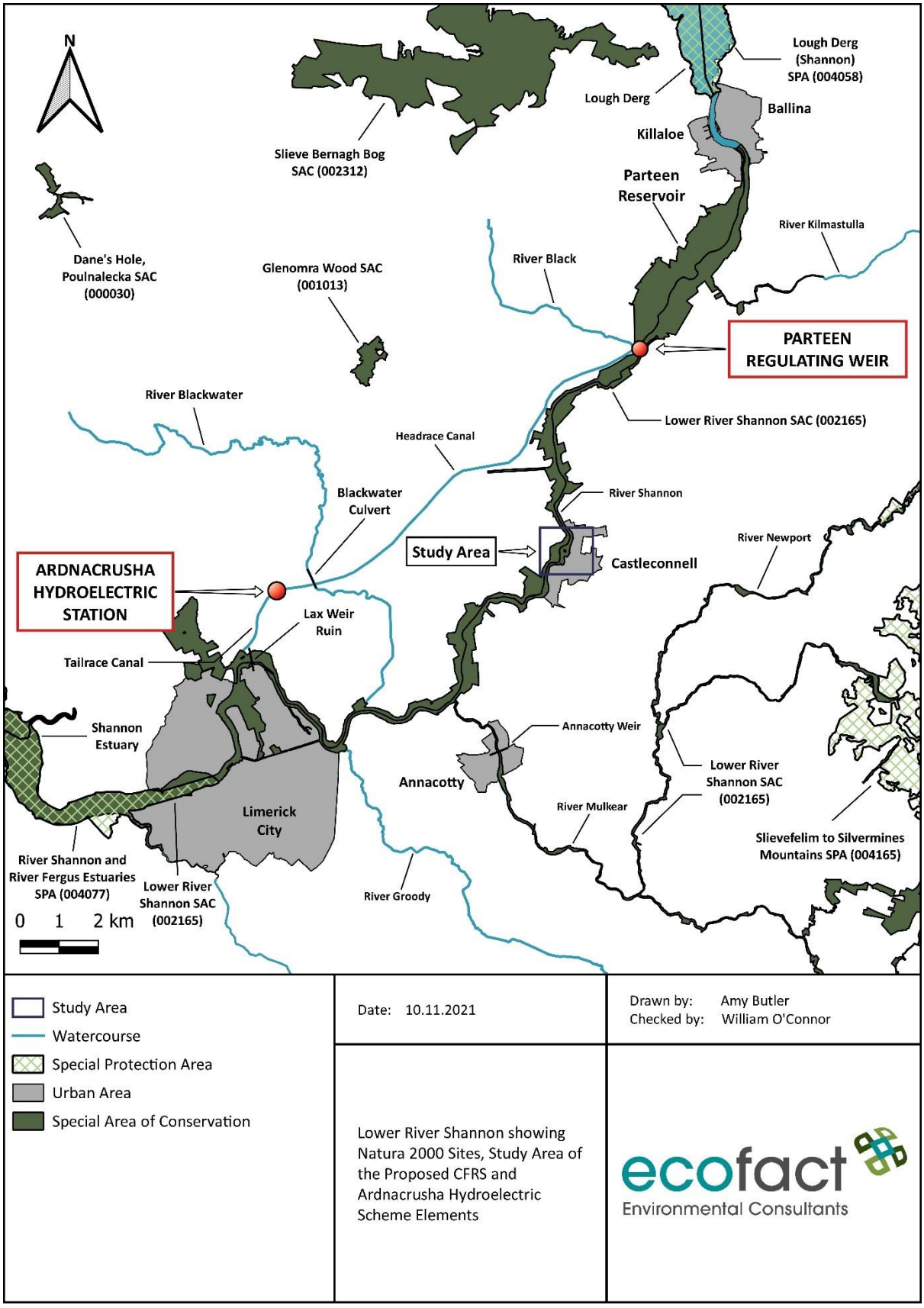


Figure 1 Lower River Shannon showing Natura 2000 Sites, Study Area of Proposed CFRS and Ardnacrusha Hydroelectric Scheme Elements.

2. METHODOLOGY

2.1 Desk Study

A desktop study was undertaken to describe the aquatic ecology of the River Shannon at Castleconnell to identify the previous records of aquatic species and designated areas of protection. This involved accessing the National Biodiversity Data Centre (NBDC) (www.biodiversityireland.ie) and the databases available here. The National Vegetation Database, Online Atlas of Vascular Plants 2021 Onwards, River Biologists' Database, National Survey of Native Woodlands, Amphibians and Reptiles of Ireland, Aquatic Oligochaeta of Ireland, Clare Biological Records Centre Database 2004-2007, Freshwater Fish in Irish Lakes, Water Beetles of Ireland, Caddisflies (Trichoptera) of Ireland, Dragonfly Ireland 2019 to 2024, Mayflies (Ephemeroptera) of Ireland, True Bugs (Heteroptera) of Ireland, All Ireland Non-marine Molluscan Database and Invasive Species Ireland databases were all accessed and reviewed.

The National Parks and Wildlife Service (www.npws.ie) website and online maps were accessed in relation to designated areas, qualifying interests and site synopses on relevant Special Areas of Conservation with regard to aquatic ecology.

The Environmental Protection Agency (www.gis.epa.ie/EPAMaps/) websites including Catchments.ie (www.catchments.ie) and publications relating to the Water Framework Directive (WFD) were accessed in relation to water quality status and water quality pressures in the study area.

Previous reports prepared by the Electricity Supply Board (ESB), Environmental Protection Agency, Inland Fisheries Ireland and various other studies on the Lower River Shannon were reviewed in relation to aquatic fauna in the study area. This also included the National Otter Survey of Ireland database and reports prepared by the Standing Scientific Committee on Salmon (SSCS).

Aerial imagery was accessed online in order to gain a better understanding of the study area and its surrounding habitats. All documents reviewed are included in the bibliography section of the current report.

2.2 Field Survey

2.2.1 Habitat Surveys

Habitat Surveys were carried out on the entire study area on the River Shannon, with detailed investigations at a total of 6 survey sites. Survey Site locations are illustrated in Figure 2. The survey was completed with reference to the Environment Agency's "*River Habitat Survey in Britain and Ireland Field Survey Guidance Manual 2003*" (EA, 2003) and "*A Guide to Habitats in Ireland*" (Fossitt, 2000). 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.

2.2.2 Aquatic Macroinvertebrate Surveys

Qualitative sampling of benthic (or bottom dwelling) macroinvertebrates was undertaken at the survey sites using kick-sampling (Toner et al., 2005). Survey Site locations are illustrated in Figure 2. 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.

Macroinvertebrates provide an estimation of the current health of the waterbody and the type of substrate. They are divided into 5 categories (A, B, C, D, E – "A" being the most sensitive and "E" being the most tolerant). A desk study was completed and used resources such as the NBDC species maps to identify if any rare/protected species have been recorded in the area. All samples of invertebrates were combined for each site and live sorted on the riverbank and fixed in ethanol for subsequent laboratory identification. The relative abundance of macroinvertebrates was recorded on-site at each site. Further identification was undertaken in the laboratory using a stereoscope.

Table 1 Relationship between Q-value and Ecological Status for macroinvertebrates.

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

** These values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.*
*** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses*

2.2.3 Fish Surveys

2.2.3.1 General Fish Surveys

Each survey site was assessed for potential Lamprey and Salmon habitat. Survey Site locations are illustrated in Figure 2. An electrical fishing survey was undertaken at the 6 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 Directive - Electric fishing in wadable reaches*". A portable electrical fishing unit (Smith Root-LR 24 backpack) was used during the assessments. Fishing was carried out continuously for 5 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 the released alive and spread evenly over the sampling area. No mortalities were recorded. Strict biosecurity measures were followed during all fieldwork (IFI, 2010).

2.2.3.2 Juvenile Lamprey Surveys

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'* by Harvey & Cowx (2003). Electrical 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'* by Gardiner R (2003).

Table 2 Locations of the survey sites and the fish surveys carried out at each site.

Site	NOS Grid Reference	Habitat surveys	Electrical fishing survey (salmonids)	Electrical fishing survey (lampreys)	General fish stock assessment	Kick/Sweep sampling
1	R 65517 62318	✓	✓	✓	✓	✓
2	R 65903 62691	✓	✓	✓	✓	✓
3	R 66107 62764	✓	✓	✓	✓	✓
4	R 66080 62875	✓	✓	✓	✓	✓
5	R 66089 63261	✓	✓	✓	✓	✓
6	R 65864 63574	✓	✓	✓	✓	✓

3. DESCRIPTION OF THE WORKS

Limerick City and County Council plan to carry out flood relief works on selected areas in Castleconnell, Co. Limerick. This proposal includes for flood walls, embankments, road raising, culverts, flood gates and low level plinth walls. Flood walls are proposed along the eastern bank of the River Shannon. The walls are proposed to be located on the boundary of Castelconnell town, along the Coolbawn meadows road and main street. Embankments are also proposed along the eastern bank of the shannon, as well as along an existing drain near Chapel Hill road. Road raising works are also proposed near the junction of Chapel hill road, Coolbawn meadows road and Coolbane wood road, adjacent to Castleconnell castle. A flood gate is also proposed at this junction. Culverting works are proposed in the north of the town near Rivergrove House BnB, along with a low level plinth wall. Road raising, flood gates and an embankment are also proposed along the junction between Scanlon road and The Elvers road on the eastern bank of the River Shannon.

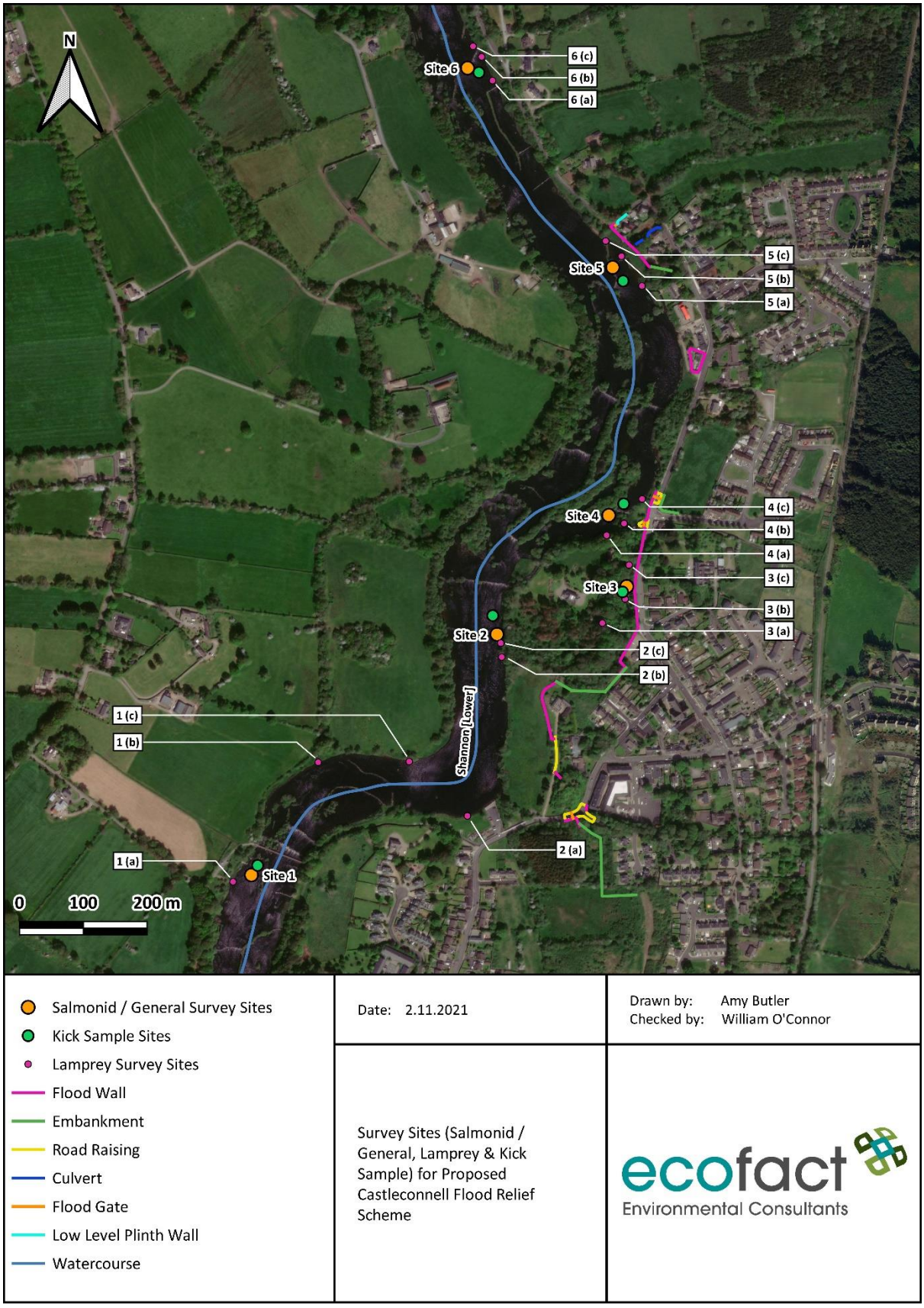
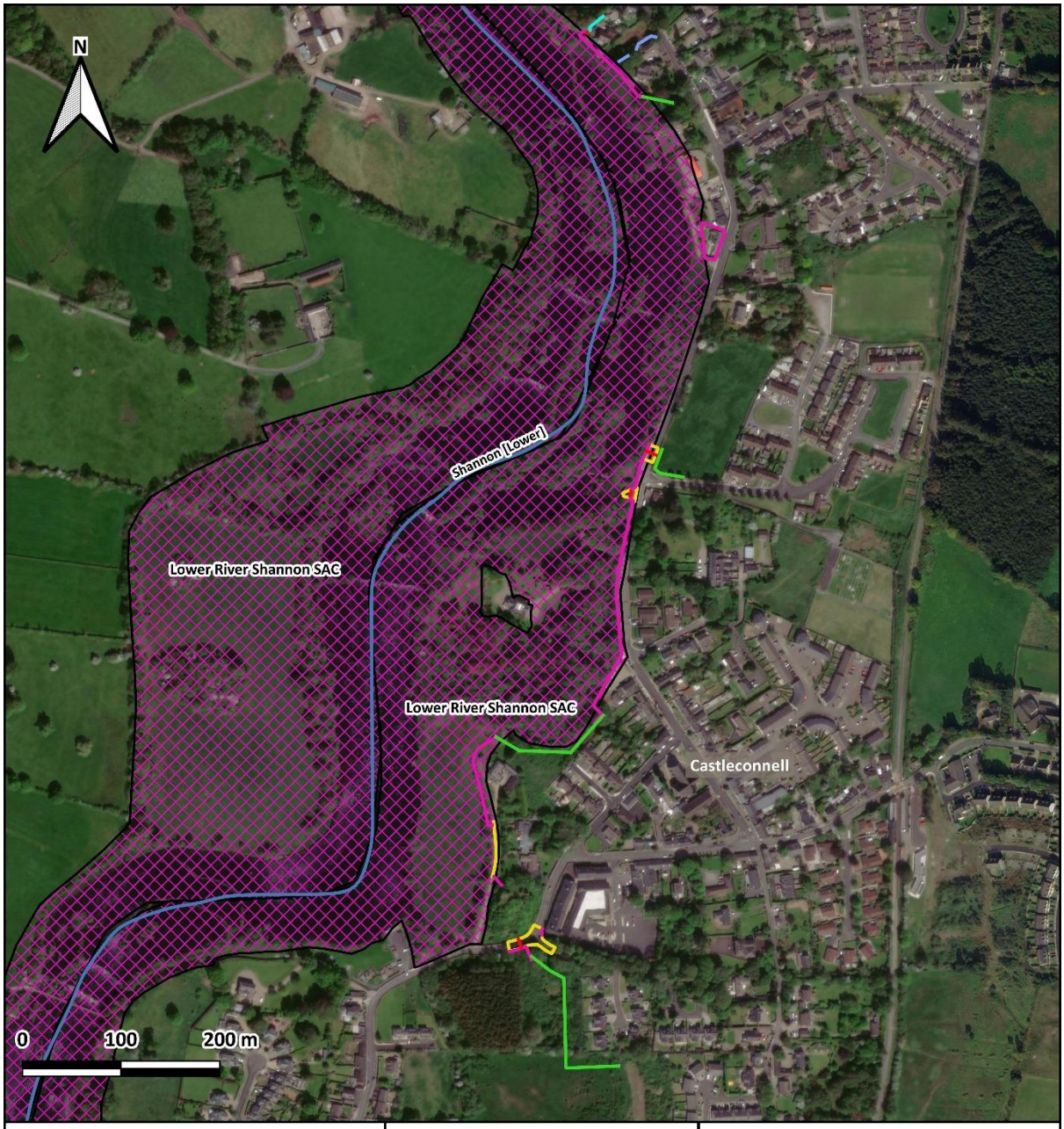


Figure 2 Survey Sites (Salmonid / General, Lamprey & Kick Sample) for Proposed Castleconnell Flood Relief Scheme.



