Appropriate Assessment

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Report No. W3451-AYE-ENV-R010

November 2025

Revision 02

Kilkenny County Council

Document Control

Project

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Client

Kilkenny County Council

Document

Appropriate Assessment

Report Number:

W3451-AYE-ENV-R010

Document Checking:

Date	Rev	Details of Issue	Prepared by	Checked by	Approved by
19 November 2024	Draft A	Issued for Internal Comments	Jeff Hean / Maran Lowry	Andrea Brogan / Barry Sheridan	
10 February 2025	00	Issued for Client Comment	Jeff Hean / Maran Lowry	Andrea Brogan / Barry Sheridan	Brendan O'Connor
12 November 2025	01	Incorporating Client Comment for Planning	Andrea Brogan	Andrea Brogan	Barry Sheridan
19 November 2025	02	Incorporating Additional Client Comment for Planning	Andrea Brogan	Andrea Brogan	Barry Sheridan

www.ayesaeng.com

www.ayesa.com/en

Contents

[1] Introduction

[1.1] Project Background

Kilkenny County Council (KCC) has, through partnership with the Office of Public Works (OPW) and Carlow County Council (CCC), taken the lead in procuring the Graiguenamanagh-Tinnahinch Flood Relief Scheme (GTFRS) (hereafter referred to as the 'Proposed Scheme'). Ayesa has been commissioned to undertake the preliminary design for the GTFRS and to ensure that it is technically, socially, environmentally, and economically viable. The proposed scheme involves the construction of raised defences within the urban area of Graiguenamanagh, along the banks of both the River Duiske and River Barrow, as well as the development of a flood storage area upstream on the River Duiske. The project description and proposed works are outlined in Section 1.3.

The location of the site of the proposed scheme is provided in Figure 1-1.

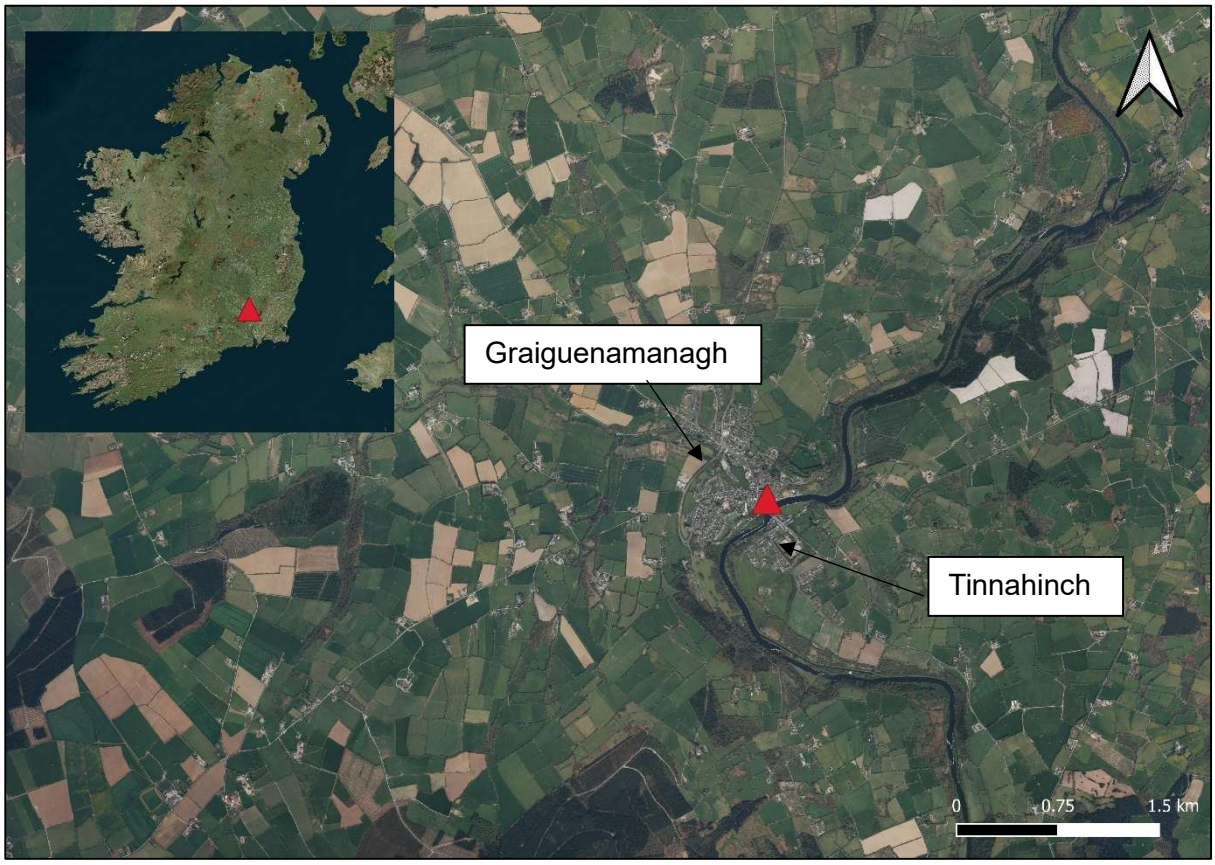


Figure 1-1: Location of the flood relief scheme works, Graiguenamanagh, Co. Kilkenny & Tinnahinch, Co. Carlow.

[1.2] Project Setting

The towns of Graiguenamanagh and Tinnahinch are separated by the River Barrow, which serves as the boundary between Co. Kilkenny (Graiguenamanagh) and Co. Carlow (Tinnahinch). The Duiske River, a tributary of the River Barrow, flows through the town of Graiguenamanagh.

The Barrow River Basin, predominantly rural and agricultural in nature, covers an area of 3,025 km^2. It includes much of Co. Carlow, portions of south Kildare, east Laois, southeast Offaly, east Kilkenny and small areas within west Wexford and Wicklow. The main river within the basin is the River

Barrow, along with its tributaries. The River Barrow and Nore Special Area of Conservation (SAC) runs through the proposed scheme area.

Graiguenamanagh, a town rich in heritage, lies at the foot of Brandon Hill and is home to the historic Duiske Abbey. The River Barrow, historically a transport route, was developed as a commercial navigation system during the 18th century. Graiguenamanagh served as a base for commercial barges operating on the river until barge traffic ceased in 1959. Today, the town is a popular location for pleasure crafts and outdoor enthusiasts. Watersports, angling, walking, and cycling are common activities in the Graiguenamanagh area. The Barrow's aquatic facilities support fishing, swimming, kayaking, and canoeing.

[1.3] Project Description and Proposed Works

A broad overview of the proposed scheme is shown in Figure 1-2, with drawings of the specific Proposed Scheme works for each highlighted area provided for in the Appendix A. The Proposed Scheme works will consist of raised defences and flood storage measures. The Proposed Scheme has been divided into 10 (ten) work areas, as set out in Table 1-1. In addition to the listed works for each area, the following common works are typically (but not always) undertaken:

- Tree removal
- Site clearance
- Accommodation works
- Services relocation
- Landscaping and public realm works

Table 1-1: Proposed scheme works.

Area No.	Description	Aspects of Work
Area 1	Storage Area	Raised earthfill impoundment structure. Reinforced concrete flow control structure with hydraulic control and downstream flume for flow control. Spillway Section over southern part of storage embankment. New access roads, lighting and mechanical and electrical equipment to storage area. Diversion of ESB poles/cables.
Area 2	Well Lane to High Street Bridge	Raised defence on the left bank from The Globe upstream to the first pedestrian access bridge. Local waterproofing of existing walls and raising of windowsills. Local land raising/steps to tie into new raised flood defences. Modification of pedestrian access bridge.

Area No.	Description	Aspects of Work
		Debris Trap at Well Lane. Installation of Non-Return Valves (NRVs) at outfalls.
Area 3	Turf Market	Raised defences on left bank from High Street Bridge downstream to first pedestrian access bridge. Replacement pedestrian access bridge and parapets. Installation of NRVs on outfalls on left bank. Improvement to the existing riverside walls to including removal of vegetation, lime mortar-based repointing and replacement of missing masonry. Provision of replacement waterproof doors in lieu of existing doors. Provision of pump sumps to drain low lying ground during flood events.
Area 4	Turf Market to The Hub	Raised defences on both banks from Turfmarket Bridge to the bridge at The Hub. Drainage system at Peg Washingtons Lane.
Area 5	Boat Club	Raised embankment on the right bank in the field north of the boat club. Raised defence on the right bank from upstream of the boat club to Graiguenamanagh Quay. Installation of non-return valves on outfalls to the River Barrow. Drainage system to include pumped rising main. Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Landscape and Public Realm Works.
Area 6	Graiguenamanagh Quay	Raised defence on the right bank along Graiguenamanagh Quay to include glass wall section and sliding flood gates. Utility diversion (Foul, ESB, Public Lighting). Installation of non-return valves on outfalls to the River Barrow. Drainage system. Public Realm Landscaping Works.

Area No.	Description	Aspects of Work
Area 7	The Dock	Raised defence on the right bank from Graiguenamanagh Bridge to the bridge at The Hub to include hinged flood gate for access to historic dock. Demolition of existing building at Peg Washington's Lane. Drainage system and a pumping station. Landscape and Public Realm Works.
Area 8	The Hub	Raised defence on the right bank from the bridge at The Dock to the rear of the Uisce Éireann pumping station. Raised embankment on the right bank within the grounds of The Hub. Local land raising to facilitate orderly completion of flood defences whilst maintaining access. Drainage system from Peg Washington's Lane. Install NRVs on outfalls.
Area 9	Hotel Street	Raised embankment and defence wall on the left bank in the field upstream of Graiguenamanagh Bridge. Groundwater drainage systems to tie into drainage on Tinnahinch Quay. Local ramps to maintain access to Barrow River. Install NRV on outfall.
Area 10	Tinnahinch Quay	Raised defences on the left bank at Tinnahinch Quay tying into high ground at a private residence on Tinnahinch Quay, adjacent to the Millrace. Waterproofing to existing wall of building immediately downstream of Graiguenamanagh Bridge. Drainage systems including small pump station (underground). Flood gate fitted to the Quay Road adjacent to existing Millrace sluice gate with additional flood gates fitted at two locations on Tinnahinch Quay. Kiosk relocation. Install NRVs on outfalls.

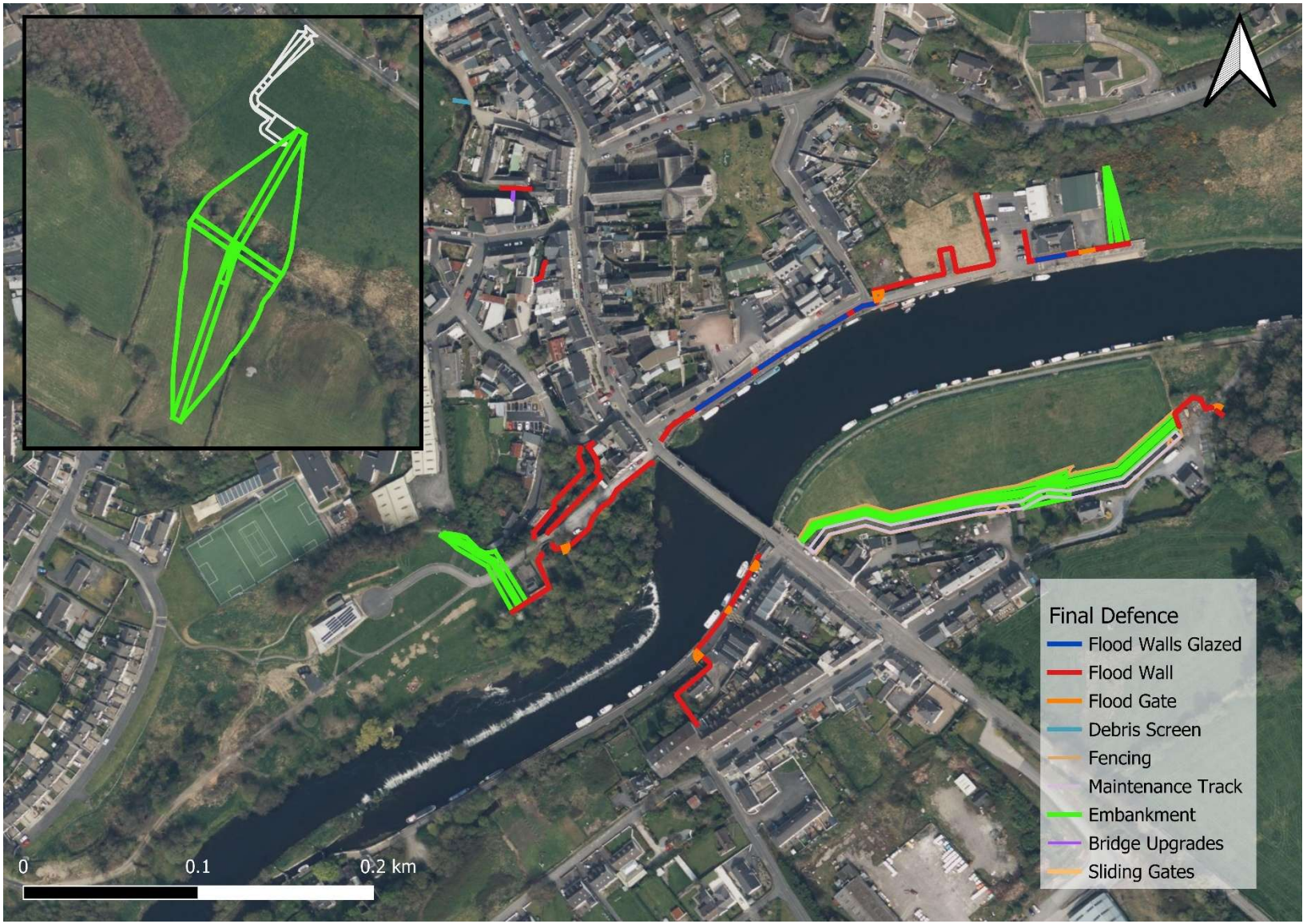


Figure 1-2: Layout of the proposed FRS works, Graiguenamanagh, Co. Kilkenny & Tinnahinch, Co. Carlow.

[1.4] Detailed Construction Methodology

This section describes the construction activities and sequencing for the Proposed Scheme and outline mitigation measures which have been incorporated into the design, and which will be implemented during the construction phase to ensure the potential impacts of the construction activities on the environment are avoided, prevented and/or reduced.

[1.4.1] Instream Works

Instream works are anticipated at the locations listed in Table 1-2 below. Descriptions and examples of the types of works are provided below.

The following standard instream practices/methodologies will be applied to all instream works:

- River diversion will be put in place where needed.
- Methods favouring 'no-dig' solutions have been selected where suitable.

In-stream temporary access platforms will be built where necessary. These shall be lined with terram such that original bed is unaffected and can be reinstated in orderly fashion.

Table 1-2: Instream Works Locations & Descriptions

Area No.	Area Description (Compound No.)	Instream Works
Area 1	Storage Area	Temporary River Diversion Flow Control Structure Flume for Flow Monitoring Temporary River Crossing(s) (culvert stream)
Area 2	Well Lane to High Street Bridge	Debris Trap Wall Improvements at The Globe Temporary Access (culvert stream)
Area 3	Turf Market	Wall construction Bridge replacement Temporary Access (culvert stream)
Area 4	Turf Market to The Hub	Wall construction Temporary Access/crossing (culvert stream)
Area 5	Boat Club	NRV on Outfall Outfall Headwalls
Area 6	Graiguenamanagh Quay	NRV on Outfalls
Area 7	The Dock	NRV on Outfalls New outfall from Pumping Station

Area No.	Area Description (Compound No.)	Instream Works
Area 8	The Hub	Outfall Headwalls New Outfall from Pumping Station
Area 9	Hotel Street	Outfall Headwalls New outfall from Pumping Station
Area 10	Tinnahinch Quay	NRV on Outfalls

[1.4.1.1] Temporary River Diversion

In order to build instream online structures, the River Duiske will need to be temporarily diverted. This will entail constructing a new channel around the works area. The channels will be lined or hydroseeded to reduce sediments entering the watercourse.

Figure 1-3: Example River diversion (on right) with access crossing to allow structure construction in watercourse (left)
(Source: https://www.wardandburke.com/project/river-feagle-clonakilty-certified-drainage-scheme/)

[1.4.1.2] Flow Control Structures

The structures will be built inline on the River Duiske. They involve the excavation of the bed of the watercourse to lay concrete structures to control flows. All work will be executed in the dry following a river diversion/ damming.

Figure 1-4: Example storage area with flow control structure in flood conditions (Source: https://www.wardandburke.com/project/river-feagle-clonakilty-certified-drainage-scheme/)

[1.4.1.3] Temporary River Crossing

In order to obtain access to both banks of a watercourse, it will be necessary to provide a temporary access through the river. The river will be culverted for the duration of the works and reinstated afterwards. The temporary culvert will be designed in a manner as not to impede the passage of fish along the river. The typical process would be to lay a terram layer on the riverbed, place pipework, and then backfill with suitable granular material, over which a temporary road is constructed.

Figure 1-5: Example temporary river crossing
(Source: https://www.austieca.com.au/documents/item/319)

[1.4.1.4] Debris Trap

The structure consists of columns constructed instream at a location where they will catch debris for removal by those maintaining the scheme. To construct the columns, the riverbed must be excavated, and the columns inserted.

Figure 1-6: Example Column Debris Trap
(Source:https://www.facebook.com/iominfrastructure/photos/pcb.3489431467799559/3489431287799577/?type=3&theater)

[1.4.1.5] Wall construction/Improvements

There are typically concrete, or sheet piled structure, sometimes with a cladding such as timber, stone or concrete to finish. They can be built on traditional soil bearing foundations or placed on piles.

Figure 1-7: Example wall construction including stone facing.

Figure 1-8: Example Wall Construction/Improvements (relevant to Turf Market and at The Globe)

[1.4.1.6] Bridge replacement

A bridge replacement entails a new bridge to provide flood protection and often include a reinforced parapet wall to contain flood flows. Bridge abutments need to be constructed within the channel in order to secure the bridge.

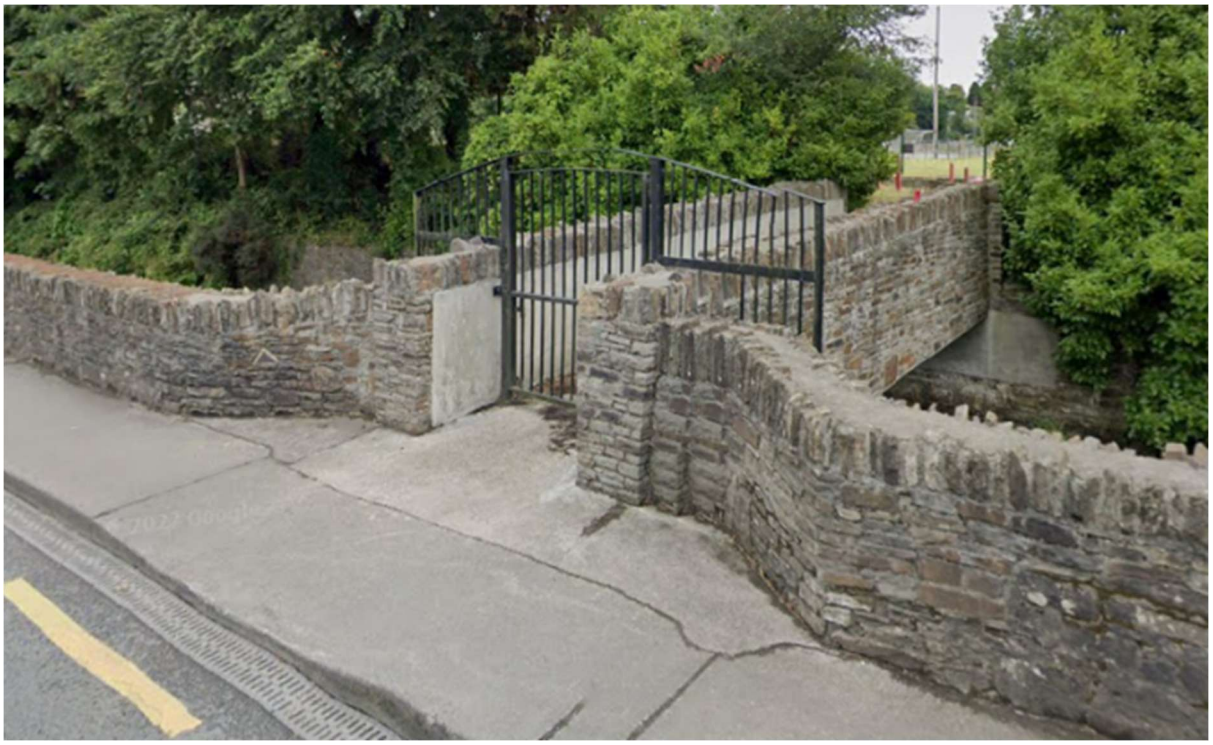


Figure 1-9: Example Bridge replacement/modifications

[1.4.1.7] NRVs on Outfall

Non-return valves (NRVs) are placed on existing and proposed outfalls to ensure flood water do not back-up and surcharge the pipeline. They typical take the form of flap valves and in-line rubberised valves.

Figure 1-10: NRV placed on a pre-existing outfall in Graiguenamanagh.

[1.4.2] Structures

Where structures are to be constructed the methodology will be as follows (noting that temporary works are not listed):

- Strip commencing surface to below the formation level where applicable.
- Place and compact blinding layers to require specification or prepare the receiving surface.
- Assemble, cast or install components such as reinforced concrete and steel and precast concrete bridges.
- Backfill works to proposed specification and reinstate surroundings.

Table 1-3: Structures – Construction Issues & Methodology

Defence No.	Description	Key Issue(s)	Methodology
C03_E002 & C03_SG001	Flow Control at Storage Area	Timing (aquatic ecology)	Divert river and construct reinforced concrete flow control structure in a dried out working area.

Defence No.	Description	Key Issue(s)	Methodology
C03_HW001	Flume at Storage Area	Timing (aquatic ecology)	As above.
C03_B001	Pedestrian Bridge	Timing (aquatic ecology)	For Turfmarket, pipe river and create dry works area. Use piped foundations where needed – micropiling only. Favour pre-cast solutions given short instream seasonal window.
C03_B002	Pedestrian Bridge	Timing (aquatic ecology)	For residential access bridge, utilise existing abutments and modify existing bridge and install steel lightweight gangway to tie in at appropriate levels.

[1.4.3] Walls

Walls are to be constructed at the following locations:

- Tinnahinch Quay
- The Quay Wall
- Boat Club Road Wall
- The Hub Road Wall
- The Dock
- Turf Market
- Turf Market

The methodology will be as follows (noting that temporary works are not listed):

- Strip commencing surface to below the formation level for foundations where applicable.
- Place and compact blinding layers to require specification.
- Assemble, cast or install wall components such as reinforced concrete, hydraulic barriers and glass walls.
- Backfill walls to proposed specification and reinstate surroundings.
- Install french drain along dry side of wall (where required).

[1.4.4] Embankments

Embankments are to be constructed at the following locations:

- The Hub
- Hotel Street
- Boat Club
- Storage Area

The methodology will be as follows (noting that temporary works are not listed):

- Strip topsoil from existing ground below the footprint of the embankment.
- Place and compact earth fill in layers to require specification.
- Place erosion control matting on embankment and tie into anchor detail.
- Place topsoil on embankment and hydroseed.
- Install french drain along dry side of embankments (where required).

[1.4.5] Drainage (Pumping Stations & Pipework)

Drainage works, pumping stations and some works to existing sewers are anticipated. Drainage will be implemented at the following locations:

- The Hub
- Tinnahinch Quay Pipework
- Tinnahinch Pumping Station
- The Dock Pipework
- The Dock Pumping Station

The methodology will be as follows (noting that temporary works are not listed):

- Establish traffic managements as needed.
- Excavate open trenches/pits as needed, noting need for archaeological mitigation.
- Construct the works to required specification.
- Reinstate original surface or complete public realm works as necessary.

[1.4.6] Flood Gates & Barriers

Flood gates will be installed in numerous locations where level access to the quays is needed. They will be fitted at the following locations:

- Flood Gate – Tinnahinch Tow Path
- Flood Gates – Tinnahinch Quay
- Sliding Flood Gates– The Quay
- Flood Gate – The Quay/Boat Club Access
- Flood Gate – Boat Club

- Hinged Flood Gate – The Dock
- Flood Gate – Hotel Street Embankment/Barrow Way

A hinged lift and swing gate will be used on the Dock and in Tinnahinch, whilst lift and slide gates will be used on Graiguenamanagh Quay. The default position for the hinged gates will be closed (but not set) where possible (The Dock and the Tinnahinch Quay in Winter). In Summer, the gates at Tinnahinch will be set open as default.

The sliding gates at Graiguenamanagh Quay will remain open as the default position.

All gates will be fixed to reinforced concrete walls/pillars.

[1.4.7] Land Raising

Land raising is proposed where access must be maintained whilst cutting off flood routes. land will be raised at the following locations:

- The Hub
- Boat Club Car Park
- Hotel Street
- Mass Path

Land raising will typically consist of:

- Stripping the existing surface to firm ground.
- Placement of impermeable material and a new surface finish to the design heights.
- Installation of any barriers needed following the change in levels.

[1.4.8] Outfalls

NRVs will be fitted to all outfalls below the design flood level that cannot be raised. Where downpipes at Turf Market can be raised for example, this will be the preferred methodology. NRV will be fitted to all other outfalls.

An underwater installation team will be required to fit NRV on the quays in Tinnahinch and Graiguenamanagh.

[1.5] Purpose of Report

This document comprises the Screening for Appropriate Assessment (AA) and Natura Impact Statement (NIS), prepared in accordance with the requirements of the European Communities (Birds and Natural Habitats) Regulations 2011 (Statutory Instrument No. 477/2011), as amended[1].

[1] Natura 2000 sites (also called European sites) consist of Special Areas of Conservation (SACs) designated under European Directive 92/43/EEC on the Conservation of Natural Habitats and Wild

This report has been prepared by Ayesa on behalf of KCC for the proposed GTFRS. A comprehensive AA must be carried out for the works, including the preparation of an NIS to support decision making by An Coimisiún Pleanála in their role as the Competent Authority.

The primary purpose of this report is to provide relevant material to inform a decision by the Competent Authority, as required under Articles 6.3 and 6.4 of the EU Habitats Directive, as to whether the proposed development is likely to have any significant impacts on the Conservation Objectives of a Natura 2000 (European) site. Where there are potential adverse impacts, an assessment of the prescribed mitigation of those impacts is presented.

[1.6] Format of this Report

This report has been divided into two parts to succinctly present the findings to support the planning application for the Proposed Scheme. These are:

- Part A: Appropriate Assessment Screening.
- Part B: Natura Impact Statement.

[1.7] Preparation of this Report

Table 1.2 provides a summary of the staff involved in the reporting.

Table 1-4: Team involved in this report.

Title	Name	Role	Qualifications	Years' experience
Ecology Lead	Brendan O'Connor	Report sign-off	CIEEM Membership	20+
Director	Barry Sheridan	Report review	MA Environmental Science IES Chartership	20+
Environmental Consultant	Andrea Brogan	Report review	MA Environmental Humanities	3
Senior Ecologist	Maran Lowry	Assessment and Report Review	BSc Marine Biology	10
Senior Ecologist	Jeff Hean	Report preparation and assessment	Ph. D in Zoology IES Member	10

Flora and Fauna (the 'Habitats Directive') and Special Protection Areas (SPAs) designated under Directive 2009/147/EC, (the codified version of 79/409/EEC as amended) on the conservation of wild birds (the 'Birds Directive.')

Brendan O'Connor is the Ecology Lead for the overall project and has responsibility for all ecological surveys and reporting. He is expert in ecological matters and the full spectrum of environmental assessment techniques, methodologies and statutes. Professionally, he is a member of relevant institutes requiring the highest standards of professional competence and integrity. He is a member of the Chartered Institute of Ecology and Environmental Management (CMIEEM).

Barry Sheridan is Environmental Director for Ayesa. He is an experienced Environmental Manager, responsible for leading teams of engineers and scientists and has had responsibility for delivering complex Environmental and Planning projects throughout Ireland, the UK, Europe, Africa and the Middle East. He had responsibility for reviewing this report.

Andrea Brogan is Environmental Consultant on this project. She is experienced in report writing and review. She had responsibility for the review of the project construction details and formatting.

Maran Lowry is a Senior Ecologist and published scientific author. He assisted with the assessment by conducting an extensive review of the NIS. He is experienced in both terrestrial and aquatic ecology and has significant experience in relation to the Habitats Directives and associated Regulations, having prepared and reviewed numerous ecology reports for a wide variety of proposed developments, including wastewater treatment plants, water schemes, flood relief schemes, and solar farms, as well as extensive experience assessing forestry applications for the purposes of AA.

Jeff Hean is Senior Ecologist for this report. He was responsible for the collation of all ecological surveys and reporting prepared by a number of consultants on this project. Jeff is an expert in ecological matters and the full spectrum of environmental assessment techniques, methodologies, and statutes. He has significant experience in relation to the Habitats Directives and associated Regulations. He has prepared numerous reports for AA, including Natura Impact Statements, and Environmental Impact Assessment reports for a wide variety of proposed developments, including wastewater treatment plants, flood defence schemes, soil recovery works, bridge improvements, landfills, large industrial developments, and private housing.

[1.8] Consultation

Consultation has been carried out with the public and various stakeholders, the purpose of which was to engage with them, to gather local knowledge on flooding and environmental constraints, and to establish opportunities for addressing flood risk in the area.

A number of statutory bodies have provided information/advice to date. Responses relevant to this report are as follows:

- In September 2023, Inland Fisheries Ireland (IFI) provided advice to the project team with regard to the in-river works.
- In June 2023, the National Parks and Wildlife Service (NPWS) responded to the consultation on the EIA Scoping Report, noting that several of the specialist ecological survey methods deviate from accepted good practice, took place outside of the optimal survey period, and do not meet the required number of survey visits. The NPWS recommended that further surveys be conducted following the guidance outlined in the

NRA's Guidance for Ecological Surveying Techniques (NRA, 2009) and Guidelines for the Treatment of Bats (NRA, 2005). Further surveys took place in 2023 and 2024, and their results are described in Section 4.2.

[2] Appropriate Assessment Process

The AA process is a sequential process consisting of four potential stages. If at the first stage in the process it is determined that there will be no significant effect on a European site, the process is effectively completed. The four stages are as follows:

- Stage 1 – Screening of the proposed plan or project for AA (PART A).
- Stage 2 – An AA of the proposed plan or project (PART B).
- Stage 3 – Assessment of alternative solutions; and
- Stage 4 – Imperative Reasons of Overriding Public Interest (IROPI) / Derogation.

Stage 1 relates to Regulation 42 of the Birds and Natural Habitats Regulations; Stage 2 relates to Article 6(3) of the Habitats Directive; Stages 3 and 4 to Article 6(4) of the Habitats Directive.

[2.1] Stage 1: Screening (PART A)

The aim of the screening stage is to assess if the plan or project is directly connected with or necessary to the management of European site(s), or, on the basis of best scientific knowledge, if the plan or project, individually or in combination with other plans or projects, is likely to have a significant effect on a European site. This is done by examining the proposed plan or project and the conservation objectives of any European sites that might potentially be affected. If screening determines that there are likely to be significant effects, or the significance of effects is uncertain or unknown, it will be recommended that the project is brought forward to full AA.

[2.2] Stage 2: Appropriate Assessment (PART B)

The aim of Stage 2 of the AA process is to identify any adverse impacts that the plan or project might have on the integrity of relevant European sites. As part of the assessment, a key consideration is ‘in-combination’ effects with other plans or projects. Where adverse impacts are identified, mitigation measures can be proposed that would avoid, reduce, or remedy any such negative impacts and the plan or project should then be amended accordingly, thereby avoiding the need to progress to Stage 3.

[2.3] Stage 3: Assessment of Alternative Solutions

If it is not possible during Stage 2 to reduce impacts to acceptable, non-significant levels by avoidance and/or mitigation, Stage 3 of the process must be undertaken which is to objectively assess whether alternative solutions exist by which the objectives of the plan or project can be achieved. Explicitly, this means alternative solutions that do not have significant negative impacts on the integrity of a European site. It should also be noted that EU guidance on this stage of the process states that, “other assessment criteria, such as economic criteria, cannot be seen as overruling ecological criteria” (EC, 2001). In other words, if alternative solutions exist that do not have negative impacts on European sites, they should be adopted regardless of economic considerations.

[2.4] Stage 4: Imperative Reasons of Overriding Public Interest (IROPI) / Derogation

This stage of the AA process is undertaken when it has been determined that negative impacts on the integrity of a European site will result from a plan or project, but that no alternatives exist. At this stage of the AA process, it is the characteristics of the plan or project itself that will determine whether the competent authority can allow the plan or project to progress. This is the determination of 'over-riding public interest'. It is important to note that, in the case of European sites that include 'priority' habitats or species, as defined in Annex I and II of the Directive, the demonstration of 'overriding public interest' is not sufficient and it must be demonstrated that the plan or project is necessary for 'human health or safety considerations'. Where plans or projects meet these criteria, they can be allowed, provided adequate compensatory measures are proposed. Stage 4 of the process defines and describes these compensation measures.

[2.5] Legislative Background and Guidance Documents

[2.5.1] International Legislation

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, better known as the "Habitats Directive", provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000. These are Special Areas of Conservation (SACs) designated under the Habitats Directive and Special Protection Areas (SPAs) designated under the Conservation of Wild Birds Directive (79/409/ECC) as codified by Directive 2009/147/EC.

Articles 6(3) and 6(4) of the Habitats Directive set out the decision-making tests for plans and projects likely to have a significant effect on or to adversely affect the integrity of European Sites (Annex 1.1). Article 6(3) establishes the requirement for AA screening, stating the following:

"*Any plan or project not directly connected with or necessary to the management of the [European] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*"

Article 6(4) states:

"*If, in spite of a negative assessment of the implications for the [European] site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of a social or economic nature, Member States shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 sites is protected. It shall inform the Commission of the compensatory measures adopted*."

[2.5.2] The Requirement for AA Screening

Section 42(1) of S.I. No. 477 of 2011, the European Communities (Birds and Natural Habitats) Regulations 2011 states:

"*A screening for Appropriate Assessment of a plan or project for which an application for consent is received, or which a public authority wishes to undertake or adopt, and which is not directly connected with or necessary to the management of the site as a European Site, shall be carried out by the public authority to assess, in view of best scientific knowledge and in view of the conservation objectives of the site, if that plan or project, individually or in combination with other plans or projects is likely to have a significant effect on the European site*."

Where the screening process cannot exclude the possibility that a plan or project, individually or in combination with other plans or projects, could have a significant effect on a European site, there is a requirement under Article 42(9) of these Regulations for the preparation of an NIS to inform the AA process.

[2.5.3] Screening Determination

In accordance with Regulation 42(7) of the Birds and Natural Habitats Regulations 2011 (S.I. No. 477/2011), as amended:

"*The public authority shall determine that an Appropriate Assessment of a plan or project is not required where the plan or project is not directly connected with or necessary to the management of the site as a European Site and if it can be excluded on the basis of objective scientific information following screening under this Regulation, that the plan or project, individually or in combination with other plans or projects, will have a significant effect on a European site*."

Further, under Regulation 42(8):

"(a)Where, in relation to a plan or project for which an application for consent has been received, a public authority decides that an Appropriate Assessment is required, the public authority shall give notice of the determination, including reasons for the determination of the public authority, to the following—

i. the applicant,

ii. if appropriate, any person who made submissions or observations in relation to the application to the public authority, or

iii. if appropriate, any party to an appeal or referral.

(b) Where a public authority has determined that an Appropriate Assessment is required in respect of a proposed development it may direct in the notice issued under subparagraph (a) that a Natura Impact Statement is required."

[2.5.4] National Legislation

The Planning and Development Act 2024 Part 6 which gives effect to the State's obligations under paragraphs 3 and 4 of Article 6 of the Habitat's Directive.

[2.5.5] Guidance Documents on Appropriate Assessment

Where an AA is necessary, the AA requirements of Article 6(3) of the Habitats Directive 92/43/EEC (European Communities 2001) follow a sequential approach as outlined in the following guidance documents:

- OPR Practice Note PN01: Appropriate Assessment Screening for Development Management, Office of the Planning Regulator, 2021.
- Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities. Department of Environment, Heritage, and Local Government, 2010 revision.
- Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities. Circular NPWS 1/10 and PSSP 2/10.
- 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.
- Communication from the Commission on the precautionary principle. European Commission (2000).
- Guidance Document on Article 6(4) of the Habitats Directive 92/43/EEC (European Commission, 2007).
- Guidelines for Good Practice AA of Plans under Article 6(3) Habitats Directive (International Workshop on Assessment of Plans under the Habitats Directive, 2011).
- Managing Natura 2000 Sites: The Provision of Article 6 of the Habitats Directive 92/43/EEC (European Commission Environment Directorate General, 2018); [hereafter referred to as MN 2018].

PART A: Stage 1 – Appropriate Assessment Screening

[3] Introduction

Part A of this report details the AA Screening review.

The scope of this assessment is to identify potential impacts (direct and indirect) attributable to the project and to determine the likelihood of significant effects, if any, that the project could have on European sites.

[3.1] Methodology for Stage 1: AA Screening

This AA Screening has been completed in the following logical order:

- Definition of the zone of influence (ZoI) for the proposed works;
- Identification of the European sites that are situated (in their entirety or partially) within the ZoI of the proposed works;
- Identification of the most up-to-date Qualifying Interests (QIs) / Special Conservation Interests (SCIs) for each European site occurring either wholly or partially within the ZoI;
- Identification of the environmental conditions that maintain the QIs at the desired target of Favourable Conservation Status;
- Identification of the threats/impacts, actual or potential, that could negatively impact the environmental conditions of the QIs/SCIs within the European sites;
- Highlighting the activities of the proposed works that could give rise to significant negative impacts; and
- Identification of other plans or projects, for which in-combination impacts would likely have significant effects.

The following issues have been considered:

- The nature and quality of habitats within the site of the proposed development;
- Information relating to the ecology of the European sites, including the statuses of QIs/SCIs and the relevant conservation status and objectives for these species;
- The key structural and functional relationships maintaining the integrity of the European site;
- The status of other annexed habitats and species occurring in proximity to the site of the proposed development; and
- The scale and nature of the aspects of the project in relation to the European sites.

[3.1.1] Desktop Information Consulted for this Report.

Sources of data reviewed as part of the Screening process for this project included:

- NPWS site synopses and conservation objectives for relevant Natura 2000 sites (accessible at https://www.npws.ie/)
- Birds of Conservation Concern in Ireland (BoCCI) list of bird species of conservation concern 2020-2026 (accessible at https://birdwatchireland.ie/birds-of-conservation-concern-in-ireland/)
- National Biodiversity Data Centre (NBDC) – 1 km- and 2 km-square species reports (accessed online on 05/12/2024)
- The status of EU Habitats and Species in Ireland 2013, NPWS, ed. D. Lynn
- Article 17 Reports (NPWS, 2019)
- Aerial photographs
- Ecology Surveys 2020-2024, W3451-AYE-ENV-R007 (Ayesa, 2025)
- Bat Survey Report – W3451-ENV-R001 (ByrneLooby, 2020)
- Bat Survey Report (Veon, 2025)
- Environmental Constraints Study Report – W3451-BL-ENV-R001 (ByrneLooby, 2021)
- Ecological Report on the River Barrow at Graiguenamanagh, Co. Kilkenny (Aquafact International Services Ltd. , 2020)
- Electrofishing Survey of the Duiske River, Graiguenamanagh, Co. Kilkenny (Aquafact International Services Ltd. , 2021)
- Graiguenamanagh Q Values Survey (Aquafact International Services Ltd, 2021)
- Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (*Austropotamobius pallipes*) survey (Triturus, 2021)
- Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (*Margaritifera margaritifera*) survey (Triturus, 2021)

[3.1.2] Development Site Habitat Assessments

An extended habitat survey was carried out on 16-18/02/2021 and primarily focused on semi-natural and other vegetated land up to approximately 100 m either side of watercourses within the town area. Follow up habitat surveys were completed on 26-27/06/2024, during which the upstream storage area was surveyed, as well as a review of the extents previously surveyed within the townland.

All surveys were completed by qualified ecologists and in accordance with relevant legislation, particularly the 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (CIEEM, 2018), through the additional recording of specific features indicating the presence, or likely presence, of protected species or other species of nature conservation significance. Moreover, all site assessments aligned with the Heritage Council's Best Practice Guidance for Habitat Survey and Mapping (Smith et al., 2011) and habitats were classified to level 3 of the Fossitt (2000) classification system. To illustrate the general aquatic and terrestrial habitat quality, photographs were taken using a digital camera. Grid references were recorded using a GPS

handset. Site evaluation is based on the guidelines of the Chartered Institute of Ecology and Environmental Management (CIEEM 2018).

Potential Annex I habitats observed at/near the survey site were recorded and assessed for distribution, general health, and prevalent species. Determination of the presence or absence of Annex I habitats was carried out in consultation with the habitat descriptions provided in the most recent Article 17 Reports (NPWS, 2019). The Interpretation Manual of European Union Habitats (EU, 2013) was also consulted. In addition, the spatial GIS data for the Article 17 Reports were examined to determine the distribution of these habitats (as known to the NPWS) within the study area.

The site and immediate surroundings were inspected for the presence of invasive species, as listed in the Third Schedule of the Birds and Natural Habitats Regulations (S.I. No. 477/2011). Regulation 49 (2) states that "*any person who plants, disperses, allows or causes to disperse, spreads or otherwise causes to grow in any place any plant listed in the Third Schedule, shall be guilty of an offence*".

[3.1.3] Site Specific Surveys for Ecological Receptors

Specified survey work for individual species of interest has been carried out over a 4-year period in the towns of Graiguenamanagh and Tinnahinch. These surveys were undertaken as part of the proposed scheme by Ayesa ecologists and specialised subconsultants. Given the extensive time spent on the preliminary design of the scheme, an ecologist's review was undertaken to determine the validity of the original species-specific surveys that had been undertaken. This review was undertaken in line with a CIEEM Advice Note (CIEEM, 2019). Follow-up surveys were then undertaken. The full details of all completed surveys are outlined in the following sections.

The ecology baseline survey report (Ref: W3451-AYE-R-ENV-007) is provided in Appendix B of this report. The full suite of surveys conducted to date is included in Table 3-1 below.

Table 3-1: Ecological surveys conducted to date in relation to the GTFRS.

Survey Name	Survey Date
Habitats and species survey	June 2020, February 2021, August 2023, June 2024
Bat survey	September 2020, August 2023, June 2024
Wintering birds survey	February 2021, December 2023, January and February 2024
Breeding birds survey	February 2021, August 2023, March and May 2024
Mammal survey, including otter, badger, pine martin, red squirrel	February 2021, August 2023, March 2024
Herpetofauna survey	February 2021, March 2024
Flora survey	February 2021, June 2024
Tree survey	June 2023
Alien invasive flora species survey	February 2021; June 2024

Q values/invertebrates survey	February 2021, August 2023
Water quality sampling	August 2023
Electrofishing survey of the Duiske River	February 2021
Fish habitat survey	August 2023
White-clawed crayfish survey (incl. eDNA sampling and testing)	April 2021, August 2023
Freshwater pearl mussel survey (incl. eDNA sampling and testing)	April 21

As with the habitat surveys, all species surveys were completed by qualified specialists and in accordance with relevant legislation, particularly the 'Guidelines for Ecological Impact Assessment in the UK and Ireland' (CIEEM, 2018), through the recording of specific features indicating the presence, or likely presence, of protected species or other species of nature conservation significance.