Flood Wall
Embankment
Road Raising
Culvert
Flood Gate
Low Level Plinth Wall
Watercourse
Special Area of Conservation

Date: 10.11.2021

Drawn by: Amy Butler
Checked by: William O'Connor

Location of Proposed Flood Scheme. Lower River Shannon SAC also shown.

ecofact
Environmental Consultants

Figure 3 Location of Proposed Flood Scheme. Lower River Shannon SAC also shown.

4. RECEIVING ENVIRONMENT

4.1 Desk Study

4.1.1 Designated Areas

The proposed Flood Relief Scheme is located within the Lower River Shannon Special Area of Conservation (Site Code: 002165). This SAC is designated for Annex I habitats and Annex II species under the E.U. Habitats Directive. This site is selected for the presence of a large number of varied estuarine, aquatic and terrestrial habitats.

The Lower River Shannon SAC is designated for the following Habitats listed as Q.I.s of the site: Sandbanks which are slightly covered by sea water all the time, Estuaries, Mudflats and sandflats not covered by sea water at low tide, Coastal lagoons, Large shallow Inlets and Bays, Reefs, Perennial Vegetation of Stony Banks, Vegetated Sea Cliffs of the Atlantic and Baltic coasts, Salicornia and other annuals colonising mud and sand, Atlantic salt meadows, Mediterranean Salt meadows, Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation, Molinia meadows on calcareous, peaty or clayey-silt-laden solids and Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion, Alnion incanae, Salicion albae*). The species designated as qualifying interests of the Lower River Shannon SAC are: Freshwater Pearl Mussel *Margaritifera margaritifera*, Sea lamprey *Petromyzon marinus*, Brook lamprey *Lampetra fluviatilis*, River lamprey *Lampetra planeri*, Salmon *Salmo salar*, Common Bottlenose Dolphin *Tursiops truncatus* and Otter *Lutra lutra*. Table 3 below details these qualifying interests (NPWS, 2012a). There are no other downstream aquatic Natura 2000 sites.

Table 3 Qualifying interests of the Lower River Shannon SAC.

Natura Code	Qualifying Interest
1110	Sandbanks which are slightly covered by sea water all the time
1130	Estuaries
1140	Mudflats and sandflats not covered by seawater at low tide
1150	Coastal lagoons
1160	Large shallow inlets and bays
1170	Reefs
1220	Perennial vegetation of stony banks
1230	Vegetated sea cliffs of the Atlantic and Baltic coasts
1310	Salicornia and other annuals colonising mud and sand
1330	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
1410	Mediterranean salt meadows (*Juncetalia maritimi*)
3260	Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
6410	Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
91E0	Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)
1029	*Margaritifera margaritifera* (Freshwater Pearl Mussel)
1095	*Petromyzon marinus* (Sea Lamprey)
1096	*Lampetra planeri* (Brook Lamprey)
1099	*Lampetra fluviatilis* (River Lamprey)
1106	*Salmo salar* (Salmon)
1349	*Tursiops truncatus* (Common Bottlenose Dolphin)
1355	*Lutra lutra* (Otter)

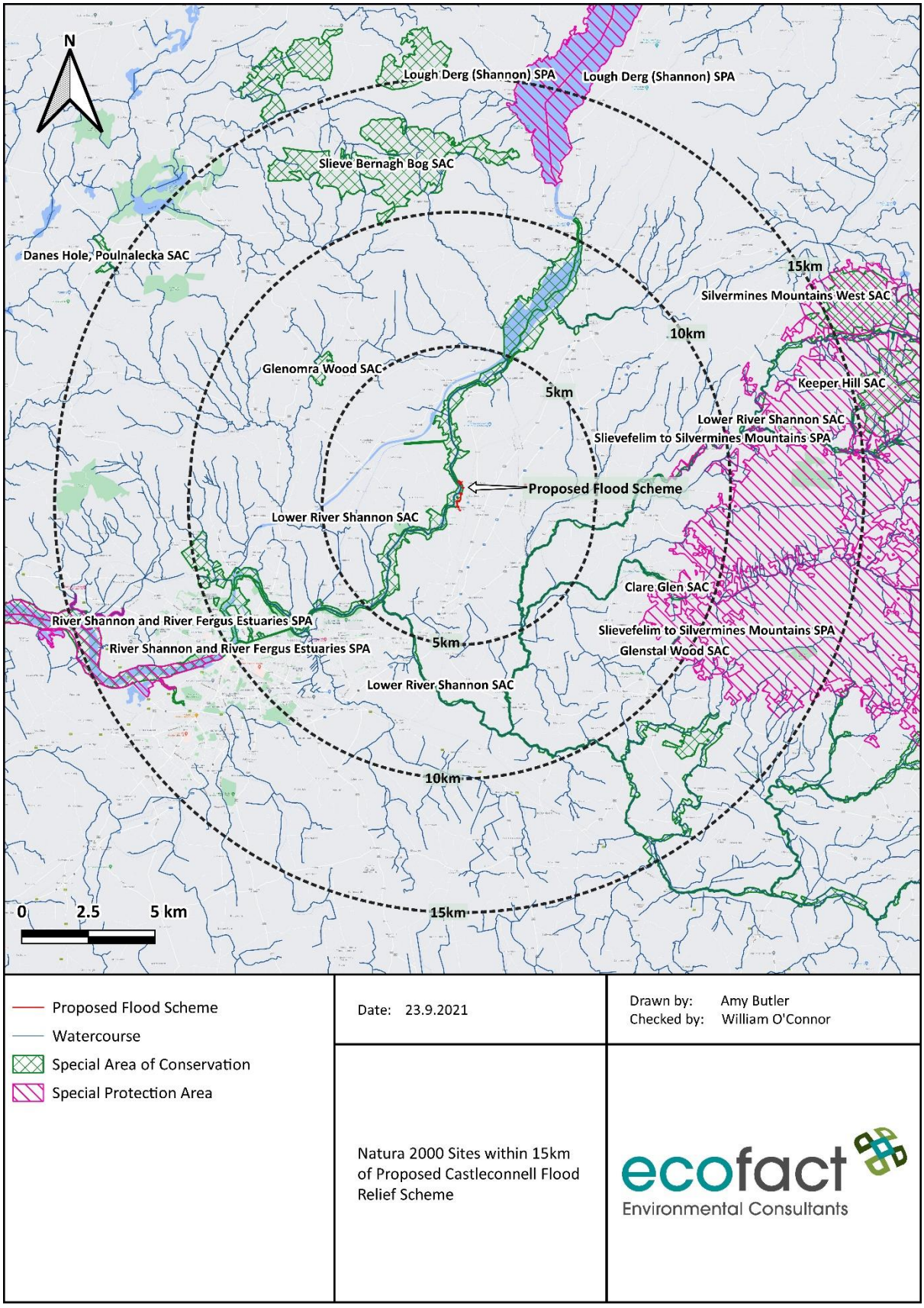


Figure 4 Natura 2000 Sites within 15km of Proposed Castleconnell Flood Relief Scheme.

The River Shannon at the site is also designated as a drinking water protected area (DWPA) as defined under Article 7 of the Water Framework Directive (WFD). This stretch is designated under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. No. 278/2007). This represents a snapshot of river waterbodies with qualifying abstractions taken at the end of 2018 for the purpose of the WFD River Basin Management Plans, with data from the EPA register of abstractions.

There are no aquatic Proposed Natural Heritage Areas or Natural Heritage Areas in the study area.

4.1.2 Shannon Catchment Overview

The River Shannon is the largest river in Ireland spanning some 360.5km in length down the Island, with a catchment area of 11,700km^2. The catchment area of the river, including that of the estuary, covers approximately 1/6 of the area of the Republic of Ireland.

The River Shannon rises in a pool in the Cuilcagh Mountain Range in Co. Cavan, known as the Shannon pot, and falls 104m in the first 14m of its journey, before it enters Lough Allen. After this point the Shannon continues its journey across Ireland's central plain. Between Battlebridge at the confluence of the Lough Allen canal, and Killaloe at the lower end of Lough Derg, which is a distance of some 185km, the river falls only 12m. The River Shannon therefore has the gentlest gradient of any of the large rivers in Europe (Heery, 1993).

The Shannon has a total surface water area of 41,000ha of surface waters upstream of Limerick city, which drains a total catchment area of approximately 11,800km^2. The catchment area from the source to the Lough Allen outlet is 425km^2. The catchment area from the Lough Allen outlet to the Lough Ree outlet is 415km^2. This section contains major tributaries such as the Inny River, Boyle River and the River Camlin. The catchment area for the river between the Lough Ree outlet and the Lough Derg outlet is 5,833km^2. The Rivers Suck, Brosna, Little Brosna, Cappagh/Kilcrow, Nenagh and Graney are major tributaries confluencing along this middle section of the river. The catchment area from the Lough Derg outlet to Limerick City is 1,431km^2. The Mulkear River joins the Shannon along this section. There are a number of large lakes located within the upper Shannon catchment area, including Loughs Allen, Key, Gara, Boderg, Bofin, Forbes, Sheelin, Ree, Ennel and Owel. The largest of the Shannon lakes, L. Derg, with a surface area of 117km^2, and mean depth of 7.55m. The five largest lakes in the system, Loughs Derg, Ree, Allen, Sheelin and Ennel comprise almost 70% of the catchments 41,000ha of surface water (O'Connor, 2003). Due to the large size of the Shannon, it is usually split into the upper and lower Shannon catchments.

There are numerous weirs and sluices along the River Shannon, making it a regulated river system for the purposes of both navigation and flood control. The most significant of these structures are located at or downstream of the outflows of Loughs Allen and Ree and at Meelick, Tarmonbarry and Rooskey. In addition to these structures, a hydroelectricity generating station is located at Ardnacrusha, immediately upstream of Limerick city.

4.1.2.1 Lower Shannon

The Lower Shannon catchment covers an area of 1,820km^2 and comprises Lough Derg as well as the Mulkear catchment. The catchment is characterised by flat limestone plains, a small proportion of which are karstified to the east of Lough Derg (EPA, 2021). The River Shannon flows into Lough Derg at Portumna and travels c. 39rkm through Lough Derg. The Shannon flows out of Lough Derg through the

steep-sided gap between the Slieve Bernagh and Arra Mountains where the towns of Ballina and Killaloe are located on the east and the west bank of the river respectively (EPA, 2021).

Downstream of Killaloe, the Lower River Shannon flows into Parteen Reservoir. Parteen Weir is located c. 6rkm downstream. At Parteen Regulating Weir, the river is diverted via a 12.6km headrace which travels to the 86MW hydroelectric generating station at Ardnacrusha. Downstream of Ardnacrusha hydroelectric station, the tailrace canal is c. 2.1km in length, and joins with the River Shannon c. 660m downstream of Parteen bridge. Downstream of Parteen Regulating Weir, the old River Shannon main channel flows south-west, through Castleconnell, Castletroy and then continues towards Limerick City where it is joined by the tailrace canal immediately downstream of the Lax weir ruin.

Parteen regulating weir controls the flow of water that travels through the old River Shannon main channel in order to run the Ardnacrusha Hydroloelectric station. The average annual river flow is 180m^3/sec (ESB, 2017). This discharge drops to an average of 99m^3/sec during summer and rises to an average of 274m^3/sec during winter (O'Connor, 2003). The turbine capacity at Ardnacrusha hydroelectric station is 400m3/s, with a minimum compensation flow of 10 m3/s. When the flow of water is greater than 410 m3/s, such as during flood events and 'high water' (i.e. when Lough Derg levels exceed 33.56m O.D.), the gates at Parteen Regulating Weir are opened to 'spill' the excess volume of water needed to regulate the river down to the original course of the river (O'Connor, 2003).

The main affected watercourse in the subject area is the Lower "old" River Shannon. Within the study area, there are some small channels, drains and streams that are not registered as watercourses by the Environmental Protection Agency due to their small size. It is noted that many of these are not of any fisheries importance but are present and therefore provide a context of the hydrology present here. These channels are mostly present in the vicinity of Castleconnell town on the eastern side of the river so may be associated with past developments in the area.

4.1.3 Aquatic Flora

The study area of the survey sites falls within the 10km grid square R66. The National Biodiversity Data Centre holds records for flowering plants within this 10km grid square from the National Vegetation Database, the Online Atlas of Vascular Plants, 2012 onwards, the EPA River biologists database and the National Invasive Species Database. Some of these flowering plants are aquatic or semi-aquatic or emergent and therefore these species would be likely to come from the River Shannon or smaller tributaries within this 10 grid square, and therefore have potential to be found at the site. Table 4 below details the flowering plant species that have potential to be within the study area.

The protected habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation'* habitat is designated within the Lower River Shannon SAC. It is noted that the full distribution of this habitat and sub-types are currently unknown (NPWS, 2012b). However, map 13 of the conservation objectives does show the known occurrences within the site boundary, which are located in Limerick City, downstream of Limerick City and in the River Bilboa in the Mulkear catchment (NPWS, 2012a). There is no mapped habitat for Castleconnell (NPWS, 2012a). NPWS note that the three main plant species listed as characteristic of this habitat are *Ranunculus, Potamogeton* spp. and *Fontinalis antipyretica* (NPWS, 2012a). There are three main sub types with this protected habitat, two of which are associated with tidal reaches of rivers: *Groenlandia densa* (L.) Four., Opposite-leaved Pondweed and *Schoenoplectus triqueter* (L.) Palla, Triangular Club-rush (NPWS, 2012b). The last sub-type is associated with fast-flowing stretches of unmodified streams and rivers and is not noted to occur at Castleconnell.

The site synopsis for the Lower River Shannon SAC also notes that the *Molinia* meadows Annex I habitat type can be found on the eastern bank of the River Shannon just north of Castleconnel, called Worldsend. It also further notes that areas of wet meadow here are dominated by Rushes *Juncus* spp. and Sedges *Carex* spp. and support a rich and diverse species-rich vegetation, including such uncommon species at Blue-eyed Grass *Sisyrinchium bermudiana* and Pale sedge *Carex pallescens*.

Alluvial woodlands occur along the River Shannon and are a protected habitat type in the Lower River Shannon SAC. These are woodland that periodically flood and are associated with rivers, in riparian areas and on islands (NPWS, 2012c). This woodland type is known to occur upstream of Limerick City and map 14 of the conservation objectives for the SAC show this habitat type to be present within the study area close to survey sites included in the current field surveys (NPWS, 2012a). These sites have been included in the National Survey of Native Woodlands in Ireland and are given the following sites codes: 1577 and 1857 (NPWS, 2012a). Perrin *et al* (2008) sets out the main report for the National Survey of Native Woodlands 2003-2008 and notes Doonass Demesne (NSNW Code 1577), just downstream of Doonass survey site, as having a threat score of 33.3% and an overall conservation score of 45.5% (Perrin *et al*., 2008). Invasive species are noted at the site, as well as other threats such as grazing, non-native regeneration and damaging activities. The other site just upstream of doonass footbridge, is called Newgarden North (NSNW Code 1857) and is rated as having a threat score of 33.3% and a conservation score of 69.7% (Perrin *et al*., 2008). Issues at this site as similar to Doonass Demesne, with invasive species, grazing and non-native regeneration (Perrin *et al*., 2008).

ESB (2020) 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, 2020a). 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 (ESB, 2020a). In 2019, a planning application was put forward by the ESB to Clare County Council for a development near Conway's Canal, on the opposite side of the river to Castleconnell (Planning Ref No.: 19603). This development included a new pedestrian gate to the existing pedestrian bridge over the River Shannon, a new steel footbridge over Conway's Canal, 50m upstream of where it flows into the River Shannon, removing instream rubble in Conway's Canal and a new gate to the rear of Summerhill House. AECOM prepared an 'Appropriate Assessment Screening Report and Natura Impact Statement' for the proposed development as well as an 'Ecological Appraisal Report' (AECOM, 2019a & 2019b). Each of these reports note the presence of the Annex I Habitat *Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation* in Conway's Canal at the site (AECOM, 2019a & 2019b).

Table 4 Flowering Plant Species that have potential to be within the study area, based on National Biodiversity Data Centre online records for the 10km grid square R66.

Common Name	Scientific Name	Date of Last Record	Database	Invasive Species
Alternate Water-milfoil	*Myriophyllum alterniflorum*	17/06/1991	National Vegetation Database	No
Branched Bur-reed	*Sparganium erectum*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Brooklime	*Veronica beccabunga*	23/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Bulbous Rush	*Juncus bulbosus*	14/07/2011	National Vegetation Database	No
Bulrush	*Typha latifolia*	19/06/1991	National Vegetation Database	No
Canadian Waterweed	*Elodea canadensis*	01/10/2008	River Biologists' Database (EPA)	Yes
Common club-rush	*Schoenoplectus lacustris*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Common Reed	*Phragmites australis*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Compact Rush	*Juncus conglomeratus*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Floating Sweet-grass	*Glyceria fluitans*	14/07/2011	National Vegetation Database	No
Flowering-rush	*Butomus umbellatus*	23/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Fool's water-cress	*Apium nodiflorum*	06/03/2021	Online Atlas of Vascular Plants 2012 Onwards	No
Giant Hogweed	*Heracleum mantegazzianum*	05/05/2020	Online Atlas of Vascular Plants 2012 Onwards	Yes
Hemlock water-dropwort	*Oenanthe crocata*	03/05/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Lesser water plantain	*Baldellia ranunculoides*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Nuttall's Waterweed	*Elodea nuttallii*	31/12/2006	National Invasive Species Database	Yes
River water-dropwort	*Oenanthe fluviatilis*	01/10/2008	River Biologists' Database (EPA)	No
Soft rush	*Juncus effusus*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Unbranched Bur-reed	*Sparganium emersum*	01/10/2008	River Biologists' Database (EPA)	No
Water forget-me-not	*Myosotis scorpioides*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Water Mint	*Mentha aquatica*	10/05/2021	Online Atlas of Vascular Plants 2012 Onwards	No
Water-cress	*Rorippa nasturtium-aquaticum*	25/05/2007	National Vegetation Database	No
Water-pepper	*Persicaria hydropiper*	14/07/2011	National Vegetation Database	No
Yellow Iris	*Iris pseudacorus*	15/08/2020	Online Atlas of Vascular Plants 2012 Onwards	No
Yellow water-lily	*Nuphar lutea*	08/06/2018	Online Atlas of Vascular Plants 2012 Onwards	No

4.1.3.1 Invasive Species

The Invasive Species Ireland database was accessed on the National Biodiversity Data Centre online maps for records in the study area. There are numerous records of high-impact invasive species in the area of Castleconnell. Upstream near the survey sites extent, there are records of Winter Heliotrope *Petasites fragrans* from 2016 and 2017. Downstream near the middle of Castleconnell town, there are further records of Winter Heliotrope as well as Giant Hogweed *Heracleum mantegazzianum* from 1987. Downstream of here, there are further records of Giant Hogweed again from 1987, as well as records of Himalayan balsam *Impatiens glandulifera* from downstream of Doonass footbridge from 2017.

Furthermore, there are records on the National Biodiversity Data Centre online maps of other invasive species which have been recorded from Lough Derg upstream. Due to the hydrological connection here there is some potential that these species could be spread within the wider study area. These records, and the date of their most recent record, are as follows: Least Duckweed *Lemna minuta* (2007), Water Fern *Azolla filiculoides* (2012), Water violet *Hottonia palustris* (2009), Canadian pondweed *Elodea canadensis* (1988), Curly waterweed *Lagarosiphon major* (2009) and Nuttall's Waterweed *Elodea nuttali* (2006).

4.1.4 Aquatic Fauna

4.1.4.1 Fish populations

McCarthy (1997) reported a total of 23 freshwater fish species in the catchment area above Limerick and noted that the fish community in the shannon includes a large proportion of introduced species. The fish community includes the European Eel *Anguilla Anguilla*, Flounder *Platichthys flesus*, Sea lamprey *Petromyzon marinus*, River lamprey *Lampetra fluviatilis*, Brook lamprey *Lampetra planeri,* Atlantic salmon *Salmo salar*, and Smelt *Osmerous eperlanus* (O'Connor, 2003). The Shannon also contains a variety of resident, or largely within catchment migratory species including Pollan *Coregonus autumnalis*, Brown trout *Salmo trutta*, Northern Pike *Esox Lucius*, Perch *Perca fluviatilis*, Bronze Bream *Abramis brama*, Roach *Rutilus rutilus*, Tench *Tinca tinca*, Minnow *Phoxinus phoxinus*, Gudgeon *Gobio gobio* and Rudd *Scardinius erythrophthalmus* (O'Connor, 2003).

The Lower River Shannon SAC at the site is designated for the presence of Atlantic Salmon, Sea lamprey, Brook lamprey, River lamprey and Otter, as outlined in Section 3.1.1. The site synopsis for the SAC notes that all three species of Lamprey and Salmon have been observed spawning in the lower Shannon or its tributaries. Kurz & Costello (1999) note that Castleconnell is one of the main spawning areas for Sea lamprey and Brook / river lamprey, based on observations from O'Connor, W. The report from Kurz & Costello further notes that the silt beds downstream of these areas in Castleconnell are utilised by ammocoetes of both species (Kurz & Costello, 1999).

Cullen, P & McCarthy, T. K. (2007) conducted a study of European Eel in the Lower River Shannon and with study site was located in Castleconnell. This survey included electrofishing on ten occasions between 1996 and 1997. A total of 1467 eels were captured over the study period (Cullen & McCarthy, 2007). This study also notes that large fish were absent from the diets of most of the Lower River Shannon Eel population, with larger eels requiring larger prey. Cullen & McCarthy describe the Eel population in the lower Shannon as dense in the lower reaches of a large river system (2007).

The National Biodiversity Data Centre also has records of bony fish from the 10km grid square R66. From the Freshwater Fish in Irish Lakes dataset there are records of Common Bream x Rudd *Abramis*

brama x Scardinius erythrophthalmus, European Eel and Pike, all with most recent records from 1995. From the Clare Biological Records Centre Dataset from 2004-2007 there are records of Common Bream, Common Carp *Cyprinus carpio* (invasive Species), Perch, Rudd and Tench, all with most recent records from 2005.

In 1959, a salmon hatchery unit was constructed at Parteen Regulating Weir by the ESB. This hatchery involved annual releases of juvenile salmon produced at the hatchery with the aim of recovery of wild salmon in the catchment area. A new fish-lock system was also installed at Ardnacrusha hydroelectric station, as part of a proposal by the ESB to investigate fish passage issues. These measures were introduced to attempt to conserve the salmon population in the River Shannon (ESB, 2020a). The River Shannon Salmon Management Programme was also set up in 1990 (ESB, 2020a). All hatchery reared smolt have been adipose fin-clipped since 1991, with selected breeding lines micro-tagged, as well as the retention of unfed fry for smolt production in the coming year (ESB, 2020a).

In 2010, the ESB established the Shannon Fishery Partnership following discussions with the Shannon Fisheries Preservation and Development Co Ltd (SFPDC). The partnership comprises representatives from the ESB, the SFPDC, IFI and an independent chairperson (ESB, 2020b). The aim of the partnership is to develop a structure to identify the needs of the fishery, ensure conservation and sustainable yield in line with scientific advise, develop a 5-year plan for maintenance and enhancement, enhance recreational angling and stakeholder involvement (ESB, 2020b). Programmes of work as outlined in the 2020 report include silver and juvenile eel trap and transport, tree and shrub clearance, instream habitat works, electrical fishing, recreational fishing infrastructure, fish counters, smolt release and salmon hatchery activities (ESB, 2020b). The report notes that the fish counter at Ardnacrusha and Parteen weir malfunctioned in 2020 (ESB, 2020b). Overall, this report shows that the wild salmon population in the River Shannon continues to decline and healthy populations are not being restored.

The Standing Scientific Committee on Salmon presented a report to Inland Fisheries Ireland on the Status of Irish Salmon Stocks in 2016, which also outlines the objective of meeting 'Conservation Limits' in relation to the Fisheries (Amendment) Act 1999 (Standing Scientific Committee on Salmon, 2017). This Conservation Limit is applied by SSCS to establish the status of individual stocks as defined by the International Council for Exploration of the Sea (ICES) and the North Atlantic Salmon Conservation Organisation (NASCO) (SSCS, 2017). This report utilised the 'Upper Shannon' which is noted to be above Parteen weir and the impoundment here at the hydroelectric station, and data was collected using fish counter data from IFI. The report shows that the Upper Shannon area is not meeting it's conservation limit, with 0.05 of its CL achieved, meaning a deficit of 47,156. SSCO therefore advise that restoration programmes be introduced (SSCO, 2017). The updated version of this report in 2020 prepared by Gargan, *et al.,* (2020) gives the average salmon count for the Upper Shannon catchment (above Parteen) as 1,429, meeting 5% of its conservation limit. The recommendation is the same, that there should be no harvest fisheries and restoration programmes should be given precedence (Gargan, *et al,* 2020).

Inland Fisheries Ireland (2019) *Report on Salmon Monitoring Programmes* for 2017 to 2018 gives results of salmon monitoring at a site near Castleconnell in the Old Main Channel, with a mean catch of 5.5 salmon fry/5 mins of fishing. This is compared with a total of 18.2 salmon fry/ 5 mins in 2018 and a total of 35.68 salmon fry/5 mins for the 2019 results of the Salmon Monitoring Programme by IFI (IFI, 2021).

4.1.4.2 Macroinvertebrates

The National Crayfish Plague Surveillance Programme was set up in 2018 and is jointly funded by the National Parks and Wildlife Service (NPWS) and the Marine Institute and assesses the prevalence of crayfish plague on the Island. Crayfish plague is now present in 34 catchments across Ireland, and some are located within the wider Shannon catchment. This includes the Shannon Estuary South catchment (24), Lower Shannon (25C) which is from Killaloe upstream to Portumna, Upper Shannon (26D), Upper Shannon (25G), Lower Shannon (25A) including the Brosna, Upper Shannon (26A) near Lough Allen and Upper Shannon (26B).

Freshwater White-clawed Crayfish *Austropotamobius pallipes* were also recorded most recently in 1994 from the River Biologists Database (EPA). Crayfish plague was reported in 2018 from the River Al in Athlone which is a tributary of the River Shannon. There is some potential that crayfish plague has spread this far down the catchment as this species has not been recorded since 1994 according to online records. As noted above, Crayfish plague has been reported in the catchment upstream of Killaloe.

There are numerous aquatic macroinvertebrate records for the 10km grid square R66. These records span across the following databases: River Biologists' Database, Aquatic Oligochaeta of Ireland, Clare Biological Records Centre Database 2004-2007, Water Beetles of Ireland, Caddisflies (Trichoptera) of Ireland, Dragonfly Ireland 2019 to 2024, Mayflies (Ephemeroptera) of Ireland and True Bugs (Heteroptera) of Ireland.

The annelids *Glossiphonia complanate* and *Potamothrix moldaviensis* have been recorded in the 10km grid square R66 from the River Biologist's Database (EPA) and Aquatic Oligochaeta of Ireland databases respectively.

A total of 21 aquatic beetles have been recorded in this grid square, including the following 3 threatened species: *Hydrocyphon deflexicollis, Hydroporus obsoletus* and *Nebrioporus depressus.* A total of 57 different species of Caddisflies have been recorded in the 10km grid square. None of these caddisfly species are noted to be threatened and most records are from 2015. For Dragonflies, a total of 16 different species have been recorded in this grid square and none of these species are threatened. The most abundant of these are the Large red damselfly *Pyrrhosoma nymphula*, Four-spotted chaser *Libellula quadrimaculata*, Common blue damselfly *Enallagma cyathigerum* and Common hawker *Aeshna juncea*. A total of 9 different species of Mayfly have been recorded including the threatened species *Rhithrogena germanica* which was last recorded in 1996. The most abundant mayfly in the 10km grid square is *Baetis rhodani*. For the True Bugs, a total of 5 species have been recorded. For True Flies, a total of 12 species have been recorded and none of these are noted to be threatened species.

4.1.4.3 Molluscs

The vulnerable and threatened Duck Mussel *Anodonta anatine* was last recorded in the 10km grid square in 1982, according to the All-Ireland Non-marine Molluscan Database. There is no potential for the Annex II species Freshwater Pearl Mussel to be present here. This species range is confined to the River Cloon which flows into the Shannon Estuary, far downstream of the study area. There is therefore no known population upstream of downstream of Castleconnell.

4.1.4.4 Invasive Species

There are also a number of invasive species relating to aquatic fauna that have been recorded in the 10km grid square R66, and indeed in other areas within the wider study such as Lough Derg upstream. Due to the hydrological connection, there is potential that these species could be spread to areas downstream. These species include the Zebra Mussel *Dreissena polymorpha,* which arrived in Lough Derg in 1990 and has colonised much of the area here including the study area at Castleconnell. 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. 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 last recorded in 2005 from the Freshwater Fish in Irish Lakes dataset.

4.1.4.5 Mammals

The National Biodiversity Data Centre online maps show records of Otters in the study area as part of the Otter Survey of Ireland 1982 by the Vincent Wildlife Trust, with the record being droppings in 1980. There are no more recent recordings of Otters from the study area in this database. However, Otter are known to be present along this stretch of the River Shannon in the study area. The Otter Survey of Ireland 2004/2005 shows that these surveys indicated that Otters were present in 70.53% of sites in the Shannon River Basin District (which included some sites in the vicinity of Castleconnell), compared to 100% from the surveys in 1980/81 (Bailey & Rochford, 2006). Otter spraints were also collected as part of this study, which were then analysed to obtain the percentage occurrence of prey categories for each river basin district. This showed that frogs accounted for the highest percentage in the Shannon River Basin District at 42.9%, followed by Stickleback at 35.7% and Salmonids at 21.4%. Cyprinids (10.7%), Eels (17.9%), Stoneloach (3.6%), Birds (7.1%), Mammals (17.9%), Unidentified Bones (3.6%) and Crayfish (10.7%) comprised the remainder of prey items found in Otter spraint in the Shannon RBD (Bailey & Rochford, 2006). This also gives an indication of what aquatic prey items are present at Castleconnell, in particular with Eels, Stoneloach, Stickleback and Crayfish.