[3.1.3.1] Bird Surveys – Spring 2021

A winter bird survey was carried out on 16-18/02/2021, with a breeding bird survey completed on 02/04/2021.

Both surveys involved line transects along the routes shown in Figure 3-1. Surveys were carried out early in the morning, approximately 30 minutes after sunrise. Where possible, surveying was avoided during heavy rain, strong winds, or poor visibility (e.g., fog). Each transect line was walked by the ecologist, and all avian species observed (visually or aurally) were recorded. Binoculars were used to scan the surrounding landscape during the transect. Direct sightings were recorded in line with the guidance contained in the Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012), which recommends sightings to be grouped into the following distance bands (perpendicular to and either side of the transect line):

- Within 25 m
- Between 25 m and 100 m
- Greater than 100 m
- Birds in flight at any distance

The location of the 2021 bird surveys is provided in Figure 3-1.

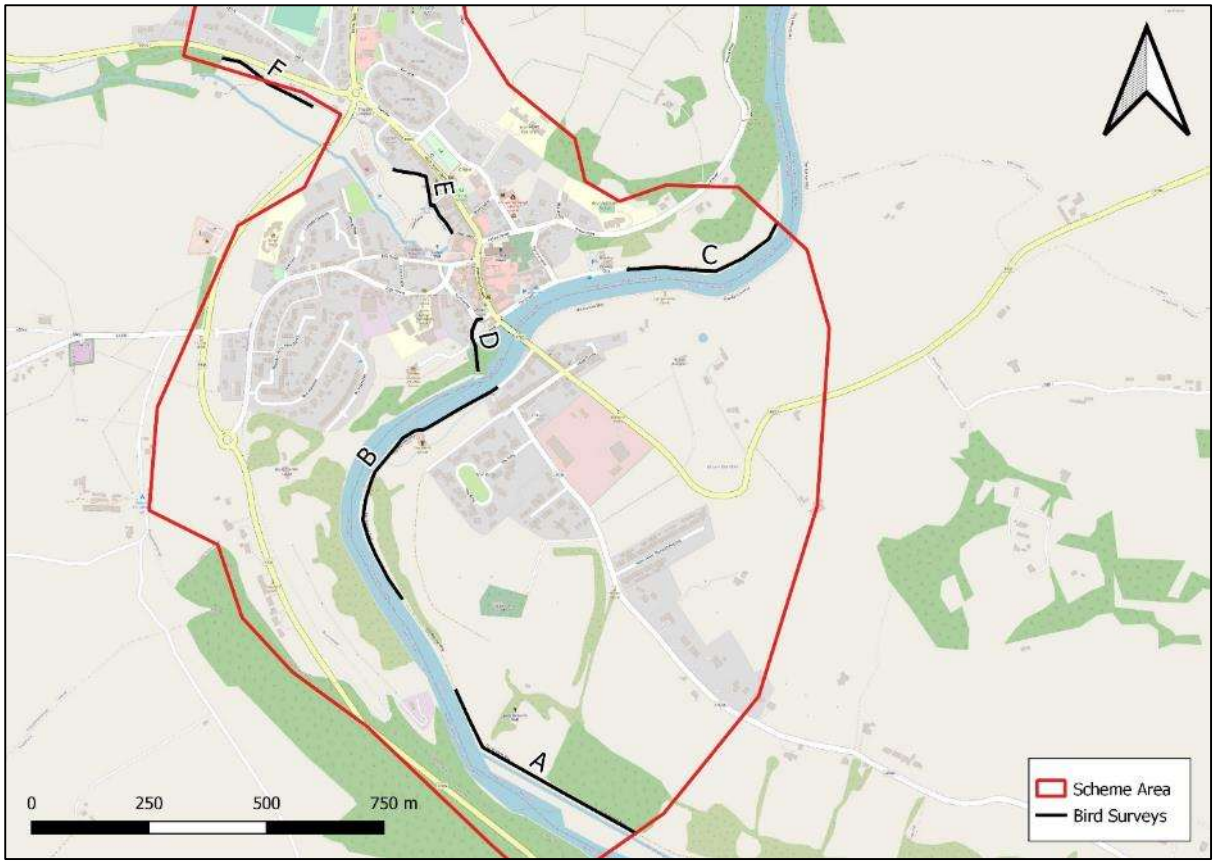


Figure 3-1: Survey transects routes used in the 2021 bird surveys.

[3.1.3.2] Bird Surveys - Spring/Summer 2024

These surveys were undertaken to get up to date findings of breeding bird activities across the whole scheme area. The ecologists identified eight stationary vantage points adjacent to and within the study area from which to carry out the point counts/surveys, whilst continuing to record birds between the vantage points. Five points were located within Graiguenamanagh Town (Figure 3-3), and the remaining three points were located at the upstream storage site (Figure 3-4).

Three surveys of the site were carried out, beginning at approximately 09:00 on 28-29/03, 22-23/05/2024, and 26-27/06/2024. Counts began in the early morning so that they coincided with maximum bird activity but avoided concentrated song activity at dawn (BTO, 2023).

Weather conditions within the project site were recorded at the time of survey. Activities that occur at the site that are or have the potential to cause disturbance to waterbirds were also recorded, regardless of whether they cause a noticeable disturbance to birds at the time of observation, or not.

The ecologists stayed at each stationary location for 30 minutes continuously scanning the surrounding areas using a pair of binoculars (Celestron 71008 SkyMaster 25 x 70 Binoculars), and all bird species observed were recorded. Information regarding the species of bird, number of birds (of the same species) and the birds' behaviour were similarly noted. The Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012) recommends sightings to be grouped into distance bands (perpendicular to and either side of the transect line), however this was deemed unnecessary on this occasion as no distance sampling analysis will be

undertaken. The primary purpose of this survey is to identify which species utilize the site and the surrounding areas, not to provide accurate counts for population trends as in the CBS.

Aural recordings were also obtained using the app BirdNET (Kahl, Wood, Eibl, & Klinck, BirdNET: A deep learning solution for avian diversity monitoring, 2021). BirdNET's in-app machine learning was used to determine species, according to Kahl et al. (2021) BirdNET has a mean average precision of 0.791 for single-species recordings. Despite the high level of confidence, the ecologist compared aural records obtained in the field to existing records to add a higher level of certainty to species identification

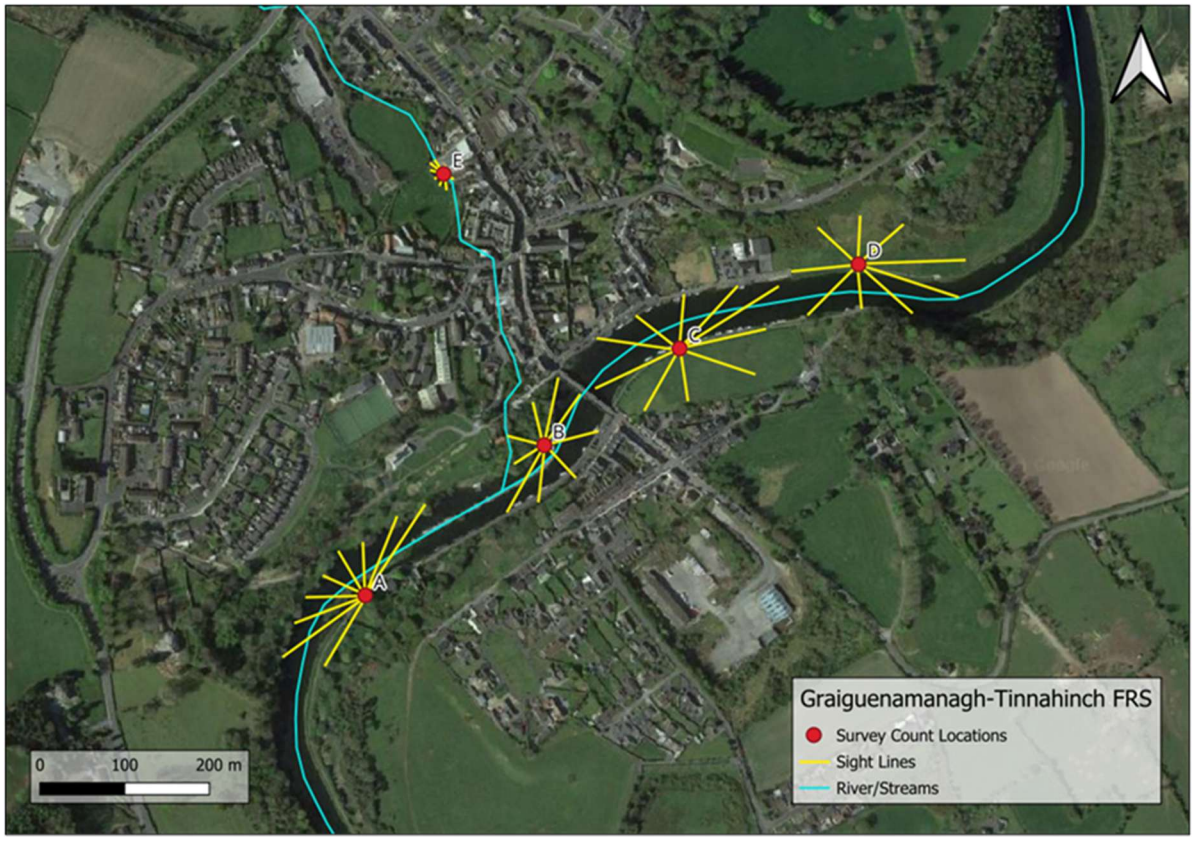


Figure 3-2: Breeding bird survey count locations and sight lines (Graiguenamanagh Town).

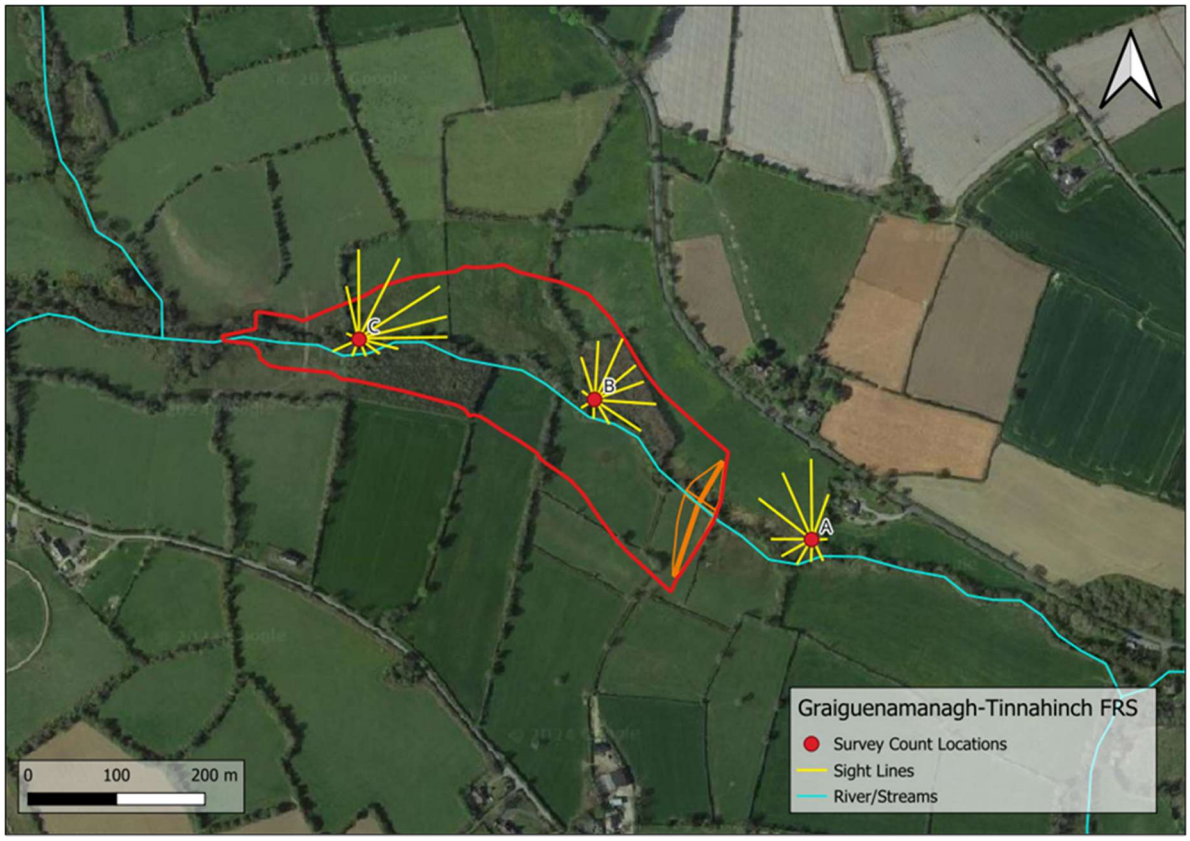


Figure 3-3: Breeding bird survey count locations and sight lines (upstream storage area).

[3.1.3.3] Bird Surveys – Winter 2023/2024

A series of wintering bird surveys were conducted at the upstream storage area, as well as within the townlands by Ayesa's internal ecology team. These were conducted across three visits within the wintering bird survey season in Winter 2023/2024. The ecologists utilised the same eight stationary vantage points as for the breeding bird surveys and shown in Figure 3-2 and Figure 3-3. Three surveys of the site were carried out, beginning at approx. 9 am on 19-20/12/23, 16-17/01/24, and 22-23/02/24.

The survey methodology was in line with that utilised in the Breeding Bird Surveys 2024.

[3.1.3.4] Mammal Surveys

Surveys for volant and non-volant mammal species, including otter (*Lutra lutra*), badger (*Meles meles*), pine martin (*Martes martes*), and red squirrel (*Sciurus vulgaris*), were conducted in the vicinity of Graiguenamanagh Town on 16-18/02/2021 and 9-11/08/2023. Similar mammal surveys were completed in the upstream storage area between 27-29/03/2024.

Mammal surveys were completed through the detection of field signs, mammal footprint tunnels, and by direct observations. The mammal footprint tunnels were subsequently collected on the 11/08/2023 and their data collected for analysis. These field surveys were carried out using the methodology outlined below.

The Ecologist noted features of interest during the mammal surveys. This type of survey involves actively searching for and documenting specific features of interest. Any such features were photographed, and their GPS locations were recorded. Features of interest for

this project included non-volant mammals, particularly otters, deer, badgers, pine martens, red squirrels, hedgehogs (*Erinaceus europaeus*), Irish stoat (*Mustela erminea hibernica*), Irish mountain hare (*Lepus timidus hibernicus*), and pygmy shrews (*Sorex minutus*).

The Ecologist searched for and took note of the following evidence (if observed):

- Direct sightings of mammals (live or dead)
- Burrows, setts, dens, dreys, day nests, holts, and otter couches
- Prints and hair traces
- Prey/food remains
- Faeces
- Scratching posts at the base of tree trunks
- Snuffle holes (small scrapes where badgers have searched for insects, earthworms, and plant tubers)
- Trails, paths, and runs.

The search area for all mammals comprised all land within the site boundary, the surrounding agricultural grasslands, and along both sides of a 600 m stretch of the River Duiske, where possible, within the boundary of the upstream storage area. Evidence of otter (prints, spraint, prey remains) was surveyed for along the banks of the River Duiske up to 20 m back from the river bank within the riparian zone.

Figure 3-5 below provides an overview of the area extent that was surveyed for tracks and signs of mammals.

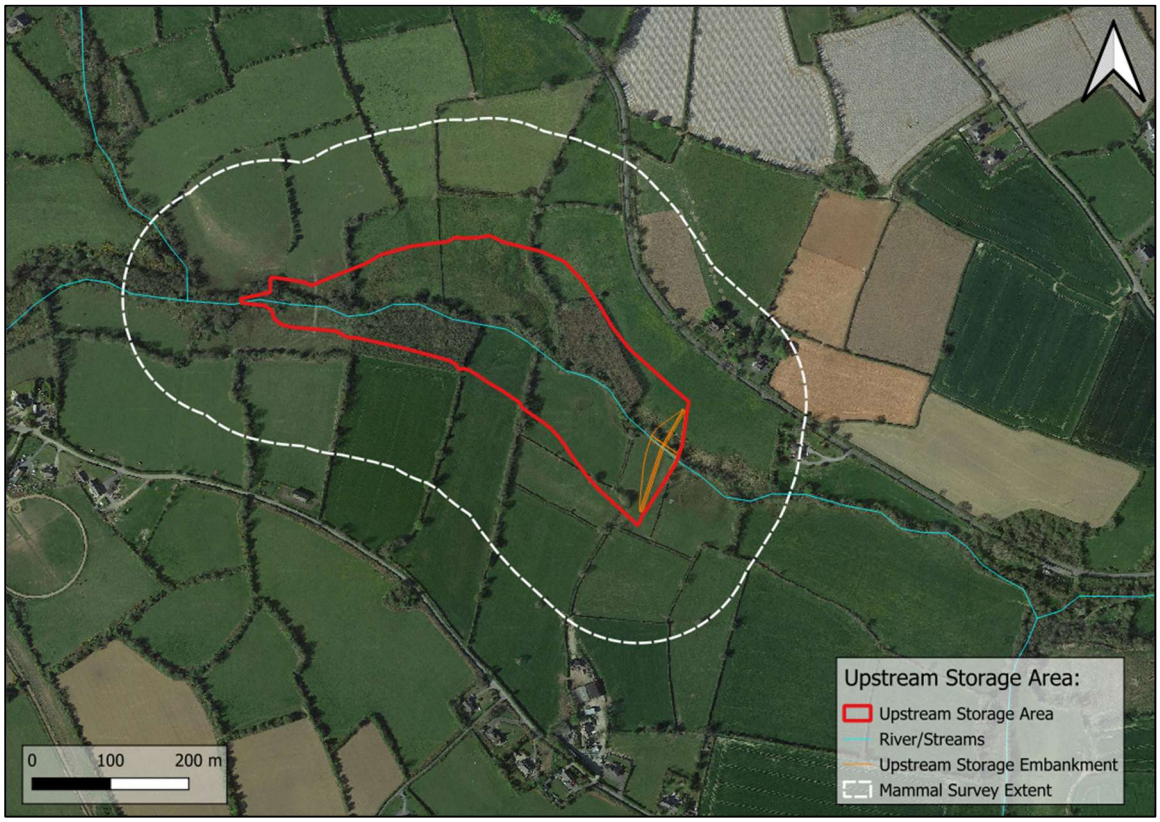


Figure 3-4: Mammal survey extent (upstream storage area).

[3.1.3.5] Mammal Footprint Tunnel Surveys

The mammal footprint tunnel (as outlined in Figure 3-5) provides a non-invasive and effective presence/absence survey method for small mammals, particularly hedgehogs and other elusive/nocturnal mammals. For this survey, the tunnels used were designed to determine otter presence. The ecologists used corrugated plastic/corriboard sheets to construct the tunnels into a triangular shape. Separately, corriboard was cut into thin trays to fit the middle section of the tunnel, i.e., the bait tray (Figure 3-6). A shallow plastic bowl was secured to the centre of the bait tray, and two pieces of ink pads (wash cloth cut in half) were attached either side of the bowl and doused in a mix of black acrylic paint and washing up liquid (long lasting ink).

Additionally, strips of masking tape were used to serve as ink pads by pouring the ink on top of the tape placed on either side of the bowl. Two labelled A4 sheets were secured onto the bait tray at either end to be used as the tracking paper (Figure 3-6). Dog food pouches in jelly/gravy was used as bait for the mammal tunnels. Once the bait trays were set up, they were slid back into the triangular tunnel and pegged into position using camping pegs in suitable sheltered locations, namely along hedgerows and riverbanks. The tunnels were left in place for one week at locations indicated in Figure 3-7.

Note: The mammal walks into the tunnel, over the tracking sheets, and then over the inkpads to the shallow bowl of dog food. When the mammal exits the tunnel their pawprint, now covered in ink, marks the tracking paper, leaving the ecologists with decipherable and distinctive prints for identification.

The labelled tracking papers were then removed from the baiting trays and photographed. The ecologists used a ruler to measure the dimensions of the various footprints and used online resources to narrow down and identify which animals the tracks belong to.

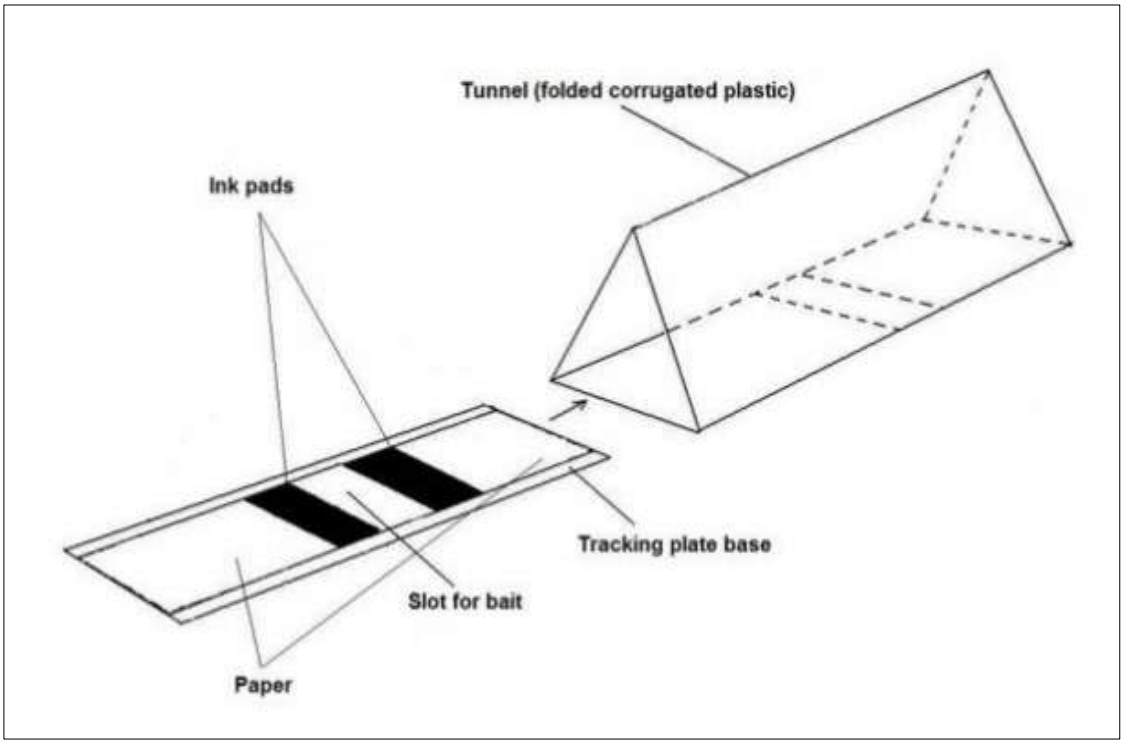


Figure 3-5: Design of the tracking tunnels and sliding baiting tray with ink pads and tracking paper used to capture the footprints of small mammals.

Figure 3-6: Mammal footprint tunnels (left: setup; right: results three days later).

Figure 3-7: Locations of mammal tunnels utilised in the 2023 & 2024 surveys.

[3.1.3.6] Fish

An electrofishing survey was completed during February 2021 on the Duiske River through Graiguenamanagh town and Graiguenamanagh Stream at Borris Road, north of Graiguenamanagh Town. It was considered that, due to water depth and velocity, an electrofishing survey of the River Barrow was not safe. Electrofishing was carried out using battery powered backpack electrofishing equipment (Smith-Root Lr-24) which was deployed at 240v / 40Hz / 18% duty cycle pulse DC settings across all survey locations.

At each site, electrofishing was carried out over an elapsed period totalling 10 minutes (600 seconds). Actual fishing time during this period was determined using a 'fishing on' timer mechanism on the LR-24.

For salmonid species and European eel (*Anguilla anguilla*), electrofishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson et al., 2018).

Electrofishing for lamprey ammocoetes was conducted, as per Harvey & Cowx (2003), by targeting areas of sand/silt using a low frequency (20-30Hz). This was used in combination with the burst of pulses direct current setting to optimise lamprey ammocoete capture without physical damage. This was carried out after completion of the 10-minute CPUE salmonid and eel electrofishing.

Further, a fish habitat survey was carried out on the upstream storage area on 09/08/2023, covering a length of 1,045 m of the Duiske River. This allowed for the identification of suitable habitat for the key fish species and their associated important life stages.

[3.1.3.7] Freshwater Pearl Mussel

The freshwater pearl mussel (FPM; *Margaritifera margaritifera*) surveys were carried out on 29-30/04/2021 in bright weather, with good underwater visibility and under base flow conditions. This helped to maximise visibility of pearl mussel against dark substrata and also helped increase chances of detection when mussels were filtering in brighter conditions. The pearl mussel survey (Stage 1 and Stage 2) was carried out under Section 23 & 34 of the Wildlife Acts 1976-2018 (licence number C136/2021) issued by the NPWS on 12/04/2021. The survey methodology used was in accordance with the Stage 1 and 2 guidelines given by the NPWS in the Irish Wildlife Manual No. 12 (Anon., 2004) (guidelines currently being updated but unpublished at the time of survey). The surveyors were also cognisant of the latest European-wide guidance for FPM survey methodology (e.g., Boon et al., 2019).

To complement the site surveys and to detect potentially cryptic or low-density populations of FPM within the study area, water samples from sites along the Duiske River and River Barrow were analysed for *Margaritifera margaritifera* environmental DNA (eDNA) in April 2021. The Turfmarket Weir (Duiske) and Tinnahinch Weir (Barrow) sampling points were strategically chosen to maximise habitat coverage within the study area.

[3.1.3.8] White-Clawed Crayfish

White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at 14 survey sites under an NPWS open licence (no. C145/2021), as prescribed by Sections 9, 23 and 34 of the Wildlife Acts 1976-2018. This included the capture of crayfish and release to their site

of capture, under condition No. 6 of the licence. The survey was completed in April 2021 and consisted of trapping in the vicinity of the proposed in-stream works, head-searching, sweep-netting, and snorkelling (in accordance with Reynolds et al. (2010) and Peay (2003)), riparian walkovers (mustelid spraint), and eDNA analysis. Furthermore, an appraisal of crayfish distribution and habitat was completed whilst undertaking SCUBA dive surveys for the accompanying FPM survey (Triturus, 2021) of the River Barrow within the survey area.

Further presence/absence surveying, carried out by APEM, took place on 09/08/2023 upstream of the flood storage works area on the Duiske River. During this survey, a 100 m stretch of suitable river was chosen for survey within the 500 m survey stretch, utilising hand-search and crayfish traps.

[3.1.4] Cumulative and In-Combination Impacts

It is a requirement of AA that the cumulative or in-combination effects of the proposed development alongside other plans or projects are assessed. Cumulative impacts can be defined as the significant effects a project/plan/programme may have, either individually or in combination with other plans or projects.

In accordance with EC Article 6 Guidance Document (EC, 2018), in order to ensure all impacts upon the site are identified, including direct and indirect impacts attributable to cumulative impacts, the following steps were completed:

- Identify all projects/plans that might act in combination: Identify all possible sources of effects from the project or plan under consideration, together with all other sources in the existing environment and any other effects likely to arise from other proposed projects or plans.
- Impacts identification: Identify the types of impacts that are likely to affect aspects of the structure and functions of the site vulnerable to change.
- Define the boundaries for assessment: Define boundaries for examination of cumulative effects which will be different for different types of impact and may include remote locations.
- Pathway identification: Identify potential cumulative pathways (e.g. via water, air, etc.; accumulations of effects in time or space).
- Prediction: Prediction of magnitude/extent of identified likely cumulative effects.
- Assessment: Comment on whether the potential cumulative impacts are likely to be significant.

[3.1.5] Zone of influence

The 'zone of influence' (ZoI) for a development is defined as, “the area over which ecological features may be affected by biophysical changes because of the proposed project and associated activities. This is likely to extend beyond the project site, for example where there are ecological or hydrological links beyond the site boundaries” (CIEEM, 2019). The ZoI will vary for different ecological features depending on their sensitivity to an environmental change (CIEEM, 2018).

Irish guidance (Department of Environment, Heritage and Local Government, 2010) states, "for the zone of influence, a distance of 15 km is currently recommended in the case of plans derives from UK guidance (Wilson et al, 2006)". The guidance goes on to state that, "***for projects, the distance could be much less than 15 km, and in some cases less than 100 m, but this must be evaluated on a case-by-case basis with reference to the nature, size and location of the project, the sensitivities of the ecological receptors, and the potential for in-combination effects***". Additionally, a practice note issued by the Office of the Planning Regulator (OPR, 2021) states that, "The zone of influence of a proposed development is the geographical area over which it could affect the receiving environment in a way that could have significant effects on the Qualifying Interests of a European site. This should be established case-by-case using the Source-Pathway-Receptor framework and not by arbitrary distances (such as 15 km)".

The ZoI will vary for different ecological features depending on their sensitivity to an environmental change. It may therefore be appropriate to identify different zones of influence for different features. The features affected could include habitats, species, and ecosystems, and the processes on which they depend.

Although there is currently no guidance tool that specifically enables determination of a ZoI for each unique project/development, the following parameters are considered when establishing the zone of influence (CIEEM, 2018):

- Important ecological features that could occur within the project site and surrounding area based on knowledge of the local distribution of relevant habitats and species.
- Activities that may generate ecological impacts and which of these might have an influence on ecological features beyond the site boundaries.
- The presence of migratory species and/or use of nearby habitats by migratory species.
- Habitats that may be used by mobile species that make regular movements to, from, or across the proposed development/project site.
- Key ecological processes or species activity periods;
    - These include seasonal variations in distribution, abundance and activity.
- Key hydrodynamic processes at/near the proposed development/project site.
- Historical distributions, status, and management of designated sites compared with present.
- Key factors influencing distribution and abundance of the feature(s).
- The presence of ecological features/receptors whose disappearance would have significant consequences for other features.
- Direct construction impacts (e.g., direct removal of benthic biodiversity).
- Damage to spawning grounds (e.g., salmonids and lampreys) along the watercourses through physical disturbance, pollution, and/or noise- and vibration-related disturbance.
- Obstruction of movement/migration routes of mobile species, especially fish, birds, and mammals (e.g., otter).
- Impacts on feeding resources and breeding areas for birds, fish, and mammals.

- Subsequent provision of substrate for colonisation by native or non-native species.

The ZoI for this project was identified through a review of the nature of the project, the type of impacts and effects that could arise as a result, the distance between the project and Natura 2000 sites, and the QIs/SCIs of the Natura 2000 sites. The following parameters are examples of works that were given specific consideration when defining the ZoI:

- Access and travel on/off-site, including temporary access routes for construction vehicles and/or plant.
- Areas for plant maintenance and for storage of oils, fuels, and chemicals.
- Movement of materials to/from or within a site.
- Vegetation/habitat clearance, including tree felling.
- Noise and vibration disturbance and vibration from construction activities, particularly within watercourses, due to rapid and extensive transmission of sound underwater.
- Assembly areas for components of construction.
- Ground excavation, infilling, and landscaping.
- Removal or disturbance of sediments or disruption of sediment transport.
- Potential release of contaminants from disturbed sediment.
- Dust generation from plant and vehicle movement.
- Environmental incidents and accidents (e.g., spillages, noise, and emissions)
- Construction of structures and hard surfaces.
- Storage areas for construction/excavated materials.

Considering the nature, extent, and location of the proposed works, particularly because the proposed works will occur directly along the banks of watercourses and within watercourses themselves (in some instances), a ZoI of 10 km was used to account for Natura 2000 sites that may be affected by the scheme (see Figure 3-8).

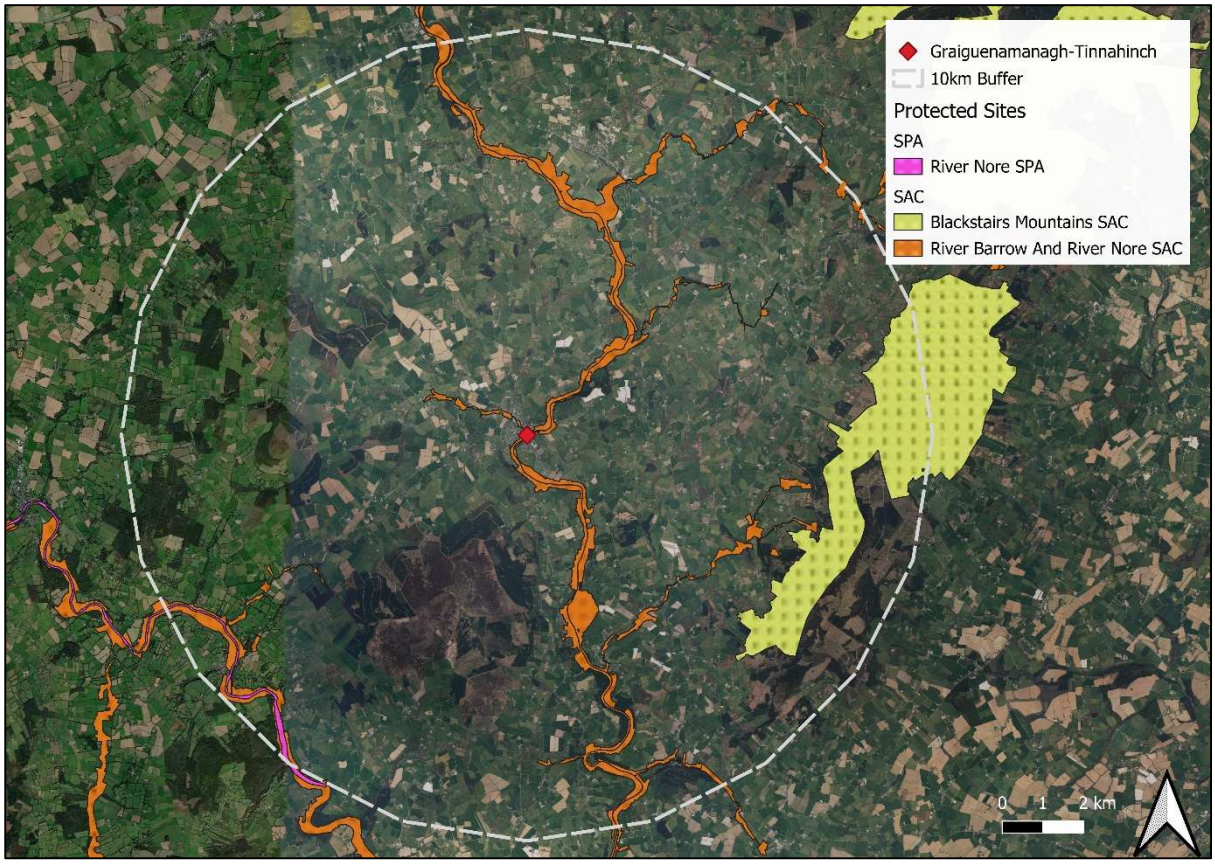


Figure 3-8: Natura 2000 sites in the 10 km ZoI.

[3.1.6] Source-Pathway-Receptor Model

The likely significant effects of the proposed development on any Natura 2000 site were assessed using the source-pathway-receptor model, where:

- A 'source' is defined as the individual element of the proposed works that has the potential to impact on a Natura 2000 site, its qualifying features, and its conservation objectives.
- A 'pathway' is defined as the means or route by which a source can affect the ecological receptor. Pathways are established by surface water, groundwater, and land and air.
- A 'receptor' is defined as the SCI of SPAs or QI of SACs for which conservation objectives have been set for the Natura 2000 sites being screened.

This methodology is based on source > pathway > receptor chain principles and involves assessing likely significant effects on Natura 2000 sites within the ZoI in relation to three pathways individually: 1) surface water, 2) land and air, 3) groundwater. The results of each pathway are then combined in a concluding section to identify if/where likely significant effects may arise.

Where a source-pathway-receptor link between the proposed development and a European site exists, and there is a potential negative impact, further assessment is required. This assessment has been undertaken in accordance with EC Article 6 Guidance Document (EC,

2018). In order to ensure all potential/likely significant effects upon the site are identified, a sequential method of assessment was followed, as outlined in Section 3.1.

The screening process uses a combination of GIS analysis and qualitative assessment to identify which construction/operation activities, on which specific watercourses, are likely to have significant effects on the integrity of Natura 2000 sites. This screening report has been produced in line with the guidance outlined in Section 2.5.5, with the most up-to-date versions used.

[3.2] Assessment of Likelihood of Significant Effects

In assessing the likelihood of the occurrence of significant effects, the logic applied is as follows:

- The likelihood of an effect occurring was assessed, considering the process/emission magnitude, duration, timing and frequency, as well as the connectivity with the proposed project site and the sensitivity of the QI/SCI to the process/emission in question.
- Additionally, where a pathway between the proposed works and a Natura 2000 site was identified, the likelihood of significant effects was assessed in respect to the conservation objectives of habitats and species identified for those receptor Natura 2000 sites (e.g., distribution, abundance, maintenance of biotic and abiotic factors, and/or species composition).
- For example, where it has been determined that the proposed works will likely affect a given habitat, ultimately influencing the abundance of species that utilise that habitat, a likely significant effect is determined.

Where doubt exists about the risk of a significant effect, use of the precautionary principle requires this effect to be considered appropriately within the Article 6 assessment process.

[4] Ecological Receptors Survey Results

[4.1] Desktop Study

This section provides a broad overview of the results of the desktop study showing key/important habitats and/or ecological features associated with Natura 2000 sites. Figure 4-1 below shows the distribution of qualifying habitats and species proximal to the proposed scheme works.

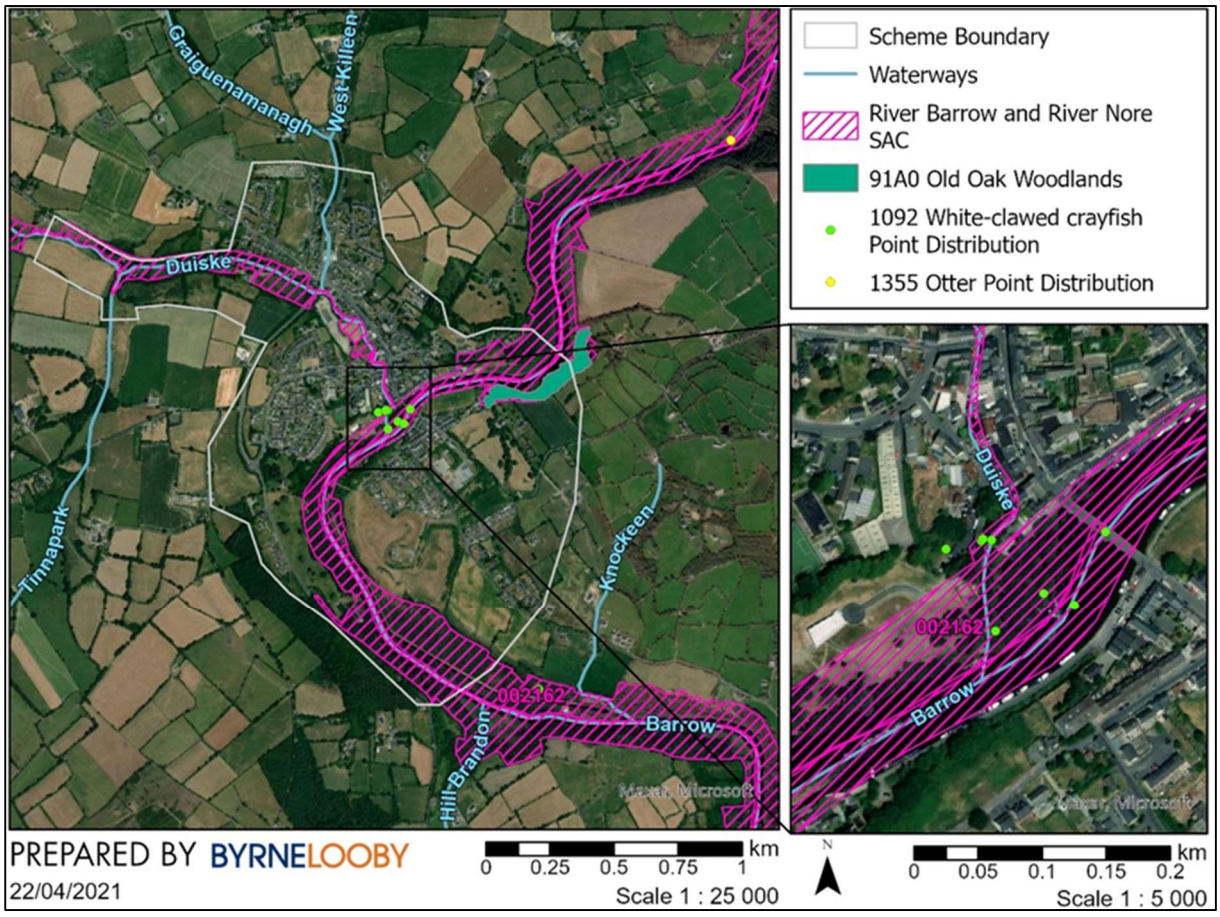


Figure 4-1: QIs proximal to Graiguenamanagh-Tinnahinch (NPWS, 2021).

Available literature and data (see Section [3.1]) were initially checked to establish the known distribution of species listed as QIs/SCIs of the European site.

The status of protected species possibly occurring in the watercourses adjacent to, or downstream of, the site of the proposed development was assessed as follows:

- Available records on the distribution of the FPM and the Nore FPM (*Margaritifera durrovensis*) were checked NPWS, 2013; NBDC, 2024
- The habitat quality for salmon (*Salmo salar*) was assessed based on the criteria outlined by Kennedy (1984) and by Bardonnet and Baglinière (2000) for the physical in-stream requirements of this species for spawning, nursery, and adult habitat.
- The habitat quality for the three species of lamprey in Ireland (brook (*Lampetra planeri*), river (*Lampetra fluviatilis*), and sea (*Petromyzon marinus*) lamprey) was

assessed based on the criteria outlined by Maitland (2003) and by Johns (2002) for the physical in-stream requirements of these species for spawning, nursery, and adult habitat. The sea lamprey is restricted in its distribution in the Barrow to below the weir at Bahanna Woods, which acts as a barrier to its upstream migration. Available records on the distribution of these species were also checked (NPWS, 2013; NBDC, 2024).

- Twaite Shad (*Alosa fallax fallax*) is also restricted in its distribution in the Barrow to below the weir at Bahanna Woods. Available records on the distribution of this species were checked (NPWS, 2013; NBDC, 2024).
- The presence of otter was checked during a riverbank survey for holts or couching sites, an examination of hard bankside surfaces for the presence of spraints, and bankside mud/sand for imprints. The habitat quality for this species was assessed, based on the criteria outlined by Chanin (2003). Available records on the distribution of this species were also checked (NPWS, 2013; NBDC, 2024).

[4.2] Survey Results

[4.2.1] Habitats

A site visit was completed and habitats within the study area encompassing the scheme works were assessed (as outlined in Section 3.1.2). Determination of the presence or absence of Annex I habitats was carried out in consultation with the habitat descriptions provided in the most recent Article 17 Reports (NPWS, 2019). The Interpretation Manual of European Union Habitats (EU, 2013) was also consulted. In addition, the spatial GIS data for the Article 17 Reports were examined to determine the distribution of these habitats (as known to the NPWS) within the study area.[2]

Further information on the range and distribution of these habitats was obtained from the literature available from the NPWS on the River Barrow and Nore SAC. Online aerial photography (Google) was also used as a resource.