4.1.5 Water Quality

4.1.5.1 Biological Monitoring

The Environmental Protection Agency (EPA) carry out biological monitoring on a number of sites on the Lower River Shannon in the Lower Shannon Hydrometric Area (25). There are a total of 9 monitoring sites on the lower Shannon, including one at Castleconnell. The overall assessment of the lower Shannon from the EPA is as follows: *'Moderate ecological conditions persist in the Shannon at World's End, Castleconnell in August 2018'*. The most recent monitoring data available is from 2018.

The closest monitoring site upstream of Castleconnell is actually at Portumna, upstream of Lough Derg, with no monitoring points located in between this stretch on the Lower Shannon. The site upstream was most recently rated as Q4 in 1984 (EPA Station Code: 25S01 2300), corresponding to Water Framework Directive (WFD) status 'Good'. The site at Castleconnell is located at World's End, immediately upstream of the study area for the current baseline study. This site was most recently rated as Q34 in 2018 (EPA Station Code: 25S01 2500), corresponding to WFD Status 'Moderate'. Looking at the monitoring trends for the lower Shannon, no site was rated above Q4 since 1984, where the two

furthest upstream stations were rated as Q4-5, with one upstream of Banagher, Co. Galway, and one downstream. At the same time in 1984, all other sites surveyed on the lower Shannon were evaluated as being Q4. Declines were noted first from 1993, with the two lower sites, one at Castleconnell and one at Athlunkard Bridge in Limerick, rated as Q3-4. Both of these sites continued to receive this rating over the years, with the exception of Q4 in 2002 for the Castleconnell site, which subsequently fell again to Q3-4 to following monitoring year in 2008.

4.1.5.2 Water Framework Directive

The WFD set out objectives to be met by river waterbodies in Ireland before 2021. Waterbodies are then assessed for their potential risk of not meeting these objectives set out by WFD, and therefore are assigned a Risk rating. Waterbodies that are At Risk can then be prioritised for implementation of measures. The Lower River Shannon, from the base of Parteen reservoir at Ardnacrusha hydroelectric station up until the World's End immediately upstream of the study area at Castleconnell, is assessed as being 'At Risk'. After this point, the Shannon main channel, from Castleconnell up until its tidal are at Limerick City, is assessed as being 'Not At Risk'. Similarly, the WFD River Waterbody status for the period 2013-2018, was given as 'Moderate' for the area of Ardnacrusha hydroelectric station downstream to Castleconnell, while areas downstream of this point were 'Unassigned'. The catchments online maps also show that that River Shannon above Castleconnell does suffer from hydromorphology pressures.

4.1.5.3 Discharges

There are multiple wastewater discharges along the lower Shannon main channel. The first downstream of Lough Derg is at Ballina / Killaloe (Reg. No.: D0189-01). The most recent Annual Environmental Report for the plant is from 2019 (Uploaded on 27-8-20; Checked 2-11-21), which states that the plant is compliant with Emission Limit Values (ELVs) (Irish Water, 2019). However, the ambient monitoring results show that the plant is not meeting its required Environmental Quality Standards (EQS), with deteriorations noted for Ammonia, BOD, Ortho-P concentrations downstream of the discharge (Irish Water, 2019). The AER also noted that the plant is constructed for a i.e. of 4500 but the collected load is 5243 p.e. with no capacity remaining, meaning that the plant is currently overloaded. However it is note that it is not expected that the plant will exceed its capacity in the next three years, which leads to some uncertainty (Irish Water, 2019). There were 9 complaints of a blocked sewer in 2019, as well as incidents relating to a uncontrolled release due to pump failure and network infrastructure, breach of ELVs due to a sludge issue, and equipment offline due to maintenance, which were all reported to the EPA (Irish Water, 2019).

Further downstream, there is another wastewater treatment plant at O'Brien's Bridge, which is known as the Brookhaven, Montpelier plant (Reg. No.: A0499-01). This plant discharges directly into the River Shannon on the Montpelier, Limerick side of the river via a 400mm diameter open ended sewer (EPA, 2011). The Inspectors report for the plant states that the agglomeration has a population equivalent (p.e.) of 49, and the WwTP consists of primary treatment only with a septic tank, with a design capacity of 50 p.e. (EPA, 2012). There is a designated bathing water located in the vicinity of the discharge. An NIS was completed as noted in the Inspector's report, which stated that mitigation measures proposed include maintaining the current management regime of the septic tank, which if followed would therefore not adversely affect the integrity of the European Site(s) (EPA, 2012). No Annual Environmental Report (AER) has been completed for the plant (Checked 2-11-21).

Moving further downstream after O'Brien's Bridge, the next discharge point is at Castleconnell, which consists of a storm water overflow, within the study area. The Castleconnell agglomeration is treated at Castletroy WwTP, which discharges into the River Shannon downstream. The Castletroy WwTP deals with effluent from the following three agglomerations: Castletroy, Castleconnell, Mountshannon (EPA, 2009). The storm water overflow at Castleconnell is noted to be an emergency overflow at the pumping station but standby pumps are in place (EPA, 2009). The most recent Annual Environmental Report for Castletroy WwTP was completed in 2020 (Uploaded 11-8-21; Checked 2-11-21). This AER states that the plant is compliant with ELVs set out in the license, and the ambient monitoring results do meet required EQS (Irish Water, 2020). The design capacity of the plant is noted to be 45,000 p.e., with a collected load of 40,200 p.e., and a remaining capacity of 4,800 p.e. (Irish Water, 2020). There was one complaint for sewage noted in the 2020 report, and 13 no. incidents reported to the EPA in 2020, ranging from spillages to uncontrolled releases caused by weather and blocked sewers (Irish Water, 2020). There are further discharge points on the Shannon main channel downstream however the rest are located in the tidal sections of the river, with the Limerick City WwTP at Bunlicky, as well as at Shannon town and various agglomerations along the coast in the estuary.

4.1.6 Angling and Fisheries

Reale, A (2011) describes the Castleconnell fishery of the past which was once famous for large spring salmon, and significant declines were recorded following the construction of the Shannon hydroelectric scheme. O'Reilly (2002) describes the Castleconnell fishery as having 8 beats, each about a half mile long. It is noted here that salmon caught during recent times are a much lower weight than previous records, and that fishing on the Shannon in general has declined greatly in recent years, with the construction of the hydroelectric dam greatly reducing the volume of water in the flow of the old river (O'Reilly, 2002).

Significant fisheries modifications have been completed on this stretch of the River Shannon over the years. These modifications were introduced on the river in order to enhance habitat due to the 10m^3/s compensation flows as part of the Ardnacrusha Hydroelectric Scheme, but many of the works were completed during the 1980s and 1990s. Therefore when water is 'spilled' through Parteen Regulating Weir gates during high water events, the modifications are not suitable for these water levels and therefore are unfishable during these periods. The modifications set out to create salmon pools and include intrusive structures such as the wall at Beat 5 but have significantly altered the natural hydro-geomorphological processes. These works are also expected to have increased the likelihood of flood events in the area of Castleconnell, as they increase vegetation encroachment onto the river and thus reduce the rivers ability to hold water during flood events.

The 'River Shannon Fishery' article in the Old Limerick Journal from 1998 shows a map of the salmon pools once found at Castleconnell in 1941, which was after the construction of the Ardnacrusha Hydroelectric scheme but prior to the fisheries modifications undertaken in the 1980s and 1990s. This article notes that the river was full of big fish in 1928 and 1929, with one fish weighing close to 60lbs (Old Limerick Journal, 1998).

5. FIELD SURVEY RESULTS

5.1 Overview

5.1.1 Study Area

The extent of the field survey comprised a stretch of the Lower River Shannon c. 1.7rkm in length adjacent to Castleconnell. The study area takes into account the main areas affected by the proposed Castleconnell Flood Relief Scheme as well as areas both upstream and downstream of this point. The extent of the study area stretches from the Doonass Footbridge downstream of Castleconnell Village to an area known locally as 'Pa's Gap' upstream of the village. This survey stretch comprises areas that used to be well known as a fishery historically, and has undergone fishery modifications in the past. There are numerous weirs, side channels, walls, artificially created pools, islands and riparian woodland present here. The river is affected by extreme water abstraction and regulation as part of the operation of the Shannon hydroelectric scheme.

The width of the old River Shannon in the study area ranges from between 80m and 160m in wetted width. Some of the sites are located on side channels and adjacent small streams. Due to the fisheries modifications, flows are very varied here, even at individual sites. This results in a range of different vegetation types for both high flow and slow flowing water, as well as varied fish habitat. Vegetation encroachment is common in the study area.

5.1.2 Aquatic Flora

The protected habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation'* habitat is designated within the Lower River Shannon SAC. This habitat was not recorded on the River Shannon at Castleconnell during the current survey – but it does exist within the study area, for example in Conway's Canal.

There were several species of submerged vegetation recorded. The non-native invasive species Canadian waterweed *Elodea canadensis* was common throughout the survey area. This species out competes native species for nutrients and space and can lead to an overall decrease in biodiversity. Large stands of the species can cause anoxic conditions by reduced the movement of water (NIEA, 2020). Also present in high abundances were *Potamogeton spp.* including Pondweed *Potamogeton natans* and Curled Pondweed *P. crispus* can be found in a variety of habitats and is capable of withstanding in highly eutrophic conditions (Preston & Croft, 2001/1997). The species was recorded at several sites along the river at depths of up to c. 1.5m. Where it was it occurred in small groups which were widespread in the river. *P. natans* was also recorded throughout. This species was also recorded throughout the survey stretch. This species is most common in still and slow flowing waters but can also occur in faster moving waters (Preston & Croft, 2001/1997). This species tended to be more common in areas of allow flowing water on the river edges where Yellow water-lily also occurs. Yellow-water lily *Nuphar lutea* also occurs throughout the survey area and was strictly confined to areas of slow flowing water. In addition to these species the green algae *Cladophora sp.* was common in the survey stretch. The high occurrence of this species is indicative of enrichment. Filamentous algae was common in several areas.

Other submerged species which are present include Water milfoil *Myriophyllum* sp. which occurred sporadically throughout the survey stretch. In addition, Great water-moss *Fontinalis antipyretica* was common throughout and Bistort *Persicaria amphibia* occurred in discrete areas of slow-moving water.

The species Water-crowfoot *Ranunculion sp.* was also recorded. However, the Annex I habitat which it can form is not believed to occur in this stretch. The protected habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation'* habitat is designated within the Lower River Shannon SAC. When designating this habitat in the SAC the basis for selection was the presence of plant species such as *Ranunculus*, *Potamogeton* spp. and *Fontinalis antipyretica* (European Commission, 2007). There are three main sub types with this protected habitat. Two of the sub-types are associated with the tidal rivers: *Groenlandia densa* (L.) Four., Opposite-leaved Pondweed and *Schoenoplectus triqueter* (L.) Palla, Triangular Club-rush (NPWS, 2012b). The last sub-type is associated with fast-flowing stretches of unmodified streams and rivers and is not noted to occur at Castleconnell. During the survey *Ranunculus*, *Potamogeton spp.* and *Fontinalis antipyretica* were identified. While 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.

This habitat occurs in nutrient poor fast flowing waters. It is stated in the Article 17 reports that "*High conservation value sub-types are associated with natural hydrological regimes, including functioning floodplains*." The river here is not under a natural hydrological regime with ESB abstracting a significant proportion of the River Shannon flow which maintains a flow rate of 10cm^3 for large periods of time. There are also several fisheries modifications to the River Shannon upstream and in the survey stretch such as weirs, rocks and groynes. These have changed the river levels in areas resulting in some deeper areas and an increasingly confined channel. This is typically unsuitable for this habitat (NPWS, 2019; Hatton-Ellis and Grieve, 2003). Eutrophication and water pollution are also an issue. As stated above in Section 4.1.5 there are water quality issues here such as the WwTP at O' Brien's bridge, Ballina / Killaloe in addition to hydromorphological changes to the river. Cumulatively these impacts have made this section of the River Shannon generally unsuitable for the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion vegetation'*.

Several species of emergent plants were also recorded which were confined to the edges, fishing features and islands. The dominant species present 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,* Bull rush *Typha latifolia*, Common club-rush *Schoenoplectus lacustris* and Water Hemlock *Oenanthe crocata*.

5.1.3 Fish populations

A total of 15 fish species were recorded during the current survey. Atlantic Salmon and Brown Trout were present throughout the study area. Juvenile salmon numbers were very variable but locally abundant in suitable habitats. Adult salmon are also present in the study stretch and were seen during the survey. Brown Trout numbers were very low and salmon is the dominate salmonid in this stretch of the river. Small numbers of eels were recorded along the study stretch. Brook lampreys, River Lampreys, and Sea Lampreys were all recorded. However, lamprey numbers were considered to be very low and were absent from a number of areas despite habitats appearing to be physically suitable. Three-spined stickleback was one of the most common fish species recorded. One Flounder was recorded during the survey. Stone loach, Minnow, Dace, Roach, Gudgeon, Pike and Perch were also recorded. Overall, the fish community recorded was dominated by non-native cyprinid species. The most common fish species recorded was the non-native minnow.

5.1.4 Aquatic Macroinvertebrates

Aquatic macroinvertebrates in the study area spanned across 12 orders and a total of 34 different families. Overall there were only two Group A families recorded, and Group A species were only recorded at 3 sites within the study area. These Group A families were Family Heptagenidae and Ephemeridae, with three species present. These species were *Ecdyonurus* sp., *Ecdyonurus venosus* and *Ephemera danica* and were very scarce.

Group B pollutant sensitive species in the study area spanned across two orders and 5 different families. One stonefly *Leuctra hippopus* was present in the study area in small numbers. The remaining Group B species comprised cased caddisflies, with 4 species recorded. Group B species were recorded at every site in the study area, with some having higher diversity of species and greater numbers. The abundances ranged from present to small numbers.

Group C pollutant tolerant was the most common group across the study area, with the highest diversity also across the groups. Group C species were recorded across 8 different orders and 22 families. There were a total of four Group C mayflies recorded across 3 families. The large dark olive *Baetis rhodani* was present at every site with abundances ranging from scarce/few to fair numbers. The blue winged olive *Serratella ignita* was present at almost every site, mostly recorded in fair numbers. The freshwater shrimp *Gammarus* sp. was recorded at every site in the study area. Abundance of this species ranged from small numbers to numerous. One Class C leech was present and this was *Piscicola geometra*. Three bugs in Group C were present from families Notonectidae, Corixidae and Gerridae. This consisted of Water Boatman *Sigara distincta*, Common Backswimmer *Notonecta glauca* and water striders *Gerris* sp. A total of 7 species of snails in Group C were recorded in the study area. Abundances of these snails ranged from present to fair numbers, with *Lymnaea stagnalis* and *Bithniya tentaculata* both being recorded at each site and with the highest abundances. Two Group C beetles were present in the study area and these were *Haliplus rufieollis* and *Gyrinus caspius* with abundances ranging from present to small numbers. True flies in Group C were represented by *Similium* sp. and green chironomid, which were present at most sites. A total of 10 species of caseless caddisflies were recorded in the study area, across the families Hydropsychidae, Rhyacophilidae, Polycentropodidae and Philopotamidae. The most common species throughout the study area were *Polycentropus kingi, Hydropsyche* sp. and *Plectrocnemia geniculata.* Abundances of Group C species ranged from present to fair numbers, with *Hydropsyche siltali* having the highest abundance at one of the sites.

Group D very pollutant tolerant species in the study area were represented by two species, the crustacean *Asellus aquaticus* and the leech *Glossiphonia* sp. Each of these species were present at most sites in the study area, with abundances ranging from present to small numbers. Only one Group E species was recorded at the site in the family Chironomidae, represented by *Chironomous* sp. which was only recorded as present at each site it was found.

Overall the study area 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.

5.2 Results from the Individual Survey Sites

5.2.1 Site 1

5.2.1.1 Site Location

Site 1 was located at Doonass bridge, which connects Clonlara, Co. Clare to Castleconnell, Co. Limerick. The kick sampling survey site in this location was located upstream of Doonass Bridge on the right bank as this is where the most riffle habitat was recorded. Lamprey survey site 1 (a) was located downstream of the bridge on the right bank. Lamprey survey sites 1 (b) and 1 (c) were located c. 163m upstream and c. 300m upstream of the footbridge respectively. These sites were both located on the left bank of the river. Lamprey survey site 1 (b) was located just adjacent to the confluence of an unregistered drain / stream in an area of silt on the bank of the river. Lamprey survey site 1 (c) was located on the left bank of the river on a bend, adjacent to riparian trees.

5.2.1.2 Aquatic Habitats

The habitat at this site was a mixture of riffle and glide. Several fishery features on the river here in the form of small weirs have formed riffles in the area. Riffles are most common upstream of Doonass Bridge on the right bank. There are two weirs upstream of Doonass Bridge which span the channel – upstream of these there is glide habitat. Glide is also present downstream of the bridge. There are small areas of pool habitat particularly, particularly in a back water channel upstream of Doonass Bridge on the right bank and also in the lamprey survey areas.

Water depth varies throughout the site, with depth being approximately 1m within 10m of the river bank. Water depth increases towards the middle of the channel with these areas being largely inaccessible by wading. The substrate also varies in parts, with larger boulders in areas of stronger flows and cobble and sand noted in areas with slower flows. At the edges of the river where vegetation occurs there are silt deposits also. There are several small instream islands at the site, the largest of which are on the right hand side of the river upstream of Doonass bridge. There were also silt deposits around these islands and they created some pool habitat. This area also had a high density of instream vegetation. The back channel of these islands had little flow in areas, high levels of shading and some filamentous algae growth along with a moderate level of silt.

During the lamprey survey a farmer came to site and washed a slurry tank out. This was done over the grass but localised pollution was caused by this activity.

5.2.1.3 Fish populations

A total of 191 individual fish comprising of 12 species recorded at Site 1. Juvenile Atlantic Salmon were recorded at the site. There were 16 individuals recorded which resulted in a CPUE of 3.2 fish / min. Low numbers of Brown Trout were recorded (0.8 fish / min). The most abundant fish species recorded was Minnow with 100+ individuals present, followed by Roach (n=30), and Three-spined stickleback (n=20). Also recorded at this site in smaller numbers (>10), and decreasing abundance were Dace, Stone Loach, Gudgeon, Eel, Flounder, Perch, and Pike.

A total of 37 juvenile lampreys were recorded at Site 1 during the group specific survey. The majority of lamprey recorded (n=35) were River / Brook Lamprey. There were 2 Sea Lamprey recorded at Site

1. This corresponded to a River / Brook Lamprey density of 3.89 lamprey/m^2 and a density of 0.22 lamprey/m^2 overall.

5.2.1.4 Aquatic Macroinvertebrates

A total of 30 macroinvertebrates species were found at Site 1. These were spread across 24 families. There were no pollutant sensitive Class A macroinvertebrates recorded at the site. There were several species Class B, pollutant sensitive macroinvertebrates recorded. These consisted of Caddisflies (Tricoptera), Damselflies (Zygoptera) and one True Bug (Hemiptera). These were all recorded in fair numbers. The cased caddisfly larvae of *Lepidostoma hirtum*, *Phryganea grandis* and *Potamophylax latipennis* were all recorded in small numbers. There were two species of damselfly recorded from the same family. These were *Calopteryx splendens* and *Calopteryx virgo*. These were both recorded in fair numbers. They were recorded most often during vegetation sweeps and were also observed as adults in flight. Lastly, the pollutant tolerant true bug *Aphelocheirus aestivalis* was recorded in fair numbers. Class C pollutant tolerant macroinvertebrates were the most common group recorded.

There was a total of 22 Class C species recorded consisting of Mayflies (Ephemoptera), Caseless Caddisflies (Trichoptera), True Flies (Diptera), Snails (Gastropoda), Crustaceans (Crustacea) and True Bugs. The most abundant were the mayfly larvae *Seratella ignita*, the caseless caddis fly larvae *Rhyacophila dorsalis,* the snail *Bithynia tentaculata*, the freshwater shrimp *Gammarus deubeni*, and the three true bugs *Notonecta glauca* and *Gerris* sp. Were all recorded in fair numbers. Class C species recorded in small numbers include the mayfly *Baetis rhodani*, black fly larvae *Similium* sp. and the snails *Lymnaea stagnalis.* There were six Class 6 species recorded as scarce/few. These included the caseless caddis flies *Hydropsyche augustipennis*, *H. pellucidulata*, *Rhyacophila dorsalis* and *Polycentropus kingi*. In addition, the true fly larvae green chironimid and the leech *Pisciola geometra* are Class C and were also recorded in scarce/few numbers. There were five Class C species recorded as present only. These were the caseless caddisfly larvae *Plectrocnemia conspersa* and *Polycentropus flavomaculatus.* Also recorded as present were the were three snail species including *Succinea putris*, *Theodoxus fluviatilis* and *Valvata cristata*.

There was on Class D and one Class E representative recorded at the site. These were the crustacean *Asellus aquaticus* and the *bloodworm Cironomous* sp. These were recorded in small numbers and as present respectively. The non-native invasive species the Zebra mussel *Dreissena polymorpha* was also recorded at the site.

Overall, Class C were the dominant macroinvertebrate group recorded at the site. However, Class B species were present in relatively high numbers and there was a general lack of Class D and E species. Due to this the site is rated Q3-4 equivalent to “Moderate” WFD status and indicative of slightly polluted conditions.

5.2.2 Site 2

5.2.2.1 Site Location

Site 2 was located on the main channel of the river (right bank) within the Castleconnell village area, on the stretch known as Castlelough and near Island House. The kick sample survey site was located within ruffle habitat just upstream of the main pool at Castlelough. Lamprey survey Site 2 (a) was located within Castlelough at the Ferry Playground carpark area. Lamprey survey Sites 2 (b) and 2 (c) were located upstream near at the confluence of the Island House distributary.

5.2.2.2 Aquatic Habitats

Compared to Site 1 the complexity of habitats at Site 2 is somewhat lower and is dominated by Castlelough. The kick sampling site was located at a weir spanning the river length at the site which has resulted in some riffle habitat being present. The water at this site varied greatly and access was very difficult. The middle sections of the river are very deep and it was not possible to wade here; while the edges range in depth from c. 1-2m. There are several established islands and also areas of instream emergent vegetation. The substrate throughout the site varies considerably. It compromised boulder at rock in the vicinity of the weirs. Upstream of the weird the substrate consists of sand / cobble. At the edges of the river there are deposits of silt. The average wetted width at Site 2 is c. 90m.

The weir at the kick sampling site compromised of old boulders. The wetted width at this weir is c. 80m. There is a further weir just upstream of the first one, with a length of c. 110m. This weir has some small islands near the left bank side. On the right bank there is a significant island with several trees upstream of this weir and not included in the site. Extensive filamentous algae was noted on the boulders at these weirs.

There are silt deposits in the area particularly at the lamprey survey sites. At lamprey survey Site 2 (a), there was no overhanging vegetation at this site and therefore no shading is present. There is also no emergent vegetation. At lamprey survey Site 2 (b) there is a small back channel. Due to the adjacent woodland and riparian vegetation, there is some shading on this site. There is also some emergent vegetation close by. The main flow is blocked here due to the back channel, so flows are slower, resulting in the build-up of algae in this glide/pool habitat. At lamprey survey Site 2 (c) there is some shading present due to the riparian trees as well as some emergent vegetation. The main flow is diverted into the middle of the channel due to the presence of the back channel downstream as well as a small section of trees separating the back channel from the main channel.

5.2.2.3 Fish populations

There was a total of 26 individual fish recorded at Site 2, comprising 4 species. There were no salmonids recorded at this site. The most common species was Three-spined stickleback with 10 individuals present followed by Stone Loach, Minnow, and Eel.

A total of 11 juvenile lampreys were recorded at Site 2. At Site 2 (a) there was 1, at 2(b) there were 3 and 2(c) there were 7. These were all identified as River / Brook Lamprey. The density of lamprey at the site was 1.22 lamprey pe m^2 which is considered to be very low.

5.2.2.4 Aquatic Macroinvertebrates

A total of 21 macroinvertebrate species spread across 19 different families were recorded at Site 2. The Class A pollutant sensitive Mayfly *Ephemera danica* was recorded at this site as scarce / few. A number of Class B pollutant sensitive species were also recorded at this site, with the highest abundances being 'Fair numbers' of both the True bug *Aphelocheirus aestivalis* and the Damselfly *Calopteryx splendens*. Other Class B species recorded included the cased caddis flies *Lepidostoma hirtum* and *Phryganea grandis* and the damselfly *Calopteryx virgo* at Present, Scarce/few and Scarce/few respectively in relation to abundances at this site.

Overall, the majority of macroinvertebrate species recorded at Site 2 were Class C pollutant tolerant macroinvertebrates. These species spanned across Mayflies (Ephemeroptera), Caseless caddis flies

(Tricoptera), True Flies (Diptera), Snails (Mollusca, Gastropoda), Crustaceans (Crustacea), Leeches (Hirunidae) and Bugs (Hemiptera). The most abundant were the freshwater shrimp *Gammarus deubeni,* common backswimmer *Notonecta glauca* and water striders *Gerris* sp. with numerous numbers. True flies were represented by *Similium* sp. with fair numbers at this site. The snails *Lymnaea stagnalis* and *Bithnynia tentaculata* were recorded in fair numbers and small numbers respectively. The Class C Mayfly *Baetis rhodani* was recorded as scarce/few at Site 2. Green chironomid were also recorded in small numbers. Class C species recorded as present at Site 2 include the caseless caddis flies *Polydentropus kingi, Plectrocnemia geniculata* and the snail *Theodoxus fluviatilis*.

There were two Class D Very pollutant tolerant species recorded at this site represented by leeches and crustaceans. The leech *Glossiphonia* sp. was recorded as present and the crustacean *Asellus aquaticus* was recorded in fair numbers. There was one Group E Most pollutant tolerant species recorded at Site 2 and this was *Chironomous* sp. The invasive zebra mussel *Dreissena polymorpha* was also recorded during the macroinvertebrate surveys, with the abundance of scarce/few.

Overall, Class C were the dominant macroinvertebrate group recorded at the site. However, one Group A species was recorded as well as some Group B species with some recorded as fair numbers. There was a general lack of Class D and E species and therefore this site is rated as Q3-4 equivalent to 'Moderate' WFD status and indicative of slightly polluted conditions.

5.2.3 Site 3

5.2.3.1 Site Location

Site 3 is located on a small stream adjacent to a residential dwelling called Island House. This stream is not registered by the EPA. The stream at Site 3 flows through an area of broadleaved woodland, which is located east of the main old River Shannon channel. Downstream of Site 3, the stream flows for c. 260rm before flowing into the River Shannon just downstream of Site 2. This site is adjacent to the Main Street in Castleconnell. The kick sample site is located just c. 22m downstream of The Elvers road bridge.

Lamprey survey site 3 (a) is located c. 35m downstream of the bridge site on the right bank of the stream. Lamprey survey site 3 (b). is located c. 65m upstream of site 3 (a) and c. 24m downstream of The Elvers road. Lamprey survey site 3 (c) is located on an adjacent drain / stream which is again not registered by the EPA. This site is located on the northern side of the entrance road to the residential dwelling here known as 'Island House'.

5.2.3.2 Aquatic Habitats

The stream at Site 3 is a relatively small waterbody consisting of mostly glide and pool habitat. This is a backchannel of the River Shannon and is immediately downstream of a bridge, which is to a private entrance of a house. This stream here has a wetted width of approximately 4m. The wetted width is uniform throughout most of this stretch however it does reduce to 2.5m in areas downstream of the bridge. The substrate at the site comprises a mixed substrate of cobble and stones. This area is heavily shaded as it flows through a woodland and there are several overhanging trees. This has resulted in a high level of canopy cover for most of the survey section of c. 70%. There is no large vegetation on the banks however they are covered in ivy. There were low levels of instream vegetation present. In this area is increased siltation when disturbed. There is no instream vegetation at this site and emergent vegetation is not common.

There are some silt deposits here such as approximately 35rm downstream of the bridge site at the edge of the bank. This was lamprey survey site 3 (a). The substrate here at this site however was mostly cobble making it sub-optimal for lamprey. The wetted width at this site is c. 3m. Again, this area is heavily shaded here by riparian trees as the stream flows through woodland. There is no instream vegetation and emergent vegetation is sparse. Moving upstream, at lamprey survey site 3 (b) substrate here is mostly cobble again and lamprey habitat is suboptimal. The area is heavily shaded by overhanging riparian trees. Some siltation is noted here. At lamprey survey site 3 (c) the wetted width is c. 2m. The main substrate present here is cobble and juvenile lamprey habitat is therefore again suboptimal. This site is heavily shaded by the woodland and overhanging riparian trees here. There is no instream vegetation.

At the Site 3 bank channel there was evidence of pollution. Due to the low flow there were significant siltation in areas. There was also filamentous algae growths on the siltation.

5.2.3.3 Fish populations

At Site 3 there were 33 individual fish recorded across 6 species. There were no Salmon recorded at this site but there was one Brown Trout. The most common species recorded were Minnow and Roach with 10 individuals of each. There were 7 Three-spined stickleback recorded, 3 Eel and 2 Stone Loach.

At Site 3 there were 5 juvenile lampreys recorded. Of these 4 were identified as River / Brook Lamprey and 1 as Sea Lamprey. All lampreys were caught at Site 3 (c). The density of River / Brook Lamprey was 0.44 lamprey/m^2 and of Sea Lamprey was 0.11 lamprey/m^2

5.2.3.4 Aquatic Macroinvertebrates

A total of 25 macroinvertebrate species were recorded at Site 3. This spanned across 24 different macroinvertebrate families. The Class A pollutant sensitive Mayfly *Ecdyonurus* sp. was recorded as present at this site and was the only Class A species recorded during the survey. Class B pollutant sensitive species were spread across 4 different families. The caseless caddisflies *Lepidostoma hirtum* and *Potamophylax latipennis,* in the Lepidostomatidae family and Limnephilidae family respectively were both recorded in small numbers. The Class B damselfly *Calopteryx splendens* was also recorded as scarce/few. The true bug *Aphelocheirus aestivalis* was also recorded in small numbers.

Overall, the majority of macroinvertebrate species recorded at Site 3 were Class C pollutant tolerant macroinvertebrates. These species spanned across Mayflies (Ephemeroptera), Caseless caddis flies (Trichoptera), True flies (Diptera), Beetles (Coleoptera), Snails Mollusca, Gastropoda), Crustaceans (Crustacea), Leeches (Hirudinae) and Bugs (Hemiptera). The most abundant were the freshwater shrimp *Gammarus deubeni* in common numbers. Recorded with the abundance of Fair numbers, were the Group C Mayflies *Serratella ignita* and *Baetis rhodani.* The following Group C species were recorded at Site 3 with an abundance of Small numbers: the snail *Lymnaea stagnalis* and the bugs common backswimmer *Notonecta glauca* and water striders *Gerris* sp. Class C mayfly *Caenis luctuosa* was recorded as present at Site 3, while the caseless caddisflies *Rhyacophila dorsalis* and *Polycentropus kingi* were recorded as scarce/few. Group C true flies were represented by *Similium* sp. and Green chironomid, both recorded as scarce/few. The water beetle *Haliplus ruficollis* was also recorded as scarce/few, while the larger coleopteran *Gyrinus caspius* was recorded as present. The Group C Snail *Bithniya tentaculate* was also recorded as present at Site 3. Finally for Group C, the leech *Piscicola geometra* was recorded as scarce/few.