Table 4-1 outlines the habitats observed throughout the proposed scheme area.

Table 4-1: Habitats recorded within the study area.

Habitat Name	Habitat Code (as per Fossitt, 2000)
Stone walls and other stonework	BL1
Earth banks	BL2
Buildings and artificial surfaces	BL3
Arable crops	BC1
Improved agricultural grassland	GA1
Amenity grassland (improved)	GA2
Dry meadows and grassy verges	GS2
Wet grassland	GS4

[2] https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

Habitat Name	Habitat Code (as per Fossitt, 2000)
(Mixed) broadleaved woodland	WD1
Scattered trees and parkland	WD5
Hedgerows	WL1
Treelines	WL2
Scrub	WS1
Ornamental/non-native shrub	WS3
Eroding/upland rivers	FW1
Depositing/lowland rivers	FW2
Drainage ditches	FW4
Spoil and bare ground	ED2
Recolonising bare ground	ED3
Built Ground	BL3
Oak-birch-holly woodland	WN1
Wet pedunculate oak-ash Woodland	WN4
Riparian woodland	WN5
Wet willow-alder-ash woodland	WN6

The proposed scheme area proximal to Graiguenamanagh town is primarily comprised of primary build / hardstanding ground, with amenity grasslands (GA2), grassy verges (GS2), Treelines (WL2) and scattered trees and parkland (WD5) interspersed throughout the area. The River Barrow (FW2) forms the Southeastern boundary between of Graiguenamanagh town and Tinnahinch town, whilst the River Duiske (FW1), a tributary of the River Barrow, traverses North-South through Graiguenamanagh town.

The landscape surrounding the proposed scheme area is primarily comprised of improved agricultural land (GA1) with woodlands (WD1, WN1, WN4, WN5 and WN6), hedgerows (WL1), treelines (WL2) and scrub (WS1) interspersed throughout the landscape.

The upstream storage area (which is proposed along the River Duiske) is primarily comprised of upland river (FW1), riparian woodland (WN5), and Oak-birch-holly woodland (WN1), with improved agricultural land (GA1), hedgerows (WL1), treelines (WL2) and scrub (WS1) observed throughout the area.

Flora species observed and recorded within treelines (WL2), mixed broadleaf woodland (WD1) and riparian woodland (WN5) throughout the scheme area (Graiguenamanagh and immediate surrounds, and the upstream storage area) include Scot's pine (*Pinus sylvestris*), sycamore (*Acer pseudoplantanus*), willows (*Salix* spp. e.g., *S. triandra, alba*, *S. Fragilis*, and *S. viminalis*), holly (*Ilex aequifolium*), hazel (*Corylus avellana*), birch (*Betula pubescens*), non-native beech (*Fagus sylvatica*), ash (Fraxinus excelsior). Typical floral species observed in hedgerows (WL1) included gorse (*Ulex europaeus*), nettle (*Urtica dioica*), bracken (*Pteridium aquilinium*), hawthorn (*Crategus monogyna*), blackthorn (*Prunus spinosa*), horse chestnut (*Aesculus hippocastanum*).Dry meadows and verges exhibited species such as red and white clover (*Trifolium pratense* and *T. repens*), vetch (*Vecia cracca*), daisy (*Belis perennis*), honeysuckle (*Lonicera spp*.), bird's-foot trefoil (*Lotus corniculatus*), dock (*Rumex* spp.), thistle

(*Cirsium* spp.), cleavers (*Geum urbanum*), ivy (*Hedera helix*), perennial rye grass (*Lolium perenne*), cock's foot (*Dactylus glomerata*), dandelion (*Taraxacrum* spp.), knapweed (*Centaurea nigra*), meadow sweet (*Filipendula ulmaria*).

Scrub habitats throughout the scheme area exhibited floral species including meadowsweet, purple loosestrife (*Lythrum salicaria*), marsh ragwort (*Senecio aquaticus*), ground ivy (*Glechoma hederacea*), and hedge bindweed (*Calystegia sepium*).

Aquatic plant species observed along watercourses (FW1, FW2) and drainage lines (FW4) included rush (*Juncus effusus*), bulrush (*Typha latifolia*), and water lily (*Nuphar lutea*).

Indian balsam (*Impatiens glandulifera*), an introduced and invasive species, was found to be abundant in some areas, particularly along the Duiske River and, to a lesser extent, the River Barrow. Japanese knotweed (*Reynoutria japonica*), another non-native/invasive species, was recorded to a lesser extent along the same two waterbodies, while only one giant rhubarb (*Gunner* sp.) plant was recorded in the Duiske River. These species are currently undergoing a treatment programme. Garden escapes included cherry laurel, butterfly bush (*Buddleja* sp.), and Lawson's cypress (*Chamaecyparis lawsoniana*).

Details on the presence of habitats designated as QIs for the River Barrow and River Nore SAC are provided in Section 6. Information pertaining to the distribution and extent of habitats and species was sourced from NBDC and NPWS. The survey results of all ecological surveys outlined in Section [3.1.3] are contained within the Ecological Surveys Report in Appendix B. The details relevant to this report are outlined in the following account.

[4.3] Faunal Ecological Receptors

[4.3.1] Freshwater Invertebrates

In 2021, five locations, consisting of 3 in the Duiske and 2 in the River Barrow, were sampled by Aquafact (see Figure 4-2). The Duiske River received a quality status of unpolluted as it entered Graiguenamanagh. Stations 2 and 3 located further downstream in the town were classified as slightly polluted. Although Stations 2 and 3 received a lower Q-value than station 1 they both recorded more sensitive species. Station 2 recorded three pollution sensitive species and Station 3 two sensitive species, while Station 1 only recorded one such species. However, Stations 2 and 3 also contained a higher abundance and diversity of pollution tolerant species.

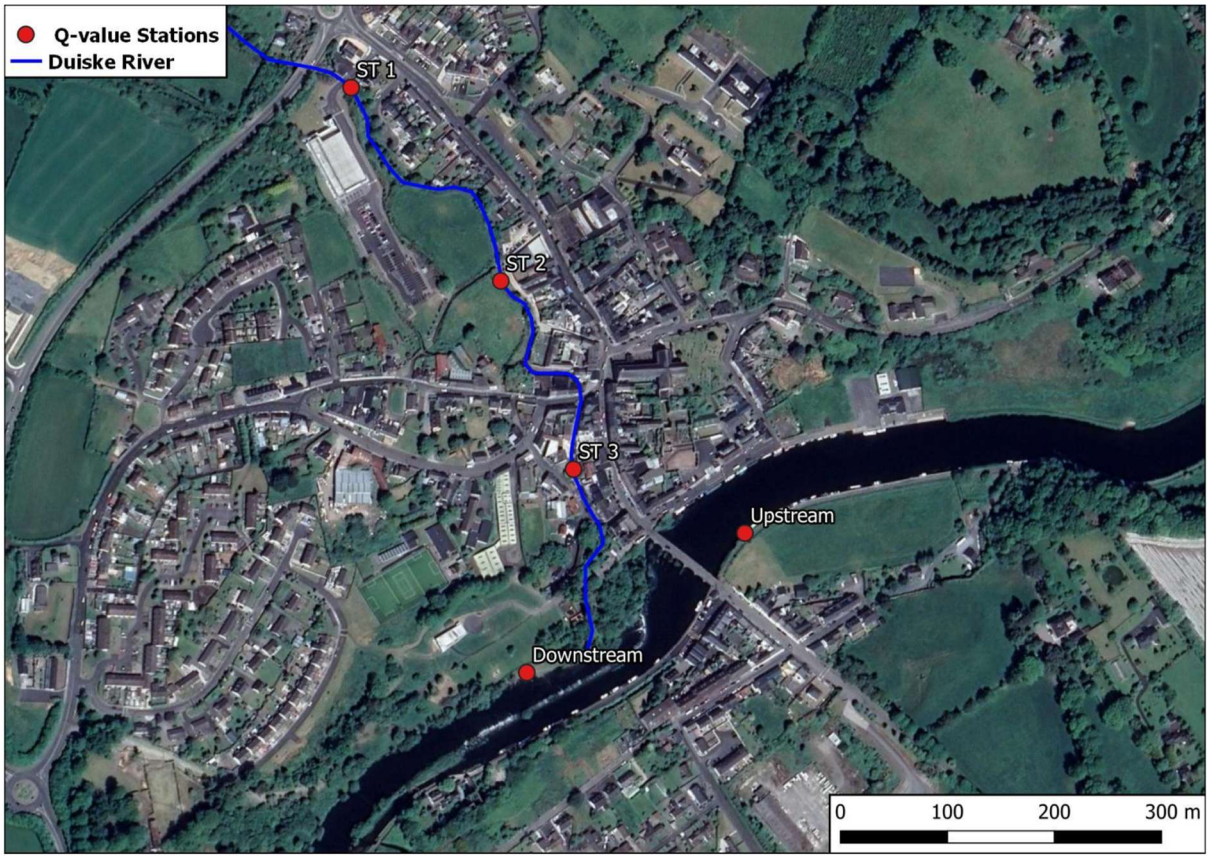


Figure 4-2: Q-value sampling station (source: Aquafact, 2021)

Both of the stations located within the Barrow River were classified as moderately polluted. However, due to the depth of the river and it being in flood, these stations could not be sufficiently sampled for health and safety reasons. The upstream station was sampled from the riverbank while the only location that could be sampled downstream was on a flooded grassy bank.

A similar methodology was employed by APEM during surveying of 3 sites in the upstream storage area in 2023. According to the results of surveying by Triturus in 2021 and APEM in 2023, white-clawed crayfish (WCC) is apparently now absent. No evidence of WCC was found at the proposed site during hand search and trapping surveys. However, the sensitivity and conservation importance of this species, its listing as a QI feature for the SAC, and its presence within the system prior to the outbreak of crayfish plague, means that consideration of this species is required irrespective of whether it is recorded.

Freshwater pearl mussel is listed as a QI for the River Barrow and River Nore SAC (NPWS, 2011). However, extant populations are only known to occur in three tributaries. These are the Mountain River, Ballymurphy River (Ballyroughan River) (i.e. not the main River Barrow channel) and Aughavaud River ≥4 km upstream (Triturus, 2021). The Mountain River and Ballymurphy River populations are located c. 7km and 5km upstream of Graiguenamanagh, respectively. The freshwater pearl mussel would appear to be extinct in the main channel of the River Barrow (Triturus, 2021).

There were no contemporary or historical records for freshwater pearl mussel available for the Duiske River, Graiguenamanagh River or River Barrow in the vicinity of Graiguenamanagh or Tinnahinch (Triturus, 2021).

eDNA analysis for FPM in the Duiske River by Triturus in 2021 returned a negative result for FPM eDNA (0 positive of 12 qPCR replicates, respectively). These results were considered as evidence of the species' absence from the Duiske River and its tributaries (i.e. Graiguenamanagh and Tinnapark Rivers) with the nearest being the Mountain and Ballymurphy Rivers located.

However, a positive result for FPM eDNA was returned in the River Barrow sample collected at Lower Graiguenamanagh-Tinnahinch Weir (C0280) (1 of 12 qPCR replicates) (see Figure 4-3). Although eDNA was present at low concentrations, this result indicated the presence of FPM an undefined distance upstream of Lower Tinnahinch Weir.

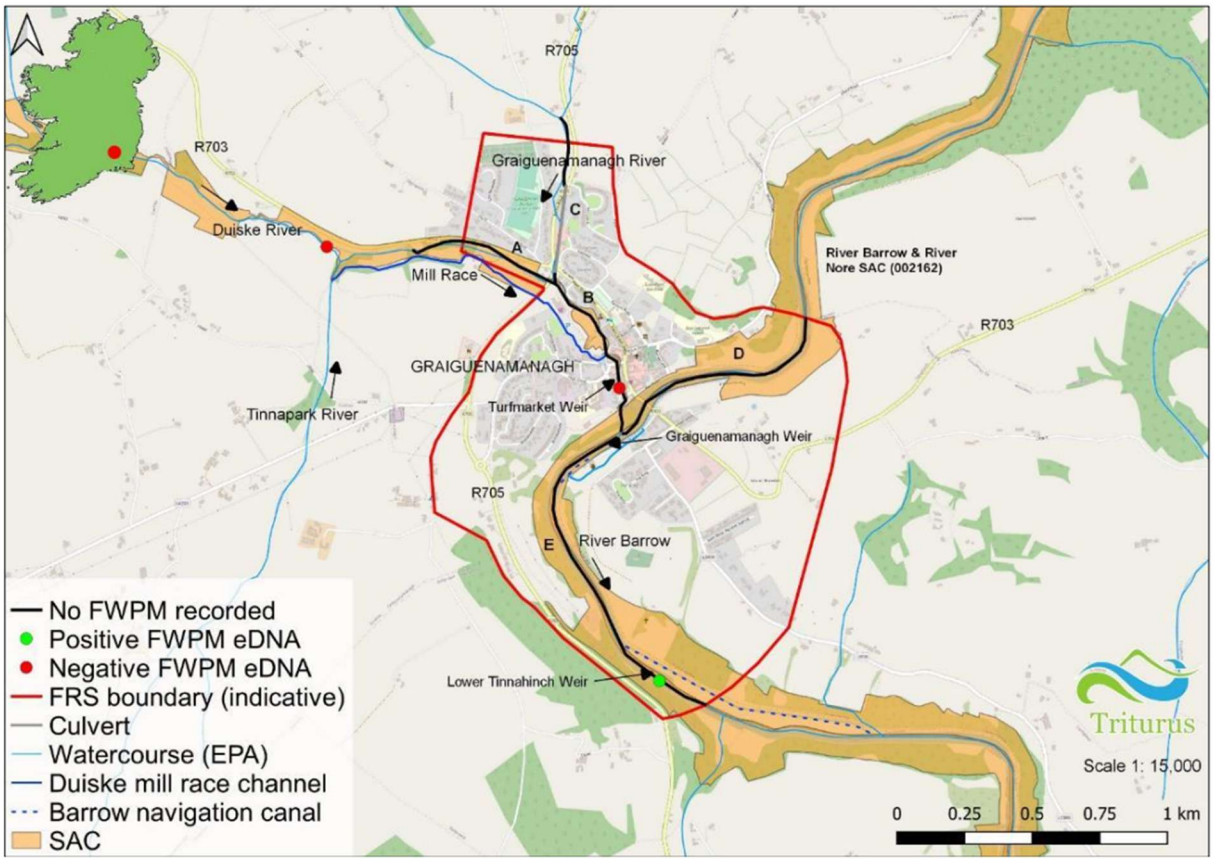


Figure 4-3: FPM survey (source: Triturus, 2021)

[4.3.2] Fish

A desk-based fisheries assessment was carried out by AQUAFACT in 2021. This report focuses on a study carried out by Delanty *et al.* (2017) on fish stocks in the entire catchment of the Barrow. The following text is adapted from the concluding summary of AQUAFACT's fisheries assessment.

The River Duiske catchment supports at least four protected species of fish, namely brown trout *(Salmo trutta)*, Atlantic salmon *(Salmo salar)*, European eel (*Anguilla anguilla*), and at least one of three species of lamprey.

The adjacent River Barrow supports up to twelve species of fish as per the following table (Table 4-2) from Delanty *et al.* (2017). The non-migratory fish species listed are expected to occur in the main channel of the River Barrow throughout the year.

Table 4-2: Fish species in the River Barrow catchment (*sensu* Delanty et al., 2017).

Fish Species	Total Count	No sites present
Dace	1381	32
Roach	754	28
Perch	224	26
Minnow	442	24
Atlantic Salmon (juvenile)	774	20
Atlantic Salmon (adult)	19	7
Pike	58	19
Gudgeon	215	17
Brown Trout (juvenile and adult)	139	16
European Eel	33	15
Stone loach	22	11
Roach x Bream hybrids	14	6
3 spined stickleback	8	1
Flounder	2	1

An electrofishing survey was carried out by Triturus Environmental Ltd (on behalf of AQUAFACT) in February 2021 at the locations shown in Figure 4-4.

Five species were encountered during the survey, namely, Brook Lamprey (*Lampetra planeri)*, Atlantic Salmon (*Salmo salar*), Brown Trout (*Salmo trutta)*, European Eel (*Anguilla anguilla)* and Stone Loach (*Barbatula barbatula*).

Figure 4-4: Electrofishing survey locations (Site D1, D2 and D3) – from AQUAFACT (2021)

Atlantic salmon was present at the two sites on the Duiske River but was absent at site D1 on the Graiguenamanagh Stream. Brown trout was present at all of the survey locations. Brook lamprey was present at two of the three sites being absent at the most downstream site D3. Eels were present at both sites on the Duiske River but were absent at site D1 on the Graiguenamanagh Stream. A single stone loach was found on the most downstream survey site D3. Results are presented in Table 4-3: Results of electrofishing survey (AQUAFACT, 2021).

Table 4-3: Results of electrofishing survey (AQUAFACT, 2021)

Site Number	0+ brown trout		1++ brown trout		0+ salmon		1++ salmon		European eel		Brook lamprey	
	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2
D1	0	0	3	0.022	0	0	0	0	0	0	3	0.022
D2	11	0.039	9	0.032	8	0.029	7	0.025	3	0.01	35	0.125
D3	8	0.04	3	0.015	14	0.07	7	0.035	2	0.01	0	0

The Graiguenamanagh Stream, site D1, was a poor to moderate quality spawning channel due to the compacted bed and extremely limited clean gravels. The nursery value appeared good with riffle and glide sequences and macrophyte cover. However, the fisheries survey results did not reflect this, given an absence of juvenile trout. This was considered as a consequence of the poor spawning habitat rather than the river profile attributes (see Figure 4-5). The channel had very localised pool and deeper glide habitat that supported a small adult trout population. The poor downstream connectivity with the Duiske due to extensive culverting and smaller size of the channel likely accounted for the absence of both European eel and Atlantic salmon that were present downstream (sites D2 & D3).

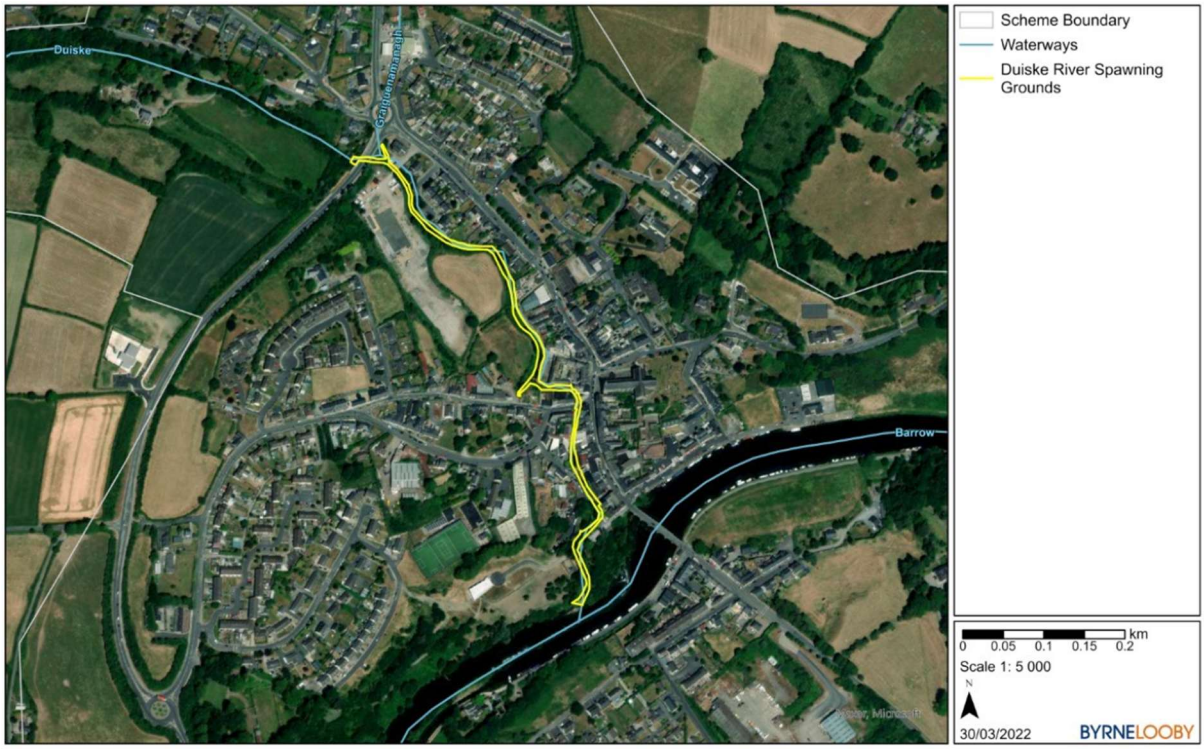


Figure 4-5: Duiske River Spawning Grounds – from AQUAFACT (2022).

The stream supported moderate quality brook lamprey habitat with localised sand/silt beds on meanders near glide and pool. The ammocoete densities recorded in these patches of habitat were low indicating that while small local populations were present, the habitat was sub-optimal overall. Nevertheless, lamprey habitat is often fragmented and isolated in small stream habitats and the presence of any local populations can be considered of high conservation value.

Threats to the site are the historical artificial straightening of the river and a risk of siltation.

In terms of fisheries value, the Duiske River was considered particularly good quality salmonid nursery given its larger size and semi-natural profile*,* i.e.*,* mixed glide, riffle, and pool sequences. The Atlantic salmon densities also indicate it of extremely high importance in the Barrow catchment as an Atlantic salmon nursery.

Salmonid spawning habitat at site D2 was considered overall particularly good given the presence of well sorted coarse, medium, and fine gravels amongst cobbles. Holding habitat was also good due to the presence of deeper glide and pool. The combination of exceptionally good nursery and spawning habitat was reflected in the very good numbers of juvenile salmonids, including mixed cohorts of Atlantic salmon parr. Eel habitat was moderate overall due to downstream impediments to eel passage (i.e.*,* weir) with small numbers captured. Lamprey ammocoete habitat was excellent locally with silt and sand beds in pool and glide slack areas supporting healthy populations. The sediment was light and uncompacted with good organic content and indicating extremely high suitability for ammocoetes. Exceptionally good ammocoete habitat was recorded adjoining both bridge abutments at the Well Lane footbridge.

Salmonid spawning habitat at site D3 was considered moderate but improved to good locally given pockets of course, medium, and fine gravels in pool tailings. Holding habitat was limited overall due to a paucity of deeper pools which was reflected in the lower number of adult salmonids recorded. The combination of good nursery habitat and moderate-good spawning was reflected in the good numbers of juvenile salmonids, including mixed cohorts of Atlantic salmon. Eel habitat was moderate overall due to more limited pools, bedded substrata (due to high flows) and impediments to fish passage (i.e., weir). Lamprey ammocoete habitat was not recorded present due to the high energy of the lower Duiske River and the absence of any significant accumulations of suitable ammocoete burial habitat. Particularly good lamprey ammocoete habitat is known to be present outside of the survey reach downstream near the Duiske confluence with the River Barrow (pers. obs.).

A small weir 0.5 m high located downstream of a small bridge (52.54008488 W, -6.95567596 N) was identified as a potential threat to eel passage in the river.

During the fish habitat survey undertaken by APEM in 2023, it was found that the channel of the Duiske River surveyed provides a good mix of aquatic habitats, favoured by a range of fish and invertebrate species. Salmonid and mixed juvenile habitat was prevalent with adult salmonid passageway and resting and holding areas being found along the reach. These species including lamprey and salmon are assumed to be present.

[4.3.2.1] Atlantic salmon (*Salmo salar*)

There are no NBDC records relevant to this site. However, it is known that the distribution and range of Atlantic salmon spans almost the entire country.

Migratory adult Atlantic salmon destined to spawn in the River Duiske catchment are expected to enter the River Barrow during the summer months. They remain in the river's deep waters until the completion of maturation before initiating movement into the River Duiske closer to spawning time, likely in December. The nature of the River Duiske does not suggest that it offers suitable holding habitat for adult salmon over a prolonged period. Juvenile salmon might be expected to leave the River Duiske at the smolt stage, typically during the months of March through May, when river flows are elevated and the water temperature range is 7-13°C. Salmon smolt migrating downstream from areas higher up in the River Barrow catchment might also be expected to pass through Graiguenamanagh during these months and under such conditions. The River Barrow catchment currently supports an Atlantic salmon population/stock which is estimated to be below its conservation limit, based on recent catchment wide electrofishing survey data (IFI, 2020). The electrofishing survey by AQUAFACT found that Atlantic salmon was present in the River Duiske.

[4.3.2.2] Lamprey species

The River Barrow catchment-wide electrofishing survey of June-August 2015, which was reported on by Delanty et al. (2017), does not provide specific identification of lamprey species recorded in the River Duiske. However, both river and sea lamprey transformers have been recorded during November 2020 among fish impinged and subsequently washed off band screens at Great Island Cooling Water System, Campile, Co. Wexford, which abstracts cooling water from Waterford Harbour, downstream of the River Barrow. Of course, the lamprey spp. recorded by Delanty *et al.* (2017) in the River Duiske may also be brook lamprey that would be expected to migrate locally within the River Duiske. The electrofishing survey by AQUAFACT found that brook lamprey was present in the River Duiske.

[4.3.2.3] Twaite Shad

Only one record is held by the NBDC, indicating twaite shad presence approximately 10 km downstream from the project area is shown in Table 4-4.

Table 4-4: Existing Records – Twaite Shad (NBDC).

ID	Grid Ref	Date	Precision	Notes
A	S726379	10/05/2014	100 m	Irish Federation of Sea Anglers Catch Data

Twaite Shad (*Alosa fallax fallax*) is restricted in its distribution in the Barrow to below the weir at Bahanna Woods (which acts as a barrier to its upstream migration). However, in line with the precautionary principle, potential impacts on this species have been assessed in this report.

[4.3.3] European otter (Lutra Lutra)

A summary of existing data for otter is provided below in Table 4-5: Existing Records – Otter Records were available from the National Biodiversity Data Centre (NBDC) and from the NPWS Article 17 Spatial Dataset (2019).

Table 4-5: Existing Records – Otter

ID	Grid Ref.	Date	Precision	Notes
A	S684444	23/11/04	100 m	NBDC Narrow stream with dense riparian vegetation of gorse and brambles and a few trees. Surrounding grassland very wet and used for grazing cattle. Two spraints 200 m u/s on rock proximal to stream.
B	S722446	04/04/17	100 m	NBDC Sighting of live animal
ID	Coordinates (ITM)	Date	Precision	Notes
C	673585, 645895	n/a	n/a	Article 17 Spatial Data
D	673534, 645845	n/a	n/a	Article 17 Spatial Data
E	672186, 644694	n/a	n/a	Article 17 Spatial Data
F	671990, 639396	n/a	n/a	Article 17 Spatial Data

The field survey by Ayesa ecologists in 2021 gathered evidence of otter activity within the scheme area. The whole of the river corridor provides suitable habitat for otter.

Table 4-6: Field Survey - Evidence of Otters

ID	Coordinates (ITM)	Notes
1	670526, 644040	Potential couch on River Barrow adjacent to where the mill race joins the canal by Tinnahinch Castle.
2	670659, 643367	Potential holts on River Duiske. Located where mill race goes under the R705 near Aldi. This area is extremely dry due to the shelter of the overpass, there is very little vegetation, and the soil is very loose. There are a number of scars in the embankment where it seems otters have attempted to burrow, but the soil was too unstable to sustain a solid tunnel and kept collapsing. For this reason, the Ayesa ecologists note that it is unclear if any of these were ever viable holts.
3	670624, 643195	Potential spraint on River Barrow. It had a grainy texture common with otter spraints but had a pale colour that suggested that it may simply be dog faeces. Located on a clump of grass on the riverbank.

Ayesa ecologists, when surveying in the upstream storage area in 2023, in conjunction with the mammal tunnel surveys, did not observe any live sightings of otter during the field surveys. o otter holt/couch was observed; however, otter spraints and potential food remains were

observed. Further surveys in 2024 did not record any evidence of Otter in the townlands of Graiguenamanagh-Tinnahinch, nor in the upstream storage area.

[5] Source-Pathway-Receptor Model

[5.1] Sources

The information hereunder provides a broad description of potential risk of significant effects through surface water/groundwater, air, and land pathways. However, it must be noted that the descriptions below provide information on typical sources of significant effects but do not encapsulate actual significant effects that will be incurred from the proposed scheme works. Section 6 provides a full description of the likelihood of significant effects to QIs / SCIs and their conservation objectives.

[5.1.1] Sediment

Degradation of freshwaters resulting from excess inputs of sediment is a global concern (e.g., Heino et al., 2020; Gaffney et al., 2020), There is a wide body of literature investigating sediment transport in watersheds from source to sea in Ireland (e.g., Lyons et al., 2021; McKenzie et al, 2023) and proxy watersheds abroad (e.g., Noe et al., 2020; Xu et al., 2023; Zhang et al., 2024). Whilst sedimentation outside of the influence of human activity does occur, such as naturally occurring soil erosion of streambanks, and plays an important role in freshwater systems for nutrient transfer typical ecosystem functioning (see Buendia et al., 2013; Turley et al., 2014), the effects of sedimentation his is greatly exacerbated by anthropogenic actives (e.g., Gaffney et al., 2020; Wu et al., 2020).

Specifically, fine sediment can have deleterious effects on waterbodies and is a major pressure on water quality in Irish rivers (see McKenzie et al, 2023). Fine sediment may have deleterious consequences for the ecological communities present in a water body, impacting on primary producers, invertebrates and fish (e.g., Collins et al., 2011; Jones et al., 2012; Piggott et al., 2012; McKenzie et al, 2023). Within fluvial systems, sedimentation occurs as either suspended sediment in the water column or as deposited sediment that covers the benthic surface, although given the nature of movement within a water column, there is some degree of transfer between both types (Benoy et al., 2012). The primary impact of fine or suspended sediment on macrophytes and algae occurs through light impedance in the water column, which may alter the ability for periphyton and submerged and/or emergent plants to carry out photosynthesis (Bilotta and Brazier, 2008; Gaffney et al., 2021; Wu et al., 2020). Impacts of elevated sedimentation to invertebrates typically surround through abrasions and obstruction up of respiration mechanisms (i.e., spiracles), or through smothering / burial in the instance of benthic invertebrates (McKenzie et al., 2023). Additionally, sedimentation can indirectly result in the alteration and / or loss of macrophyte and algal communities, and directly through the deterioration and / or loss of ecological niches within watercourses (see McKenzie et al., 2023). Similarly, for salmonid fish, key impacts include abrasions and blocking of gill mechanisms, along with the smothering of respiring eggs/larvae (Bilotta and Brazier, 2008).

Primary sources of sedimentation and/or siltation will arise from,

- The construction of the upstream storage area, which will encompass 1) the construction of a raised earthen wall as the primary component of the upstream impoundment, 2) the construction of the upstream impoundment spillway, 3) the temporary diversion of the Duiske River flow path during construction works.

- General construction works encompassed within the flood relief scheme works, including demolition of existing infrastructure (e.g., boundary walls, bollard removals, flood wall repairs, etc), site clearance, construction of new flood infrastructure including in-stream works (i.e., flow control structures, bridge replacements, wall construction).

In addition to the abovementioned, consideration was also given to the following;

- Studies by Escauriaza et al. (2017; 2023) assessed computational models of flow, sediment transport and morpho dynamics in rivers, and concluded that the aquatic zone of potentially highest impact was found to be from the location of the proposed development up to 5 km downstream (also see Hamidifar et al., 2024).

[5.1.2] Flow Alterations of Watercourses

River landscapes are interconnected, complex, dynamic, interacting social–ecological systems (Hand et al., 2018; Dunham et al., 2018). The alteration of river flow regimes by dams, weirs, and water extraction is a ubiquitous and significant anthropogenic impact on freshwater ecosystems (Ekka et al., 2020).

The construction of the upstream storage area will necessitate the temporary diversion of the current flow path of the Duiske River for the duration of the construction phase. The diversion of the River Duiske will entail constructing a new temporary channel outside of the works area. Design measures included in the temporary diversion works include the lining or hydroseeding of the banks of the diversion to minimise sediment influx into the watercourse.

Additionally, the construction phase of the upstream storage area will necessitate the construction of several temporary crossings of the River Duiske. Temporary river crossings will encompass the laying of terram layer on the riverbed, with the subsequent placement of a concrete culvert to allow continued water flow. The crossing will be backfilled with suitable granular material, over which a temporary road will be constructed.

The alteration of natural flows can have short-term effects on the richness, composition, and abundance of aquatic biota (i.e., plants, amphibians, invertebrates, and fish), ecological processes and in-channel, riparian, and floodplain environments (Rolls and Bond, 2017). Alterations in natural flows can result in downstream alterations in substrate composition through increased erosion and / or deposition mechanics (see Guri et al., 2024). Alterations in erosion/deposition mechanics of watercourses typically result in the loss of bankside vegetation, which in turn may result in significant losses in refuges for fish community composition and structure, preferred breeding areas for amphibians, and preferred foraging areas for otter (e.g. Xiang et al., 2022).

The temporary channel will be blocked off and the river realigned to its original course upon completion of the construction of the flow control structure.

[5.1.3] Hydrocarbons & Toxic Contaminants

Hydrocarbons, including Polycyclic Aromatic Hydrocarbons (PAHs), are toxic organic compounds derived mainly from fossil fuels and their byproducts (Vijayanand et al., 2023). Among the anthropogenic contaminants, PAHs have caused great concern due to their toxicity, persistence, bioaccumulation, long-distance transport by air and potentially adverse

health effects on living organisms, including humans (Honda and Suzuki, 2020; Patel et al., 2020).

Owing to their highly lipophilic, carcinogenic, mutagenic, and teratogenic characteristics, PAHs contaminating the environment is a global concern in terms of ecological safety and human health (Achten and Hofmann, 2009; Naudin et al., 2019). PAHs are pervasive environmental pollutants that have been found in different environmental media, including air (e.g. Oleagoitia et al., 2019), soil (e.g. Masto et al., 2019; Syed et al., 2017), and water (e.g. Li et al, 2010; Bansal and Kim, 2015).

PAHs can originate from multiple sources, including incomplete combustion of fossil fuels and vehicle exhaust, accidental spills of aliphatic hydrocarbons (e.g., fuels and hydraulic fluids), as well as from photo/chemical/biological transformation of PAHs (Qiao et al. 2022). Owing to their low solubility and high resistivity to anoxic bacterial degradation (Karlsson and Viklander, 2008; Patrolecco et al., 2010), a significant number of PAHs are adsorbed onto suspended particulate matter (SPM) in receiving waters (Sun et al., 2009).

Hydrocarbons are known to be highly toxic, even at low concentrations (Wang et al, 2023). Aquatic organisms, especially fish and invertebrates, can suffer from acute or chronic toxicity, leading to physiological stress, weakened immune systems, or death (see Vijayanand et al., 2023). Exposure can also result in reproductive issues, growth defects, and behavioural abnormalities in wildlife (see Vijayanand et al., 2023; Usman et al, 2024). PAHs accumulate in the tissues of aquatic organisms and can move up the food chain (Vijayanand et al., 2023). Bioaccumulation can increase the risk of cancer and other illnesses in animals, birds, and humans who consume contaminated aquatic organisms (see Usman et al, 2024). Although hydrocarbons can degrade over time, this process is slow in aquatic environments (Oleagoitia et al., 2019). Their persistence can lead to long-term contamination, altering the water's chemical balance and reducing dissolved oxygen levels (Vijayanand et al., 2023; Usman et al, 2024).

Hydrocarbon sources during the proposed development works include construction vehicles and machinery, specifically those required for earthworks and excavation activities.

[5.1.4] Noise & Vibration

Noise and vibration emissions from transportation, construction, and industrial activities can significantly disrupt natural ecosystems by altering wildlife behaviour, habitats, and ecological processes (Erbe et al., 2022). The intensity and impact of these emissions depend on factors such as proximity to wildlife habitats, frequency, and duration of activities, with prolonged or frequent disturbances leading to severe effects. Impacts range from mild, such as brief behavioural changes and temporary avoidance, to more serious, including long-term displacement from crucial feeding or breeding areas, chronic stress, and even injury (Kight and Swaddle, 2011).

In the instance of the proposed scheme works, the primary receptors of concern potentially receiving noise and vibration emissions are otter and avifauna. Birds, for example, rely heavily on acoustic communication for mating, territory defence, and predator warnings. Persistent low-frequency noise, such as from roadways, has been shown to decrease bird species diversity and breeding densities (Goodwin and Shriver, 2011; Reijnen and Foppen, 2006; Cooke et al., 2020). Otters are similarly impacted; they use vocalizations for social interactions and mating, which high noise levels can disrupt, potentially affecting social structures and

mating success (Gnoli, 1995; Kok, 2023). Additionally, noise pollution and vibrations from human activities can deter otters from foraging, limiting feeding opportunities and increasing competition for resources (Luo et al., 2015). Continuous exposure can cause chronic stress, leading to behavioural changes like habitat avoidance, reduced breeding success, and lower population densities (Arcangeli et al., 2022). Construction-related vibrations can also disturb sediment and riverbank substrates, reducing prey availability and degrading otter habitats (Bates, 2024).

The construction of the upstream storage area will necessitate the temporary diversion of the current flow path of the Duiske River for the duration of the construction phase, as well as the construction of several temporary crossings of the River Duiske (see 5.1.2 for details). The construction of these works will include site clearance, excavations, earth moving, all of which necessitate the use of heavy machinery which will result in noise and vibration emissions.

The de facto daytime noise limit in relation to humans, as recommended by most local authorities in Ireland, is a sound pressure level (SPL) of 55 decibels (dB).

In calculating a ZoI for noise emissions, British Standard BS 5228:2009+A1:2014 was consulted. According to guidance (Table C.1-12), the 'loudest' machine on some of the sites will be similar to a '13 tonne excavator' which will emit a SPL of ~79 dB, measured at a distance of 10 metres. The ZoI will be the distance between the source of noise and the point at which the SPL is 55 dB.

This distance was calculated by using the sound attenuation formula, as described below:

$SPL_2 = SPL_1 - 20 * \log (R_2 / R_1)$

- SPL_1 is the Sound Pressure Level at point 1 (79 dB)
- SPL_2 is the Sound Pressure Level at point 2 (55 dB)
- R_1 is the distance from the sound source to point 1 (10 m); and
- R_2 is the distance from the sound source to point 2 (Zone of Influence).
- R_2 = 158.55 metres.

The ZoI for noise emissions is therefore 158.55 metres, in all directions from each of the works locations.

[5.1.5] Habitat Loss

The loss of habitats during the proposed scheme works is a significant environmental concern, as it disrupts both aquatic and terrestrial ecosystems (Blann, 2009; Crowe, 2010). These activities include removing vegetation along riverbanks, which eliminates essential habitats for birds, mammals, and insects that rely on riparian zones for food, shelter, and breeding. Approximately 728 m^2 of woodland is to be lost in total between the upstream storage area and the Graiguenamanagh town area. The upstream storage area will account for approximately 630m^2 of lost woodland. Removing vegetation and altering flow regimes degrade in-stream habitats by increasing sedimentation and water temperatures, conditions that make the environment unsuitable for fish, invertebrates, and aquatic plants (Palmer, 2019; Burton, 2010, Hayes, 2018; Bonacina, 2023).

These activities not only diminish biodiversity but also weaken riparian zones, which are crucial for stabilising banks, filtering pollutants, and supporting diverse wildlife. Soil disturbance affects the structure and nutrient composition necessary for plant regrowth, impacting the overall health of riparian zones. Additionally, equipment used during construction and maintenance can introduce pollutants, such as oils and chemicals, further degrading both riparian and aquatic ecosystems (Ogidi, 2022). Without the stabilising effects of these natural buffers, ecosystems face increased erosion, nutrient loading, and the spread of invasive species, which fragment habitats and reduce biodiversity (Capon, 2020; Graziano, 2022; Stella and Bendix, 2019).

Direct habitat loss and fragmentation from the proposed scheme limit species movement, impacting genetic diversity and resource access. Altered habitats often fail to support the same diversity of species, leading to declines in sensitive populations.

[5.1.6] Invasive Alien Species

Spread of non-native species is a major threat to global biodiversity. Both terrestrial and aquatic habitats can be negatively affected, resulting in damage to conservation and in some cases public, animal and plant health may also be threatened (Stokes, 2004). In the context of the proposed works, the source could be activities that introduce invasive species, such as soil movement that brings non-native seeds or organisms into new areas. For invasive species, the pathway could include water channels, machinery, or soil displacement, allowing these species to spread and establish in sensitive habitats (Panov et al, 2009; Szumanska, 2021; Montagnani, 2022). Targets of the disturbance include native plants, fish, or riparian vegetation. Receptors are affected by the presence and spread of invasive species, which can outcompete native flora and fauna, altering habitat structure and ecosystem dynamics (Jhariya et al., 2022; Poland, 2021). With riparian zones along water networks, they are already highly invaded with non-native species and, consequently, there is a greater risk of further spreading these alien species as a result of the proposed scheme works (Aronson, 2017).

The proposed scheme can inadvertently contribute to the spread of invasive species, as the movement of soil, water, and machinery between sites can transport seeds, plant fragments, or other organisms to new locations (Hodkinson, 1997). Invasive plants, for example, can quickly establish in disturbed soil along watercourses, where they outcompete native vegetation, reduce biodiversity, and alter the structure of riparian habitats (Modiba et al, 2017; Kiss et al, 2019). Invasive species often thrive in areas of disturbance, making watercourses undergoing construction especially vulnerable (Richardson, 2007).

Construction activities disturb soil, creating opportunities for invasive species to establish themselves in the newly disturbed areas. Removing native vegetation can create open spaces that are quickly colonised by invasive species, which may be better adapted to thrive in disturbed environments. Construction equipment, vehicles, and materials can inadvertently carry seeds or fragments of invasive species from one location to another. As native species decline due to habitat alteration, invasive species may thrive in the absence of competition, further destabilising the ecosystem.

[5.2] Pathways

The potential pathways for impacts are assessed as follows:

- Surface water and groundwater – Impacts can be carried downstream in the normal flow of water. Upstream impacts may also be transmitted where the level of the water is altered. In rare circumstances, the works may alter the condition of the groundwater, which can be transmitted downgradient where there is hydrological connection with surface water. As such, the likelihood of significant effects to groundwater are considered in this pathway.
- Air – Noise, vibration and dust impacts can be felt as a direct result of construction works including vehicle movement, construction works and / or vegetation management.
- Land – direct result of construction works including vehicle movement as well as storage areas and vegetation management.

[5.3] Receptors

The connectivity and/or proximity of the proposed scheme works to Natura 2000 sites identified within the ZoI is assessed below. Habitats and species associated with Natura 2000 sites identified as being at risk of potential significant effects from the proposed scheme works are provided in the sections hereunder. Additionally, any sensitive/protected species/habitats within the immediate vicinity of the proposed works have also been considered.