Two Group D very pollutant tolerant species were recorded at this site represented by leeches and crustaceans. The leech *Glossiphonia* sp. was recorded as present and the crustacean *Asellus aquaticus* was recorded as scarce/few. There were no Group E species recorded at Site 3.

Overall, Class C were the dominant macroinvertebrate group recorded at the site. However, one Group A species was recorded and some Group B species were recorded in small numbers. There were only two Group D species and no Group E species at this site. Site 3 is rated as Q3-4 equivalent to 'Moderate' WFD status and indicative of slightly polluted conditions.

5.2.4 Site 4

5.2.4.1 Site Location

Site 4 was located on the main old River Shannon channel west of The Elvers road area. This survey site is located adjacent to an Island on side channel. The kick sample site is located c. 12m upstream of the weir across this side channel on the left bank. The kick sample site is located just downstream of riparian trees on an island in the main channel of the River Shannon. This island splits the main channel and results in two side channels here, and site 4 is located on the eastern side channel. The kick sample site is located in a riffle area where the flow is increased just downstream of the island. Vegetation sweeps were also carried out in emergent vegetation here.

Lamprey surveys site 4 (a) is located c. 43m downstream of the weir on the right bank. As this site is located on a bend in the river there are some accumulations of silt resulting in suitable juvenile lamprey site. Lamprey survey site 4 (b) is located c. 17m downstream of the weir, c. 12m in from the right bank of the side channel. Lamprey survey site 4 (c) is located c. 28m upstream of the weir at this side channel, on the right bank.

5.2.4.2 Aquatic Habitats

Survey Site 4 also shows high habitat complexity with several different substrates present, riffle, glide and pool habitat as well as a small weir and several different instream islands. There is a large instream Island c. 300m long here which splits the river channel. This island is heavily vegetated and has woodland habitat. There is another island to the east of this larger island and also included in the site. The survey at this site only concerned the left (east) side of the channel. On the right side the channel is much less vegetated and there are several weirs going from the largest instream island to the bank. On the subject side the channel width is c. 30m, but the width of the main river channel including the islands and side channels is c. 160m. The side channel has a slower flow than the main river channel here.

This survey site has been modified for fisheries in the past. There is a small weir at this site comprising rock and boulders and this crosses circa half the channel here. There is also a large stone platform jutting into the river here. The substrate here is predominantly rock / cobble. There are boulders around the fishery modifications. At the river edges and also in areas of low flow around the instream islands there are silt deposits.

At the kick sampling site there is a riffle area where the flow is increased just downstream of the island. The wetted width at this site is c. 28m. There are some algal growths on the substrates here which comprise mainly of cobble with some sand also present. There is no emergent vegetation at the kick sample site, which is more common downstream of the weir.

At lamprey survey site 4 (a) there is some riparian woodland with mature trees resulting in some shading of the survey site. As this site is located on a bend in the river which causes different flow rates across the channel, there are some accumulations of silt resulting in suitable juvenile lamprey site. There is some emergent vegetation in the shaded areas as well as some algal growths where flows are slower. Upstream from here in the vicinity of lamprey survey site 4 (b) there is minimal shading. There are some small islands downstream of the weir here and emergent vegetation is abundant. In between the vegetation there are some accumulations of silt where flows are slower and downstream of the islands, which provides suitable juvenile lamprey habitat. The wetted width here is c. 44m. Further upstream at lamprey survey site 4 (c) there is some emergent vegetation at this site but shading again is minimal. The wetted width at this site is c. 31m. There is suitable juvenile lamprey habitat at this site in the form of silt accumulations on the banks of the side channel. The islands at this site are located downstream of this point and none are present at lamprey survey site 4 (c).

Overall, this site has high levels of emergent and instream vegetation. *Ranunculus* sp were abundant in some areas particularly in the vicinity of the weir and the river channel and bank both had significant emergent vegetation such as Branched Bur-reed *Sparganium erectum*

5.2.4.3 Fish populations

At Site 4 there were 169 individual fish recorded, comprising of 11 species. This was the most productive site for juvenile salmon with 35 individuals recorded which resulted in a CPUE of 7 fish / min. For Brown Trout, there were 3 individuals recorded which is 0.6 fish / min. The most abundant fish species recorded was Minnow *Phoxinus phoxinus* with 55 individuals present, followed by Salmon and Three-spined stickleback *Gasterosteous aculeatus* (n=30). Also recorded at this site in relatively high numbers were Roach with 15 individuals, Dace with 12 and Stone Loach with 10. Other species recorded in smaller numbers (>10), and decreasing abundance were eel (n=4), Perch (n=2), River Lamprey (n=2) and Pike (n=1).

There were 16 juvenile lampreys recorded in the group specific surveys. They were all identified as River / Brook Lamprey, and none were recorded at Site 4 (b). The total density of River / Brook Lamprey at the site was 1.44 lamprey/m^2, which was again considered low.

5.2.4.4 Aquatic Macroinvertebrates

A total of 19 macroinvertebrate species were recorded at Site 4, each in different families. No Class A Pollutant sensitive macroinvertebrates were recorded at this site. A total of two species in Class B pollutant sensitive species were recorded and these were the cased caddisfly *Potamophylax latipennis* in the Limnephilidae family which was recorded as scarce/few, and the Damselfly *Calopteryx splendens* in fair numbers.

The majority of macroinvertebrate species recorded at Site 4 were Class C pollutant tolerant macroinvertebrates. Class C mayflies at this site were represented by *Baetis rhodani* and *Serratella ignita* which were recorded in as scarce/few and fair numbers respectively. Two species of caseless caddisflies were recorded at this site with *Hydropsyche* sp. in small numbers and *Polycentropus kingi* in scarce/few numbers. True flies were recorded at Site 4 with *Similium* sp. in fair numbers and Green chironomid recorded as present. One beetle in the Haliplidae family was recorded and this was *Haliplus rufieollis* in small numbers. Three species of snails were also recorded at Site 4. These were the Greater Pond Snail *Lymnaea stagnalis* as scarce/few, *Bithniya tentaculate* as present and the river nerite *Theodoxus fluviatilis* in scarce/few numbers. The most abundant Class C species at this site was the

freshwater shrimp *Gammarus* sp. in fair numbers. Finally for the Class C pollutant tolerant species were the bugs common backswimmer *Notonecta glauca* and water striders *Gerris* sp. both in small numbers.

Two Group D very pollutant tolerant species were recorded at this site represented by leeches and crustaceans. The leech *Glossiphonia* sp. was recorded as scarce/few and the crustacean *Asellus aquaticus* was recorded in small numbers. There were no Group E species recorded at Site 4.

Overall, Class C were the dominant macroinvertebrate group recorded at the site. No Class A species were recorded and only two Class B species were present. Two Group D species were recorded and no Class E species were present in the sample at this site. Site 4 is rated as Q3-4 equivalent to 'Moderate' WFD status and indicative of slightly polluted conditions.

5.2.4.5 Summary and Evaluation

Site 4 is rated as Q3-4 equivalent to 'Moderate' WFD status and indicative of slightly polluted conditions.

5.2.5 Site 5

5.2.5.1 Site Location

Site 5 is located on the main old River Shannon adjacent to The Elvers road. The site is located beside Rivergrove House. The kick sample site is located directly downstream of the small weir to the east. This site is c. 30m from the right (eastern) bank. Vegetation sweeps were also carried out in emergent vegetation here. Lamprey survey site 5 (a) was located c. 40m downstream of the small weir on the right bank. Lamprey survey site 5 (b) was located c. 56 upstream of lamprey survey site 5 (a) and is in an area of slower flow behind the wall that leads to the small weir. This site is c. 9m in from the right bank. Lamprey survey site 5 (c) is located c. 34m upstream of lamprey survey site 5 (b), and is also behind the wall that leads to the small weir. This site is on the right bank of the river where the wall starts and is immediately downstream of the wall.

5.2.5.2 Aquatic Habitats

Site 5 is characterised by several significant intrusive modifications. These consist of walls and weirs. These results in a variety of aquatic habitat. Again, there is a mixture of riffle, glide and pool habitat present. In the upstream section the habitat is predominantly glide and pool created by the downstream walls and weirs. Subsequently, these modifications have also resulted in riffle habitat and varying flow regimes at the site. The most dominant riffle habitat is downstream if a small weir feature. Directly upstream of here is glide habitat. On the downstream side of the walls there is pool habitat present. Depth also varies corresponding to the different habitats present. Area of riffle were the shallowed at c. 30cm deep. Glide habitat was the deepest present and was unwadable in sections at 2m+ depths. Pool habitat varied and where present at the river edges was c. 1m deep.

The entire wetted width of the main channel is c. 105m at this survey site. The site is located adjacent to a wall and a small weir which is c. 15m in length. There is a wooded instream island just downstream of the site. The flow at Site 5 is blocked due to a wall and so is located in a slower flowing section of the river. There are sections of small islands and areas of emergent vegetation all along this stretch. The side of the river with the BnB has low growing vegetation resulting in little to no shade, with the opposite side of the river having overhanging trees and branches resulting in higher levels of shade.

At the kick sample site downstream of the small weir to the east, there is a wall which leads to a small weir. The substrate comprises mainly cobble with some sand also present. The flow downstream of the weir results in a riffle type habitat. There are some algal growths also present on the substrate. There is some build-up of silt deposits here which was noted during the disturbance from kick sampling.

At lamprey survey site 5 (a) c. 40m downstream of the small weir on the right bank. there is emergent vegetation and some silt deposits providing juvenile lamprey habitat. There are also some mature riparian trees in this area. Downstream of this site there is a further side channel leading to an island connected by a bridge from a residential house. There is also some instream vegetation here. Upstream from here and towards lamprey survey site 5 (b) the amount of instream and emergent vegetation noticeably increases due to the change in flow rate from the main channel. There is also a lot of algal growths and silt deposits here due to the slow flow. Signs of enrichment were also noted. The wetted width of this small side channel behind the wall is c. 27m. Further upstream there are more areas of silt. These areas is away from the main flow of the channel and therefore also has evidence of algal growths and lots of emergent vegetation.

5.2.5.3 Fish populations

There was a total of 41 individual fish comprising 5 species recorded at this site. No Brown Trout recorded at this site. A total of 5 Salmon recorded, resulting in a CPUE of 1 fish/min. The most common fish species recorded were Minnow and three-spined Stickleback. Stone Loach and Gudgeon were also recorded.

At Sites 5(b) and 6(c) there were 13 juvenile River / Brook Lamprey recorded. There were no lamprey recorded at Site 5 (a) and there were no Sea Lamprey recorded at Site 5 overall. The 13 River / Brook Lamprey recorded resulting in an overall lamprey density of 1.44 lamprey/m^2.

5.2.5.4 Aquatic Macroinvertebrates

A total of 24 macroinvertebrate species were recorded at Site 5, spread across 22 different families. There were no Class A pollutant sensitive macroinvertebrates recorded at this site. A total of 6 different Class B pollutant sensitive species were recorded however. These were spread across two orders. Four cased caddisflies were recorded at Site 5, the Class B *Oecetis notata* and *Lepidostoma hirtum* both recorded as present, and *Phryganea grandis* and *Potamophylax latipennis* recorded as scarce/few and small numbers respectively. Two Class B damselflies were also recorded. These were *Calopteryx splendens* as scarce/few and *Calopteryx virgo* in small numbers.

The majority of macroinvertebrate species recorded at Site 5 were Class C pollutant tolerant macroinvertebrates. Class C mayflies at this site were represented by *Baetis rhodani*, *Serratella ignita* and *Centroptilum luteolum* which were recorded as small numbers, fair numbers and present respectively. Two species of caseless caddis flies were recorded at Site 5, with *Hydropsyche* sp. in small numbers and *Polycentropus kingi* recorded as present. One True fly *Similium* sp. was also recorded as scarce/few. One beetle in the Haliplidae family was recorded and this was *Haliplus rufieollis* as scarce/few. Four species of snails were recorded at Site 5. These were *Lymnaea stagnalis* and *Theodoxus fluviatilis* both recorded as present, with *Bithniya tentaculata* recorded in small numbers and *Planorbis carinatus* recorded as scarce/few. The freshwater shrimp *Gammarus* sp. was recorded as common at this site. One Class C leech was also recorded: *Piscicola geometra* which was present. Finally for the Class C pollutant tolerant species were the bugs common backswimmer *Notonecta glauca* and water striders *Gerris* sp. both in fair numbers.

One Group D very pollutant tolerant species were recorded at this site represented by the leech *Glossiphonia* sp. was recorded as present. There were no Group E species recorded at Site 5.

Overall, Class C were the dominant macroinvertebrate group recorded at the site. No Class A species were recorded and a total of 6 Class B species were present, with some in small numbers at this site. One Group D species was recorded and no Class E species were present in the sample at this site. Site 5 is rated as Q3-4 equivalent to 'Moderate' WFD status and indicative of slightly polluted conditions.

5.2.6 Site 6

5.2.6.1 Site Location

Site 6 was located on an area of the Lower River Shannon known locally as Pa's gap. Sampling at this site was undertaken both upstream and downstream and in the middle of the weir.

Lamprey survey site 6 (a) was located c. 49m downstream of the large weir and c. 11m upstream of the small weir and wall on the right bank of the river. Lamprey survey site 6 (b) was located c. 40m upstream of lamprey survey site 6 (a) and c. 10m downstream of the large weir on the right bank of the river. Lamprey survey site 6 (c) was located c. 10m upstream of the large weir across this site just c. 3m in from the right bank of the river.

5.2.6.2 Aquatic Habitats

Survey Site 6 was located at a prominent weir known as Pa's Gap. The entire river channel is c. 100m in width here. Water depth varies but is deeper towards the middle of the site at c. 1.5m. Substrates also varied but was largely dominated by large cobble with small patches of gravel in-between. Some large boulders were also observed. There was significant bankside vegetation at this site. At the kick sampling site itself there was no emergent vegetation. There were some submerged pondweeds present and significant filamentous algae growth. The substrate consisted of mainly cobble and some silt deposits were noted upon disturbance of the river bed. The wetted width of this area is c. 120m. Some algal growths were noted on the substrate in this area also. There is a pronounced riffle at the weir site. Upstream of this the habitat is glide with an area of pool on the left bank where there was silt deposits.

On the right side of the channel there were several instream islands coming from the bank and one significant one downstream. These area had the majority of instream vegetation however there was also quite a large growth of pondweed upstream from Pa's Gap. Other small islands were observed downstream of the sampling location. There was very little shading at the survey site due to lack of trees and the only vegetation present were bullrushes and grasses. Algae was observed throughout the river channel at Site 6. Excessive siltation was also observed during kick samples. Another feature comprising boulders across the river channel was located directly c. 62m downstream of the survey site. This feature was reaching c. 20m into the river.

On the left bank downstream where lamprey survey site 6 (a) was located there are silt deposits. There is no shading in this area and no large mature trees. Emergent vegetation is present along the bank however. Suitable juvenile lamprey habitat is present in the form of silt deposits on the edge of the river. Upstream on the same bank there remains no mature trees and minimal shading. There is significant bankside emergent vegetation here and silt deposits. In this area the wetted width is c. 95m. At lamprey survey site 6 (c) which was located c. 10m upstream of the large weir there were significant algal

growths noted and some silt deposits suitable for juvenile lampreys. This is slow flow glide habitat Emergent vegetation is nit present directly at the site but is present on the riverbank. There are also no islands present here. The wetted width is c. 100m at this point.

5.2.6.3 Fish populations

At Site 6 there was a total of 46 individual fish species recorded. There were 4 Salmon and 1 Brown Trout. This resulted in a CPUE for Salmon of 0.8 fish/min and for Brown Trout of 0.2 fish/min. the most common species recorded was Minnow with 20 individuals present. Following this there were 8 Three-spined Stickleback present, 3 Eel and 2 Stone Loach.