[5.3.1] Natura 2000 Sites

River Nore SPA [004233]

The Site Synopsis and Conservation Objectives for the site are available at http://www.npws.ie/protected-sites/sac/004233. The location of this SPA in relation to the proposed scheme is shown in Figure 3-8. This SPA is of high conservation value for the following SCI:

- Kingfisher (*Alcedo atthis*) [A229]

Blackstairs Mountains SAC [000770]

The Site Synopsis and Conservation Objectives for the site are available at http://www.npws.ie/protected-sites/sac/000770. The location of this SAC in relation to the proposed scheme is shown in Figure 3-8. This SAC is of high conservation value for the following QIs:

- Northern Atlantic wet heaths with *Erica tetralix* [4010]
- European dry heaths [4030]

River Barrow and River Nore SAC [002162]

The Site Synopsis and Conservation Objectives for the site are available at http://www.npws.ie/protected-sites/sac/002162. The location of this SAC in relation to the proposed scheme is shown in Figure 3-8. This SAC is of high conservation value for the following QIs:

- Northern Atlantic wet heaths with *Erica tetralix* [4010]

- Estuaries [1130]
- Mudflats and sandflats not covered by seawater at low tide [1140]
- Reefs [1170]
- *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]
- European dry heaths [4030]
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]
- Petrifying springs with tufa formation (C*ratoneurion*) [7220]
- Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0]
- Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]
- Desmoulin's Whorl Snail (*Vertigo moulinsiana*) [1016]
- Freshwater Pearl Mussel (*Margaritifera margaritifera*) [1029]
- White-clawed Crayfish (*Austropotamobius pallipes*) [1092]
- Sea Lamprey (*Petromyzon marinus*) [1095]
- Brook Lamprey (*Lampetra planeri*) [1096]
- River Lamprey (*Lampetra fluviatilis*) [1099]
- Twaite Shad (*Alosa fallax fallax*) [1103]
- Salmon (*Salmo salar*) [1106]
- Otter (*Lutra lutra*) [1355]
- Killarney Fern (*Trichomanes speciosum*) [1421]

[6] Screening of Likely Significant Effects to European Sites

In assessing the likelihood of the occurrence of significant effects, the logic is as follows:

- The conditions necessary for a significant effect are considered, and
- The likelihood of that effect is assessed, considering the process/emission magnitude, duration, timing and frequency, as well as the connectivity with the proposed project site and the sensitivity of the QI/SCI to the process/emission in question.

The below definitions are relevant at this stage:

- Likely Significant Effect - Where a plan or project is likely to undermine any of the site's conservation objectives.
- Possible Significant Effect - Where a plan or project has an indicated potential to undermine any of the site's conservation objectives, but where doubt exists about the risk of a significant effect in the current context. Nevertheless, where doubt exists about the risk of a significant effect, use of the precautionary principle requires this effect to be considered appropriately within the Article 6 assessment process.

The following section identifies whether there is likelihood for significant effects to Natura sites via the designated pathways (i.e. surface water/groundwater, air, and/or land pathways) may result from the proposed scheme works. This stage of the assessment considers whether there is connectivity between Natura 2000 sites identified within the Zone of Influence.

Table 6-1: Preliminary Screening Assessment of Natura 2000 sites with ZoI

Natura 2000 Site	Upstream/Downstream Connectivity or Overlap between Proposed Scheme Works and Natura 2000 Sites within ZoI	Considered for Further Assessment?
River Nore SPA	There is distant upstream connectivity only, with the SPA being located ~ 30 km (hydrological distance) from the nearest proposed scheme works. Kingfisher, an Annex I species under the EU Birds Directive, is the sole designated SCI for the River Nore SPA. This species is known to travel large distances to forage. Additionally, the River Duiske and River Barrow provide excellent commuting corridors for Kingfisher.	Yes
Blackstairs Mountains SAC	There is distant upstream connectivity only, with the SAC being located ~ 15 km (hydrological distance) from the nearest proposed scheme works. QIs designated for this site include terrestrial habitats only. The distant connectivity between the SAC and the proposed scheme works provides sufficient buffer to any significant effects.	No
River Barrow and River Nore SAC	The proposed scheme works and associated infrastructure will occur along the main stem of the River Barrow and along the Duiske River. Both of these watercourses have been identified as key habitats that support several ecological receptors, including Salmonids, Freshwater Pearl Mussel, White-clawed Crayfish, and numerous bird species, amongst others.	Yes

The section hereunder examines the likelihood of significant effects to the conservation objectives of QIs/SCIs for each Natura site allocated for further assessment (see Table 6-1

above). Information pertaining to the Conservation Objectives of each QI and/or SCI was reviewed, along with the location of the Natura 2000 site relative to the proposed scheme works. Table 6-2, below, provides a summary of the conservation objectives of QIs and/or SCIs identified for each Natura 2000 site considered for assessment.

Table 6-2: Likelihood of significant effects to QIs / SCIs within designated River Nore SPA.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
River Nore SPA		
Kingfisher (*Alcedo atthis*) [A229]	The River Nore SPA is a long, linear site along the River Nore and is located ca. 30 km (hydrological distance) from the nearest proposed scheme works in Graiguenamanagh but is located ca. 9 km southwest via land pathway. The River Nore SPA is designated as an important site for breeding Kingfisher, which is listed as an Annex I species of the EU Birds Directive. The conservation objectives for Kingfisher include: • Maintain the favourable conservation status of supporting habitats, achieved when 1) the natural range and area of favourable habitats are increasing or stable, 2) the specific structure and functions for long-term maintenance exist and likely to continue, 3) the typical species encompassed in the favourable habitat continue to exist. • Maintain the favourable conservation status of the species, achieved when, 1) the population dynamics of the species is stable or increasing, 2) the natural range of the species is neither reduced nor likely to be reduced, 3) there is sufficiently large habitat to support the species.	The River Nore SPA is located ca. 9 km from the scheme and is ca. 30 km (hydrological distance) downstream of the proposed works. Kingfisher is the sole designated SCI for the River Nore SPA and is known to travel large distances to forage. Additionally, the River Duiske and River Barrow provide excellent commuting corridors for Kingfisher. The proposed scheme works will most likely result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons) in the Rivers Barrow and Duiske. The River Duiske offers an important foraging corridor for Kingfisher, with the original CFRAM survey in 2021 revealing several Kingfisher perches along the lower reaches of the river. Surface water run-off and sediment influxes may have significant effects to water quality and, consequently, the availability of aquatic prey items for Kingfisher (fish, amphibians, crustaceans, insects). Additionally, the proposed temporary diversion of the River Duiske during the construction of the upstream storage infrastructure will result in increased sediment run-off and alteration in surface flow, which may result in the loss of potential prey items and foraging habitat for Kingfisher. However, the proposed works are short-term and primarily limited to bankside works (with small volumes of instream works), and whereby the occurrence and abundance of aquatic communities along the River Duiske and River Barrow will not be significantly altered in the medium - or long-term. As such, significant effects to the conservation objectives of Kingfisher through surface water pathways are unlikely. Although the proposed scheme works will occur proximal to and within watercourses which may offer foraging habitat to Kingfisher, the proposed works will only result in localised short-term effects to potential prey items of Kingfisher through noise and vibration effects. Moreover, the proposed scheme works may result in additional significant effects to aquatic habitats through land pathways, specifically through the installation of flood protection infrastructure and associated works. However, there are no suitable breeding sites identified for Kingfisher proximal to the proposed FRS works, nor will the proposed FRS works result in the permanent alteration of Kingfisher prey communities along the River Duiske or River Barrow.

		Consequently, it is determined at this stage that significant effects to the conservation objectives of Kingfisher through **surface and groundwater, air or land pathways are unlikely.**

Table 6-3: Likelihood of significant effects to QIs / SCIs within River Barrow and River Nore SAC.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
River Barrow and River Nore SAC		
Estuaries [1130]	Estuarine habitats are located ca. 7.5 km downstream from the nearest FRS works (NPWS, 2024). The conservation objectives (NPWS, 2011) include: • The stable or increasing size of total area of estuarine habitat. • The maintenance (density and distribution) of sediment based invertebrate communities (e.g., polychaetes community, *Nephtys cirrose* community), which typically support intertidal wading birds.	Estuarine habitats encompass the entirety of the lower reaches of the River Barrow. The proposed scheme works will most likely not result in significant effects through surface water pathways, such as increased sedimentation and/or contaminants (such as hydrocarbons). Estuaries support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are sufficiently far away from estuarine habitats that any/all noise and vibration emissions will be completely dissipated. As such, it is determined that noise and vibration effects are unlikely to result in significant effects to estuarine habitats. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into estuary habitats. Consequently, it is determined that significant effects to the conservation objectives of estuaries through **surface and groundwater, air or land pathways are unlikely.**
Mudflats and sandflats not covered by seawater at low tide [1140]	This habitat type is found in the lower reaches of the River Barrow, specifically within the lower reaches of the estuary where the River Barrow enters the Waterford Bay (NPWS, 2024). The conservation objectives (NPWS, 2011) include: • The stable or increasing size of total area of estuarine habitat. • The maintenance of the extent of Zostera dominated community. • Natural maintenance (density and distribution) of sediment based invertebrate communities (e.g., polychaetes	Mudflats and sandflats occur extensively throughout the lower reaches of the River Barrow. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). The estuarine reaches of the River Barrow are located > 7 km from the nearest proposed scheme works, wherein a significant dilution effect is afforded. Mudflats/sandflats support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are sufficiently far away from Mudflats/sandflats habitats that any / all noise and vibration emissions will be completely dissipated. As such, it is determined that noise and vibration effects are unlikely to result in significant effects to mudflats and sandflat habitats.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	community, *Nephtys cirrose* community), which typically support intertidal wading birds.	Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into mudflats/sandflats habitats. Consequently, it is determined that significant effects to the conservation objectives of mudflats/sandflats through **surface and groundwater, air or land pathways are unlikely.**
Reefs [1170]	This habitat type is represented as an extensive area of honey-comb worm biogenic reef occurs adjacent to Duncannon, Co. Wexford on the eastern shore of the estuary (NPWS, 2024). The conservation objectives (NPWS, 2011) include: • Maintain a stable or increasing total area of the habitat. • No decline in habitat distribution or occurrence. • Conserve the community distribution types within these habitats, namely Fucoid-dominated intertidal reef community complex; Mixed subtidal reef community complex; Faunal turf-dominated subtidal reef community; Anemone- dominated subtidal reef community; and Laminaria- dominated community complex.	Reef habitats occur in an isolated portion along the eastern coastline of the lower portions of the River Barrow estuary. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Reef habitats are located > 30 km from the nearest proposed scheme works, wherein a significant dilution effect is afforded. Reef habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. However, the proposed scheme works are sufficiently far away (> 30 km) from reef habitats that any / all noise and vibration emissions will be completely dissipated. As such, it is determined that noise and vibration effects are unlikely to result in significant effects to reef habitats. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into reef habitats. Consequently, it is determined that significant effects to the conservation objectives of reefs through **surface and groundwater, air or land pathways are unlikely.**
Salicornia and other annuals colonising mud and sand [1310]	Salicornia colonising mud and sand are found in the creeks of the saltmarshes and at the seaward edges of them within the River Barrow estuary (NPWS, 2024). The conservation objectives (NPWS, 2011) include: • Maintain a stable or increasing total area of the habitat. • No decline in habitat distribution. • Maintain and / or restore the physical structure (sediment supply, creeks & pans, flooding and regime) of the habitat. • Maintain vegetation height, zonation and cover.	Salicornia colonising mud and sand occur throughout the lower reaches of the River Barrow estuary. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). The lower estuarine reaches of the River Barrow are located > 30 km from the nearest proposed scheme works, wherein a significant dilution effect is afforded. Salicornia colonising mud and sand habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are sufficiently far away (> 30 km) from estuary habitats that any / all noise and vibration emissions will be completely dissipated. As such, it is determined that noise and vibration effects are unlikely to result in significant effects to Salicornia colonising mud and sand

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
		Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into estuary habitats. Consequently, it is determined that significant effects to the conservation objectives of Salicornia colonising mud and sand through **surface and groundwater, air or land pathways are unlikely.**
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] **Mediterranean salt meadows (*Juncetalia maritimi*) [1410]**	Salt meadows occur at the southern section of the site in old meadows where the embankment has been breached, along the tidal stretches of in-flowing rivers of the estuarine section of the River Barrow. Salt meadows appear as narrow bands on the channel side of Common Reed (*Phragmites australis*) beds and in narrow fragmented strips along the open shoreline (NPWS, 2024). The conservation objectives (NPWS, 2011) of these habitats include, • Maintain a stable or increasing total area of the habitat. • No decline in habitat distribution. • Maintain and / or restore the physical structure (sediment supply, creeks & pans, flooding and regime) of the habitat. • Maintain vegetation height, zonation and cover. • Maintain the representative range of sub-communities with typical saltmarsh species.	Salt meadow habitats occur throughout the lower reaches of the River Barrow estuary. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons) as the lower estuarine reaches of the River Barrow are located > 30 km from the nearest proposed scheme works, wherein a significant dilution effect is afforded. Salt meadow habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are sufficiently far away (> 30 km) from salt meadow habitats that any / all noise and vibration emissions will be completely dissipated. As such, it is determined that noise and vibration effects are unlikely to result in significant effects to Salt Meadows habitats. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into salt meadow habitats. Consequently, it is determined that significant effects to the conservation objectives of Salt Meadows through **surface and groundwater, air or land pathways are unlikely**.
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260]	Watercourses of plain to montane levels that exhibit floating river vegetation are well represented in the Barrow and in the many tributaries of the site (NPWS, 2024). The conservation objectives (NPWS, 2012) of these habitats include, • Maintain a stable or increasing total area of the habitat. • No decline or change in habitat distribution or occurrence. • Maintain the hydrological regime of the watercourses (river flow, tidal influence, freshwater seepages).	Examples of floating vegetation can be found throughout the River Barrow, and proximal to Graiguenamanagh town. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons), resulting in altered water quality, and alteration of preferred habitat quality. Floating vegetation habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. However, floating vegetation habitats are typically not affected by noise and vibration effects. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into the River Barrow. Consequently, it is determined that significant effects to the conservation objectives of Montaine rivers (aka floating vegetation habitats) through **surface**

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	• Maintain substratum composition - dominated by the particle size ranges, appropriate to the habitat sub-type (frequently sands, gravels and cobbles). • Maintain water quality to prevent changes in species composition. • Maintain vegetation composition – habitats should include typical species in good condition.	**and groundwater pathways are <u>likely</u>** but significant effects through **air or land pathways are <u>unlikely.</u>**
European dry heaths [4030]	Dry heath at the site occurs in pockets along the steep valley sides of the rivers especially in the Barrow Valley and along the Barrow tributaries where they occur in the foothills of the Blackstairs Mountains (NPWS, 2024). The conservation objectives (NPWS, 2012) of these habitats include: • Maintain a stable or increasing total area of the habitat. • No decline or change in habitat distribution or occurrence. • Maintain the physical structure in soil nutrient status (free-draining, acid, low nutrient soil with rocky outcrops). • Maintain the vegetation structure of the habitat through, 1) percentage cover of characteristic shrub indicator species, 2) percentage cover of senescent gorse, 3) percentage cover of long shoots of bilberry, 4) percentage cover of scattered native trees and shrubs, and 5) number of positive indicator species. • Maintain the vegetation composition through, 1) low percentage cover of negative indicator species, 2) number of bryophytes or non-crustose lichen, 3) cover of bracken (< 10%), 4) low percentage cover of weedy negative indicator species (< 1%), 5) no decline in distribution or population size of rare, threatened or scare species.	European dry heaths are primarily located in areas proximal to the Blackstairs Mountains SAC, located to the East of Graiguenamanagh town. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). European dry heaths are located > 15 km (along the River Barrow watercourse) from the nearest proposed scheme works, wherein a significant dilution effect is afforded. European Dry heath habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are sufficiently far away (> 7 km) from dry heath habitats that any / all noise and vibration emissions will be completely dissipated. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into European dry heath habitats. Consequently, it is determined that significant effects to the conservation objectives of European Dry Heaths through **surface and groundwater, air or land pathways are <u>unlikely.</u>**
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels [6430]	Eutrophic tall herb vegetation occurs in association with the various areas of alluvial forest and elsewhere where the floodplain of the river is intact (NPWS, 2024). The conservation objectives (NPWS, 2012) of these habitats include:	Hydrophilous tall herb communities occur throughout the River Barrow and River Nore, with the nearest alluvial woodland habitat located on the eastern bank of the River Barrow, ~ 150 m from the nearest proposed scheme works.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	• Maintain a stable or increasing total area of the habitat. • No decline or change in habitat distribution or occurrence. • Maintain the hydrological regime of the habitat (flooding depth and/or height of the water table). • Maintain the vegetation structure as it regards to sward height. • Maintain the vegetation composition (broadleaf herb: grass ration, typical species, low abundance of negative indicator species).	The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Tall herb communities are typically associated with alluvial and broadleaf woodlands, comprised of terrestrial plant species. As such, surface water run-off and/or sediment influxes will most likely not have significant effects to Tall herb communities. Flora are not typically affected by noise & vibration effects, unless in close proximity to severe noise & vibration sources. Tall herb communities are located ~ 150 m from the nearest proposed scheme works, wherein noise & vibration emissions will be greatly dissipated. The proposed scheme works will not occur proximal to tall herb communities and will therefore not result in direct habitat loss through encroachment/intrusion into hydrophilous tall herb community habitats. Consequently, it is determined that significant effects to the conservation objectives of alluvial woodlands through **surface and groundwater and air and land pathways are unlikely.**
Petrifying springs with tufa formation (*Cratoneurion)* [7220]	Petrifying springs with Tufa formation is a rare habitat in Ireland and one listed with priority status on Annex I of the E.U. Habitats Directive. These hard water springs are characterised by lime encrustations, often associated with small waterfalls (NPWS, 2024). The conservation objectives (NPWS, 2012) of these habitats include, • Maintain a stable or increasing total area of the habitat. • No decline or change in habitat distribution or occurrence. • Maintain the hydrological regime of the habitat (height of the water table, water flow). • Maintain water quality to typical oligotrophic and calcareous conditions. • Maintain vegetation composition to ensure typical species.	Petrifying springs with tufa formation habitats typically only occur along the River Nore. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). The nearest petrifying springs habitat is located > 20 km from the nearest proposed scheme works, wherein a significant dilution effect is afforded. Additionally, the proposed scheme works are sufficiently far away (> 10 km – direct line) from petrifying springs habitats that any/all noise and vibration emissions will be completely dissipated. Furthermore, the proposed scheme works will not result in direct habitat loss through encroachment/intrusion into petrifying spring habitats. Consequently, it is determined that significant effects to the conservation objectives of petrifying springs through **surface and groundwater, air or land pathways are unlikely.**
Alluvial forests with *Alnus glutinosa* and *Fraxinus*	This habitat type is a priority habitat on Annex I of the E.U. Habitats Directive. These habitats can be found along the length of the River Barrow and River Nore (NPWS, 2024). The	Alluvial forests occur throughout the River Barrow and River Nore, with the nearest alluvial woodland habitat located ca. 7 km upstream from the proposed FRS scheme works along the River Barrow. As such, the proposed scheme

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
***excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) [91E0]**	conservation objectives (NPWS, 2011) of this habitat type include, • Maintain a stable or increasing total area of the habitat. • No decline in habitat distribution. • Maintenance of woodland size (i.e., larger than 3 ha [min]). • Maintain diversity of the structure of woodlands (cover & height, community diversity & extent, natural regeneration, and density of dead / fallen timber). • Maintain the hydrological regime (flooding depth / height of water table).	works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Alluvial forests habitats support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are located proximal 7 km upstream from the nearest proposed scheme works and will most likely not be subjected to noise and vibration effects. The proposed scheme works will not result in direct habitat loss through encroachment/intrusion into woodland habitats. Consequently, it is determined that significant effects to the conservation objectives of alluvial forests through **surface & groundwater, air, or land pathways are unlikely**.
Old sessile oak woods with Ilex and Blechnum in the British Isles [91A0]	This habitat type is a priority habitat on Annex I of the E.U. Habitats Directive. These habitats can be found along the length of the River Barrow and River Nore (NPWS, 2024). The conservation objectives (NPWS, 2011) of this habitat type include, • Maintain no decline in the occurrence of old sessile oak woods. • Maintain the composition of typical vegetation composition within old sessile oak woods, achieved when 1) there is no decline in the cover of native tree species within old oak woods, 2) the occurrence of typical occurrence of species remains unchanged, and 3) no negative indicator species are present.	Old sessile oak woods occur throughout the River Barrow and River Nore, with the nearest alluvial woodland habitat located on the eastern bank of the River Barrow proximal (ca. 200 m) to the nearest proposed scheme works. However, the proposed works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons) due to the downstream location of the works. Old sessile oak woods support a multitude of species, including highly mobile, sedentary, migratory and resident species. The proposed scheme works are located ca. 200 m from the nearest works wherein at this distance, typical noise emissions from the proposed works will be dissipated to levels below 50 dB (see example calculation in Section 5.1.4). Considering that the proposed works will only occur along the western bank of the River Barrow and whereby the nearest Old sessile oak woods are located along the eastern bank of the River Barrow, the Proposed Scheme works will not result in direct habitat loss through encroachment / intrusion into woodland habitats. Consequently, it is determined that significant effects to the conservation objectives of Old sessile oak woods through **surface & groundwater, air and land pathways are unlikely.**
Desmoulin's Whorl Snail (*Vertigo moulinsiana*) [1016]	Desmoulin's Whorl Snail is listed as an Annex II species under the EU Habitats Directive. The River Barrow and River Nore SAC is recognised as a very important site for numerous	Desmoulin's Whorl Snail is known to be present along both the River Nore and River Barrow. However, these sites are limited in size and number, with the nearest confirmed site of Whorl snail being located ca. 9 km upstream from Graiguenamanagh along the River Barrow. The proposed scheme works are

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	protected species (NPWS, 2024). The conservation objectives (NPWS, 2011) of this species includes, • Maintain no decline trend in the number of occupied sites. • Maintain the population size and density of adults. • Maintain the total area of occupancy (1 ha of suitable habitat per site). • Maintenance habitat quality through, 1) preferred vegetation type, 2) soil moisture levels.	unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons), considering that the nearest confirmed location of whorl snail is > 8 km upstream from the nearest proposed scheme works, there is very low/no likelihood of significant effects to its conservation objectives from surface water run-off. Additionally, the proposed scheme works are sufficiently far away (> 8 km – direct line) from the nearest confirmed location of Whorl snail presence, wherein effects through noise & vibration petrifying springs habitats that any/all noise & vibration or land pathways is negligible. Consequently, it is determined that significant effects to the conservation objectives of Desmoulin's Whorl Snail through **surface and groundwater, air or land pathways are <u>unlikely.</u>**
Freshwater Pearl Mussel (*Margaritifera margaritifera*) [1029] **Nore Freshwater Pearl Mussel (*Margaritifera durrovensis)* [1990]**	Freshwater Pearl Mussel is listed as an Annex II species under the EU Habitats Directive. The River Barrow and River Nore SAC is recognised as an important site for numerous protected species (NPWS, 2024). The conservation objectives (NPWS, 2011) for this species within the SAC include: • Maintain the distribution of populations. • Restore the population size of the number of adults (~5000 individuals). • Maintenance of population structure – recruitment (restore at least 20 % of juveniles), no more than 5 % decline in number of adults. • Restore and maintain habitat extent. • Restore and maintain water quality to "good" levels. • Restore and maintain substratum quality (filamentous algae (absent or trace, < 5 %, and macrophytes (absent or trace, < 5 %)), substratum quality to include very little fine sediments, oxygen availability, and flow variability to appropriate hydrological regimes. • Maintain sufficient juvenile salmonid numbers to host glochidial larvae.	The inclusion of FPM as a QI to the River Barrow and River Nore SAC is still under consideration. Nevertheless, FPM is listed as a protected species under Annex II of the EU Habitats Directive. The Nore FPM is recognised as an endangered sub-species of pearl mussel and is listed as an Annex II species. Nore FPM are limited in their distribution to the upper reaches of the River Nore, > 10 km from proposed scheme works (NPWS, 2011). FPM are not known to be present along the River Barrow and the River Duiske (NPWS, 2024) in the vicinity of Graiguenamanagh town. Further, physical ecological surveys revealed no evidence of FPM or supporting habitats along the River Duiske nor along the River Barrow immediately adjacent to Graiguenamanagh town. Similarly, supplementary ecological surveys using eDNA analysis revealed no evidence of FPM along the River Duiske, but the presence of FPM was detected using eDNA methods at a single site along the River Barrow in the vicinity of the Tinnahinch weir, downstream of the nearest proposed works. The high sensitivity of eDNA analysis likely enabled a detection of these upstream freshwater pearl mussel populations from the Lower Tinnahinch Weir water sample. Although highly variable, downstream transport of eDNA in riverine environments is known to extend to >100 km. In light of this, it is unclear whether our analysis detected pearl mussel eDNA from the upstream Mountain River or Ballymurphy River populations. The Mountain River and Ballymurphy River populations are located c. 7 km and 5 km upstream of Graiguenamanagh, respectively. Alternatively, the detected eDNA may have originated from pearl mussel washed into the main Barrow channel from the Mountain River.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
		Although the proposed scheme works may result in sediment run-off or sediment disturbance, it is determined that significant effects to this QI through surface water pathways, such as increased sedimentation and/or contaminants (such as hydrocarbons) are unlikely, primarily because of the lack of evidence of FPM communities occurring near or downstream of the proposed works. As such, the proposed scheme works will not occur proximal to FPM habitat, thus ruling out potential noise and vibration effects to this species. Moreover, because no evidence for the presence of FPM or supporting habitat was revealed during the ecological surveys, the proposed scheme works will not result in significant effects to FPM habitats through land pathways. Consequently, it is determined that significant effects to the conservation objectives of FPM and Nore FPM through **surface and groundwater, air or land pathways are unlikely.**
White-clawed Crayfish (*Austropotamobius pallipes*) [1092]	White-clawed crayfish is listed as an Annex II species under the EU Habitats Directive. The River Barrow and River Nore SAC is recognised as a very important site for numerous protected species (NPWS, 2024). The conservation objectives (NPWS, 2011) of this species includes, • Maintain the occurrence of distribution of individuals. • Maintain the population structure through recruitment of juveniles and/or females with eggs. • Ensure the omission of alien crayfish species from river sites. • Ensure the omission of disease (i.e., crayfish plague). • Restore and maintain water quality to “good” levels. • Ensure no decline in habitat quality heterogeneity.	White-clawed Crayfish (WCC) is listed as a protected species under Annex II of the EU Habitats Directive. The proposed scheme works would most likely result in significant effects through surface water pathways, such as alterations to natural flows, increased sedimentation and / or contaminants (such as hydrocarbons), particularly during the river diversion and river crossing works. However, the ecological surveys for WCC in 2018, 2020 and 2021 using eDNA revealed no evidence for the presence of WCC along the Duiske River nor along the River Barrow proximal to Graiguenamanagh town. Further, it is unlikely that the proposed scheme works will subject WCC or their supporting habitat to noise & vibration effects as they are not present within the works area. Moreover, the proposed scheme works will not result in significant effects to the WCC population or supporting habitats through land pathways, specifically through the river diversion and culvert crossing works nor any of the proposed scheme works infrastructure and associated works. Consequently, it is determined that significant effects to the conservation objectives of Desmoulin’s Whorl Snail through **surface and groundwater, air or land pathways are unlikely.**

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
Petromyzon marinus **(Sea Lamprey) [1095]** ***Lampetra planeri*** **(Brook Lamprey) [1096]** ***Lampetra fluviatilis*** **(River Lamprey) [1099]**	The River Barrow and River Nore SAC is recognised as a very important site for Lamprey species, which are listed as Annex II species under the EU Habitats Directive (NPWS, 2024)..The conservation objectives (NPWS, 2012) of both these species includes; • Allow / maintain > 75% of main river stem accessible from estuary for anadromy. • Maintenance of population structure of juveniles (at least 3 three age/ size groups). • Maintain density of juveniles. • No decline in extent and distribution of spawning beds. • Maintenance of > 50% of available juvenile habitat.	Lamprey species are listed as a protected species under Annex II of the EU Habitats Directive. Lamprey are known to exist throughout the length of the River Nore and River Barrow, although there is a deficit in occurrence data of all three species. The Proposed Scheme works may result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). The fish community survey (Triturus, 2021) revealed the presence of Brook lamprey along the lower reaches of the River Duiske, suggesting a strong probability that Sea and River Lamprey may be present along the River Barrow and River Nore. As such, surface water run-off and/or sediment influxes may have significant effects on the conservation objectives of Lamprey. The Proposed Scheme works will occur proximal to and within watercourses (in some instances), wherein Lamprey spawning and nursery habitats will be subjected to noise & vibration effects. Moreover, the proposed scheme works may additionally result in significant effects to preferred Lamprey habitats through land pathways, specifically through the installation of proposed scheme infrastructure and associated works. Consequently, it is determined that significant effects to the conservation objectives of Lamprey through **surface and groundwater, air or land pathways are likely.**
Twaite Shad (*Alosa fallax fallax*) [1103]	The River Barrow and River Nore SAC is recognised as a very important site for Twaite Shad, which are listed as Annex II species under the EU Habitats Directive (NPWS, 2024).The conservation objectives (NPWS, 2012) of both these species includes; • Allow / maintain > 75% of main river stem accessible from estuary for anadromy. • Maintenance of population structure of juveniles (at least 3 three age/ size groups). • Maintain density of juveniles. • No decline in extent and distribution of spawning beds.	Twaite Shad is listed as a protected species under Annex II of the EU Habitats Directive. The River Barrow is one of only a few spawning grounds in the Republic of Ireland for Twaite Shad. The proposed scheme works may result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Although the fish community survey (Triturus, 2021) did not reveal the presence of Twaite Shad, the importance of the River Barrow as a spawning ground for the species must be considered. As such, surface water run-off and/or sediment influxes may have significant effects to Twaite Shad.

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	• Maintenance of > 50% of available juvenile habitat.	The proposed scheme works will occur proximal to and within watercourses (in some instances), wherein Twaite Shad spawning and nursery habitats will be subjected to noise & vibration effects. Moreover, the proposed scheme works may additionally result in significant effects to preferred Twaite Shad habitats through land pathways, specifically through the installation of proposed scheme infrastructure and associated works. Consequently, it is determined that significant effects to the conservation objectives of Twaite Shad through **surface and groundwater, air or land pathways are likely.**
Salmon (*Salmo salar*) [1106]	The River Barrow and River Nore SAC is recognised as a very important site for Atlantic Salmon, which are listed as Annex II species under the EU Habitats Directive (NPWS, 2024). The conservation objectives (NPWS, 2012) for this species includes; • No significant decline in % of accessible river extent for anadromy (maintain 88 -100 %). • Conservation of the number of spawning adults (as dictated by NASCO). • Maintain density of fry & juveniles. • No significant decline in the abundance of out-migrating smolt. • No Significant decline in abundance and distribution of redds. • Maintenance water quality along main river stem and key tributaries.	Salmon are listed as a protected species under Annex II of the EU Habitats Directive. Additionally, the River Barrow is recognised as an important salmonid river. The River Nore and River Barrow is primarily a grilse fishery. The upper stretches of the River Nore and River Barrow are very important for Salmon spawning The proposed scheme works may result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). The fish community survey (Aquafact 2017, Triturus, 2021) revealed the presence of adult and juvenile Salmon along the lower reaches of the River Duiske, suggesting a strong presence of Salmon along the River Barrow in the vicinity of Graiguenamanagh town. As such, surface water run-off and/or sediment influxes may have significant effects on the conservation objectives of Salmon. The proposed scheme works will occur proximal to and within watercourses (in some instances), wherein Salmon spawning and nursery habitats will be subjected to noise & vibration effects. Moreover, the proposed scheme works may additionally result in significant effects to preferred Salmon habitats through land pathways, by the works taking place on the river banks and the permanent associated infrastructure. Consequently, it is determined that significant effects to the conservation objectives of Salmon through **surface and groundwater, air or land pathways are likely.**

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
Otter (*Lutra lutra*) [1355]	The River Barrow and River Nore SAC is recognised as a very important site for Atlantic Salmon, which are listed as Annex IV species under the EU Habitats Directive (NPWS, 2024)..The conservation objectives (NPWS, 2012) for this species includes; • No significant decline in distribution. • No significant decline in terrestrial habitat (ca. 193 ha), marine habitat (ca. 812 ha) or extent of freshwater habitat (ca. 104km) utilised by otter. • No significant decline / change in abundance of couches or holts. • No significant decline in the abundance of fish biomass along watercourses. • No significant increase in the number of barriers to connectivity.	Otter is listed as a protected species under Annex IV of the EU Habitats Directive. The proposed scheme works may result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Although the mammal surveys along the River Duiske (2021, 2024) did not reveal direct evidence of otter, there was several instances of indirect evidence suggesting the presence of Otter (e.g., prints, kills). Additionally, the mammal survey conducted in 2021 revealed evidence of Otter (holts, couches, spraint) along the River Barrow, specifically along the lower reaches of the River Duiske and the River Barrow (proximal to the rowing club). As such, surface water run-off and/or sediment influxes may have significant effects on the conservation objectives of Otter. The proposed scheme works will occur proximal to and within watercourses (in some instances), wherein foraging and traversing habitats for Otter will be subjected to noise & vibration effects. Moreover, the proposed scheme works may additionally result in significant effects to preferred habitat utilised by Otter for foraging, traversing and grooming/resting through land pathways, specifically through the installation of proposed scheme infrastructure and associated works. Consequently, it is determined that significant effects to the conservation objectives of Otter through **surface and groundwater, air or land pathways are <u>likely.</u>**
Killarney Fern (*Trichomanes speciosum*) [1421]	The River Barrow and River Nore SAC is recognised as an important site for several protected species, including Killarney Fern, which is protected under the Flora (Protection) Order (2015). The conservation objectives (NPWS, 2012) for this species includes; • No significant decline in distribution. • Maintain the population size through the number of colonies. • Maintain the population structure of colonies that exhibit unfurled fronds. • No significant decline / change in habitat extent.	Killarney Fern is listed as an Annex I specie sunder the EU Habitats Directive. Killarney Fern is present near alluvial woodland habitat located on the eastern bank of the River Barrow, proximal to the FRS works. The proposed scheme works are unlikely to result in significant effects through surface water pathways, such as increased sedimentation and / or contaminants (such as hydrocarbons). Killarney fern is associated with alluvial woodlands, caves, and exposed rock, and is classified as a terrestrial plant species. As such, surface water run-off and/or sediment influxes will not have significant effects on the conservation objectives of Killarney Fern. Flora are not typically affected by noise & vibration effects, unless in close proximity to severe noise & vibration sources. Confirmed locations of Killarney

Designated QI / SCI [EU Code]	Conservation Objectives and Comments	Assessment of Likely Significant Effects
	• Maintain the hydrological conditions of colonies through appropriate humidity of sites. • No significant change to shading extent of preferred sites. • Maintain the absence of alien invasive species.	fern are located ~150 m from the nearest proposed scheme works, wherein noise & vibration emissions will be greatly dissipated. The proposed scheme works will occur proximal to but not within confirmed Killarney Fern habitats and will therefore not result in direct habitat loss through encroachment/intrusion into Killarney Fern habitats. Consequently, it is determined that significant effects to the conservation objectives of Killarney fern through **surface and groundwater and air and land pathways are unlikely**.

[6.1] Cumulative and In-Combination Effects

It is a requirement of Appropriate Assessment that the cumulative or in-combination effects of the proposed development together with other plans or projects are assessed. Cumulative impacts can be defined as a project/plan/programme likely to have a significant effect on a European Site, either individually or in combination with other plans or projects. Considering the information presented in Section [3], any project/plan/programme which may generate noise within the ZoI (158m) identified in Section [5.1.4] is considered to have potential to interact with the proposed development to cause significant effects to European sites.

The following sources were consulted in order to determine if there were any other plans or projects in the area which could result in cumulative impacts:

- EIA Portal (DHPLG, 2024)
- Carlow Council - Planning System (Carlow County Council, 2024)
- Kilkenny Council - Planning System (Kilkenny County Council, 2024)
- Graiguenamanagh-Tinnahinch Local Area Plan 2021-2027 (Kilkenny County Council and Carlow County Council, 2022)

There are nine recently lodged planning applications located in close proximity to the proposed scheme works at time of writing (November 2025). Only one of the projects in the vicinity of the proposed works required completion of an AA/NIS (see applications 2460326 and 0560086 in no. 6 and 7 of the below list) however this site is located downstream of the proposed flood relief works. The planning applications are as follows:

1) Location: near Graiguenamanagh Bridge (application number: 2460053). This application involves “change of use from restaurant to short term holiday accommodation including internal alterations to provide a studio apartment on the ground floor and a two bedroom (3 person) apartment on the first floor, communal storage space in the basement and all associated site works”.

- There are proposed scheme works proposed immediately north and east of this development. This involves the upgrading of an existing wall and the construction of an embankment. Given the small-scale nature of works for the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

2) Location: Turfmarket, Graiguenamanagh (application number: 2460122). This application involves “the change of use of existing store to short term let with extension to rear of building. (2) Proposed new entrance gate. (3) New roof over existing stone wall building to be used as store/garage and connection to all existing services and all associated site works”.

- There are proposed scheme works planned on the development site boundary of the above-mentioned planning application. This involves the creation of a new flood defence wall. However, these works are near completion so works will not take place concurrently. Therefore it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

3) Location: The Hub (application number: 22477). This application involves “new stand-alone amenities, including new toilets and showering facilities, campers' kitchen,

laundry room and a dog washing station, all of which will be connected to all of the existing services and all associated works".

- There are flood relief works proposed within this development site. This involves the construction of an embankment and ramp. It is anticipated that collaboration with the developers will ensure works do not take place concurrently. Therefore, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

4) Location: The Ring (application number: 2360309). This application involves "the erection of an extension and alterations to existing dwelling and all associated site works".

- There are flood relief works proposed in close proximity to this development. This involves the upgrading of an existing wall and implementation of flood gates. Given the small-scale nature of upgrading the existing wall located south of the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

5) Location: Bray's Lane (application number: 2460038). This application involves "renovation and extension to existing derelict cottage and permission to demolish existing shed to rear and all associated site works".

- There are flood relief works proposed in close proximity of this development. This involves the placement of a debris trap. Given the small-scale nature of the placement of a debris trap proximal to the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

6) Location: Tinnahinch Lock Keeper's House (application number: 2460326). This application involves refurbishment works to the existing protected Lock House structure and the construction of a 116.5m^2, single-storey extension located within the River Barrow and River Nore SAC, the decommissioning of an existing not fit for purpose septic tank and construction of a new EPA code of practice secondary and tertiary treatment system. An NIS has been prepared in relation to the project and accompanies this planning application.

- Located 1.9km downstream of flood scheme works. There is a small chance of in-combination impacts to surface water through sedimentation, and potential accidental contamination, given that the application also involves works adjacent to the river bank and a tributary of the River Barrow, the Knockeen Stream.

7) Location: Tinnahinch Lock Keeper's House (application number: 2560086). The application consists of the retention of a 20.3m^2 garden storage shed, concrete footing and associated site works located within the River Barrow and River Nore SAC. This retention is for a temporary structure for domestic storage provision required until the completion of the works associated with the application for planning permission 24/60326 (see previous).

- Located 1.9km downstream of flood scheme works. There is a small chance of in-combination impacts to surface water through sedimentation, and potential accidental contamination, given that the application also involves works adjacent to the river bank and a tributary of the River Barrow, the Knockeen Stream. However, these are not considered to be significant.

8) Location: Graiguenamanagh Canoe Club (application number: 2460375). This application is “to construct assessable floating pontoon & disabled kayak launch and all associated site works Protected Structure (RPS Ref No: D152)”.

- There are flood relief works proposed in close proximity of this development. This involves the construction of flood defence walls and embankments at the clubhouse. Given the small-scale and temporary nature of the above-mentioned planning application, it is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding environment.

9) Location: Primary Healthcare Building (application number: 2560412). This application involves “the construction of a) a two-storey primary healthcare building, including roof plant area and building signage, b) a single storey service building, including ESB sub-station and service yard, (c) a gas fuel storage compound, d) car and bicycle parking, a set down area, footpaths, public site lighting, pumping station, SuDS drainage, and water mains works; and (f) Totem pole signage, site boundary treatments, landscaping, and all associated site development works to facilitate the development”. Proposed to make use of existing site entrance off the Graiguenamanagh Relief Road (R705), and to include an extension of the access road and pedestrian footpath; (e). The Primary Healthcare Centre facility will provide for HSE health and social care services, dental, and general practice with associated meeting rooms, administrative offices, staff accommodation, receptions and ancillary uses.

- This planning application is located >400m from the closest flood relief works. It is not anticipated that these projects will significantly interact with one another causing negative impact on surrounding habitats or species.

There are no plans or projects in the vicinity of the proposed works requiring EIA to be completed.

No other live or recently approved planning applications were identified in the vicinity of the proposed works. Therefore, as none of these developments are within or adjacent to the proposed working areas, there is not considered to be a risk of in-combination effects with these other plans or projects.

In summary, significant cumulative or in-combination effects are considered unlikely.

[7] Screening Statement

The Screening exercise was completed in compliance with the relevant EC and national guidelines. Article 42 (7) of the European Communities (Birds and Natural Habitats) Regulations 2011 states that: *"The public authority shall determine that an Appropriate Assessment of a plan or project is not required […] if it can be excluded on the basis of objective scientific information following screening under this Regulation, that the plan or project, individually or in combination with other plans or projects, will have a significant effect on a European site."*

The potential impacts from the works for the proposed scheme have been considered in the context of the European Sites potentially affected and the conservation objectives of their Qualifying Interests.

Connectivity via an aqueous pathway (River Barrow and River Duiske) exists between the project scheme area and all three European sites within a 10 km radius. Of these sites, the River Barrow and River Nore SAC, and the River Nore SPA, were brought forward for further assessment due to the identification of likely significant effects thereon, while likely significant effects to Blackstairs Mountains SAC were ruled out. Subsequently impacts to the QI of River Nore SPA were considered unlikely.

Given the above connectivity, it has been determined that the likelihood of significant negative effects to the River Barrow and River Nore SAC via surface and groundwater, air and land pathways cannot be ruled out as they pertain to the following Qis:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- Salmon (*Salmo salar*)
- Sea Lamprey (*Petromyzon marinus*)
- Brook Lamprey (*Lampetra planeri*)
- River Lamprey (*Lampetra fluviatilis*)
- Twaite Shad (*Alosa fallax fallax*)
- Otter (*Lutra lutra*)

Based on the above information, a Natura Impact Statement needs to be completed to progress this report.

Part B: Stage 2 – Natura Impact Statement

[8] Introduction

Part 1 of this Report detailed the Appropriate Assessment (AA) Screening review.

This chapter reports the methodology followed for the Appropriate Assessment process for addressing possible impacts of the GTFRS to the River Barrow and River Nore SAC and River Nore SPA.

[8.1] Methodology for Stage 2: Appropriate Assessment

The methodology undertaken at Stage 1 of this AA, as outlined in Section [3.1], was also utilised in the Stage 2 Natura Impact Statement due to the depth of information available in advance of the preparation of this report.

[9] Impact Assessment

This chapter provides a description of the qualifying habitats and species found within the River Barrow and River Nore SAC and River Nore SPA in the vicinity of the proposed work locations.

A detailed description of the potential impacts associated with the proposed scheme works for each of the site-specific conservation objectives including attributes and targets set for the individual qualifying interest features is provided.

Where required, mitigation measures[3] are described. The potential impacts affecting habitats and species as a result of the proposed works within the SAC and SPA include:

- Loss of primary or qualifying habitat or species where the works will require removal of habitat or species within the site/s.
- Loss of primary or qualifying habitat or species within the site/s as a result of release of sediments and/or suspended silt into watercourses within or outside and upstream of the site/s during the works.
- Loss of primary or qualifying habitat or species within the site/s as a result of release of other pollutants, such as oils and petrochemicals, into watercourses within or outside and upstream of the site/s during the works.
- Temporary habitat loss and/or fragmentation.
- Temporary barrier to faunal movement.
- Temporary disturbance due to noise and vibration disturbance when using plant and machinery.
- Dewatering during cofferdam construction.
- Potential impacts from invasive plants.
- Cumulative impacts.