No juvenile lamprey recorded at Site 6. The river here is very modified with lots of introduced and moved rock. This may have affected lamprey numbers. Also, this is near the upper end of the fast water at Castleconnell and there is no further lamprey spawning habitat between the World's end car park and Parteen Regulation Weir. Sea Lampreys have been observed spawning below Pa's Gap in the past.

5.2.6.4 Aquatic Macroinvertebrates

A total of 33 species of macroinvertebrates were found. These were spread across 30 families. There was one species of pollutant sensitive Class A macroinvertebrates recorded on site. These were the mayfly *Ecdyonurus* sp, which was present. Table 5 illustrates the results recorded during the survey.

A total of 7 pollutant sensitive Class B macroinvertebrates were recorded. There was just one member of the family Leptoceridae recorded as present. This is the cased caddisfly, *Oecetis notata*. Three species were recorded as scarce/few. These are the damselflies *Calopteryx splendens* and *C. virgo*, and the cased caddisfly *Lepidostoma hirtum.* Two species recorded as small numbers was the stonefly *Leuctra hippopus*, and the caddisfly *Potamophylax latipennis*. There was just one species recorded in fair numbers. This was the True Bug, *Aphelocheirus aestivalis*, in the family Aphelocheiridae.

A total of 22 pollutant tolerant Class C macroinvertebrates were observed. Five species were recorded as present. These are the mayflies *Caenis lactulose* and *Centroptilum luteolum*, the caseless caddisflies *Plectrocnemia genticulata* and *Chimarra marginate*, and the Bug *Notonecta glauca*. Four species were recorded as scarce/few. These were the mayfly *Baetis rhodani*, the beetle *Haliplus refieollis*, and the bugs *Gerris* sp. and *Sigara distincta*. Thirteen species were recorded in small numbers. These are the leech *Piscicola geometra*, the freshwater shrimp *Gammarus deubeni*, the snails *Succinea putris Lymnaea stagnalis*, *Bithnyia tentaculata* and *Planorbis carinatus*, the beetle *Gyrinus caspius*, the mayfly *Serratella ignita,* and the caseless caddisflies *Hydropsyche angustipennis, H. siltalai, H. pellucidulata H. contubernalis* and *Polycentropus flavomaculatus*.

A total of two Class D and one Class E species were observed at the site. The Class D species was the leech *Glossiphonia* sp. recorded as present, and the freshwater louse *Asellus aquaticus* recorded as scarce/few. The only Class E species recorded was the bloodworm *Chironomous* sp. as present in the sample.

Overall, Class C dominated the sample (66.66%). However, there was a significant amount of Class B macroinvertebrates recorded (21.21%) in the sample. Due to the presence of Class A species, a relatively high amount of Class B and a low amount of pollution tolerant species (9.09%), a Q rating of Q3-4 has been given to this site.

Table 5 Relative abundances according to the DAFOR scale of the plant species recorded in the subject stretch of the River Shannon at Castleconnel.

Common Name	Scientific Name	Vegetation Type	Native and Non-native	Relative Abundance
Water Mint	*Mentha aquatica*	Emergent	Native	Occasional
Yellow Iris	*Iris pseudacorus*	Emergent	Native	Occasional
Curled Pondweed	*Potamogeton* crispus	Submerged	Native	Occasional - Frequent
Broad leaved Pondweed	*Potamogeton natans*	Submerged	Native	Occasional - Frequent
Pondweed	*Potamogeton* spp.	Submerged	Native	Occasional
Fool's watercress	*Apium nodiflorum*	Emergent	Native	Occasional
Watercress	*Nasturtium officinale*	Emergent	Native	Occasional
Bistort	*Persicaria amphibia*	Emergent	Native	Occasional
Branched bur-reed	*Sparangium erectum*	Emergent	Native	Frequent - Abundant
Reed sweet-grass	*Glyceria maxima*	Emergent	Native	Frequent
Bull rush	*Typha latifolia*	Emergent	Native	Occasional
Great water-moss	*Fontinalis antipyretica*	Submerged	Native	Frequent - Abundant
Yellow water lily	*Nuphar lutea*	Emergent	Native	Occasional
Canadian waterweed	*Elodea canadensis*	Submerged	Non-native	Occasional
Water-milfoil	*Myriophyllum sp.*	Submerged	Native	Occasional
Water-crowfoot	*Ranunculus sp.*	Submerged	Native	Abundant
Common club-rush	*Schoenoplectus lacustris*	Emergent	Native	Occasional
Common Reed	*Phragmites australis*	Emergent	Native	Frequent
Giant Hogweed	*Heracleum mantegazzianum*	Emergent	Non-native	Occasional
Water Hemlock	*Oenanthe crocata*	Emergent	Native	Occasional
Unbranched Bur-reed	*Sparganium emersum*	Emergent	Native	Occasional
Water-cress	*Rorippa nasturtium-aquaticum*	Submerged	Native	Occasional
Filamentous algae	*Cladophora*	Submerged	Native	Frequent - Abundant
Common Reed	*Phragmites australis*	Emergent	Native	Frequent

Table 6 Results of the aquatic macroinvertebrate surveys at the 6 sites on the old River Shannon at Castleconnell, Co Limerick.

	Pollution sensitivity group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
MAYFLIES (Uniramia, Ephemeroptera)							
Family Heptagenidae							
Ecdyonurus sp.	A						*
Ecdyonurus venosus	A			*			
Family Ephemeridae							
Epemera danica	A		**				
Family Caenidae							
Caenis luctuosa	C			*			*
Family Ephemerellidae)							
Serratella ignita	C	****		****	****	****	***
Family Baetidae							
Centroptilum luteolum	C					*	*
Baetis rhodani	C	***	**	****	**	***	**
STONEFLIES (Plecoptera)							
Family Leuctridae							
Leuctra hippopus	B						***
CASED CADDIS FLIES (Tricoptera)							
Family Leptoceridae							
Oecetis notata	B					*	*
Family Lepidostomatidae							
Lepidostoma hirtum	B	***	*	***		*	**
Family Phryganeidae							

	Pollution sensitivity group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Phryganea grandis	B	***	**			**	
Family Limnephilidae							
Potamophylax latipennis	B	***		***	**	***	***
CASELESS CADDIS FLIES (Trichoptera)							
Family Hydropsychidae							
Hydropsyche sp.				***	***	***	
Hydropsyche angustipennis	C	**					***
Hydropsyche siltalai	C	****					***
Hydropsyche pellucidulata	C	**					***
Hydropsyche contubernalis	C						**
Family Rhyacophilidae							
Rhyacophila dorsalis	C	**		**			
Family Polycentopodidae							
Polydentropus kingi	C	**	*	**	**	*	
Polycentropus flavomaculatus	C	*					***
Plectrocnemia conspersa	C	*	*	*			
Plectrocnemia geniculata	C						*
Family Philopotamidae							
Chimarra marginata	C						*
DAMSELFLIES (Odonata, Zygoptera)							
Family Calopterygidae							
Calopteryx splendens	B	****	****	**	****	**	**
Calopteryx virgo	B	****	**			***	**
TRUE FLIES (Diptera)							
Family Simulidae							
Similium sp.	C	***	****	**	****	**	
Family Chironomidae							
Green chironomid	C	**	***	**	*		
Chironomous sp.	E	*	*				*
BEETLES (Coleoptera)							
Family Haliplidae							
Haliplus rufieollis	C			**	***	**	**
Family Gyrinidae							
Gyrinus caspius	C			*			***
SNAILS (Mollusca, Gastropoda)							
Family Lymnaeidae							
Lymnaea stagnalis	C	***	****	***	**	*	***
Family Hydrobiidae							
Bithynia tentaculata	C	****	***	*	*	***	***
Family Planorbiidae							
Planorbis carinatus	C					**	***
Hippeutis complanata	C						
Family Succineidae							
Succinea putris	C	*					***
Family Neritidae						*	
Theodoxus fluviatilis	C	*	*		**	*	
Family Valvatidae							
Valvata cristata	C	*					
MUSSELS (Mollucsa, Lamellibranchiata)							
Dreissena polymorpha	-	*	**	***	****		
CRUSTACEANS (Crustacea)							
Amphipods (Amphipoda)							
Family Gammaridae							

	Pollution sensitivity group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Gammarus sp.	C	****	*****	*****	****	*****	***
Family Asellidae							
Asellus aquaticus	D	***	****	**	***		**
LEECHES (Hirudinae)							
Family Piscicolidae							
Piscicola geometra	C	**		**		*	***
Family Glossiphonidae							
Glossiphonia sp.	D		*	*	**	*	*
BUGS (Hemiptera)							
Family Aphelocheiridae							
Aphelocheirus aestivalis	B	****	****	***	*	****	****
Family Notonectidae							
Notonecta glauca	C	****	*****	***	***	****	*
Family Corixidae							
Sigara distincta	C						**
Family Gerridae							
Gerris sp.	C	****	*****	***	***	****	**
Number of families		23	19	24	19	22	28
Q-Rating		**Q3-4**					
Biological Status		**Moderate Status (Slightly Polluted)**					

* Present = 1 individual, ** Scarce/Few = <1%, *** Small numbers = <5%, **** Fair numbers = 5-10%, **** Common = 10-20%, ***** Numerous = 25-50%, ****** Dominant = 50-75%, ******* Excessive = >75%

Table 7 Overall catch results from the 6 juvenile salmonid / general fish stock survey sites assessed using electrical fishing during August 2021.

Species		Site number / Fish numbers					
Common name	Scientific name	1	2	3	4	5	6
Salmon	*Salmo salar*	16	0	0	35	5	4
Trout	*Salmo trutta*	4	0	1	3	0	1
Eel	*Anguilla anguilla*	3	4	3	4	0	3
Minnow	*Phoxinus phoxinus*	100	5	10	55	25	20
Three-spined stickleback	*Gasterosteous aculeatus*	20	10	7	30	5	8
Stone loach	*Barbatula barbatula*	5	7	2	10	4	2
Flounder*	*Platichthys flesus*	1	0	0	0	0	0
Dace	*Leuciscus leuciscus*	6	0	0	12	0	5
Roach	*Rutilus rutilus*	30	0	10	15	0	3
Perch	*Perca fluviatilis*	1	0	0	2	0	0
Gudgeon	*Gobio gobio*	4	0	0	0	2	0
Pike	*Esox lucius*	1	0	0	1	0	0
River Lamprey	*Lampetra fluviatilis*	0	0	0	2	0	0

**Seen but not captured.*

Table 8 Electrical fishing site characteristics and salmonid CPUE for the 6 juvenile salmonid / general fish stock survey sites assessed during August 2021.

Site	1	2	3	4	5	6
Time fished (minutes)	5	5	5	5	5	5
Salmon (n)	16	0	0	35	5	4
Trout (n)	4	0	1	3	0	1
Salmon/min	3.2	0	0	7	1	0.8
Trout/min	0.8	0	0.2	0.6	0	0.2

Table 9 Overall catch results from the 6 juvenile lamprey survey sites assessed using electrical fishing during August 2021.

Site	Sub Site	River / Brook lamprey (n)	Sea Lamprey (n)	River / Brook lamprey (density)	Sea Lamprey (density)
1	A	7	1	2.33	0.33
	B	11	0	3.67	0.00
	C	17	1	5.67	0.33
	Total	**35**	**2**	**3.89**	**0.22**
2	A	1	0	0.33	0.00
	B	3	0	1.00	0.00
	C	7	0	2.33	0.00
	Total	**11**	**0**	**1.22**	**0.00**
3	A	0	0	0.00	0.00
	B	0	0	0.00	0.00
	C	4	1	1.33	0.33
	Total	**4**	**1**	**0.44**	**0.11**
4	A	4	0	1.33	0.00
	B	0	0	0.00	0.00
	C	12	0	4.00	0.00
	Total	**16**	**0**	**1.78**	**0.00**
5	A	0	0	0.00	0.00
	B	5	0	1.67	0.00
	C	8	0	2.67	0.00
	Total	**13**	**0**	**1.44**	**0.00**
6	A	0	0	0.00	0.00
	B	0	0	0.00	0.00
	C	0	0	0.00	0.00
	Total	**0**	**0**	**0.00**	**0.00**

Table 10 Summary statistics for length (cm) for salmon, trout, and eel captured during the August 2021 electrical fishing survey.

Species	Site	N	Mean	Min	Max	StDev
Salmon	1	16	8.34	4.70	13.10	2.46
Salmon	4	35	7.54	4.90	10.10	1.42
Salmon	5	5	7.90	5.30	9.80	1.69
Salmon	6	4	9.35	5.10	14.10	3.74
Species	Site	N	Mean	Min	Max	StDev
Trout	3	1	17.60	17.60	17.60	
Trout	4	3	15.37	7.90	23.10	7.60
Trout	6	1	13.00	13.00	13.00	
Species	Site	N	Mean	Min	Max	StDev
Eel	1	3	17.53	15.80	20.00	2.19
Eel	2	4	15.40	10.70	22.10	4.99
Eel	3	3	20.97	9.90	29.00	9.90
Eel	4	4	13.73	8.90	18.00	4.07
Eel	6	3	26.67	13.00	34.00	11.85

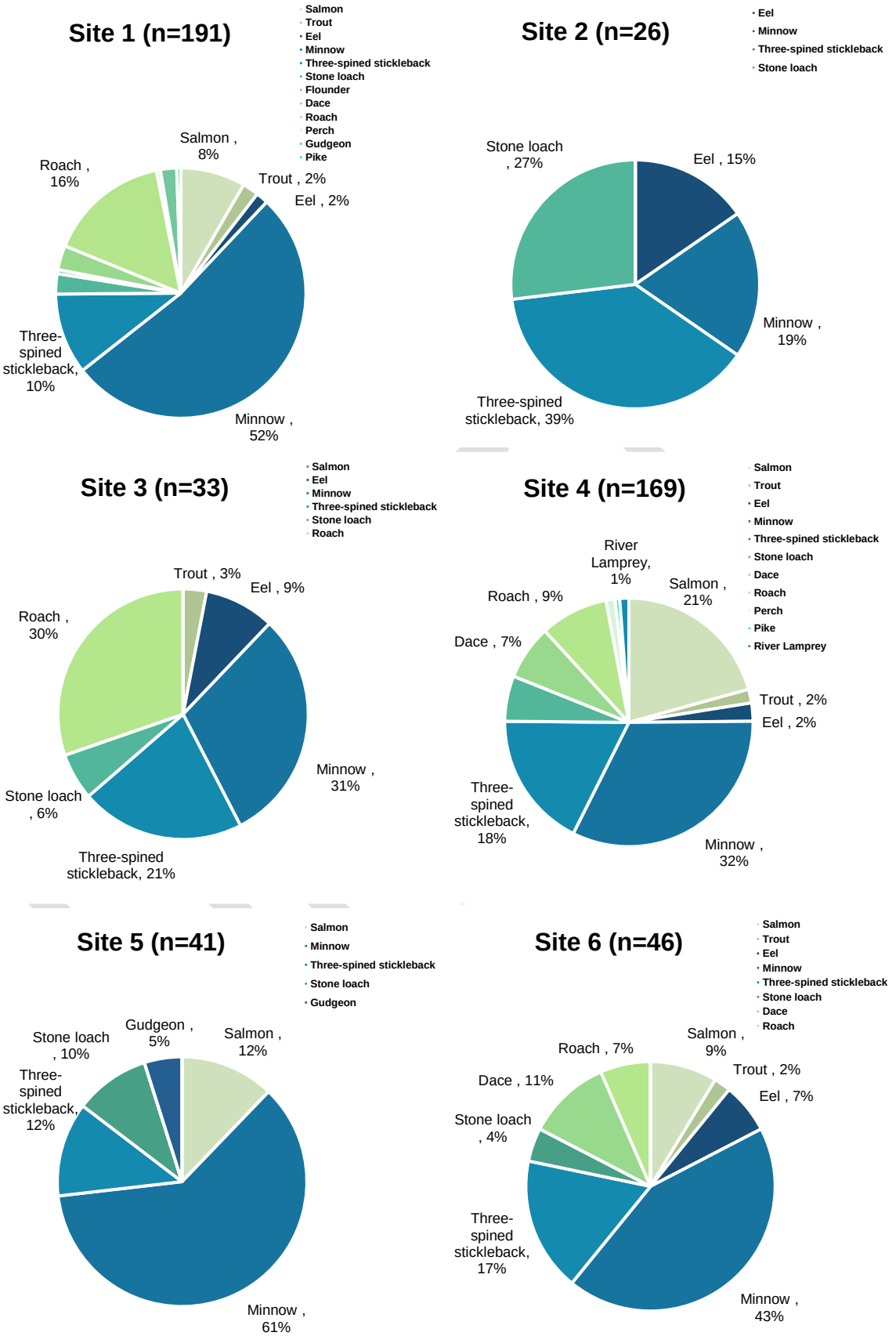


Figure 5 Relative abundances and total numbers of fish species recorded at 6 electrofishing sites on the River Shannon on Castleconnell during August 2021.