[3] Where a potentially adverse effect has been identified during an Appropriate Assessment or cannot conclusively be ruled out, it may be possible to proceed where mitigation measures can be implemented to address the adverse effect. These measures will allow any potential impacts affecting the conservation status of the River Barrow and Nore SAC and River Nore SPA to be avoided.

[9.1] Construction Phase

Section 5 of Part A (AA screening) of this report provides an overview of the potential sources of likely significant effects. Specifically, the greatest concern surrounds the influx of excessive sediment and noise & vibration emissions during the construction of the proposed scheme infrastructure, including from the diversion of the River Duiske to construct the upstream storage area. Considering the evidence of the presence of QIs which was provided by the field surveys completed throughout the proposed scheme works area, the following QIs have been identified as the primary recipients of impacts from the proposed scheme works:

- Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation
- Salmon (*Salmo salar*)
- Sea Lamprey (*Petromyzon marinus*)
- Brook Lamprey (*Lampetra planeri*)
- River Lamprey (*Lampetra fluviatilis*)
- Twaite Shad (*Alosa fallax fallax*)
- Otter (*Lutra lutra*)

Table 9-1 provides a summary of the potential significant effects to QIs listed above. The mitigation measures are further discussed in Section 10. These two sections should be read in conjunction with each other.

Table 9-1: Impact Assessment

Qualifying Interest	Conservation Objectives (as per NPWS, 2013 - 2023)	Potential Impacts	Mitigation Measures	Likelihood of Significant Negative Impacts with Appropriate Mitigation
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	Floating vegetation can be found along the length of the River Barrow and River Nore (NPWS, 2024). The conservation objectives (NPWS, 2012) of these habitats include: • Maintain a stable or increasing total area of the habitat. • No decline or change in habitat distribution or occurrence. • Maintain the hydrological regime of the watercourses (river flow, tidal influence, freshwater seepages). • Maintain substratum composition - dominated by the particle size ranges, appropriate to the habitat sub-type (frequently sands, gravels and cobbles) • Maintain water quality to prevent changes in species composition. • Maintain vegetation composition – habitats should include typical species in good condition	• Loss of density and distribution of protected habitats and associated flora and fauna. • Degradation / loss of ecosystem functioning within these habitats due to pollution effects (e.g., contaminants, poor water quality, loss of habitat structure, etc). • Die-off of individuals due to increased sedimentation and/or pollution influxes. • Loss of local and regional biodiversity associated with floating vegetation.	Neither the River Duiske nor the River Barrow exhibit stretches of watercourses supporting *Ranunculion* or *Callitricho* vegetation, although these species are known to occur along the River Barrow downstream of Graiguenamanagh Town. It is recommended that precautionary measures be taken to avoid potential impacts to these floating aquatic plant species. The works should follow protocols (as appropriate / applicable) outlined in the following reference documents, • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Biosecurity Protocols for Field Survey Work (IFI, 2010) • Guidelines for the Crossing of Watercourses During the Construction of national Road Schemes (NRA, 2008) Additionally, the following sections provide appropriate mitigation measures that should be incorporated into the construction phase of the development works - Section 10.1; 10.3; 10.4.	**Unlikely**
Salmon (*Salmo salar*)	The River Barrow and River Nore SAC is recognised as a very important site for Atlantic Salmon, which are listed as Annex II species under the EU Habitats Directive (NPWS,	• Loss of suitable foraging and spawning habitat through poor water quality stemming from sediment and/or pollution impacts, alterations	FRS works proposed to occur instream should be avoided during the prime spawning period (November – March, inclusive).	**Unlikely**

Qualifying Interest	Conservation Objectives (as per NPWS, 2013 - 2023)	Potential Impacts	Mitigation Measures	Likelihood of Significant Negative Impacts with Appropriate Mitigation
	2024). The conservation objectives (NPWS, 2012) for this species include: • No significant decline in % of accessible river extent for anadromy (maintain 88 - 100 %). • Conservation of the number of spawning adults (as dictated by NASCO). • Maintain density of fry & juveniles • No significant decline in the abundance of out-migrating smolt. • No Significant decline in abundance and distribution of redds. • Maintenance water quality along main river stem and key tributaries	in flow regime / typical surface flow as well as increased sediment influx during river diversion and culvert crossing works. • Displacement of juveniles and adults through noise & vibration effects • Loss of refuge habitat through the increased presence of alien invasive species and increased influxes of fine sediments. • Loss of local and regional biodiversity.	Similarly, stream diversion and / or stream crossing works should be avoided from October – June (inclusive). The works should follow protocols (as appropriate / applicable) outlined in the following reference documents, • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Biosecurity Protocols for Field Survey Work (IFI, 2010) • Guidelines for the Crossing of Watercourses During the Construction of national Road Schemes (NRA, 2008) Additionally, the following sections provide appropriate mitigation measures that should be incorporated into the construction phase of the development works - Section 10.1; 10.3; 10.4.	
Sea Lamprey (*Petromyzon marinus*) **Brook Lamprey (*Lampetra planeri*)** **River Lamprey (*Lampetra fluviatilis*)**	The River Barrow and River Nore SAC is recognised as a very important site for Lamprey species, which are listed as Annex II species under the EU Habitats Directive (NPWS, 2024). The conservation objectives (NPWS, 2012) of both these species includes: • Allow / maintain > 75% of main river stem accessible from estuary for anadromy. • Maintenance of population structure of juveniles (at least 3 three age/ size groups) • Maintain density of juveniles	• Loss of suitable foraging and spawning habitat through poor water quality stemming from sediment and/or pollution impacts, alterations in flow regime / typical surface flow as well as increased sediment influx during river diversion and culvert crossing works. • Displacement of juveniles and adults through noise & vibration effects • Loss of refuge habitat through the increased presence of alien invasive	Lamprey were not detected during the field surveys along the River Duiske within the scheme area. However, it is recommended that precautionary measures be taken to avoid potential impacts to Lamprey, especially within the lower reaches of the River Duiske (i.e., where the watercourse transects Graiguenamanagh Town). FRS works proposed to occur instream should be avoided during the prime Lamprey spawning period (March - June, inclusive).	**Unlikely**

Qualifying Interest	Conservation Objectives (as per NPWS, 2013 - 2023)	Potential Impacts	Mitigation Measures	Likelihood of Significant Negative Impacts with Appropriate Mitigation
	• No decline in extent and distribution of spawning beds. • Maintenance of > 50% of available juvenile habitat.	species and increased influxes of fine sediments. • Die-off of individuals due to pollution influxes and or the introduction of crayfish plague. • Loss of local and regional biodiversity.	Similarly, stream diversion and / or stream crossing works should be avoided from October – June (inclusive). The works should follow protocols (as appropriate / applicable) outlined in the following reference documents, • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Biosecurity Protocols for Field Survey Work (IFI, 2010) • Guidelines for the Crossing of Watercourses During the Construction of national Road Schemes (NRA, 2008) Additionally, the following sections provide appropriate mitigation measures that should be incorporated into the construction phase of the development works - Section 10.1; 10.2; 10.3; 10.4; 10.6.	
Twaite Shad (*Alosa fallax fallax*)	The River Barrow and River Nore SAC is recognised as a very important site for Twaite Shad, which are listed as Annex II species under the EU Habitats Directive (NPWS, 2024). The conservation objectives (NPWS, 2012) of both these species includes: • Allow / maintain > 75% of main river stem accessible from estuary for anadromy. • Maintenance of population structure of juveniles (at least 3 three age/ size groups). • Maintain density of juveniles.	• Loss of suitable foraging and spawning habitat through poor water quality stemming from sediment and/or pollution impacts, alterations in flow regime / typical surface flow as well as increased sediment influx during river diversion and culvert crossing works. • Displacement of juveniles and adults through noise & vibration effects • Loss of refuge habitat through the increased presence of alien invasive species and increased influxes of fine sediments.	Evidence of Twaite Shad was not detected during the field surveys along the River Duiske or River Barrow, within or proximal to the proposed scheme. However, it is recommended that precautionary measures be taken to avoid potential impacts to Twaite Shad. The works should follow protocols (as appropriate / applicable) outlined in the following reference documents, • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Biosecurity Protocols for Field	**Unlikely**

Qualifying Interest	Conservation Objectives (as per NPWS, 2013 - 2023)	Potential Impacts	Mitigation Measures	Likelihood of Significant Negative Impacts with Appropriate Mitigation
	• No decline in extent and distribution of spawning beds. • Maintenance of > 50% of available juvenile habitat.	• Die-off of individuals due to pollution influxes and or the introduction of crayfish plague. • Loss of local and regional biodiversity.	Survey Work (IFI, 2010) • Guidelines for the Crossing of Watercourses During the Construction of national Road Schemes (NRA, 2008) Additionally, the following sections provide appropriate mitigation measures that should be incorporated into the construction phase of the development works – Section 10.1; 10.2; 10.3; 10.4.	
Otter (*Lutra lutra*)	The River Barrow and River Nore SAC is recognised as a very important site for Otter, which are listed as Annex IV species under the EU Habitats Directive (NPWS, 2024). The conservation objectives (NPWS, 2012) for this species includes: • No significant decline in distribution. • No significant decline in terrestrial habitat (ca. 193 ha), marine habitat (ca. 812 ha) or extent of freshwater habitat (ca. 104km) utilised by otter • No significant decline / change in abundance of couches or holts. • No significant decline in the abundance of fish biomass along watercourses. • No significant increase in the number of barriers to connectivity.	• Loss of suitable foraging habitat through poor water quality stemming from sediment and/or pollution impacts, alterations in flow regime / typical surface flow as well as increased sediment influx during river diversion and culvert crossing works. • Direct disturbance of otter through noise and vibration emissions from machinery and /or human presence along / near watercourses. • Loss of refuge habitat through the increased presence of alien invasive species and increased influxes of fine sediments. • Loss of potential prey items due to reduction in water quality, sedimentation and alteration of flows. • Loss of local and regional biodiversity.	A pre-construction survey should be completed by a qualified ecologist along watercourses within the proposed scheme, to investigate for the presence of Otter. The works should follow protocols (as appropriate / applicable) outlined in the following reference documents, • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Guidelines for the Treatment of Otters prior to the construction of National Road Schemes (NRA, 2008) • Guidelines for the Crossing of Watercourses During the Construction of national Road Schemes (NRA, 2008) Additionally, the following sections provide appropriate mitigation measures that should be incorporated into the construction phase of the development works - Section 10.1; 10.2; 10.3; 10.4.; 10.5.	**Unlikely**

[9.2] Post-Construction, Operational and Maintenance Phase

The post construction phase of the Proposed Scheme works will typically include the restoration of the development site to a natural / naturalized state. Where earthen banks have been created or where bare ground has been exposed, these areas will be revegetated with natural flora following the completion of the proposed scheme works. The proposed scheme works will not impede or alter the natural flow of water within the River Barrow or River Duiske during typical “normal” flow periods and is designed to provide storage of water in the upstream area with the operation of the flow control structure, and appropriate channelling of water within the watercourse during periods of very high flow.

Maintenance for the scheme will entail the clearance of the debris trap, and infrequent vegetation maintenance. The mitigation measures detailed in Section [10], particularly as they pertain to the protection of surface water and freshwater fish, will be followed for the undertaking of the maintenance activities.

As such, it is concluded that no further impacts will stem from the operational and maintenance phase of the project.

[9.3] Cumulative Impacts Assessment

As detailed in Section [6.1], there are nine planning applications considered. There is only one application (Tinnahinch Lock Keeper’s House [application number: 2460326]) with the potential for cumulative effects. This project site is located 1.9km downstream of the Proposed Scheme works. There is a small chance of in-combination impacts to surface water through sedimentation, and potential accidental contamination, given that the application also involves works adjacent to the river bank and a tributary of the River Barrow, the Knockeen Stream. However, with the implementation of mitigation outlined in Section [10] of this NIS, and the distance of the flood relief works from this application (which allows for dilution of impact), there is **limited potential for cumulative effects.**

No impacts are expected.

[10] Mitigation Measures

[10.1] General Site Management

Compliance with the below list of recommendations is proposed, in order to minimise risks of surface water contamination by potentially harmful materials or sediment.

- Earth moving works will be avoided during very wet weather conditions to minimise the occurrence of sediment and/or contaminant mobilisation.
- Demolition material not proposed to be reutilised for further construction works must be hauled off site and disposed of at an approved licensed facility, in order to eliminate any possibility of habitat or species loss
- Fuels, lubricants and hydraulic fluids for equipment used on the construction site, as well as any solvents and oils, will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, provided with spill containment.
- Fuelling and lubrication of equipment may be conducted on the site but within designated areas and in conjunction with appropriate spill prevention measures (e.g., drip trays, plant nappies, etc).
- Oil and fuel stored in bunded areas shall be stored at an appropriate distance from any discharge point as to prevent accidental spills entering the marine environment.
- Refuelling must be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser must be operated by trained personnel. The bowser must have spill containment equipment which the operators must be fully trained in using.
- A fuel spill kit shall be retained on the site for the period of construction.
- Any spillage of fuels, lubricants, or hydraulic oils will be immediately contained, and immediate emergency control measures implemented to ensure no ingress into the aquatic environment. The nearby dirty water drain outlet must be blocked with an oil absorbent boom until the fuel/oil spill has been cleaned up and all oil and any contaminated material removed from the area. This contaminated material must be properly disposed of in a licensed facility.
- The washing of vehicles and/or construction machinery and/or HGVs must occur within designated wash areas (i.e., away from watercourses or areas connected to nearby watercourses).
- Moreover, wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks will be trapped on-site in a dedicated area, to allow sediment to settle out and reach neutral pH before clarified water is allowed to percolate into the ground.
- The site compounds will be located within the site boundaries.
    - The compounds are sited as far from any water course where possible in order to minimise any potential impacts, leaving an appropriate buffer (typically 3m) of natural bed and banks undisturbed allowing a natural bank-path. Silt fences will be erected to prevent any run-off from the perimeter of the compounds.
    - Site compounds site shall be restored to their original state following the construction phase.

[10.2] In-stream Works and River Diversion

- The stretch of river planned for temporary diversion measures will be investigated for the presence of fish species (e.g., Salmon, Trout, Lamprey, etc) by an appropriately qualified fisheries/aquatic ecologist prior to any diversion works commencing. This will occur:
    - Immediately prior to rivers/streams being diverted into a newly constructed river channel, electrofishing should be conducted to capture and transfer fish from the original channel to the new one.
    - Once the watercourse has been diverted, a manual search of the original watercourse must be made to transfer any remaining fish and / or crustaceans to the new river/stream channel.
- For any river diversion works, specific attention must be given to the avoidance of unnecessary vegetation clearance.
- Watercourse diversion works and culvert crossing works will take place during periods of low flow.
- Minimal excavation works will be undertaken to minimise potential sediment run-off into watercourses where culvert crossing and diversion will occur.
- Where feasible, soil excavation will be completed during dry periods.
- Where required, silt fences will be used along the banks of watercourses and instream where diversion works will occur to limit the runoff / influx of disturbed sediment. Additionally, silt fences will be used in areas proximal to excavation / diversion works that are susceptible to sediment influx (e.g., drainage lines, natural depressions, tributaries, etc).
- Site clearance for river diversion works will only commence and be undertaken when works are required, adopting a planned approach to avoid mass site clearing that will ultimately result in exposed ground for long periods of time.
- Any / all protected habitats / species should be identified and zoned as “no-go” areas established and suitably isolated from works using fences, barriers, screens and signage.
- Invasive or noxious plants (e.g. Japanese knotweed, Himalayan balsam, etc.) should be removed through appropriate means from the river diversion course before works commence.
- The timing of vegetation removal will be carefully considered to avoid particularly sensitive periods of the year (e.g., bird nesting season, high flow periods).
- During site clearance operations, appropriate measures must be taken to ensure the stability of the bank, particularly where there is a risk of raised water levels (i.e. seasonal high flows) until the vegetation is re-established or prior to the placement of concrete support infrastructure.
- Appropriate flow regulator infrastructure should be placed into the river diversion pathway, either as natural infrastructure (e.g., rock / boulders) or artificial infrastructure (e.g., concrete blocks) to maintain the natural flow of the diverted river, which will also minimise unnecessary sediment removal and flow downstream.

- This is particularly pertinent to consider during potential periods of higher flow following precipitation events. Alteration in the natural flow regime may result in increased sedimentation of river stretches or erosion of key habitats and / or riverbanks downstream.

- All temporary crossing structures used to cross watercourses during construction will be designed in accordance with the Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) and Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2005) to maintain fish and macroinvertebrate passage, and to prevent sedimentation and erosion.

[10.3] Spread of Alien Invasive Species

Treatment is ongoing for invasive species in the scheme area. The following management protocols regarding alien invasive species will be implemented prior to the commencement of construction works:

- Best practice construction measures will be taken to avoid the spread of invasive plant species during the construction phase as they can quickly out-compete native plant species in Ireland. Construction workers onsite must be made aware of the location of invasive species before construction activity commences and consider that physical removal and treatment of the invasive species will be undertaken only in areas where the invasives cannot be avoided by construction activities.
- It is advised that the contractor refers to the following documents, which provide detailed recommendations for the control of invasive species and noxious weeds: Chapter 7 and Appendix 3 of 'The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads' (NRA, 2010) and the Invasive Species Management Plan appended to the Construction Environmental Management Plan submitted as part of the planning application.

[10.4] Precautionary Measures for Preventing Disturbance of Otter

- In the event that a new holt / couch / evidence of Otter is identified during the construction phase, it is recommended that guidance within the "Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes" (NRA, 2008) will be followed, accordingly.

  Culvert crossing and instream works must be designed such that they do not impede the movement of Otter along watercourse. Instream works will allow enough space for otters to pass through without having to divert onto land and back onto the watercourse downstream. This is not possible for the flow control structure in the upstream storage are, however, all other instream works will allow free passage of otters.
- Careful storage of machinery by cordoning off of hazardous machinery with temporary fencing at the end of the working day and the restriction of works to daylight hours (otters and badgers are largely nocturnal) will be implemented by the contractor on site. These mitigation works will necessarily be implemented throughout the entire construction period.

- No night lighting/security lights shall be directed towards the river in a way that causes artificial illumination of the river corridor.
- Noise emission measures outlined in Section [10.6.2] will be adhered to for the protection of otters. This will help avoid significant negative impacts from site noise emissions.

[10.5] Precautionary Measures for the Protection of Salmonids

- No instream works will be carried out between the months of October and June (inclusive) to avoid the most sensitive time for fish species and fish species movements.
- Although Salmonids were only identified during fish community surveys in the lower reaches of the River Duiske, a suitably qualified fisheries ecologist will undertake an assessment of proposed sites for the watercourse diversion and culvert crossing works to determine the suitability of the site as Salmonid spawning habitat. River flow, depth and substrate will be assessed in these areas to determine suitability for salmonid spawning.
- The final placement of the inlet for the upstream storage flow control structure instream will be in such a way that the natural flow of water is not significantly altered nor impedes the movement of fish species along the watercourse.
- Bankside disturbance will be kept to an absolute minimum to avoid bank slumping and / or significant sediment influxes .
- The proposed temporary watercourse diversion works should occur along a stretch of lowest gradient (where feasible) to minimise significant alteration in surface water flow and / or sediment run-off / transport.
- The proposed temporary watercourse diversion will be lined with an appropriate substrate mix (gravels-sand-cobbles) to reflect the natural substrate composition of the watercourse.

[10.6] Disturbance to Breeding Birds

[10.6.1] Avoidance of Bird Breeding Season

- To limit the potential impact of construction on breeding birds, removal of woody vegetation will be restricted to the non-breeding season (September to February, inclusive). Where the construction programme does not allow this, an ecologist will undertake a breeding bird check immediately prior to vegetation clearance. Where no breeding birds are present, clearance may proceed without requiring a derogation licence from the NPWS. However, given that breeding birds and the nests of all bird species are protected under the Wildlife Acts, a licence would be required from the NPWS to permit the destruction of nest sites. NPWS will be consulted prior to disturbance of breeding birds during the breeding season (1st of March to the 31st of August).

- If the applicant intends to carry out clearance works during the bird breeding season, guidance should be sought from the NPWS with regard to compliance with Section 40 (1) and Section 40 (2) (e) of the Wildlife Acts (see below):

  40. (1) (a) It shall be an offence for a person to cut, grub, burn or otherwise destroy, during the period beginning on the 1st day of March and ending on the 31st day of August in any year, any vegetation growing on any land not then cultivated.

  (1) (b) It shall be an offence for a person to cut, grub, burn or otherwise destroy any vegetation growing in any hedge or ditch during the period mentioned in paragraph (a) of this subsection.

  40. (2) Subsection (1) of this section shall not apply in relation to—

  (e) the clearance of vegetation in the course of road or other construction works or in the development or preparation of sites on which any building or other structure is intended to be provided.

[10.6.2] Noise Mitigation Measures

The following mitigation measures will be adopted as standard practice and will be adhered to for the duration of the construction works:

- During the works, best practice noise reduction measures described in British Standard 5228-12009+A1:2009, Code of Practice for Noise and Vibration Control on Construction and Open Sites must be incorporated into the Construction Environmental Management Plan.
- For mobile plant items such as cranes, HGV's, excavators and loaders, maintaining enclosure panels closed during operation can reduce noise levels over normal operation.
- Mobile plant will be switched off when not in use and not left idling.
- For steady continuous noise, such as that generated by diesel engines, noise reduction must be achieved by fitting a more effective exhaust silencer system.
- Acoustic screens are required to be erected in certain locations for the duration of the proposed works. These screens shall be carefully positioned to be as effective as possible. In general, the barrier shall have no gaps or openings in the joins of the barrier material. The barrier material shall have a minimum mass per unit area of 7 kg/m^2 and minimum height of 2.4m. This will be informed by the site ecologist.
- Low decibel machinery must be used for those that will be used continuously such as water pumps to limit any noise emissions from the site in the late evenings and early mornings when mammal (i.e., otter) activity is at a higher level.

[11] Conclusion

This Appropriate Assessment Natura Impact Statement has been completed in compliance with the relevant European Commission and national guidelines. The potential impacts during the construction and operation of the proposed scheme works have been considered in the context of the European Sites potentially affected, their Qualifying Interests, Features of Interest, Special Conservation Interests and Conservation Objectives.

Robust and effective mitigation measures have been proposed for the avoidance of any impacts affecting water quality. Likewise, precautions will be taken in relation to non-native invasive species during the construction phase. Further, mitigation measures have been provided to reduce the impacts of noise and vibration during the construction phase. These will form part of a required Method Statement for the proposed works. Inland Fisheries Ireland (IFI) and the NPWS will be consulted to agree the provisions of a detailed Method Statement outlining the proposed methodology for the undertaking of works within and affecting the watercourse.

This assessment has shown that, given the proposed mitigation measures and based on the best scientific knowledge available, there will be no significant adverse impact on the integrity of the River Barrow and Nore SAC owing to the following reasoning:

- Best practice mitigation has been included in the scheme design (which would be implemented in any case i.e., even without a European Site being in the vicinity).
- Mitigation will be put in place.
- A site ecologist will be present on site, as necessary, particularly for the duration of sensitive works.
- The proposed scheme will not result in any loss or fragmentation of habitats for which the SAC or SPA is designated.
- The proposed scheme will not have any long-term recurring significant impacts on the water quality or water levels of the river or its tributaries; and
- The proposed scheme will not have any significant negative impacts on the Qualifying Interests for which the SAC is designated.

It is concluded that the conservation objectives and integrity of any Natura 2000 site will not be adversely affected by the proposed scheme works.

[12] References

Achten, C., Hofmann, T., 2009. Native polycyclic aromatic hydrocarbons (PAH) in coals - a hardly recognized source of environmental contamination. Sci. Total Environ. 407 (8), 2461e2473.

Anonymous (2004) Margaritifera margaritifera: Stage 1 and Stage 2 survey guidelines. Irish Wildlife Manuals, No. 12. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Arcangeli, G., Lulli, L. G., Traversini, V., De Sio, S., Cannizzaro, E., Galea, R. P., & Mucci, N. (2022). Neurobehavioral Alterations from Noise Exposure in Animals: A Systematic Review. International journal of environmental research and public health, 20(1), 591.

Aronson, M.F.J., Patel, M.V., O'Neill, K.M. (2017). Urban riparian systems function as corridors for both native and invasive plant species. Biol Invasions 19, 3645–3657.

Bansal, V., Kim, K.-H., 2015. Review of PAH contamination in food products and their health hazards. Environ. Int. 84, 26e38.

Bardonnet, A. and Baglinière, J. (2000). Freshwater habitat of Atlantic salmon. *Can. J. Fish. Aquat. Sci.* 57: 497 – 506

Bates, K. J, (2024), Bridging the gaps: a critical review of environmental guidelines for the construction industry working in waterways.

Bansal, V., Kim, K.-H. (2015) Review of PAH contamination in food products and their health hazards. Environ. Int. 84, 26e38.

Benoy, G.A., Sutherland, A.B., Culp, J.M., Brua, R.B., 2012. Physical and ecological thresholds for deposited sediments in streams in agricultural landscapes. Journal of Environmental Quality; Madison 41 (1), 31–40

Bilotta, G.S., Brazier, R.E. (2008) Understanding the influence of suspended solids on water quality and aquatic biota. Water Res. 42 (12), 2849–2861

Birdwatch Ireland. (2012). Countryside Bird Survey Manual. Department of Arts, Heritage and the Gaeltacht.

Blann, K. L., Anderson, J. L., Sands, G. R. and Vondracek, B. (2009) 'Effects of Agricultural Drainage on Aquatic Ecosystems: A Review', Critical Reviews in Environmental Science and Technology, 39: 11, 909 — 1001.

Bonacina, L., Fasano, F., Mezzanotte, V., & Fornaroli, R. (2023). Effects of water temperature on freshwater macroinvertebrates: a systematic review. Biological reviews of the Cambridge Philosophical Society, 98(1), 191–221.

Boon, P. J., cooksley, S., Geist, J., Killeen, I. J., Moorkens, E., Sime, I. (2019) Developing a standard approach for monitoring freshwater pearl mussel (Margaritifera margaritifera) populations in European rivers. Aquatc Conservation Marine and Freshwater Ecosystems. 29, 1-15.

BTO (2023). British trust for Ornithology – Available online: https://www.bto.org/our-science/projects/bird-ringing-scheme/ringing-publications/online-ringing-and-nest-recording.

Buendia, C., Gibbins, C.N., Vericat, D., Batalla, R.J., Douglas, A. (2013) Detecting the structural and functional impacts of fine sediment on stream invertebrates. Ecol. Indic. 25, 184–196

Burton, G.A. and Johnston, E.L. (2010), Assessing contaminated sediments in the context of multiple stressors. Environmental Toxicology and Chemistry, 29: 2625-2643.

Capon, S. J. (2020) Riparian Ecosystems, Editor(s): Michael I. Goldstein, Dominick A. DellaSala, Encyclopedia of the World's Biomes, Elsevier, Pages 170-176.Chanin P (2003). Ecology of the European Otter. Conserving Natura 2000. Rivers Ecology Series No. 10. English Nature, Peterborough.

CIEEM (2018). The Guidelines for Ecological Impact Assessment in the UK and Ireland.

CIEEM. (2019). Advice Note on the Lifespan of Ecological Reports and Surveys. Chartered Institute of Ecology and Environmental Management.

Collins, A.L., Naden, P.S., Sear, D.A., Jones, J.I., Foster, I.D.L., Morrow, K. (2011) Sediment targets for informing river catchment management: international experience and prospects. Hydrol. Process. 25 (13), 2112–2129

Cooke, S.C., Balmford, A., Johnston, A., Newson, S.E. and Donald, P.F. (2020) Variation in abundances of common bird species associated with roads. *Journal of Applied Ecology*, *57*(7), pp.1271-1282.

Crowe, O. (2010). series of ecological assessments on arterial drainage maintenance No 12 Ecological Impact Assessment (EcIA) of the Effects of Statutory Arterial Drainage Maintenance Activities on Kingfisher Alcedo atthis and other riparian birds II.

Department of Environment, Heritage and Local Government. (2010). Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities.

Dunham, J.B.; Angermeier, P.L.; Crausbay, S.D.; Cravens, A.E.; Gosnell, H.; McEvoy, J.; Moritz, M.A.; Raheem, N.; Sanford, T. (2018) Rivers are social–ecological systems: Time to integrate human dimensions into riverscape ecology and management. Wiley Interdiscip. Rev. Water, 5, e1291.

Ekka, A., Pande, S., Jiang, Y., van der Zaag, P. (2020) Anthropogenic Modifications and River Ecosystem Services: A Landscape Perspective. Water. 12, 2706.

Erbe, Christine & Dent, Micheal & Gannon, William & McCauley, Robert & Römer, Heinrich & Southall, Brandon & Stansbury, Amanda & Stoeger, Angela & Thomas, Jeanette. (2022). The Effects of Noise on Animals. 10.1007/978-3-030-97540-1_13.

Escauriaza, C., Paola, C. and Voller, V.R. (2017). Computational models of flow, sediment transport and morphodynamics in rivers. In Tsutsumi, D., and Laronne, J.B. (eds.) Gravel bed rivers. Processes and disasters. Wiley Blackwell.

Escauriaza, C.R., Contreras, M., Barros, M. (2023). Sediment Transport and Deposition in the Flow past Submerged Obstacles: Insights from High-Resolution Numerical Simulations. AGU Fall Meeting Abstracts.European Union (2013). Interpretation Manual of European Union Habitats Eur 28 April 2013 https://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

Fossitt, J.A. (2000). A Guide to Habitats in Ireland. *The Heritage Council.*

Gaffney, G., Daly, K., Jordan, P. (2021). Assessing the impact of fine sediment on high status river sites. Science of the Total Environment. 759, 143985.

Gnoli, C., Prigioni, C. (1995). Preliminary study on the acoustic communication of captive otters (Lutra lutra). Hystrix, the Italian Journal of Mammalogy, 7(1-2).

Goodwin, S. E., & Shriver, W. G. (2011). Effects of traffic noise on occupancy patterns of forest birds. Conservation biology : the journal of the Society for Conservation Biology, 25(2), 406–411.

Graziano, M.P., Deguire, A.K. and Surasinghe, T.D. (2022) Riparian buffers as a critical landscape feature: Insights for riverscape conservation and policy renovations. Diversity, 14(3), p.172.

Gui Wang, Bin Han, Yibin Wang, Jun Liu, Yunchao Zheng, Li Zheng, Zheng Lu, Z. (2023) Distribution, source, and risk assessment of polycyclic aromatic hydrocarbons (PAHs) in surface sediments from Dingzi Bay, China. Journal of Sea Research, p. 102387

Guo, W., He, M., Yang, Z., Lin, C., Quan, X. and Wang, H. (2007) Distribution of polycyclic aromatic hydrocarbons in water, suspended particulate matter and sediment from Daliao River watershed, China. Chemosphere, 68(1), pp.93-104.

Gurí, R., Benejam, L., Ordeix, M. and Arranz, I. (2024). Assessing water diversion impacts on the fish community size structure in headwater stream stretches. Hydrobiologia, 851(14), pp.3413-3431.

Hamidifar, H., Nones, M. and Rowinski, P.M., 2024. Flood modeling and fluvial dynamics: A scoping review on the role of sediment transport. Earth-Science Reviews, 253, p.104775.

Hand, B.K.; Flint, C.G.; Frissell, C.A.; Muhlfeld, C.C.; Devlin, S.P.; Kennedy, B.P.; Crabtree, R.L.; McKee, W.A.; Luikart, G.; Stanford, J.A. (2018) A social–ecological perspective for riverscape management in the Columbia River Basin. Frontiers in Ecology & Environment. 16, S23–S33.

Harvey, J. and Cowx, I. (2003). Monitoring the River, Sea and Brook Lamprey, Lampetra fluviatilis, L. planeri and Petromyzon marinus. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Hayes, D. S., Brändle, J. M., Seliger, C., Zeiringer, B., Ferreira, T., Schmutz, S. (2018) Advancing towards functional environmental flows for temperate floodplain rivers, Science of The Total Environment, Volume 633, Pp 1089-1104, ISSN 0048-9697.

Heino, J., Culp, J.M., Erkinaro, J., Goedkoop, W., Lento, J., Rühland, K.M. and Smol, J.P., (2020) Abruptly and irreversibly changing Arctic freshwaters urgently require standardized monitoring. *Journal of Applied Ecology*, *57*(7), pp.1192-1198.

Hodkinson, D. J., & Thompson, K. (1997). Plant Dispersal: The Role of Man. Journal of Applied Ecology, 34(6), 1484–1496.

Honda, M. and Suzuki, N., 2020. Toxicities of polycyclic aromatic hydrocarbons for aquatic animals. International journal of environmental research and public health, 17(4), p.1363.

IFI (2020) *Fish in Rivers Factsheet: River Barrow Catchment*. http://wfdfish.ie/wp-content/uploads/2021/08/Barrow_Catchment_2020.pdf

Inland Fisheries Ireland (IFI) (2016) *Guidelines on protection of fisheries during construction works in and adjacent to waters.*

Jhariya, M.K., Banerjee, A., Raj, A., Meena, R.S., Khan, N., Kumar, S. and Bargali, S.S. (2022) Species invasion and ecological risk. In *Natural resources conservation and advances for sustainability*. Pp. 503-531. Elsevier.

Jones, J.I., Murphy, J.F., Collins, A.L., Sear, D.A., Naden, P.S., Armitage, P.D. (2012). The impact of fine sediment on macro-invertebrates. River Restoration. Appl. 28, 1055–1071

Johns, M. (2002). Lampreys: relicts from the past. *British Wildlife.* 13: 381 - 388.

Kahl, S., Wood, C.M., Eibl, M. and Klinck, H. (2021). BirdNET: A deep learning solution for avian diversity monitoring. *Ecological Informatics.* Volume 61.

Karlsson, K. and Viklander, M. (2008) Polycyclic aromatic hydrocarbons (PAH) in water and sediment from gully pots. Water, air, and soil pollution, 188, pp.271-282.

Kennedy, G.J.A. (1984). Evaluation of techniques for classifying habitats for juvenile Atlantic Salmon (*Salmo salar* L.). *Atlantic Salmon Trust Workshop on Stock Enhancement*.

Kiss, Tímea & Nagy, Judit & Fehervary, Istvan & Vaszkó, Csaba. (2019). (Mis) management of floodplain vegetation: The effect of invasive species on vegetation roughness and flood levels. Science of The Total Environment.

Kok, Annebelle C. M. , Berkhout Boris W. , Carlson Nora V. , Evans Neil P. , Khan Nicola , Potvin Dominique A. , Radford Andrew N. , Sebire Marion , Shafiei Sabet Saeed , Shannon Graeme , Wascher Claudia A. F. (2023) How chronic anthropogenic noise can affect wildlife communities, Frontiers in Ecology and Evolution,11, 2023.

Li, Y., Liu, J., Cao, Z., Lin, C., Yang, Z. (2010) Spatial distribution and health risk of heavy metals and polycyclic aromatic hydrocarbons (PAHs) in the water of the Luanhe River Basin, China. Environ. Monit. Assess. 163 (1e4), 1e13

Li, R., Hua, P., Zhang, J. and Krebs, P., 2020. Effect of anthropogenic activities on the occurrence of polycyclic aromatic hydrocarbons in aquatic suspended particulate matter: Evidence from Rhine and Elbe Rivers. Water Research, 179, p.115901.

Luo, Jinhong & Siemers, Björn & Koselj, Klemen. (2015). How Anthropogenic Noise Affects Foraging. Global change biology. 21. 10.1111/gcb.12997.

Lyons, W.B., Carey, A.E., Gardner, C.B., Welch, S.A., Smith, D.F., Szynkiewicz, A., Diaz, M.A., Croot, P., Henry, T. and Flynn, R. (2021) The geochemistry of Irish rivers. *Journal of Hydrology: Regional Studies*, *37*, p.100881.

Masto, R.E., Singh, M.K., Rout, T.K., Kumar, A., Kumar, S., George, J., Selvi, V.A., Dutta, P., Tripathi, R.C., Srivastava, N.K. (2019) Health risks from PAHs and potentially toxic elements in street dust of a coal mining area in India. Environ. Geochem. Health 41, 1923e1937.

Matson, R., Delanty, K., Shephard, S., Coghlan, B., Kelly, F. (2018) Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams. Fisheries Research, 198, 99-108.Maitland. P.S. (2003) Ecology of the River, Brook, and Sea Lamprey. Conserving Natura.

McKenzie, M., Brooks, A., Callisto, M., Collins, A. L., Durkota, J. M., Death, R. G., Jones, J. I., Linares, M. S., Matthaei, C. D., Monk, W. A., Murphy, J. F., Wagenhoff, A., Wilkes, M., Wood, P. J., & Mathers, K. L. (2023). Freshwater invertebrate responses to fine sediment stress: A multi-continent perspective. Global Change Biology, 30, 1–13

Modiba, R.V., Joseph, G.S., Seymour, C.L., Fouché, P. and Foord, S.H. (2017) Restoration of riparian systems through clearing of invasive plant species improves functional diversity of Odonate assemblages. Biological Conservation, 214, pp.46-54.

Montagnani C, Gentili R, Brundu G, Caronni S, Citterio S. (2022) Accidental Introduction and Spread of Top Invasive Alien Plants in the European Union through Human-Mediated Agricultural Pathways: What Should We Expect? Agronomy. 12:423.

National Biodiversity Data Centre (NBDC) – 1km- and 2km-square species reports. [Online] Available at: https://maps.biodiversityireland.ie/Map (accessed: 08/12/2024).

National Biodiversity Data Centre (NBDC) (2024). Information on the known distribution and abundance of Freshwater Pearl Mussel in Ireland. Accessed 10/12/2024.

Naudin, G., Bastien, P., Mezzache, S., Trehu, E., Bourokba, N., Appenzeller, B.M.R., Soeur, J., Bornschlogl, T., 2019. Human pollution exposure correlates with € accelerated ultrastructural degradation of hair fibers. Proc. Natl. Acad. Sci. Unit. States Am. 116 (37), 18410e18415.

Noe, G.B., Cashman, M.J., Skalak, K., Gellis, A., Hopkins, K.G., Moyer, D., Webber, J., Benthem, A., Maloney, K., Brakebill, J. and Sekellick, A. (2020) Sediment dynamics and implications for management: State of the science from long-term research in the Chesapeake Bay watershed, USA. Wiley Interdisciplinary Reviews: Water, 7, Pp 1454.

NPWS (2011) River Barrow and River Nore SAC - Conservation Objectives Supporting Document - Woodland Habitats

NPWS (2012) Conservation Objectives: River Barrow and River Nore SAC 002162. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage, and the Gaeltacht.

NPWS (2013) The status of EU Habitats and Species in Ireland, ed. D. Lynn

NPWS (2016) Site Synopsis: River Barrow and River Nore SAC 002162. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage, and the Gaeltacht.

NPWS (2019) Article 17 Reports: The Status of EU Protected Habitats and Species in Ireland. Volume 1: Summary Overview. Edited by Deirdre Lynn and Fionnuala O'Neill.

NRA (2005) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin.

NRA (2009) Guidelines for the Assessment of Ecological Impacts of National Road Schemes. National Roads Authority, Dublin.

NRA (2010) The Management of Noxious Weeds and Non-Native Invasive Plant Species on National Roads'. National Roads Authority, Dublin.

Ogidi, O.I., Akpan, U.M. (2022). Aquatic Biodiversity Loss: Impacts of Pollution and Anthropogenic Activities and Strategies for Conservation. In: Chibueze Izah, S. (eds) Biodiversity in Africa: Potentials, Threats and Conservation. Sustainable Development and Biodiversity, vol 29. Springer, Singapore.

Oleagoitia, M.B.Z., Manterola, A.L., Maurolagoitia, J.I., de Dicastillo, M.D.M.L., Alvarez, J., Barandiaran, M.A., Loibide, A.I., Santa-Marina, L. (2019) Polycyclic aromatic hydrocarbons (PAHs) in air associated with particles PM2.5 in the Basque Country (Spain). Air Qual. Atmos. Health 12, 107e114.

OPR. (2021) Appropriate Assessment Screening for Development Management.

Piggott, J.J., Lange, K., Townsend, C.R., Matthaei, C.D. (2012) Multiple stressors in agricultural streams: a mesocosm study of interactions among raised water temperature, sediment addition and nutrient enrichment. PLoS One 7 (11)

Palmer, M., Ruhi, A. (2019) Linkages between flow regime, biota, and ecosystem processes: Implications for river restoration. Science365.

Panov, V., Arbačiauskas, K., Binimelis, R., Copp, G., Grabowski, M., Lucy, F., Leuven, R., Nehring, S., Paunović, M., Semenchenko, V., and Son, M. (2009). Assessing the Risks of Aquatic Species Invasions via European Inland Waterways: From Concepts to Environmental Indicators. Integrated environmental assessment and management. 5. 110-26

Patrolecco, L., Ademollo, N., Capri, S., Pagnotta, R. and Polesello, S. (2010) Occurrence of priority hazardous PAHs in water, suspended particulate matter, sediment and common eels (*Anguilla anguilla*) in the urban stretch of the River Tiber (Italy). Chemosphere, 81(11), pp.1386-1392.

Patel, A.B., Shaikh, S., Jain, K.R., Desai, C. and Madamwar, D. (2020) Polycyclic aromatic hydrocarbons: sources, toxicity, and remediation approaches. Frontiers in Microbiology, 11, p.562813.

Peay, S. (2003). Monitoring the white-clawed crayfish Austropotamobius pallipes. Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.

Poland, T. M., Patel-Weynand, T., Finch, D.M., Miniat, C. F., Hayes, D. C., and Lopez,V. M. (2021). Invasive Species in Forests and Rangelands of the United States, A Comprehensive Science Synthesis for the United States Forest Sector.

Qiao, M., Fu, L.J., Li, Z.R., Liu, D.Q., Bai, Y.H., Zhao, X. (2020) Distribution and ecological risk of substituted and parent polycyclic aromatic hydrocarbons in surface waters of the Bai, Chao, and Chaobai rivers in northern China. Environmental Pollution 257.

Qiao, M., Qi, W., Liu, H. and Qu, J. (2022) Oxygenated polycyclic aromatic hydrocarbons in the surface water environment: Occurrence, ecotoxicity, and sources. Environment International, 163, p.107232.

Reijnen, R., Foppen, R. (1994) The effects of car traffic on breeding bird populations in woodland. I. Evidence of reduced habitat quality for Willow Warblers (*Phylloscopus trochilus*) breeding close to a highway. The Journal of Applied Ecology, 31, 85

Reynolds, J. D., O'Connor, W., O'Keeffe, C. & Lynn, D. (2010) A technical manual for monitoring white-clawed crayfish Austropotamobius pallipes in Irish lakes. Irish Wildlife Manuals, No 45, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Richardson, D.M., Holmes, P.M., Esler, K.J., Galatowitsch, S.M., Stromberg, J.C., Kirkman, S.P., Pyšek, P. and Hobbs, R.J. (2007), Riparian vegetation: degradation, alien plant invasions, and restoration prospects. Diversity and Distributions, 13: 126-139

Rolls, R. J., Bond, N. R. (2017). Chapter 4 - Environmental and Ecological Effects of Flow Alteration in Surface Water Ecosystems. In: Policy and Science to Implementation and Management. Pp, 65-82.

Smith, G.F., O'Donoghue, P., O'Hora, K and Delaney, E. (2011) Best Practice Guidance for Habitat Survey and Mapping. Heritage Council.

Stella, J. C., Bendix, J. (2019) Chapter 5 - Multiple Stressors in Riparian Ecosystems, Editor(s): Sergi Sabater, Arturo Elosegi, Ralf Ludwig, Multiple Stressors in River Ecosystems, Elsevier, 2019, Pages 81-110,

Stokes, K., O'Neill, K. and McDonald, R.A. (2004) Invasive species in Ireland. Unpublished report to Environment & Heritage Service and National Parks & Wildlife Service. Quercus, Queens University Belfast, Belfast.

Sun, J.H., Wang, G.L., Chai, Y., Zhang, G., Li, J. and Feng, J. (2009) Distribution of polycyclic aromatic hydrocarbons (PAHs) in Henan reach of the Yellow River, Middle China. Ecotoxicology and environmental safety, 72, pp.1614-1624.

Syed, J.H., Iqbal, M., Zhong, G., Katsoyiannis, A., Yadav, I.C., Li, J., Zhang, G., 2017. Polycyclic aromatic hydrocarbons (PAHs) in Chinese forest soils: profile composition, spatial variations and source apportionment. Sci. Rep. 7 (1), 2692.

Turley, M.D., Bilotta, G.S., Extence, C.A., Brazier, R.E. (2014) Evaluation of a fine sediment biomonitoring tool across a wide range of temperate rivers and streams. Freshwater Biology. 59, 2268–2277

Usman, M., Zhao, Z., Yemele, O.M., Ibrahim, M., Raza, W., Rehman, Z.U., Omer, A.A., Talpur, M.M.A., Jeridi, M., Ashraf, G.A. and Danjaji, H.A. (2024) Eco-toxicological impacts of industrial wastewater and

the role of bio-electrochemical systems (BES) in remediation: a review. Clean Technologies and Environmental Policy, Pp.1-28.

Vijayanand, M., Ramakrishnan, A., Subramanian, R., Issac, P.K., Nasr, M., Khoo, K.S., Rajagopal, R., Greff, B., Azelee, N.I.W., Jeon, B.H. and Chang, S.W. (2023) Polyaromatic hydrocarbons (PAHs) in the water environment: A review on toxicity, microbial biodegradation, systematic biological advancements, and environmental fate. Environmental research, 227, p.115716

Wilson, S. & Levitt-Therivel R. (2006) Appropriate Assessment of Plans. Scott Wilson, Levett-Therivel Sustainability Consultants, Treweek Environmental Consultants and Land Use Consultants

Wu, Z., Zhao, D., Syvitski, J.P., Saito, Y., Zhou, J. and Wang, M., 2020. Anthropogenic impacts on the decreasing sediment loads of nine major rivers in China, 1954–2015. Science of the Total Environment, 739, p.139653.

Xiang, C., Huang, W., Zhou, H., Xue, L., Wang, Z., Wei Ma, W. (2022) Flow reduction effect on fish habitat below water diversion—A case study of the Central Yunnan Water Diversion Project. Ecological Engineering, 175, 106499.

Xu, G., Cheng, Y., Zhao, C., Mao, J., Li, Z., Jia, L., Zhang, Y. and Wang, B. (2023) Effects of driving factors at multi-spatial scales on seasonal runoff and sediment changes. Catena, 222, Pp.106867.

Zhang, W., Zhu, G., Zhao, L., Wang, L., Qiu, D., Ye, L., Lu, S. and Lin, X. (2024) Quantifying the changes in solute transport caused by human influence on river connectivity in inland river basins. Catena, 246, Pp.108360.

Appendix A – Proposed Scheme Drawings

Graiguenamanagh Tinnahinch
Flood Relief Scheme

PLANNING DRAWINGS
AUGUST 2025

Kilkenny County Council
Comhairle Chontae Chill Chainnigh

OPW
Oifig na nOibreacha Poibli
Office of Public Works

ayesa

Tionscadal Éireann
Project Ireland
2040

CARLOW
COUNTY COUNCIL

Graiguenamanagh Tinnahinch
Flood Relief Scheme

For Planning - Engineering

August 2025

Drawing Number	Drawing Title	Sheet	Revision
	Cover Sheet	A1	02
W3451-AYE-DWG-W-1400	Drawing List	A1	02
W3451-AYE-DWG-W-1401	Flood Relief Works - Site Location Map	A1	00
W3451-AYE-DWG-W-1402	Flood Relief Works - Site Layout Plan	A1	02
W3451-AYE-DWG-W-1403	Flood Relief Works - Site Location Plan	A1	02
W3451-AYE-DWG-W-1404	Flood Relief Works - Tinnahinch Hotel Street - Site Plan & Longitudinal Sections	A1	02
W3451-AYE-DWG-W-1405	Flood Relief Works - Tinnahinch Hotel Street - Sections - Sheet 1	A1	02
W3451-AYE-DWG-W-1406	Flood Relief Works - Tinnahinch Hotel Street - Sections - Sheet 2	A1	01
W3451-AYE-DWG-W-1407	Flood Relief Works - Tinnahinch Quay - Site Plan & Longitudinal Sections	A1	00
W3451-AYE-DWG-W-1408	Flood Relief Works - Tinnahinch Quay - Sections	A1	00
W3451-AYE-DWG-W-1409	Drawing no longer in use	-	-
W3451-AYE-DWG-W-1410	Flood Relief Works - Graiguenamanagh Quay - Site Plan & Longitudinal Sections	A1	01
W3451-AYE-DWG-W-1411	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 1	A1	00
W3451-AYE-DWG-W-1412	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 2	A1	00
W3451-AYE-DWG-W-1413	Flood Relief Works - Graiguenamanagh Quay - Sections - Sheet 3	A1	00
W3451-AYE-DWG-W-1414	Flood Relief Works - Docks & Hub - Site Plan & Longitudinal Sections	A1	00
W3451-AYE-DWG-W-1415	Flood Relief Works - Docks & Hub - Sections - Sheet 1	A1	00
W3451-AYE-DWG-W-1416	Flood Relief Works - Docks & Hub - Sections - Sheet 2	A1	00
W3451-AYE-DWG-W-1417	Flood Relief Works - Lower Turf Market - Site Plan & Longitudinal Sections	A1	00
W3451-AYE-DWG-W-1418	Flood Relief Works - Lower Turf Market - Sections	A1	00
W3451-AYE-DWG-W-1419	Flood Relief Works - High St. Lower - Site Plan & Longitudinal Sections	A1	01
W3451-AYE-DWG-W-1420	Flood Relief Works - High St. Lower - Sections	A1	01
W3451-AYE-DWG-W-1421	Flood Relief Works - Upstream Storage Area - Duiske River - GA Site Plan & Sections	A1	01
W3451-AYE-DWG-W-1422	Flood Relief Works - Upstream Storage Area - Duiske River - Access Road Plan & Details	A1	01
W3451-AYE-DWG-W-1423	Flood Relief Works - Upstream Storage Area - Duiske River - Flood Extents	A1	01
W3451-AYE-DWG-W-1424	Flood Relief Works - Treatment of Existing Walls	A1	02
W3451-AYE-DWG-W-1425	Flood Relief Works - Flood Defences Overall Asset Numbers	A1	02
W3451-AYE-DWG-W-1426	Site Works - Arboreal Impact GA Layout	A1	02
W3451-AYE-DWG-W-1427	Site Works - ESB Diversions Layout	A1	02
W3451-AYE-DWG-W-1428	Site Works - Public Lighting Diversions Layout	A1	02
W3451-AYE-DWG-W-1429	Site Works - Eir Diversions Layout	A1	02
W3451-AYE-DWG-W-1430	Stormwater Drainage - Overall Layout Plan	A1	02
W3451-AYE-DWG-W-1431	Stormwater Drainage - Tinnahinch Hotel Street & Quay - GA Layout	A1	02
W3451-AYE-DWG-W-1432	Stormwater Drainage - Graiguenamanagh Quay - GA Layout	A1	01
W3451-AYE-DWG-W-1433	Stormwater Drainage - Docks & Hub - GA Layout	A1	01
W3451-AYE-DWG-W-1434	Stormwater Drainage - Pumping Station No.1 - GA Layout, Plan & Sections	A1	00
W3451-AYE-DWG-W-1435	Stormwater Drainage - Pumping Station No.2 - GA Layout, Plan & Sections	A1	01
W3451-AYE-DWG-W-1436	Stormwater Drainage - Pumping Stations No.3-5 - GA Layout, Plan & Sections	A1	01
W3451-AYE-DWG-W-1437	Outfall Works - Overall Layout Plan	A1	00
W3451-AYE-DWG-W-1438	Outfall Works - River Barrow Outfalls - Sheet 1	A1	00
W3451-AYE-DWG-W-1439	Outfall Works - River Barrow Outfalls - Sheet 2	A1	00
W3451-AYE-DWG-W-1440	Outfall Works - River Duiske Outfalls	A1	00
W3451-AYE-DWG-W-1441	Conservation Strategy - Overall Layout Plan	A1	02
W3451-AYE-DWG-W-1442	Conservation Strategy - Wall Details	A1	02
W3451-AYE-DWG-W-1443	Site Works - UE Water Diversions Layout	A1	02
W3451-AYE-DWG-W-1444	Site Works - Autotracking Layout	A1	00
W3451-AYE-DWG-W-1445	Site Works - Biodiversity Enhancement Measures	A1	00

For Planning - Landscaping

Drawing No.	Drawing Title	Sheet	Revision
	Cover Sheet		
300	Overall Landscape Plan	A1	04
301	Landscape Plan Detail - Area 1	A1	04
302	Landscape Plan & Section Detail - Area A	A1	03
303	Landscape Sections Detail - Area A	A1	04
304	Landscape Plan & Sections Detail - Area B	A1	02
305	Landscape Plan - Detail Area 2	A1	03
306	Landscape Plan, Sections & Visuals Detail - Area C	A1	05
307	Landscape Plan Detail - Area 3	A1	02
308	Landscape Plan & Section Detail - Area D	A1	03
309	Landscape Plan & Section Detail - Area 4	A1	03
310	Landscape Plan Detail - Area 5	A1	03
311	Landscape Plan & Sections Detail - Area 6	A1	03
312	Landscape Plan Detail - Area 7 - U/S Storage Area	A1	03

Kilkenny County Council
Comhairle Chontae Chill Chainnigh

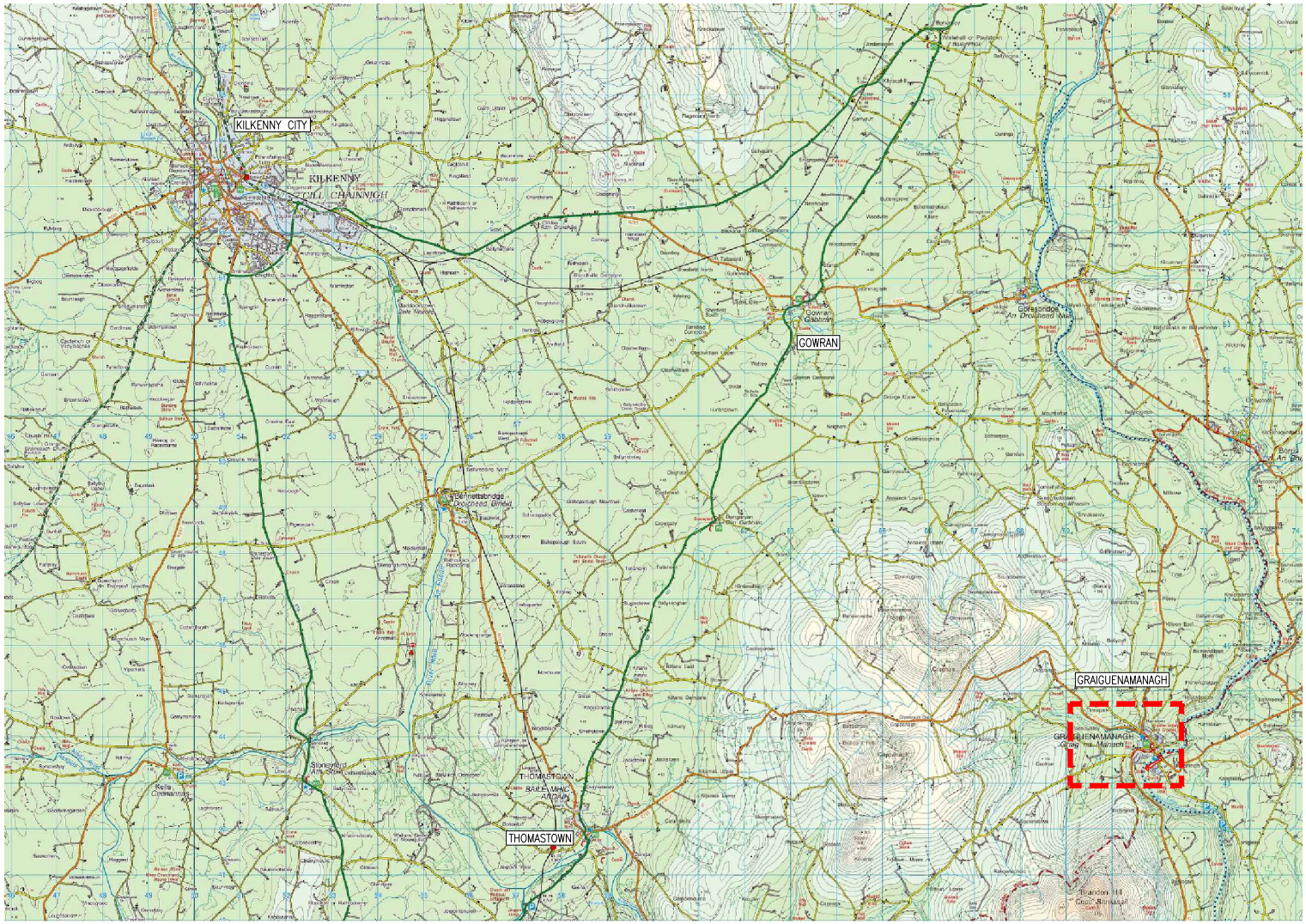
OPW Oifig na nOibreacha Poiblí / Office of Public Works

ayesa

Tionscadal Éireann Project Ireland 2040

CARLOW COUNTY COUNCIL

A1



SITE LOCATION MAP
SCALE: 1:50000

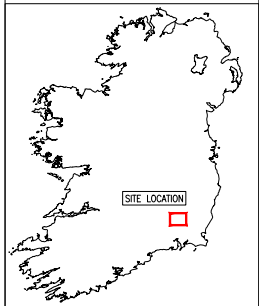
GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.

2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.

3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.



SITE LOCATION

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUED FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

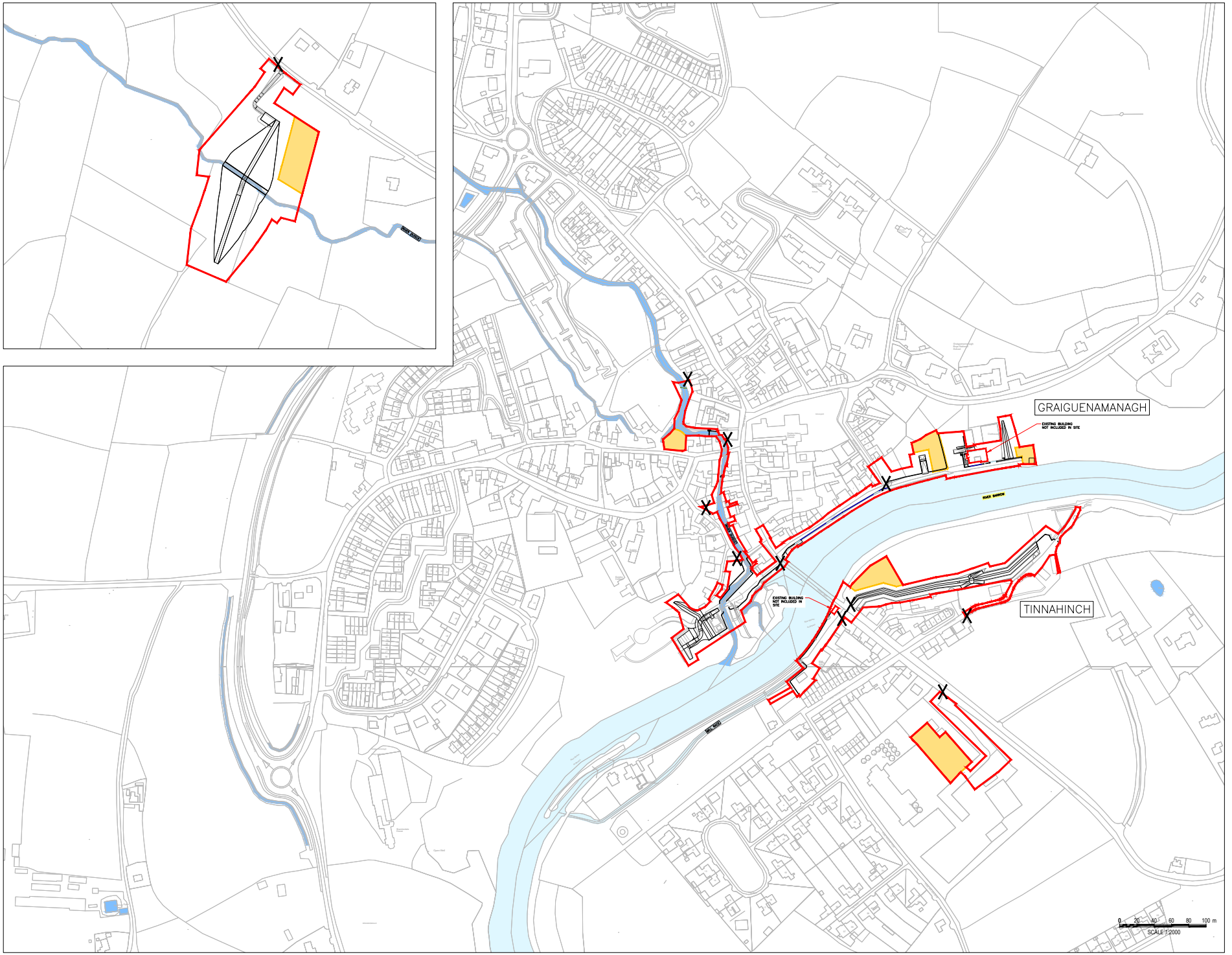
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
SITE LOCATION MAP

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1401			Rev: 00

A1



SITE EXTENT PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. OSAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423.

LEGEND:

SITE EXTENT

LOCATIONS OF SITE NOTICES

SITE COMPOUNDS

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

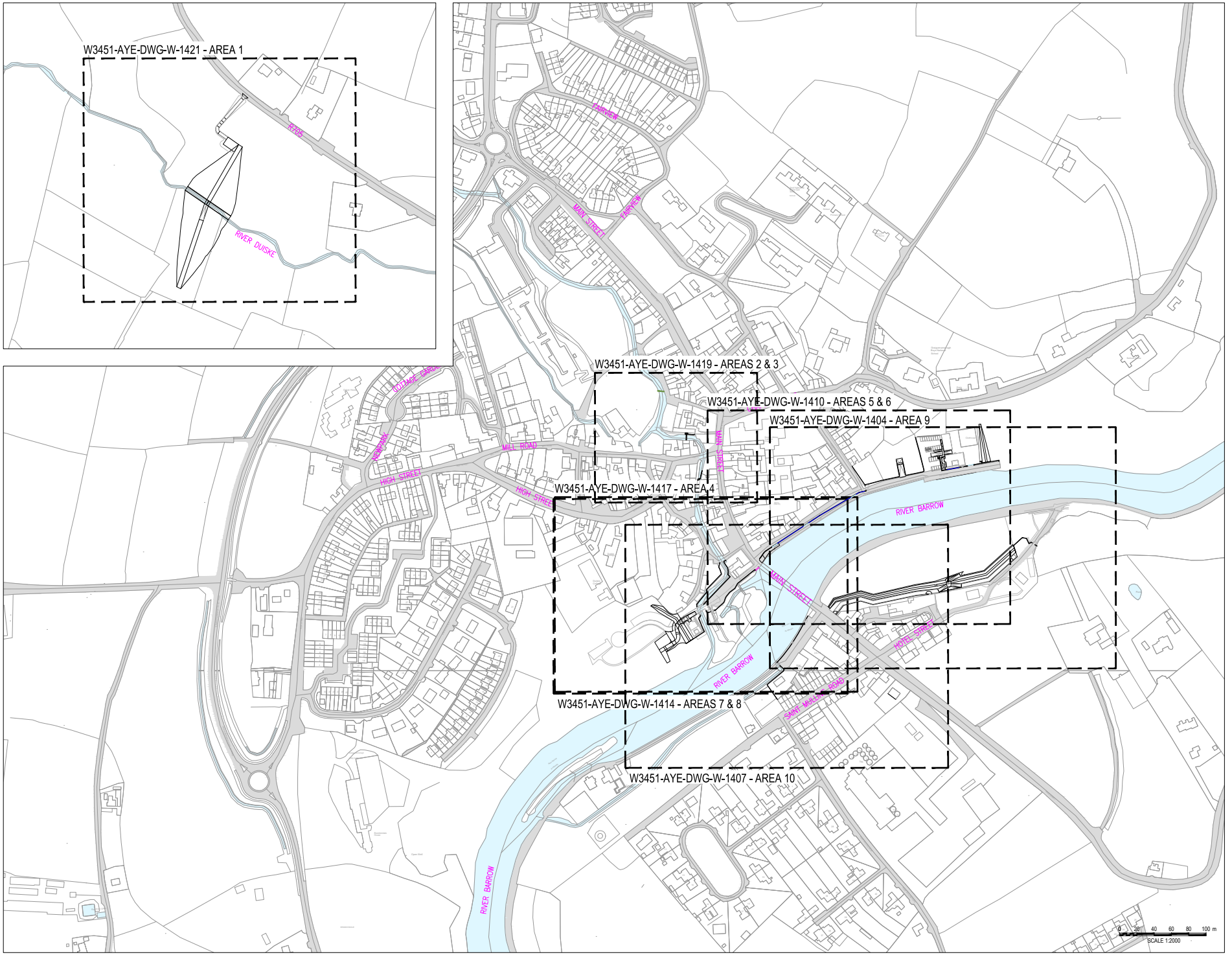
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
SITE LAYOUT PLAN

STATUS
FOR PLANNING

Date:31.07.24	Scale:1:2000	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1402			Rev: 02

A1



SITE LOCATION PLAN
SCALE: 1:2000

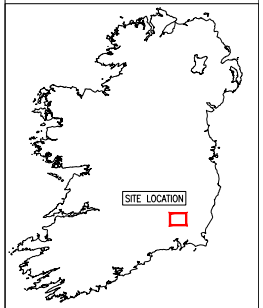
GENERAL NOTES

NOTES:

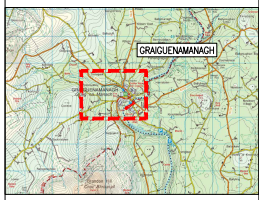
1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.

LEGEND:

EXISTING RIVER



SITE LOCATION



Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUED FOR PLANNING	LT	SH	SH
01	21.10.24	ISSUED FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUED FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

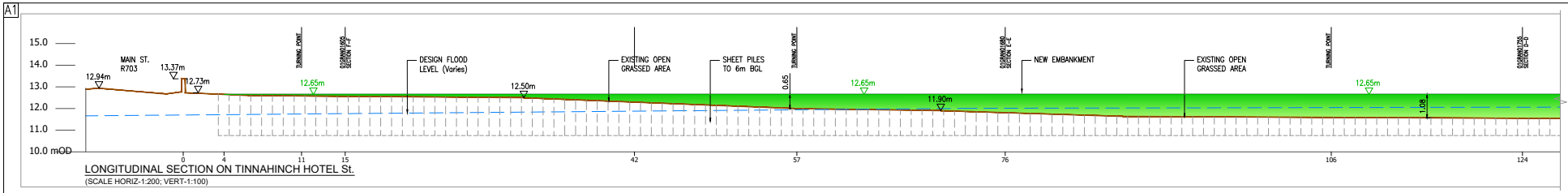
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
SITE LOCATION PLAN

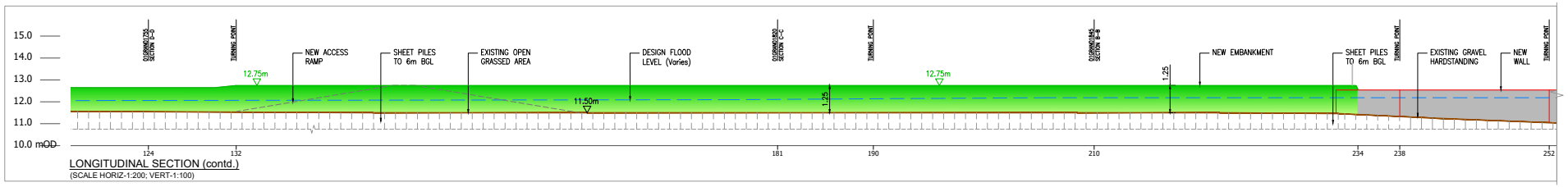
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:2000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1403			Rev: 02

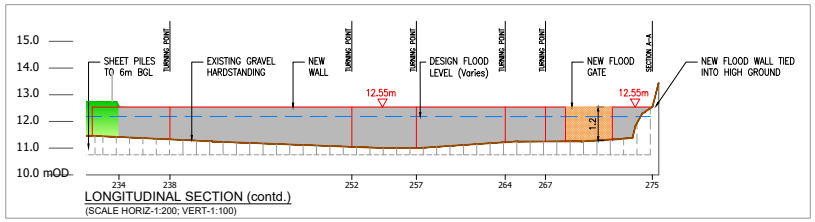
A1



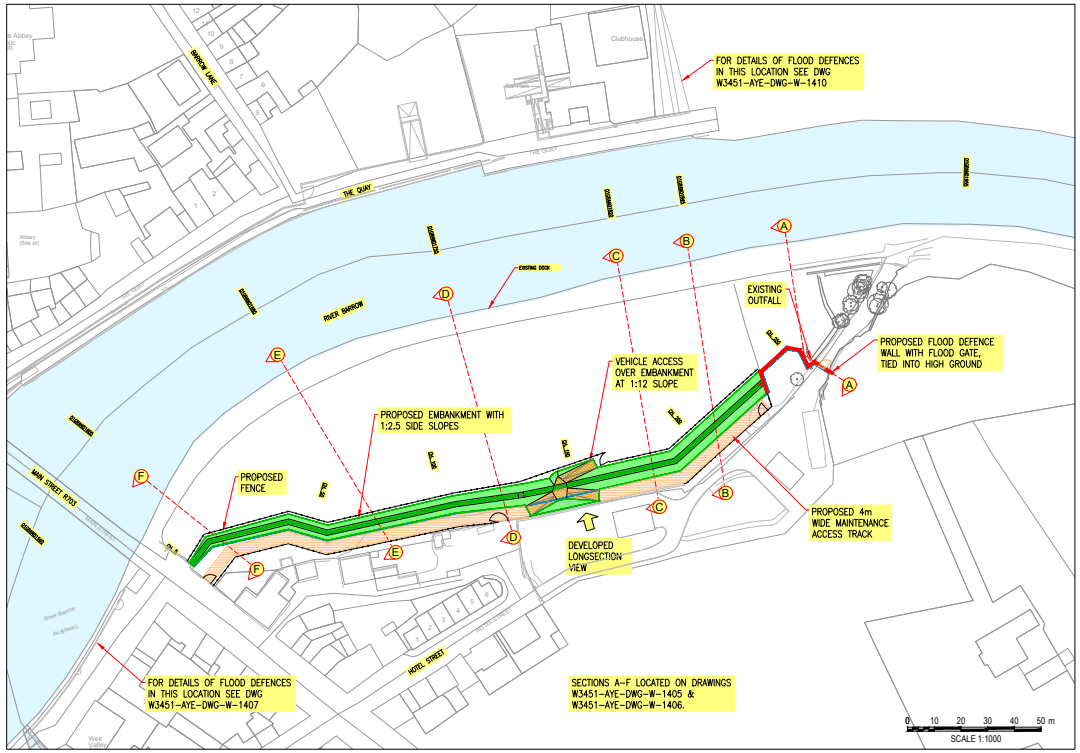
LONGITUDINAL SECTION ON TINNAHINCH HOTEL St.
(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION (contd.)
(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION (contd.)
(SCALE HORIZ-1:200; VERT-1:100)



SITE PLAN
SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHTS REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. SHEET PILE CUTOFF UNDER ALL FLOOD DEFENCES (WALLS & EMBANKMENT)

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- MAINTENANCE ACCESS TRACK
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- NEW DRAINAGE
- PROPOSED FENCELINE

KEYPLAN:

Rev	Date	Description	By	Chk	App
02	27.01.25	ISSUE FOR PLANNING	LT	SH	SH
01	11.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

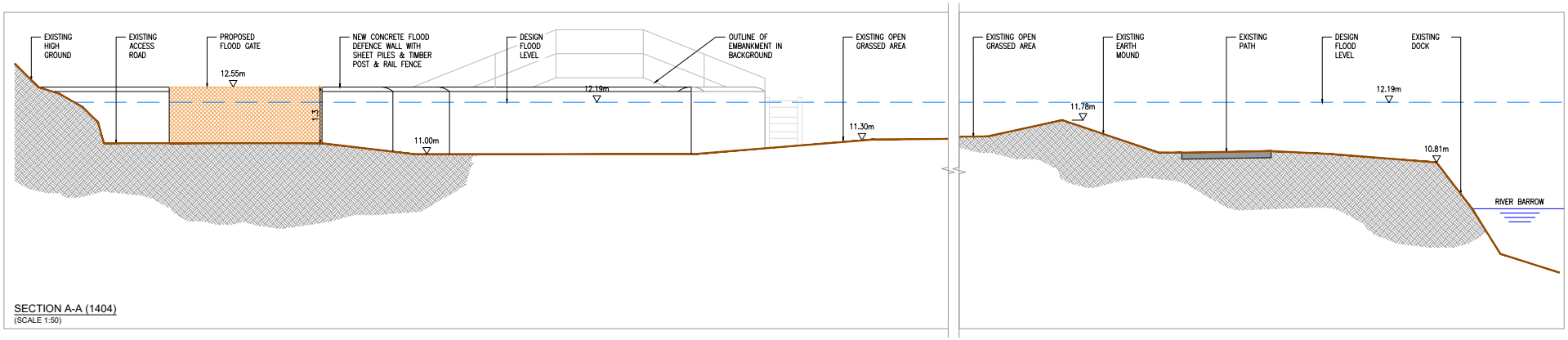
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
TINNAHINCH HOTEL STREET
SITE PLAN & LONGITUDINAL SECTIONS

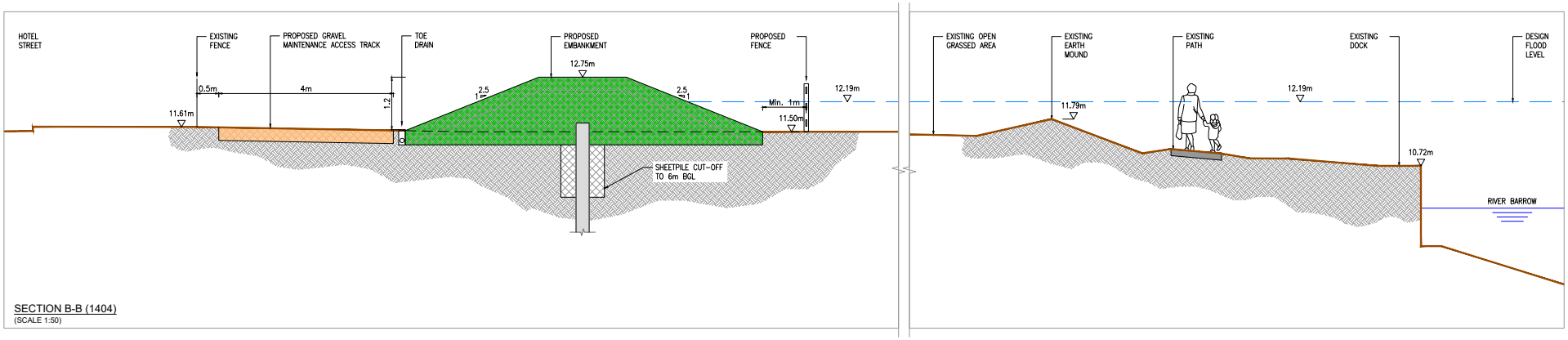
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1404			Rev: 02

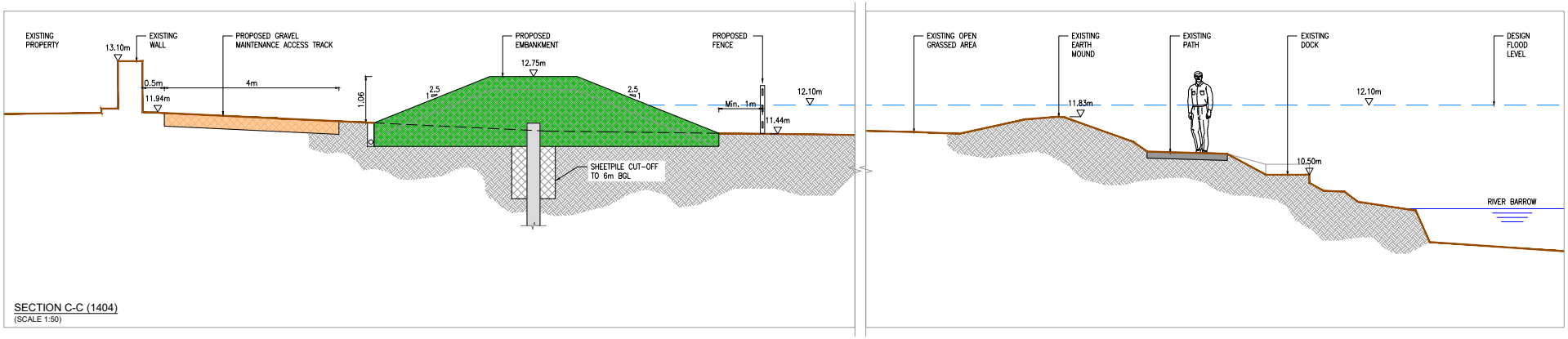
A1



SECTION A-A (1404)
(SCALE 1:50)



SECTION B-B (1404)
(SCALE 1:50)



SECTION C-C (1404)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- PROPOSED MAINTENANCE ACCESS ROAD

Rev	Date	Description	By	Chk	App
02	27.01.25	ISSUE FOR PLANNING	LT	SH	SH
01	11.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

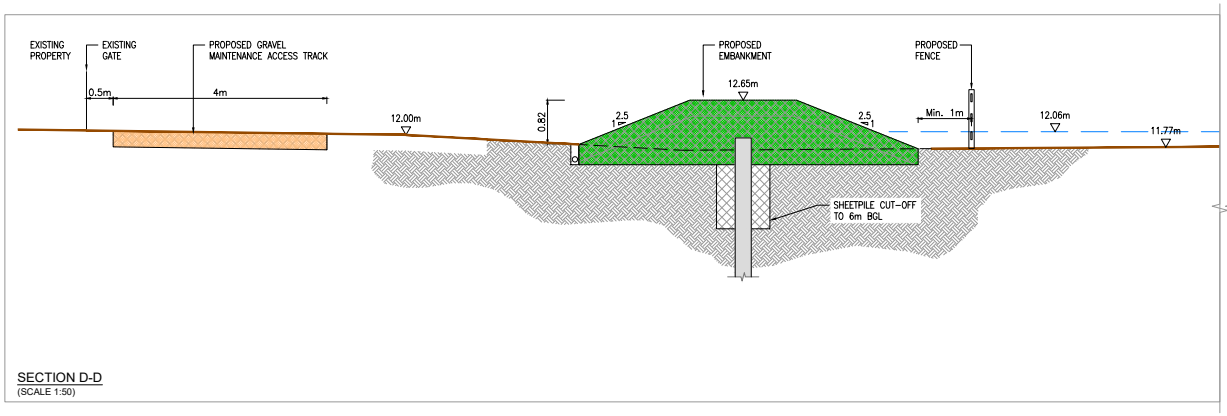
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
TINNAHINCH HOTEL STREET
SECTIONS – SHEET 1

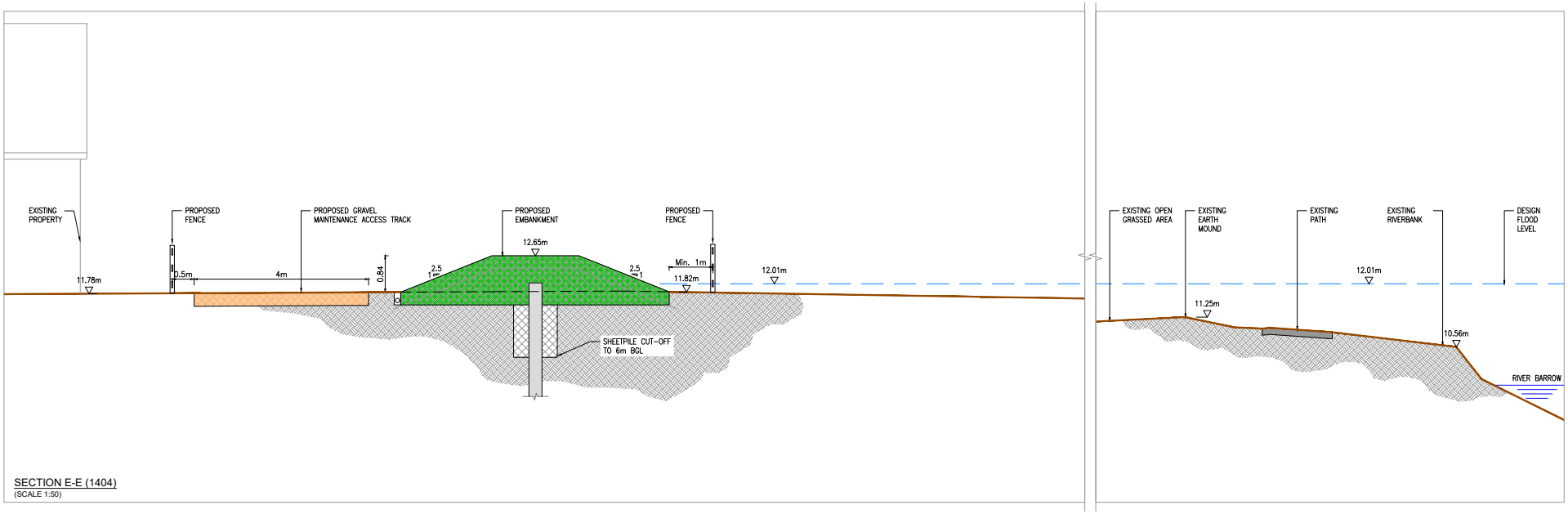
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1405			Rev: 02

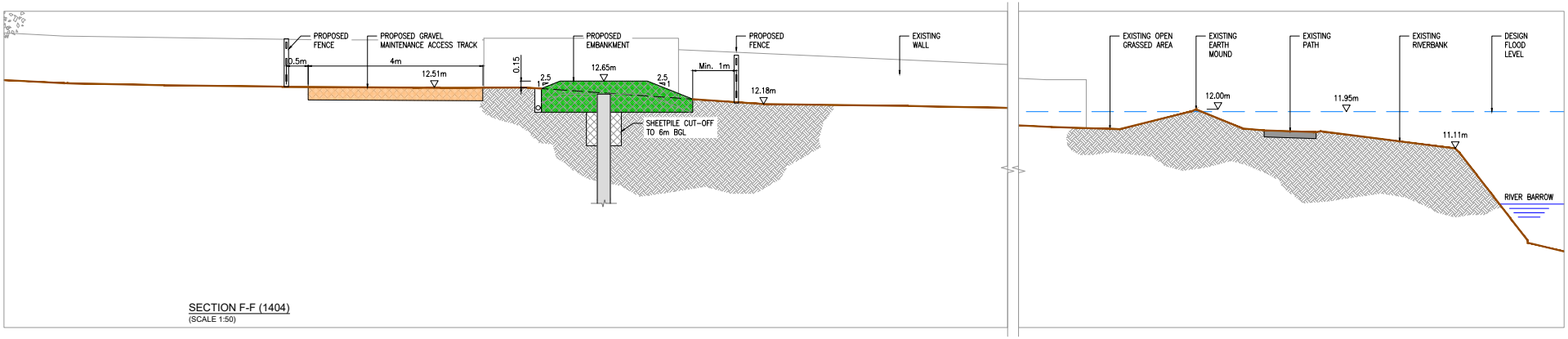
A1



SECTION D-D
(SCALE 1:50)



SECTION E-E (1404)
(SCALE 1:50)



SECTION F-F (1404)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- PROPOSED MAINTENANCE ACCESS ROAD

Rev	Date	Description	By	Chk	App
01	27.01.25	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

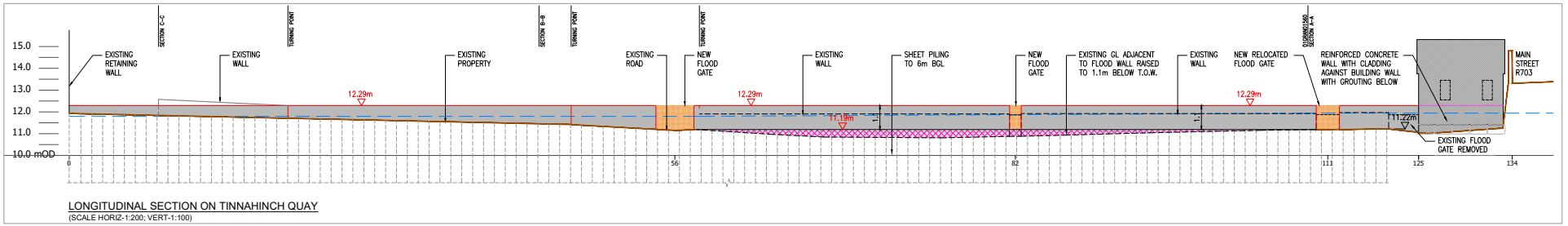
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
TINNAHINCH HOTEL STREET
SECTIONS – SHEET 2