6. SUMMARY AND CONCLUSION

Limerick City and County Council is proposing a flood relief scheme for the village of Castleconnell, Co Limerick. The current report provides a baseline description of the aquatic ecology of the receiving environment. This report was based on a detailed desk study and a field survey completed Suring August 2021. This report does not provide an impact assessment or any mitigation for the proposed scheme.

The proposed flood scheme is located on and adjacent to the "old" River Shannon channel, which is the former main channel of the Shannon before the Shannon hydroelectric scheme. This section of river has been affected by extreme water abstraction and regulation since the 1920s. A statutory minimum "compensation flow" of 10 m^3 sec^{-1} is provided for the "old" River Shannon at Parteen Regulating Weir. The abstraction and regulation has had a profound effect on the ecology and hydromorphology of the river. However the channel remains for high ecological value and designated within the Lower River Shannon SAC. This site is designated for the protection of a wide range of habitats and species, including Floating river vegetation, Alluvial forests, Salmon, all three lamprey species and Otters, which have all been recorded in the wider study area. The "old" River Shannon used to be well known as a fishery historically, and has undergone fishery modifications in the past. There are numerous weirs, side channels, walls, artificially created pools, islands and riparian woodland present here. These modifications have also affected the aquatic ecology of the channel.

The current survey was completed during August 2021 and included a detailed desk study and field surveys at 6 sites within the area of the proposed flood scheme. Field work included habitat surveys, kick/sweep sampling for aquatic macroinvertebrates as well as a general fish stock assessment and juvenile lamprey survey.

The aquatic ecology of the study area is strongly influenced by the water abstraction/regulation, fisheries modifications, and background water quality. 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 – including a farmer washing out a slurry tank at Site 1. In the local area there are also untreated sewage inputs at O'Brien's Bridge 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 with ELVs based on most recent available documents. The water abstraction and regulation reduces the assimilation capacity of the river. Although there are records of the Annex I habitat 'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]' from the general area, this habitat was not recorded at any of the survey sites. It is likely that the background unsatisfactory water quality, channel modifications, and the severe river regulation has made conditions generally unsustainable for this habitat. A range of common aquatic flora records have been noted for the study area, as well as invasive species such as Giant Hogweed, Himalayan Balsam, Curly waterweed and Nuttall's waterweed. 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. There was a paucity of group A pollutant sensitive species in the study area, with the only species recorded being *Ecdyonurus* sp. and *Ephemera danica*. The highest abundance of the Group A species at any site was scarce/few. 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 rare or notable species were found. Freshwater White-clawed Crayfish were not recorded in the current survey but have been recorded here previously. A lack of recent records and the absence recorded during the current survey may indicate the presence of Crayfish plague, which has been reported further upstream in the catchment. There are records of Swan and Duck mussels (*Anodonta* spp.) from the Lower River Shannon but none were recorded during the current survey. Freshwater Pearl Mussels do not occur in the Lower River Shannon. The non-native invasive Zebra mussel was common at all sites. 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 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 floating river vegetation is also absent.

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PLATES

Plate 1 Parteen Regulating Weir located upstream of the study area. Up to 97% of the water in the Lower River Shannon SAC is abstracted at this point to fuel Ardnacrusha hydroelectric station.

Plate 2 Parteen Regulating Weir with the old River Shannon (left channel) and headrace canal visible.

Plate 3 Ardnacrusha hydroelectric station with the headrace canal also visible.

Plate 4 Extreme water abstraction / regulation has had a profound impact on the old River Shannon within the study area. Flows are generally only 10 cumecs (which approximates the n99%ile flow).

Plate 5 Old River Shannon downstream of Castleconnell (with base 10 cumec flow).

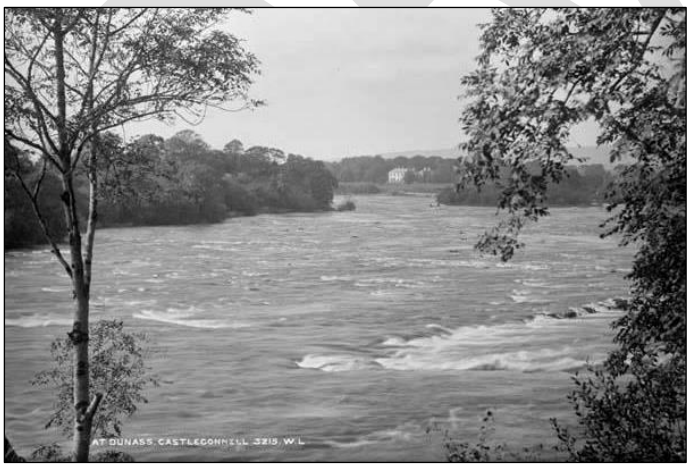

Plate 6 Lower River Shannon prior to the Shannon hydroelectric scheme. This is the same stretch of river shown in the Plate 4 and 5.

Plate 7 Adult Sea Lamprey from previous Ecofact work in the study area.

Plate 8 River Lampreys spawning in the Lower River Shannon SAC, April 2021.

Plate 9 The Lower River Shannon downstream of the of the Castleconnell footbridge, August 2021. This was Site 1 in the current survey.

Plate 10 Looking upstream from the Castleconnell footbridge, August 2021 (Site 1).

Plate 11 Looking downstream to the Castleconnell footbridge, August 2021.

Plate 12 Juvenile lamprey electrical fishing survey at Site 1 downstream of the Castleconnell footbridge, August 2021.

Plate 13 Kick sampling at Site 1 during August 2021.

Plate 14 Juvenile Brown Trout (top) and Atlantic Salmon from Site 1, August 2021.

Plate 15 Juvenile Sea Lamprey (top) and a River/Brook Lamprey ammocete from Site 1, August 2021.

Plate 16 Juvenile Sea Lamprey (top) and a River/Brook Lamprey ammocete from Site 1, August 2021.

Plate 17 Juvenile Sea Lamprey (top) and a River/Brook Lamprey ammocete from Site 1, August 2021.

Plate 18 Young-of-the-year juvenile salmon from Site 1.

Plate 19 European eels from Site 1, August 2021.

Plate 20 Gudgeon from Site 1 during the August 2021 survey.

Plate 21 Common Backswimmer (*Notonecta glauca*) from Site 1.

Plate 22 Agricultural impacts at Site 1. Farmer washed out the slurry tank at this site (via grass).

Plate 23 Lower River Shannon at Site 2. This part of the river is knowns as Castle Lough.

Plate 24 Juvenile lamprey survey at Site 2, August 2021.

Plate 25 Roach from Site 2 during August 2021.

Plate 26 The mayfly *Baetis rhodani* which was recorded at all sites in the study area.

Plate 27 Site 3 on a backchannel of the river, August 2021.

Plate 28 Dippers nest under the small bridge shown in Plate 17 (Site 3).

Plate 29 Electrical fishing survey at Site 3, August 2021.

Plate 30 Back channel of the river at Site 3 (proposed flood wall is nearby).

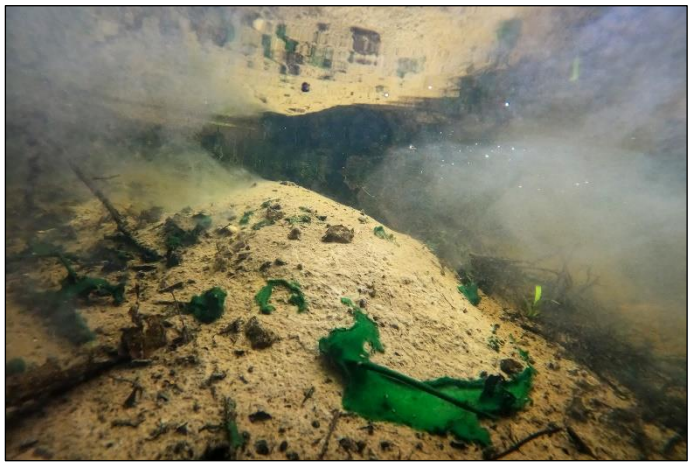

Plate 31 Silt pollution on one of the back channels at Site 3, August 2021.

Plate 32 Dace (top) and Roach from the general electrical fishing survey at Site 3.

Plate 33 Stone Loach (top) and Three-spined sticklebacks from the general electrical fishing survey at Site 3.

Plate 34 Stone Loach (top) and Minnows from the general electrical fishing survey at Site 3.

Plate 35 Juvenile lampreys from Site 3. The lower individual was a Sea Lampey ammocoete.

Plate 36 Dead Greater White-toothed Shrew (non-native species) on the riverbank at Site 3.

Plate 37 One of the channels of the old River Shannon at Site 4.

Plate 38 Survey site 4 on the channels of the old River Shannon.

Plate 39 Electrical fishing survey at Site 4, August 2021.

Plate 40 Juvenile salmon from Site 4, August 2021.

Plate 41 Juvenile salmon from Site 4, August 2021.

Plate 42 Juvenile salmon from Site 4, August 2021.

Plate 43 Fully transformed River Lampreys *Lampetra fluviatilis* from Site 4.

Plate 44 Perch recorded at Site 4 during the current survey.

Plate 45 Pike recorded at Site 4 during the current survey.

Plate 46 Amphibious Bistort *Persicaria amphibia* at Site 5.

Plate 47 Branched bur reed *Sparganium erectum* was a common emergent plant in the study area.

Plate 48 Juvenile salmon (left) and Brown Trout from Site 5.

Plate 49 Lower River Shannon at Site 6 showing one of the artificial fisheries weirs installed by the ESB. This one is known as “Pa’s Gap”.

Plate 50 Electrical fishing survey for juvenile salmonids at Site 6.

Plate 51 Kick-sampling at Site 6 during August 2021.

Plate 52 Eels recorded at Site 6 during the August 2021 survey.

Plate 53 Zebra mussel *Dreissena polymorpha* on a rock at Site 6. This species was present at all sites.

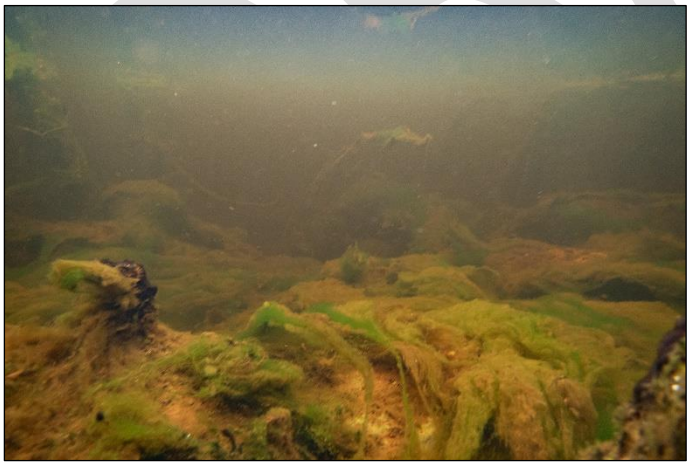

Plate 54 Lower River Shannon at Site 6 with eutrophication apparent – significant filamentous algae growth and siltation was recorded in this area. The sources of pollution affecting this area include agricultural runoff, untreated sewage discharges, and effluent from Parteen salmon hatchery.

G eDNA Survey

This appendix contains data collected during the eDNA survey carried out in the Cedarwood stream.

A water sample was collected using standard sampling protocols on 13 September 2023. The sample was sent to SureScreen Scientifics for analysis, specifically looking for evidence of European Eel Anguilla anguilla, Sea Lamprey Petromyzon marinus, Brook Lamprey Lampetra planeri, Smooth Newt Lissotriton vulgaris.

The results revealed the presence of European Eel in the Cedarwood Stream

SureScreen Scientifics

Folio No: E19235
Report No: 1
Client: JBA Consulting
Contact: Johanna Healy

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA IN WATER FOR AQUATIC SPECIES DETECTION

SUMMARY

When aquatic organisms inhabit a waterbody such as a pond, lake or river they continuously release small amounts of their DNA into the environment. By collecting and analysing water samples, we can detect these small traces of environmental DNA (eDNA) to confirm the presence or absence of the target species within the waterbody.

RESULTS

Date sample received in laboratory: 19/09/2023
Date results reported: 03/10/2023
Matters affecting result: None

TARGET SPECIES: Brook Lamprey *(Lampetra planeri)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK947	**Castleconnell- Grange House**	**R6613563302**	Pass	Pass	Pass	**Negative**	**0/12**

SureScreen Scientifics

TARGET SPECIES: European Eel *(Anguilla Anguilla)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK947	**Castleconnell- Grange House**	**R6613563302**	Pass	Pass	Pass	**Positive**	**12/12**

TARGET SPECIES: Sea Lamprey *(Petromyzon marinus)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK947	**Castleconnell- Grange House**	**R6613563302**	Pass	Pass	Pass	**Negative**	**0/12**

TARGET SPECIES: Smooth Newt *(Lissotriton vulgaris)*

Lab ID	Site Name	OS Reference	SIC	DC	IC	Result	Positive Replicates
FK947	**Castleconnell- Grange House**	**R6613563302**	Pass	Pass	Pass	**Negative**	**0/12**

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: **Lauryn Jewkes** Approved by: **Chelsea Warner**

METHODOLOGY

The samples detailed above have been analysed for the presence of target species eDNA following scientifically published eDNA assays and protocols which have been thoroughly tested, developed and verified for use by SureScreen Scientifics.

The analysis is conducted in two phases. The sample first goes through an extraction process where the filter is incubated in order to obtain any DNA within the sample. The extracted sample is then tested via real time PCR (also called q-PCR) for each of the selected target species. This process uses species-specific molecular markers (known as primers) to amplify a select part of the DNA, allowing it to be detected and measured in 'real time' as the analytical process develops. qPCR combines amplification and detection of target DNA into a single step. With qPCR, fluorescent dyes specific to the target sequence are used to label targeted PCR products during thermal cycling. The accumulation of fluorescent signals during this reaction is measured for fast and objective data analysis. The primers used in this process are specific to a part of mitochondrial DNA only found in each individual species. Separate primers are used for each of the species, ensuring no DNA from any other species present in the water is amplified.

If target species DNA is present, the DNA is amplified up to a detectable level, resulting in positive species detection. If target species DNA is not present then amplification does not occur, and a negative result is recorded.

Analysis of eDNA requires scrupulous attention to detail to prevent risk of contamination. True positive controls, negative controls and spiked synthetic DNA are included in every analysis and these have to be correct before any result is declared and reported. Stages of the DNA analysis are also conducted in different buildings at our premises for added security.

SureScreen Scientifics Ltd is ISO9001 accredited and participate in Natural England's proficiency testing scheme for GCN eDNA testing. We also carry out regular inter-laboratory checks on accuracy of results as part of our quality control procedures.

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