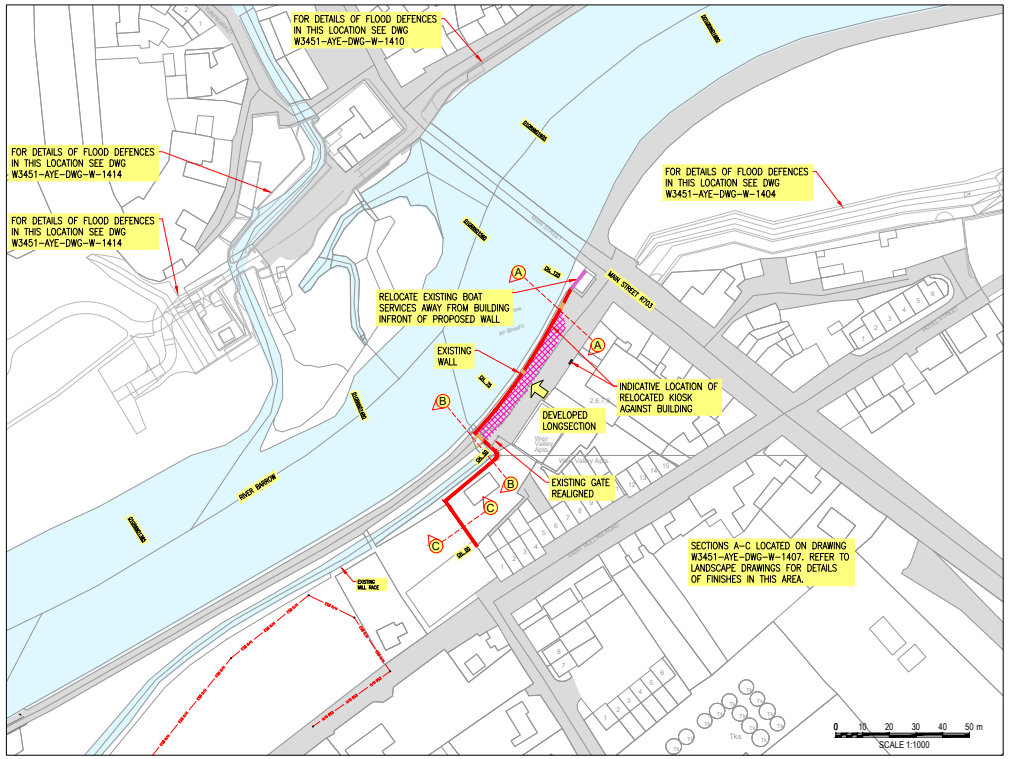
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1406			Rev: 01

A1



LONGITUDINAL SECTION ON TINNAHINCH QUAY
(SCALE HORIZ-1:200; VERT-1:100)



SITE PLAN
SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCH E, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- EXISTING OVERHEAD ESB (ESB O/H)
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- PROPOSED ROAD REGRADING

KEYPLAN:

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

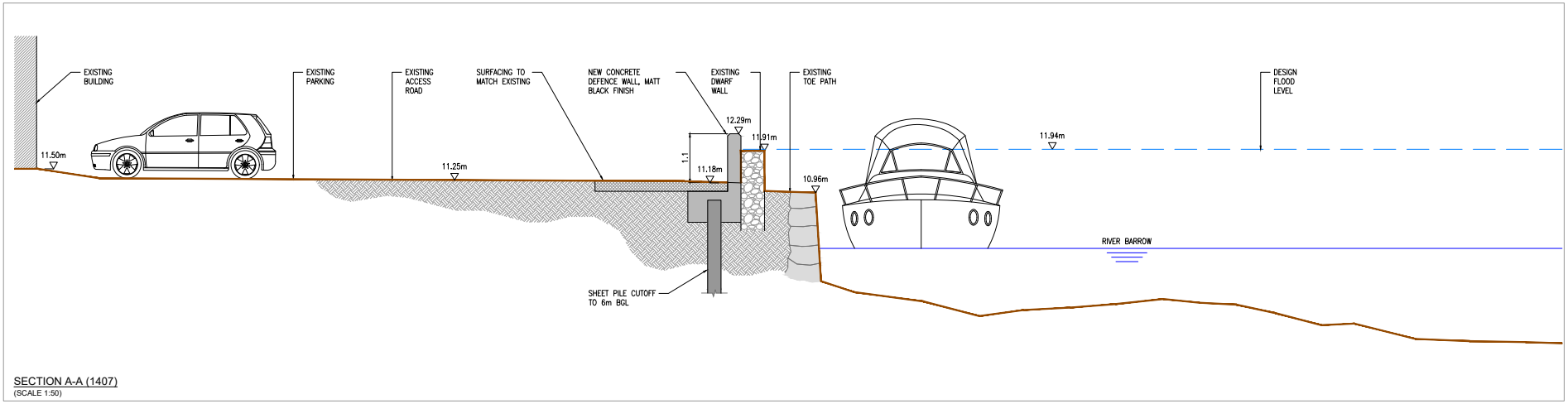
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
TINNAHINCH QUAY
SITE PLAN & LONGITUDINAL SECTIONS

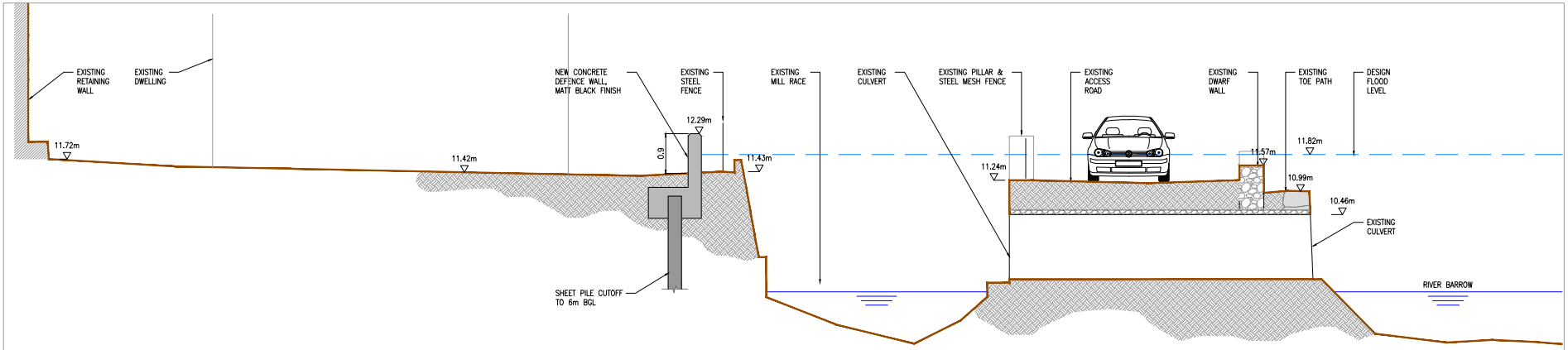
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1407			Rev: 00

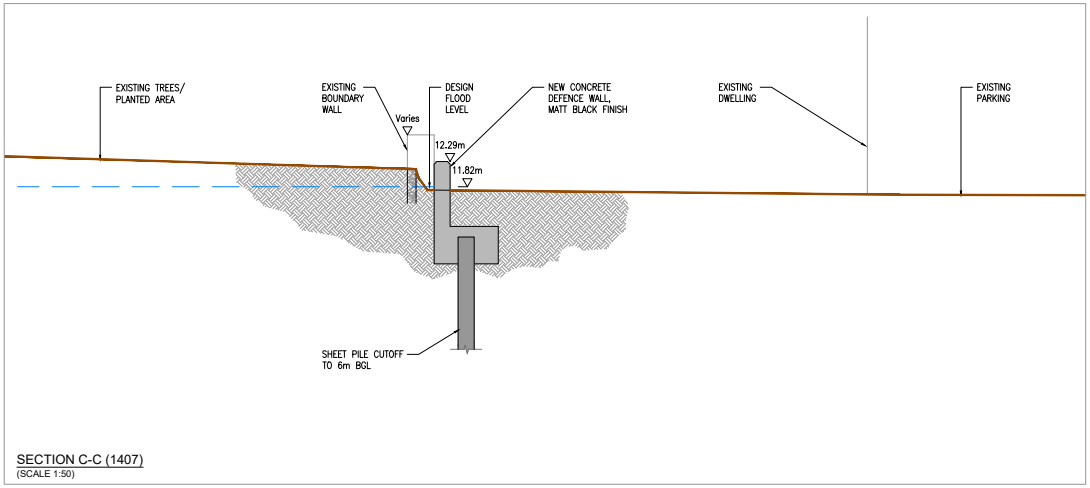
A1



SECTION A-A (1407)
(SCALE 1:50)



SECTION B-B (1407)
(SCALE 1:50)



SECTION C-C (1407)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCH E, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

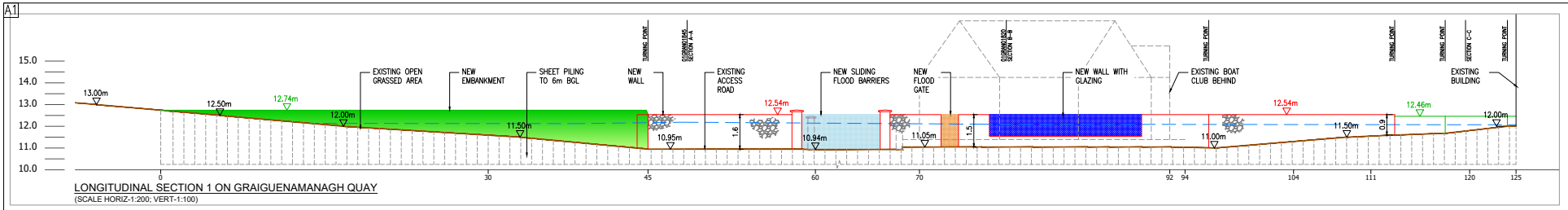
DRAWING TITLE
FLOOD RELIEF WORKS
TINNAHINCH QUAY
SECTIONS

STATUS
FOR PLANNING

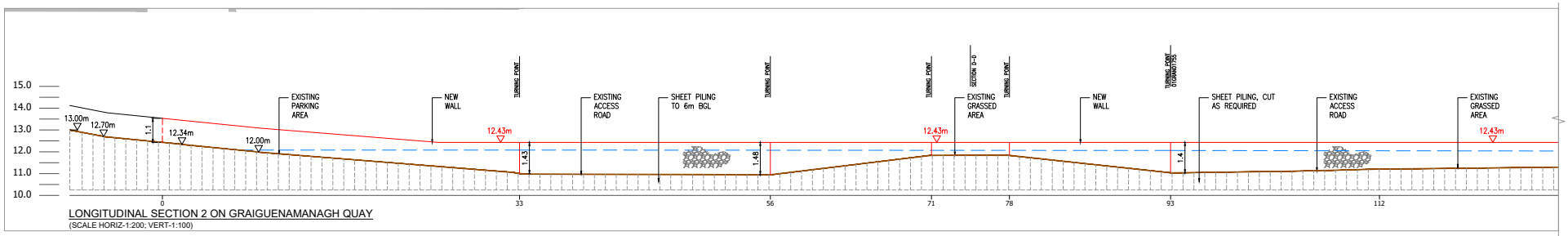
Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH

Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1408	00

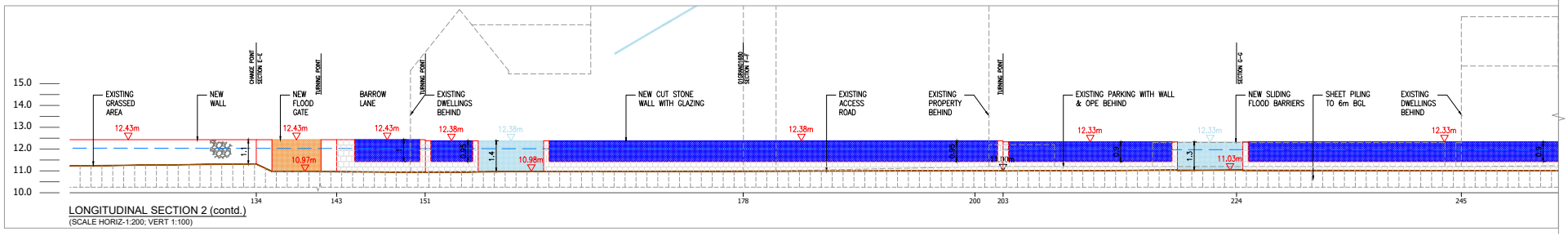
A1



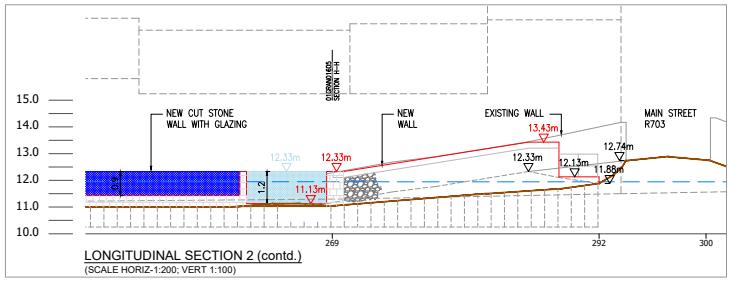
LONGITUDINAL SECTION 1 ON GRAIGUENAMANAGH QUAY
(SCALE HORIZ-1:200; VERT-1:100)



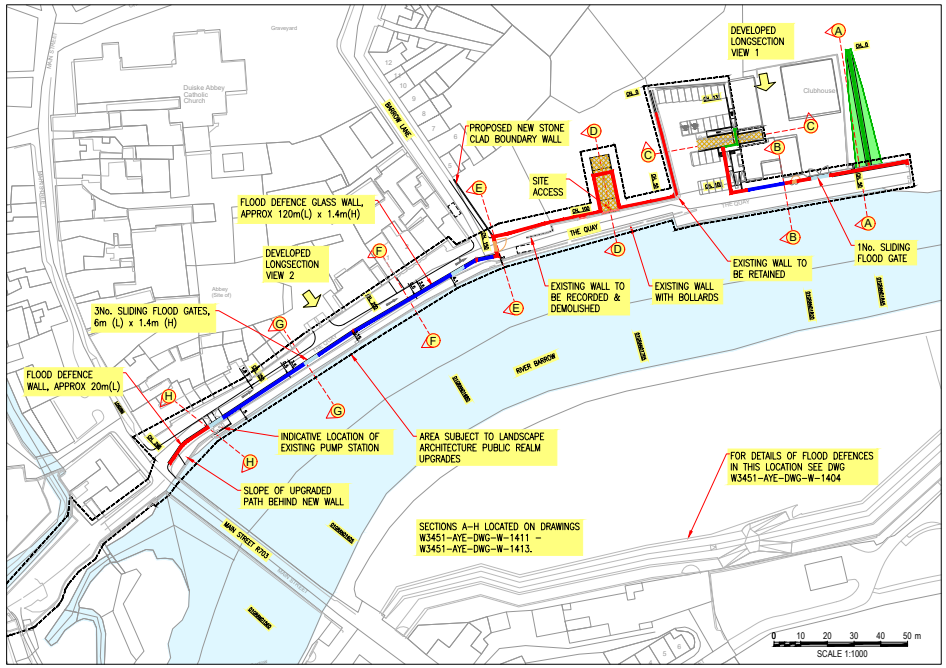
LONGITUDINAL SECTION 2 ON GRAIGUENAMANAGH QUAY
(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION 2 (contd.)
(SCALE HORIZ-1:200; VERT 1:100)



LONGITUDINAL SECTION 2 (contd.)
(SCALE HORIZ-1:200; VERT 1:100)



SITE PLAN
SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES F & H, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATES
- NEW SLIDING FLOOD GATES
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

KEYPLAN:

Rev	Date	Description	By	Chk	App
01	27.01.25	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

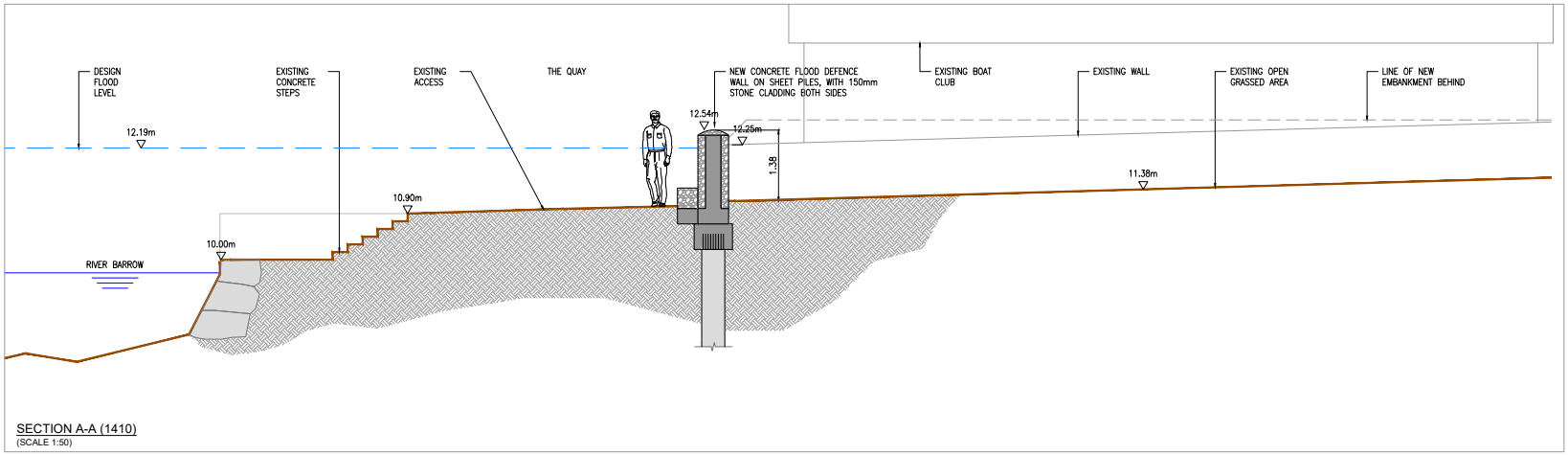
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
GRAIGUENAMANAGH QUAY
SITE PLAN & LONGITUDINAL SECTIONS

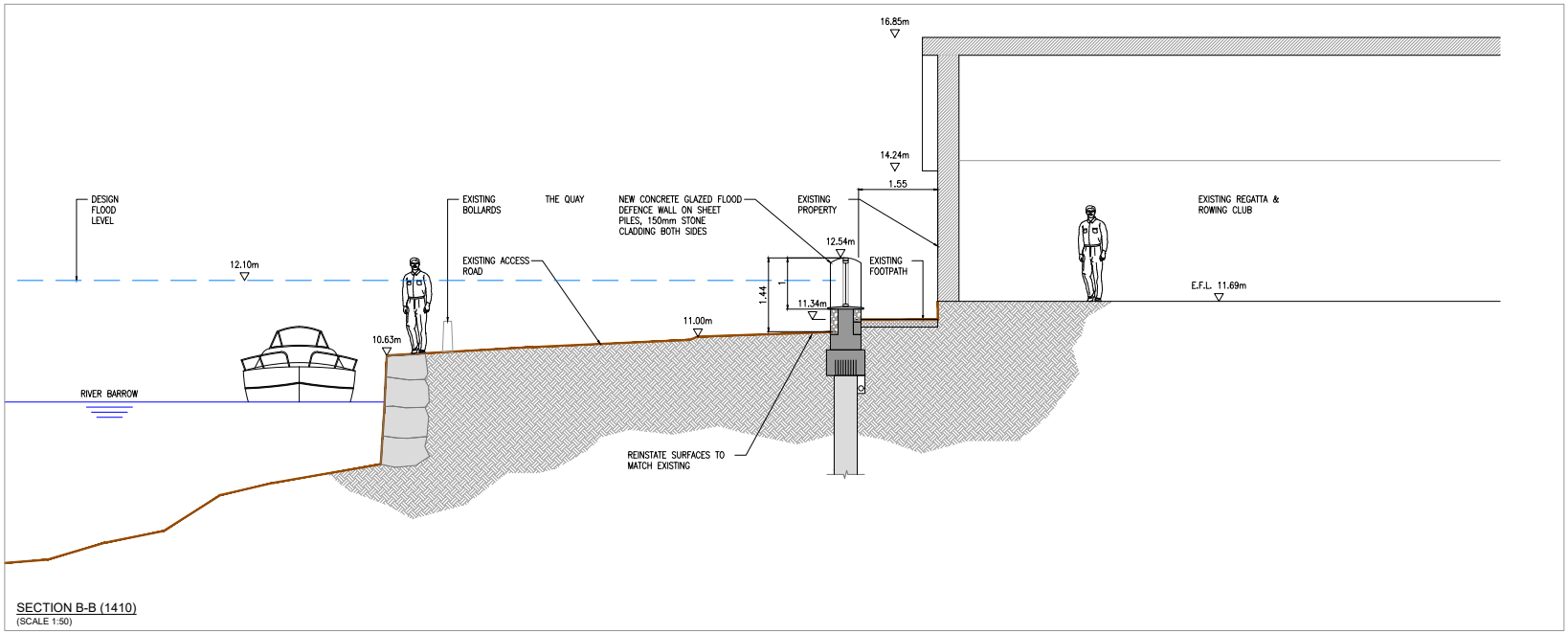
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1410			Rev: 01

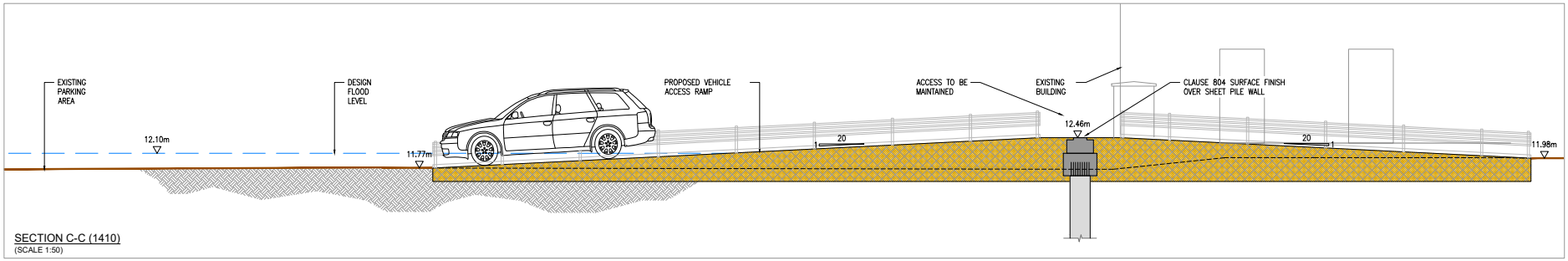
A1



SECTION A-A (1410)
(SCALE 1:50)



SECTION B-B (1410)
(SCALE 1:50)



SECTION C-C (1410)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE LANDWAY/DRY SIDE OF DEFENCES.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES F & H, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

GRAIGUENAMANAGH QUAY

PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

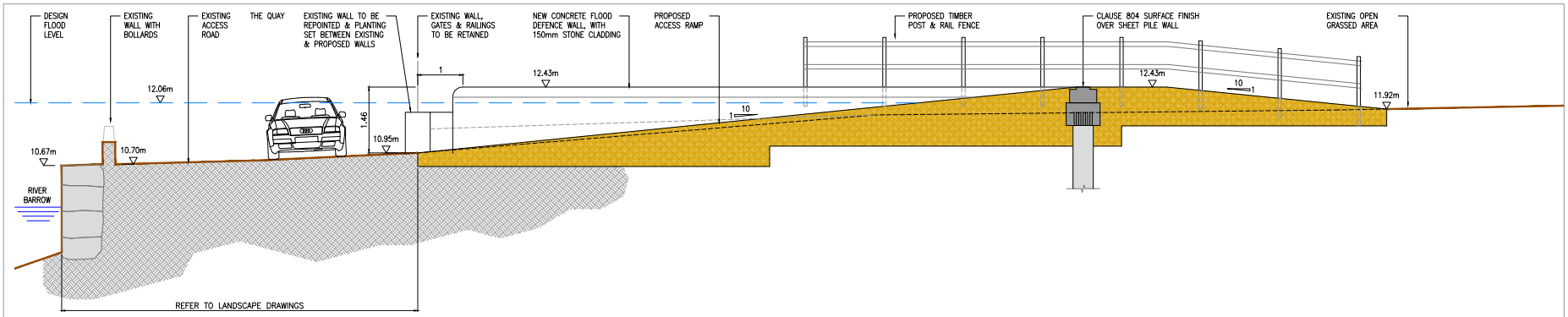
DRAWING TITLE
FLOOD RELIEF WORKS
GRAIGUENAMANAGH QUAY
SECTIONS – SHEET 1

STATUS
FOR PLANNING

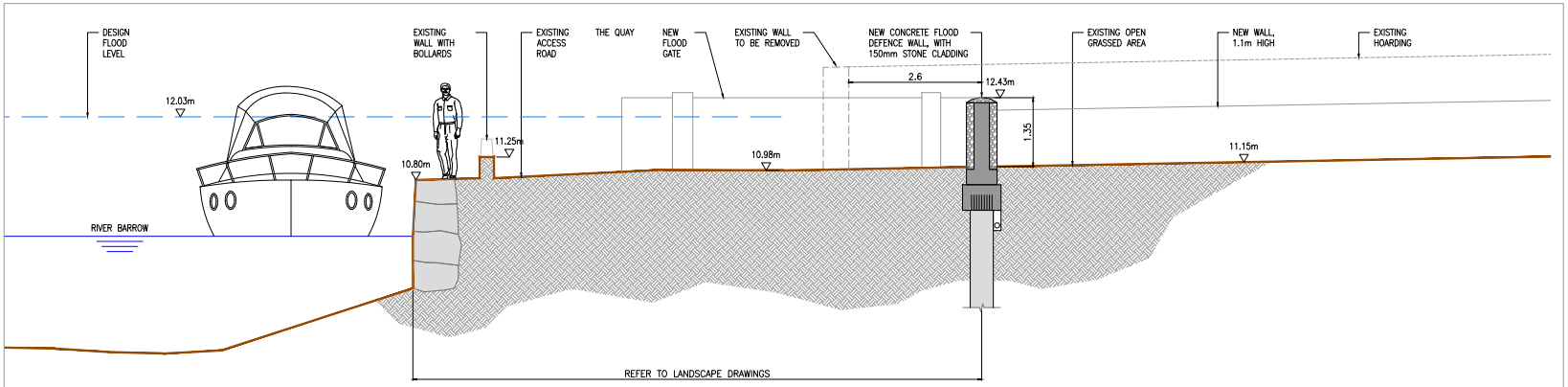
Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH

Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1411	00

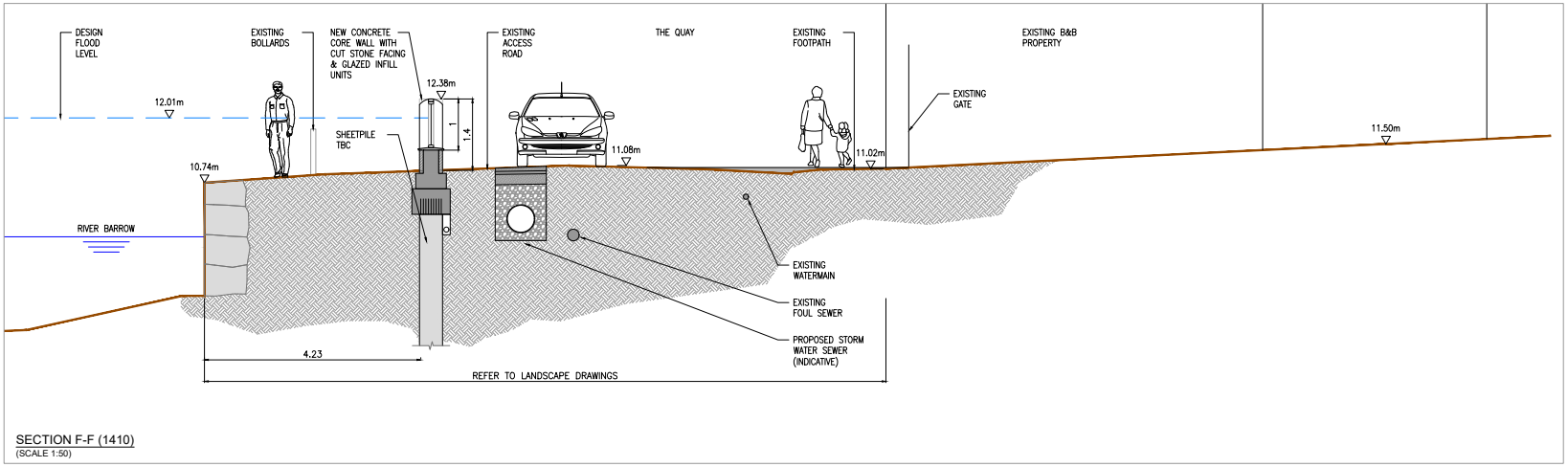
A1



SECTION D-D (1410)
(SCALE 1:50)



SECTION E-E (1410)
(SCALE 1:50)



SECTION F-F (1410)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE LANDWAY/DRY SIDE OF DEFENCES.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES F & H, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

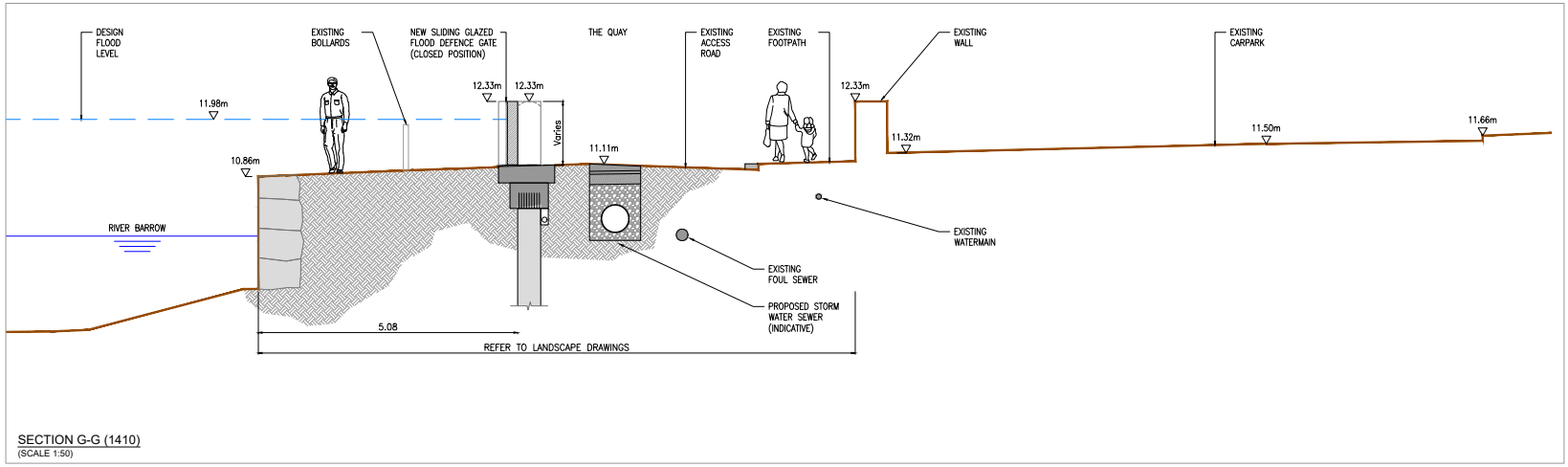
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
GRAIGUENAMANAGH QUAY
SECTIONS – SHEET 2

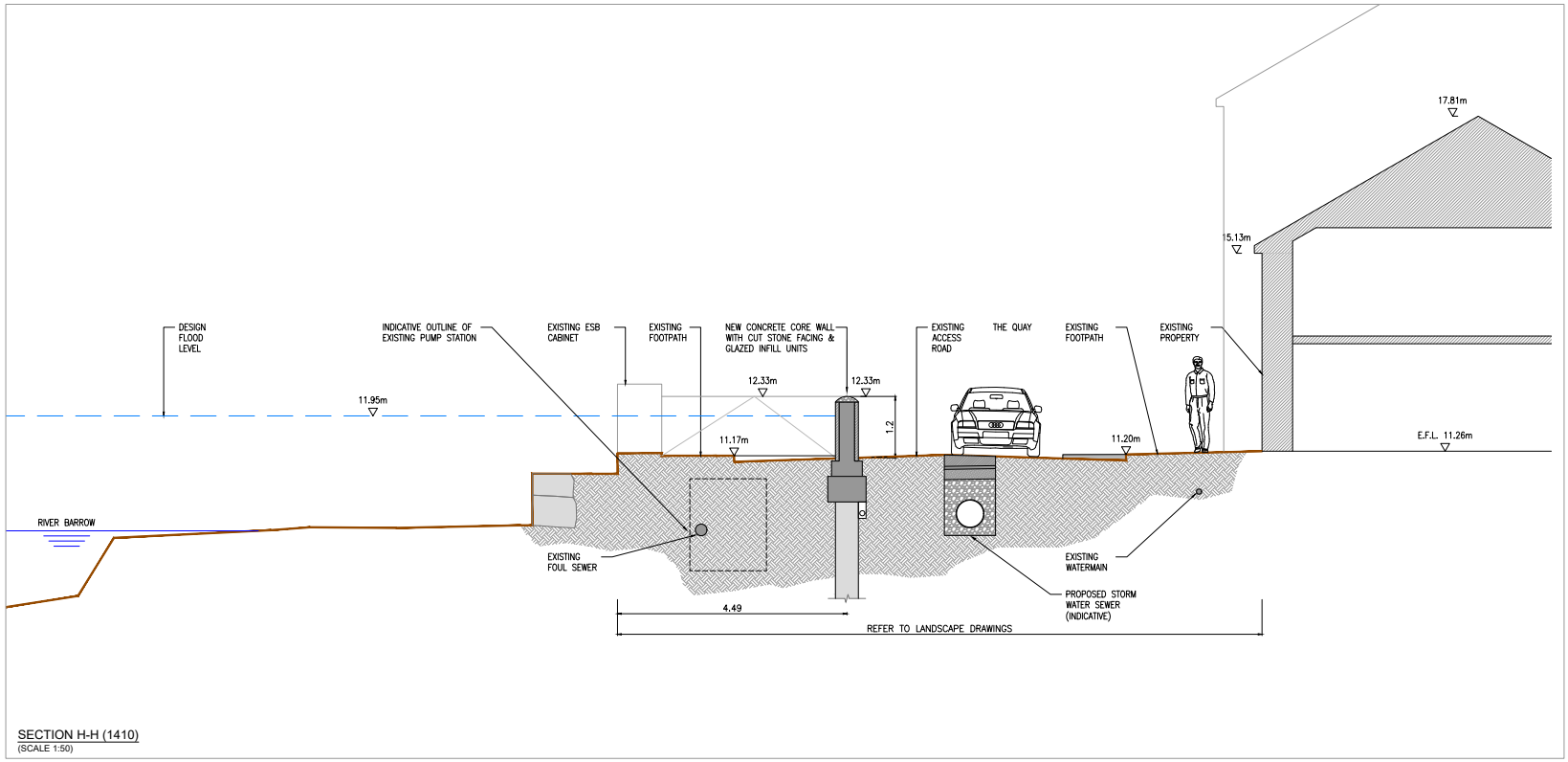
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1412			Rev: 00

A1



SECTION G-G (1410)
(SCALE 1:50)



SECTION H-H (1410)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE LANDWAY/DRY SIDE OF DEFENCES.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES F & H, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- EXISTING GROUND LEVEL
- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- GLASS WALL FLOOD DEFENCE
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

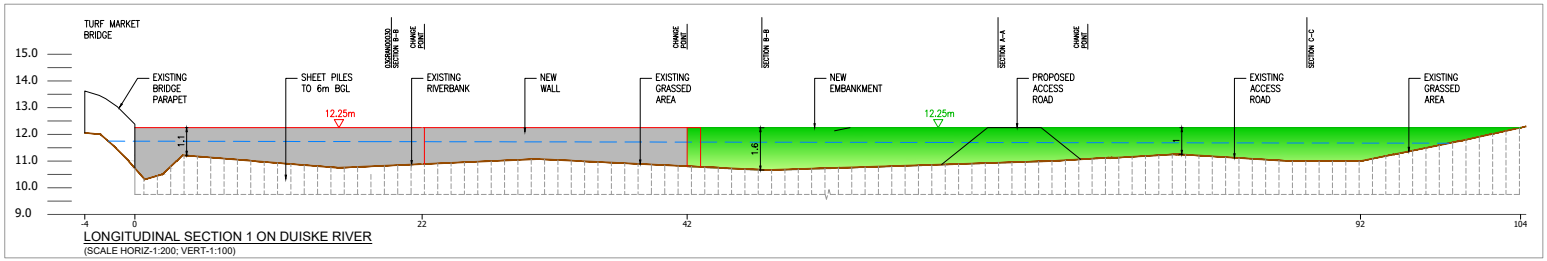
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
GRAIGUENAMANAGH QUAY
SECTIONS – SHEET 3

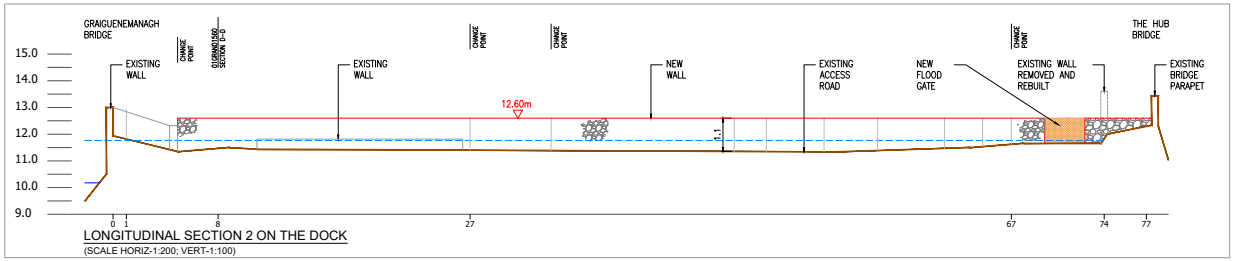
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1413			Rev: 00

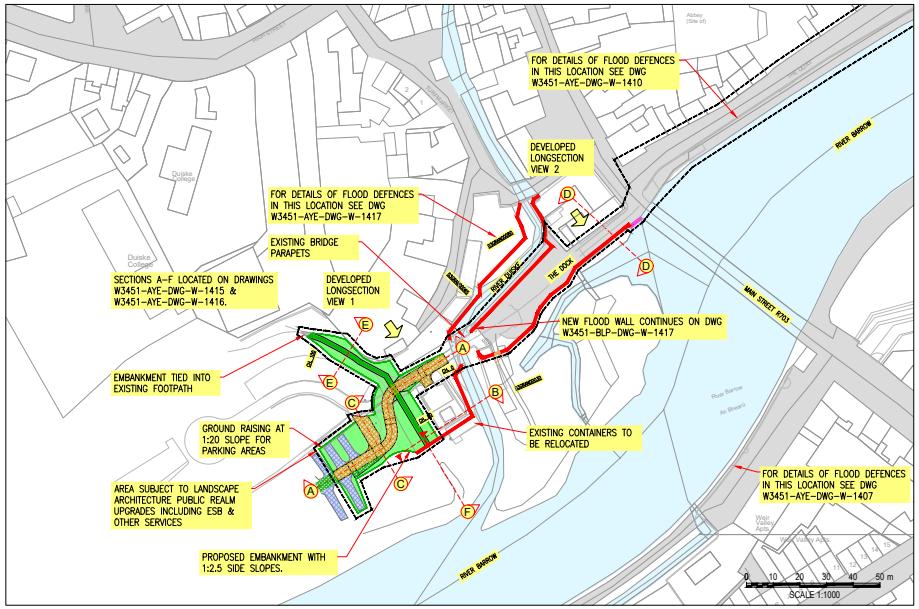
A1



LONGITUDINAL SECTION 1 ON DUISKE RIVER
(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION 2 ON THE DOCK
(SCALE HORIZ-1:200; VERT-1:100)



SITE PLAN
SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCH C, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- EXISTING VEHICLE PARKING TO BE RETAINED

KEYPLAN:

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

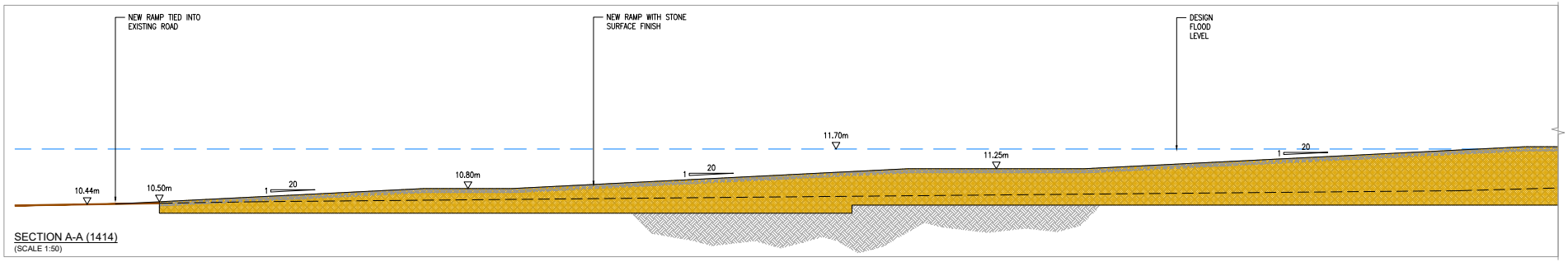
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
DOCKS & HUB
SITE PLAN & LONGITUDINAL SECTIONS

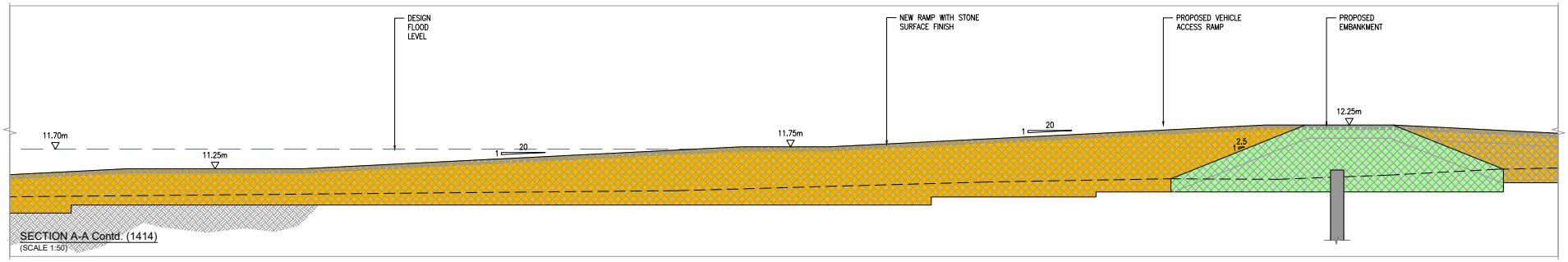
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1414			Rev: 00

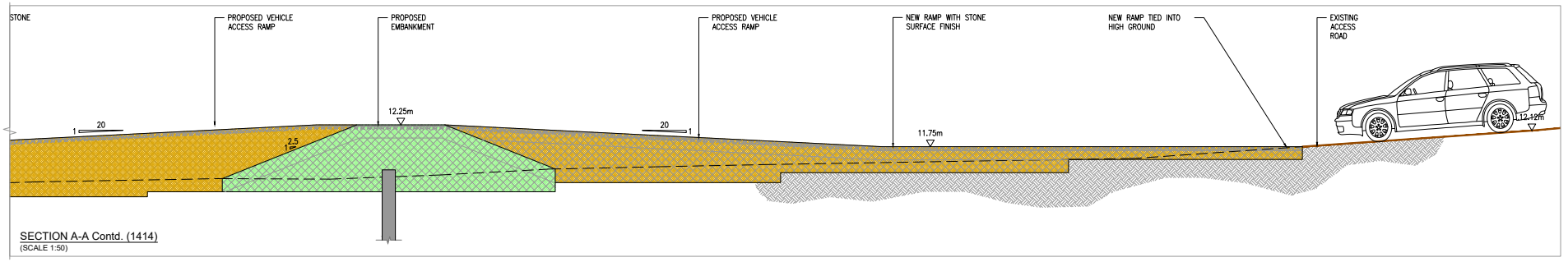
A1



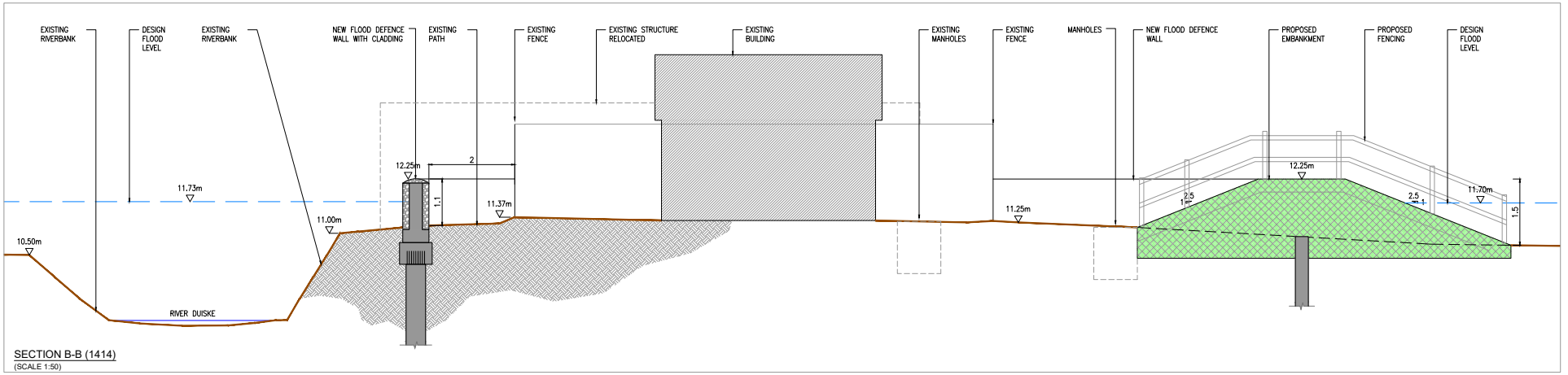
SECTION A-A (1414)
(SCALE 1:50)



SECTION A-A Contd. (1414)
(SCALE 1:50)



SECTION A-A Contd. (1414)
(SCALE 1:50)



SECTION B-B (1414)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCH C, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

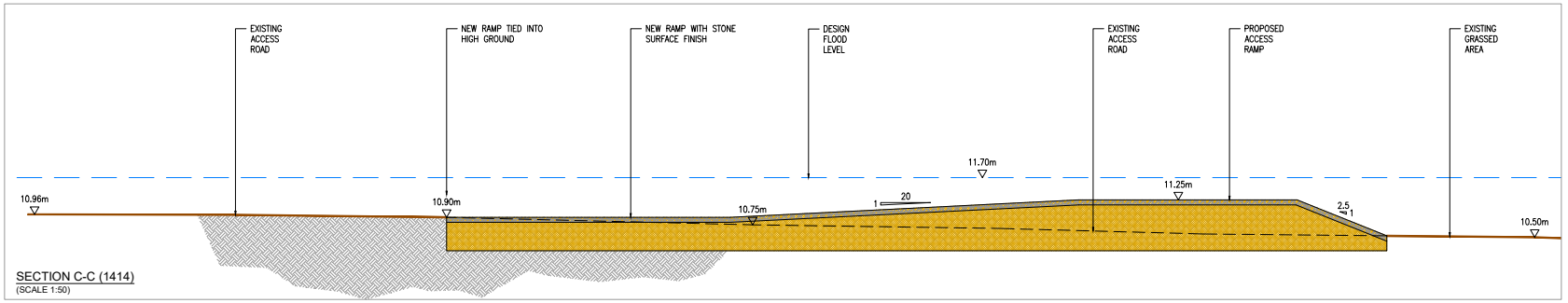
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
DOCKS & HUB
SECTIONS – SHEET 1

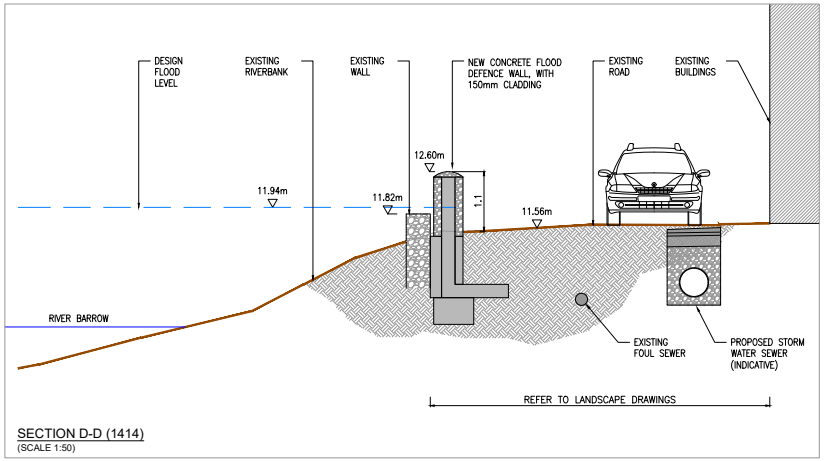
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1415			Rev: 00

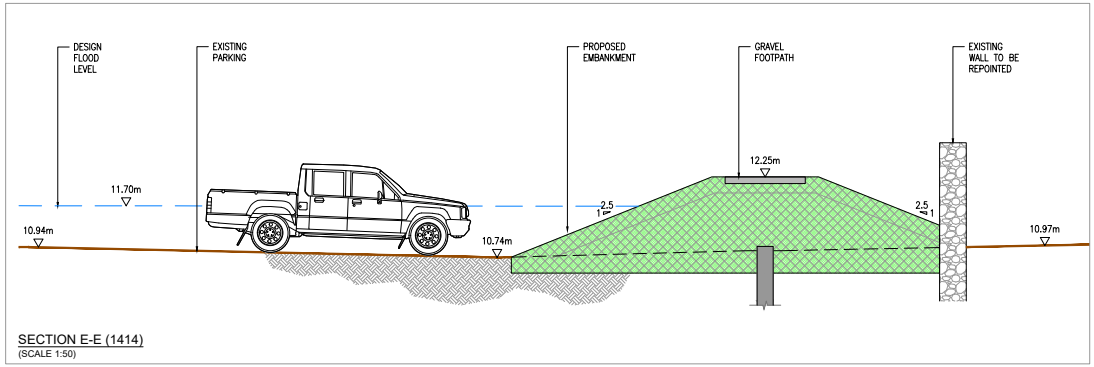
A1



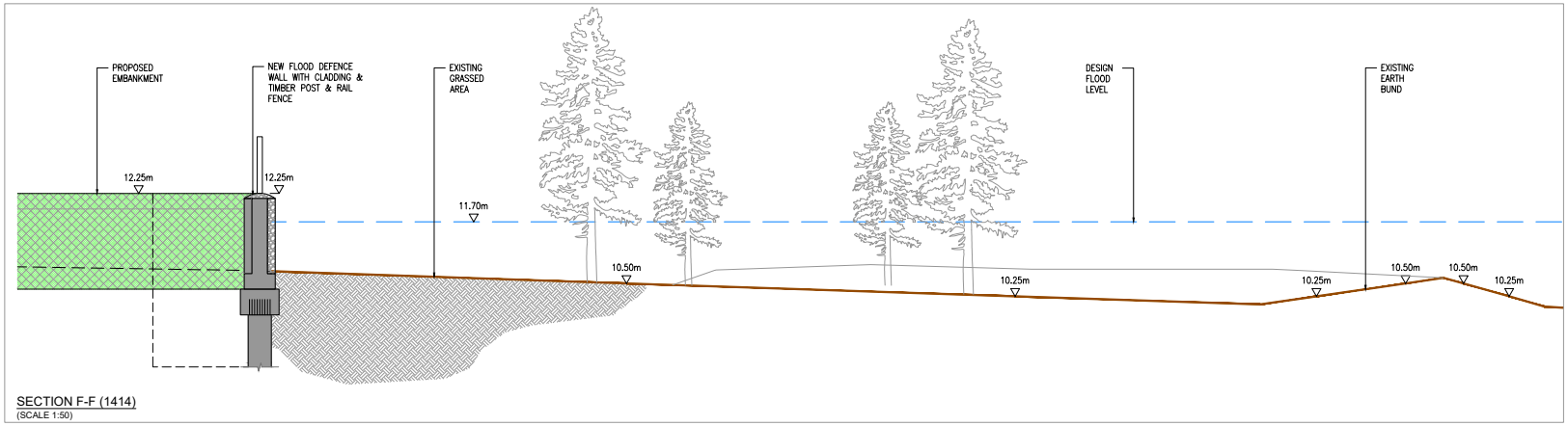
SECTION C-C (1414)
(SCALE 1:50)



SECTION D-D (1414)
(SCALE 1:50)



SECTION E-E (1414)
(SCALE 1:50)



SECTION F-F (1414)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCH C, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

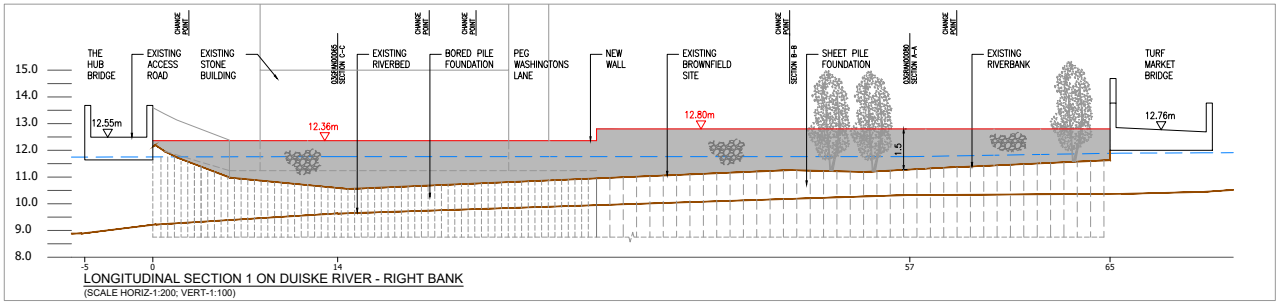
DRAWING TITLE
FLOOD RELIEF WORKS
DOCKS & HUB
SECTIONS – SHEET 2

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH

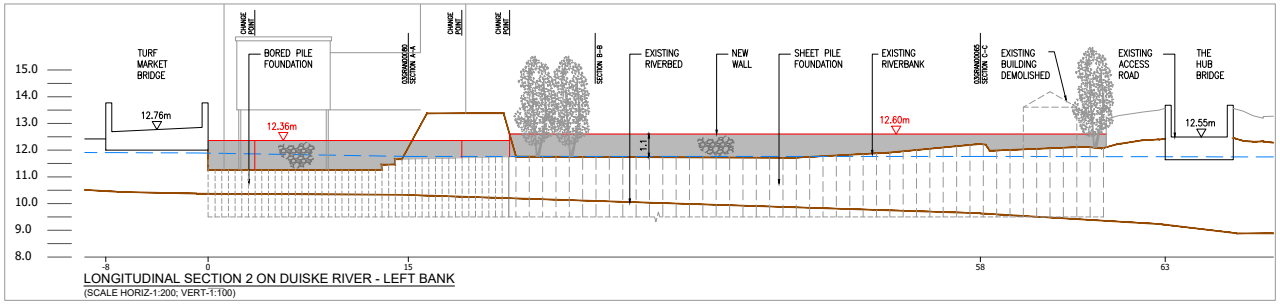
Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1416	00

A1



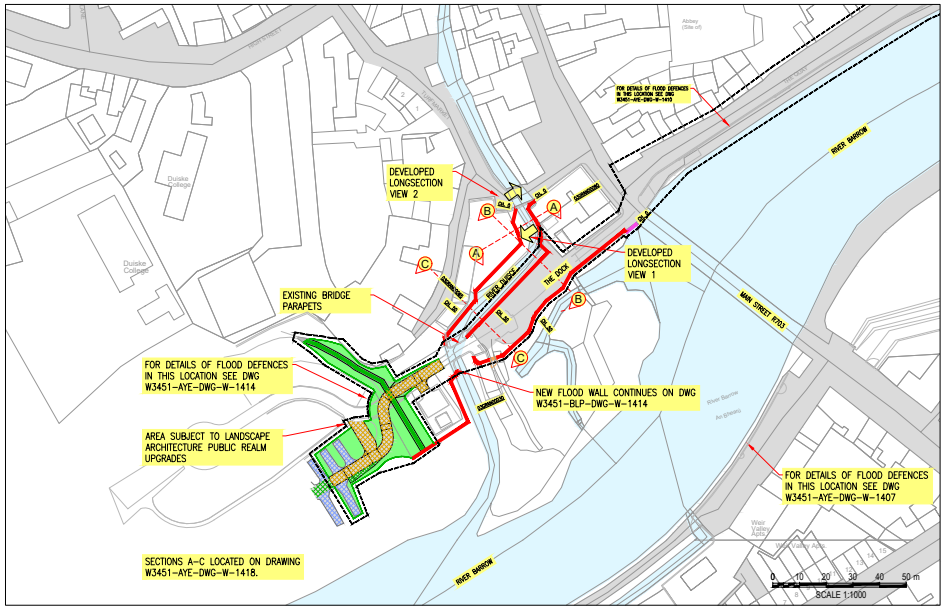
LONGITUDINAL SECTION 1 ON DUISKE RIVER - RIGHT BANK

(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION 2 ON DUISKE RIVER - LEFT BANK

(SCALE HORIZ-1:200; VERT-1:100)



SITE PLAN

SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES C & D, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- EXISTING VEHICLE PARKING TO BE RETAINED

KEYPLAN:

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT

KILKENNY COUNTY COUNCIL

PROJECT

GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE

FLOOD RELIEF WORKS
LOWER TURFMARKET
SITE PLAN & LONGITUDINAL SECTIONS

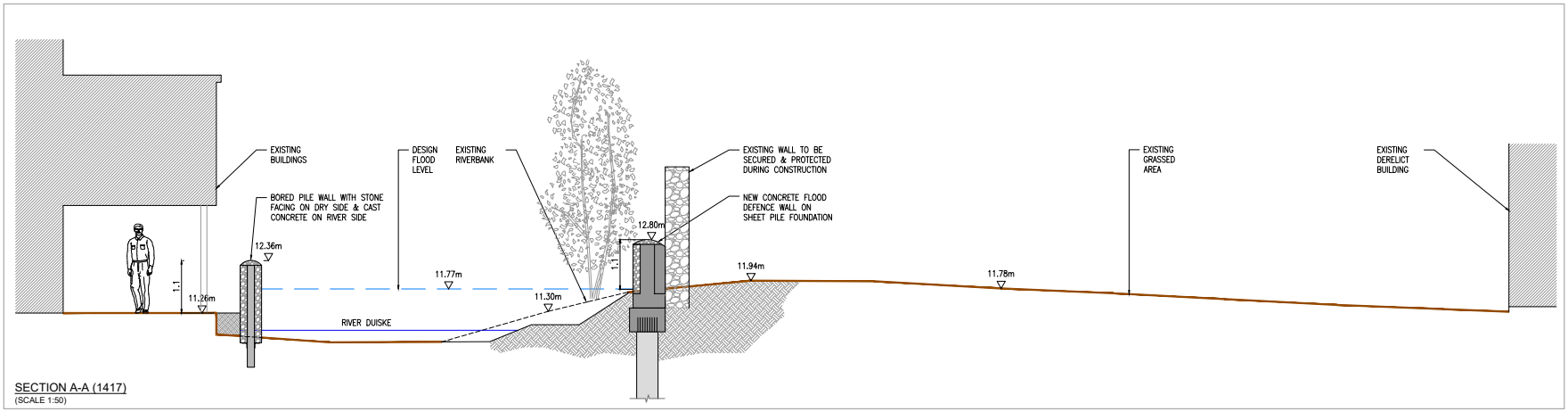
STATUS

FOR PLANNING

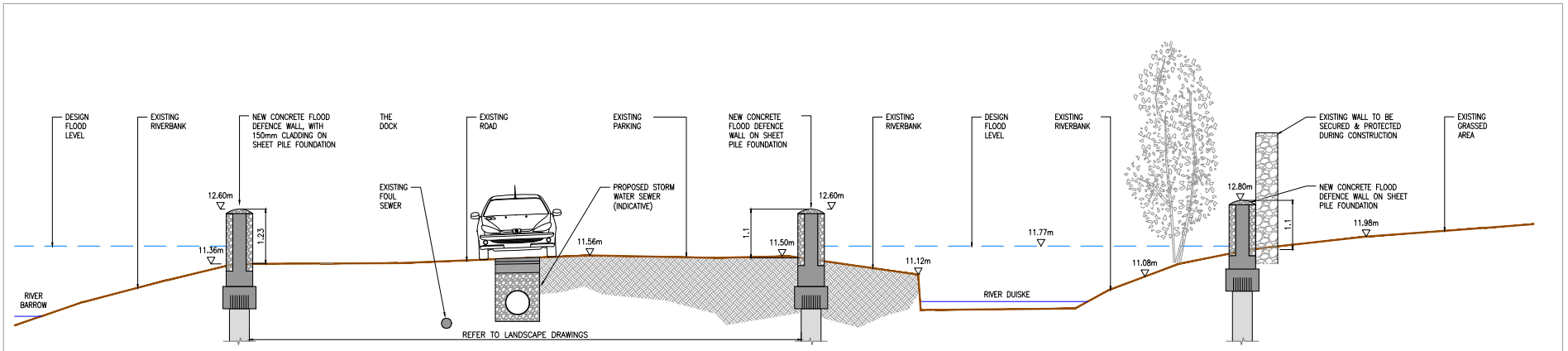
Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH

Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1417	00

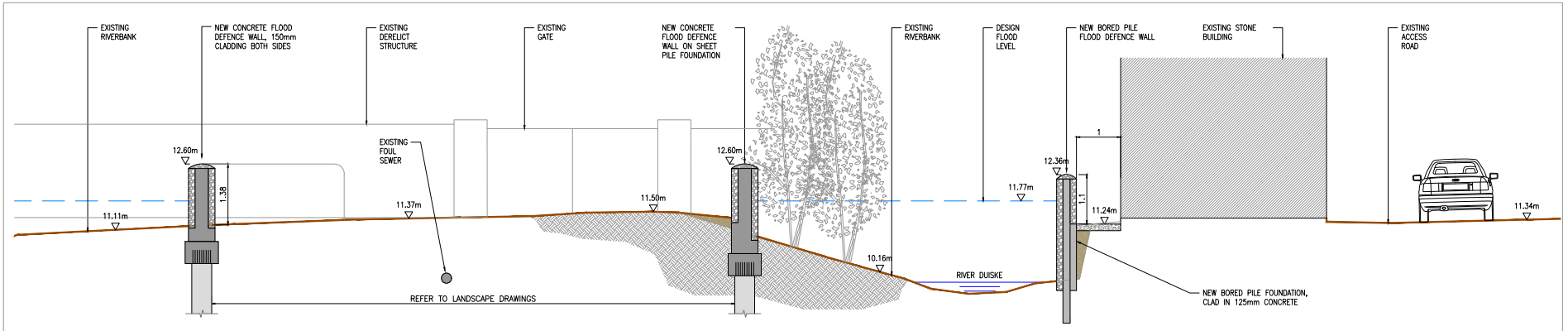
A1



SECTION A-A (1417)
(SCALE 1:50)



SECTION B-B (1417)
(SCALE 1:50)



SECTION C-C (1417)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES C & D, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED CONCRETE WALL FINISH
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

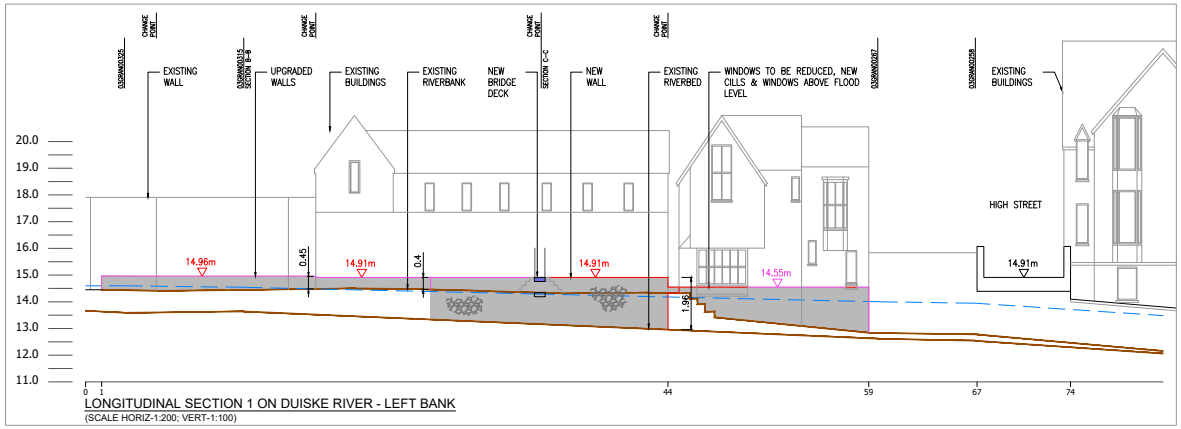
DRAWING TITLE
FLOOD RELIEF WORKS
LOWER TURFMARKET
SECTIONS

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH

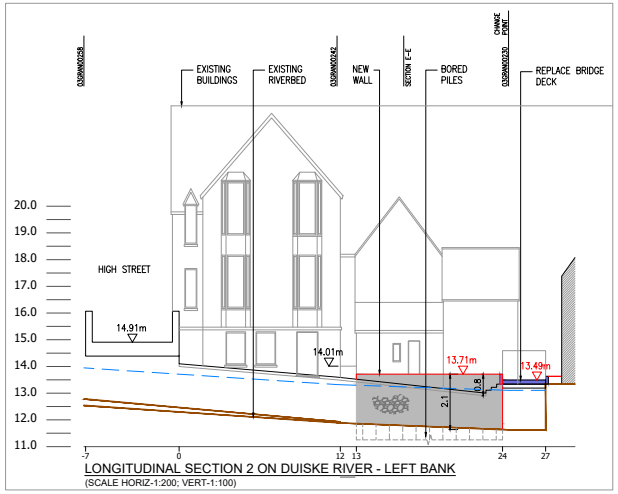
Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1418	00

A1



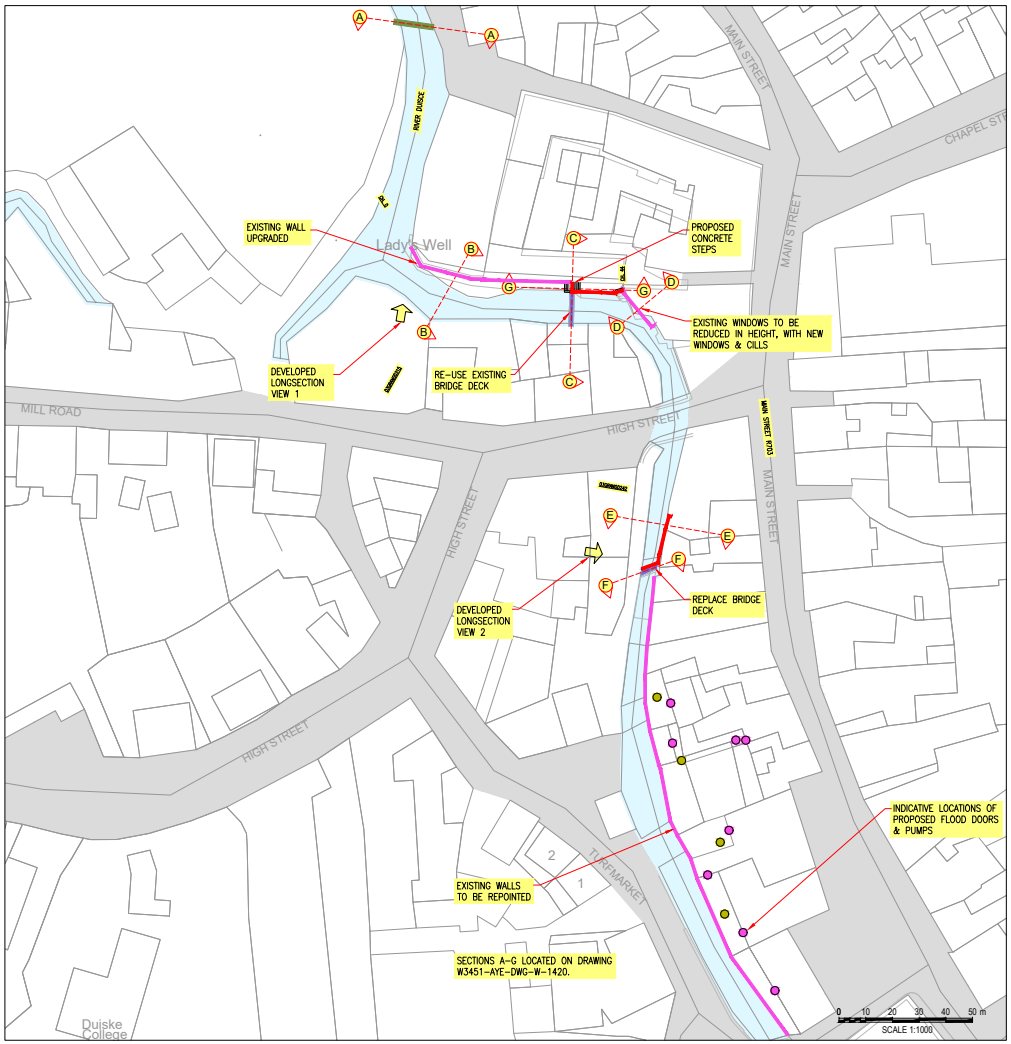
LONGITUDINAL SECTION 1 ON DUISKE RIVER - LEFT BANK

(SCALE HORIZ-1:200; VERT-1:100)



LONGITUDINAL SECTION 2 ON DUISKE RIVER - LEFT BANK

(SCALE HORIZ-1:200; VERT-1:100)



SITE PLAN

SCALE: 1:500

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES A & C, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING DEFENCES
- NEW FLOOD DEFENCE WALL
- PROPOSED FLOOD GATE
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED FOOTBRIDGE
- PROPOSED TRASH SCREEN
- PROPOSED CONCRETE WALL FINISH/RENDER
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW VEHICLE ACCESS OVER FLOOD DEFENCES
- PROPOSED PROPERTY WITH FLOOD DOORS
- PROPOSED PROPERTY WITH SUMP & SUBMERSIBLE PUMP

KEYPLAN:

Rev	Date	Description	By	Chk	App
00	04.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT

KILKENNY COUNTY COUNCIL

PROJECT

GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE

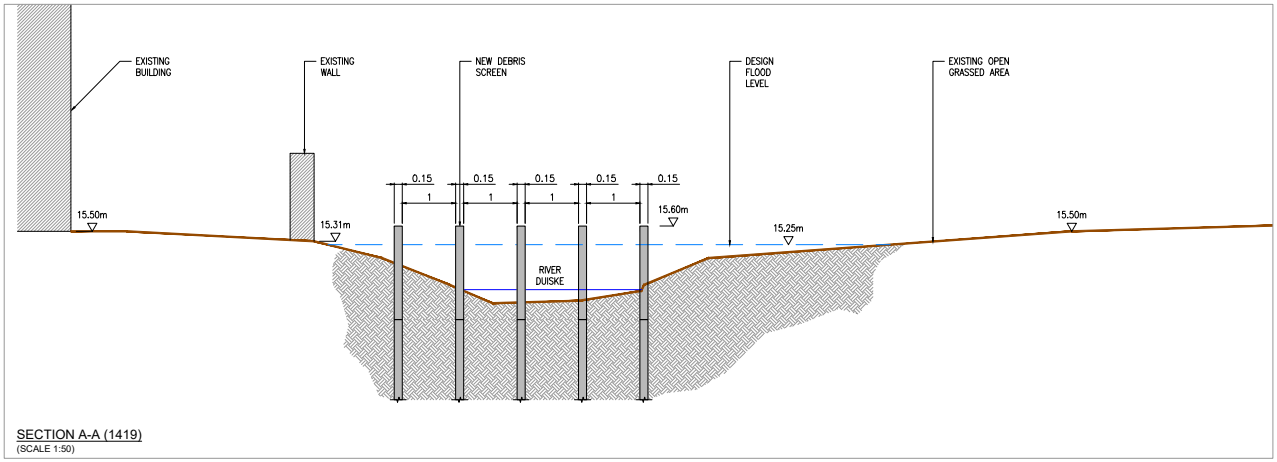
FLOOD RELIEF WORKS
HIGH STREET LOWER
SITE PLAN & LONGITUDINAL SECTIONS

STATUS

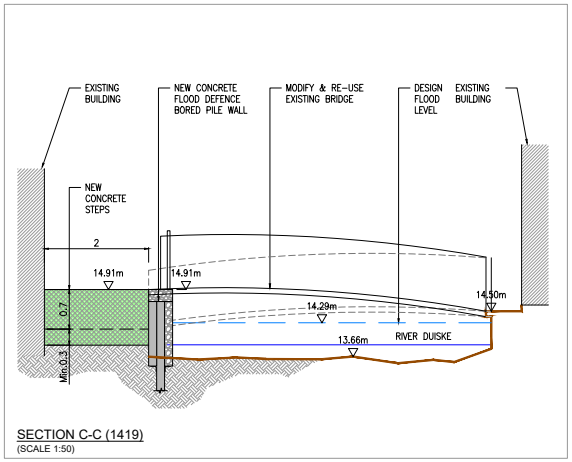
FOR PLANNING

Date: 31.07.24	Scale: 1:500	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1419			Rev: 01

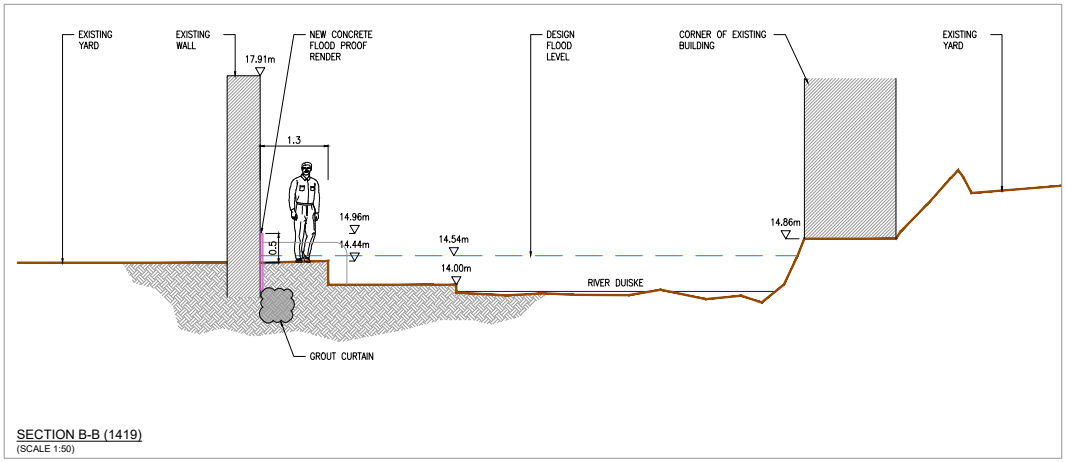
A1



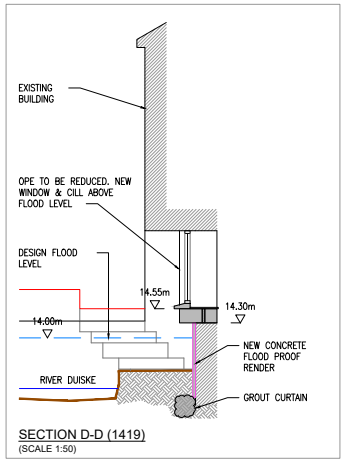
SECTION A-A (1419)
(SCALE 1:50)



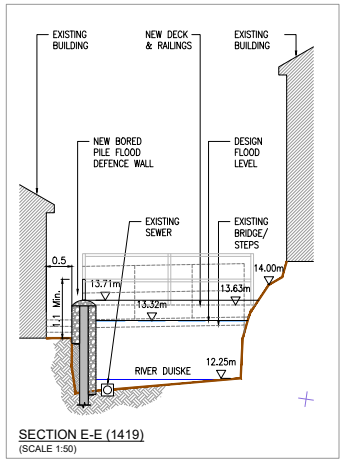
SECTION C-C (1419)
(SCALE 1:50)



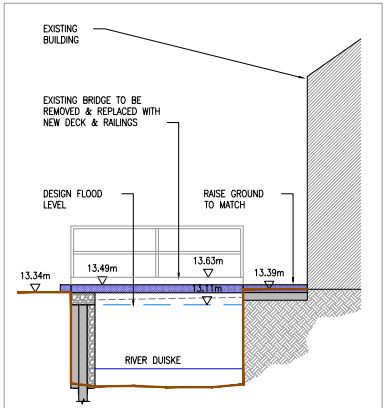
SECTION B-B (1419)
(SCALE 1:50)



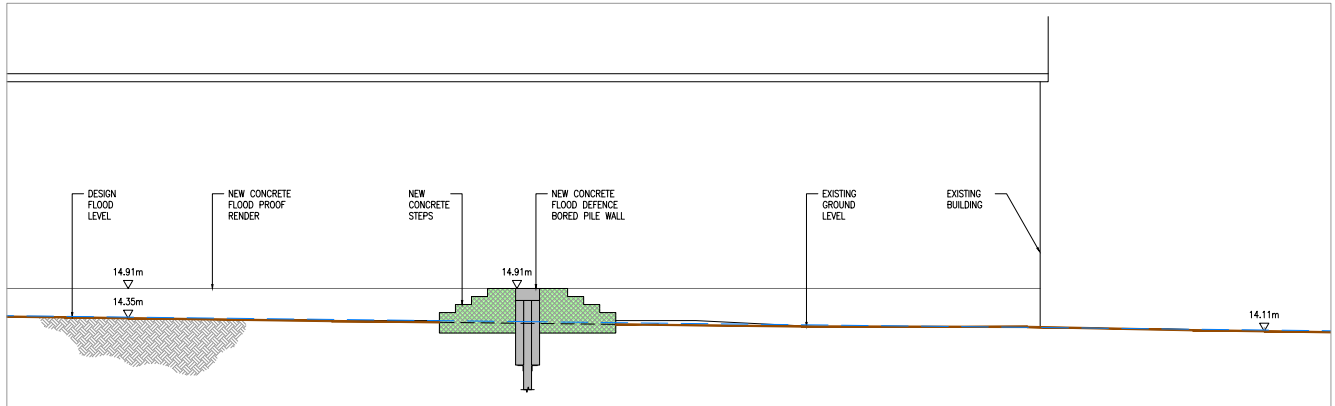
SECTION D-D (1419)
(SCALE 1:50)



SECTION E-E (1419)
(SCALE 1:50)



SECTION F-F (1419)
(SCALE 1:50)



SECTION G-G (1419)
(SCALE 1:50)

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES A & C, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

- DESIGN FLOOD LEVEL
- UPGRADE EXISTING WALL
- NEW FLOOD DEFENCE WALL
- NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND
- PROPOSED FOOTBRIDGE
- PROPOSED TRASH SCREEN
- PROPOSED CONCRETE WALL FINISH/RENDER
- PROPOSED STONE CLAD CONCRETE WALL FINISH
- NEW ACCESS OVER FLOOD DEFENCES

Rev	Date	Description	By	Chk	App
00	04.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

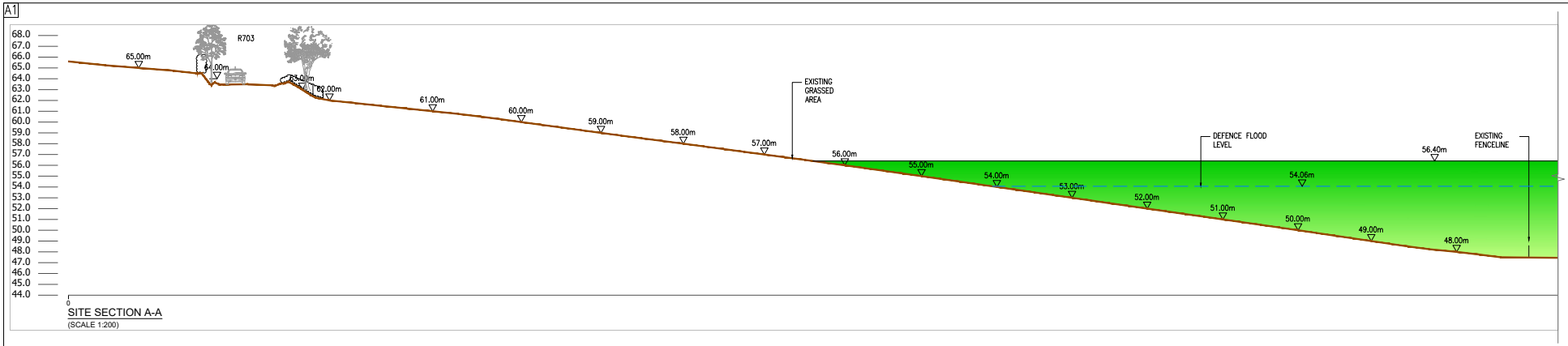
PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
HIGH STREET LOWER
SECTIONS

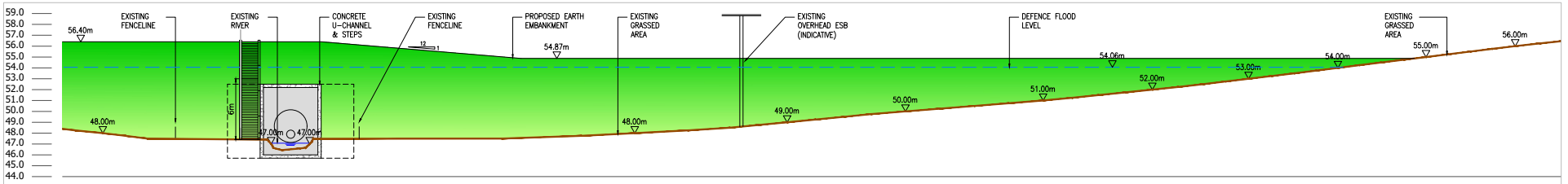
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1420			Rev: 01

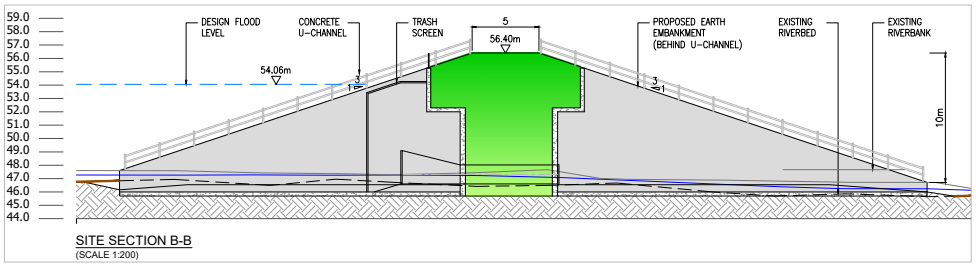
A1



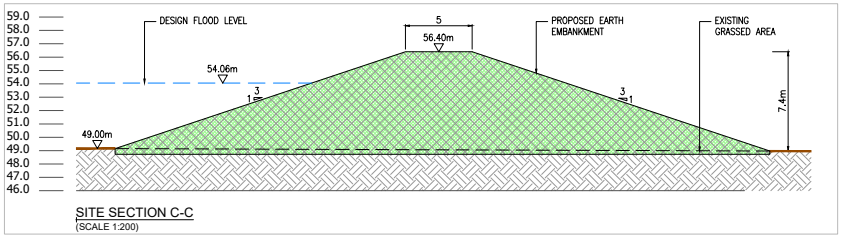
SITE SECTION A-A
(SCALE 1:200)



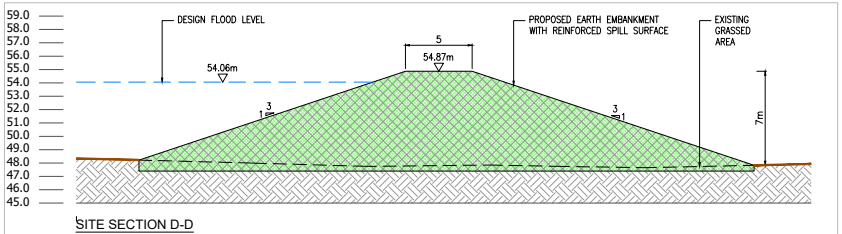
SITE SECTION A-A (Contd.)
(SCALE 1:200)



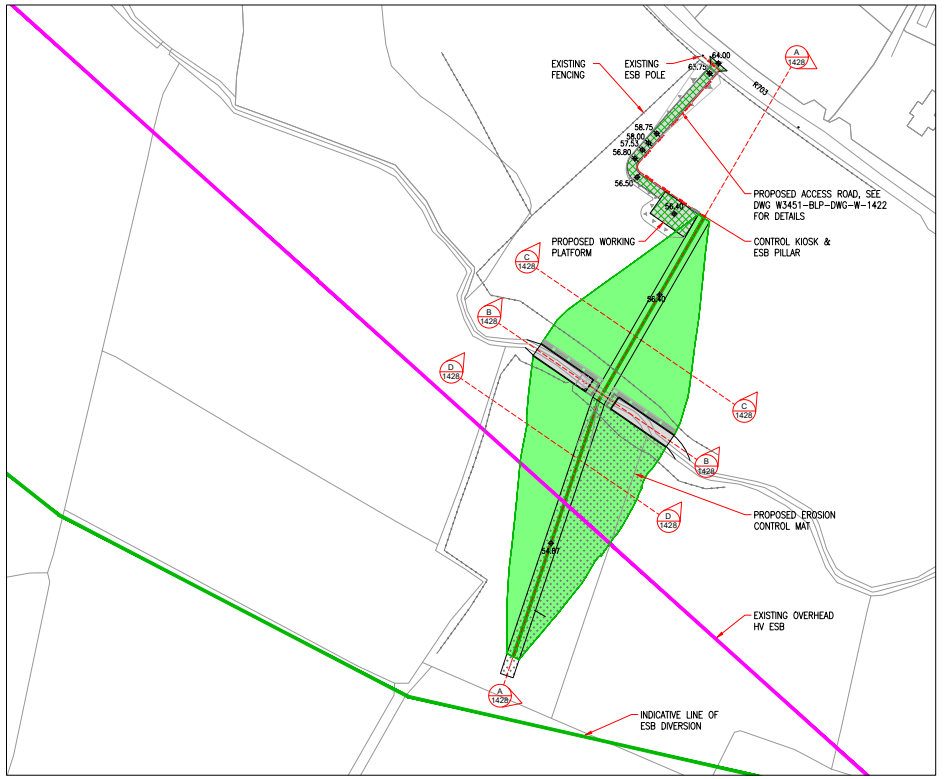
SITE SECTION B-B
(SCALE 1:200)



SITE SECTION C-C
(SCALE 1:200)



SITE SECTION D-D
(SCALE 1:200)



SITE PLAN
SCALE: 1:1000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE LANDWAY/DRY SIDE OF DEFENCES, EXCEPT RIVER SECTIONS.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.

LEGEND:

- EXISTING GROUND LEVEL
- NEW FLOOD DEFENCE EMBANKMENT
- PROPOSED CONCRETE WALL FINISH
- FLOOD DEFENCE LEVEL
- EXISTING OVERHEAD HV ESB
- PROPOSED ESB DIVERSION (INDICATIVE)
- PROPOSED SECTION THROUGH FLOOD DEFENCE EMBANKMENT
- PROPOSED EROSION CONTROL MAT
- PROPOSED VEHICLE ACCESS & WORKING PLATFORM
- PROPOSED ESB SUPPLY

Rev	Date	Description	By	Chk	App
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

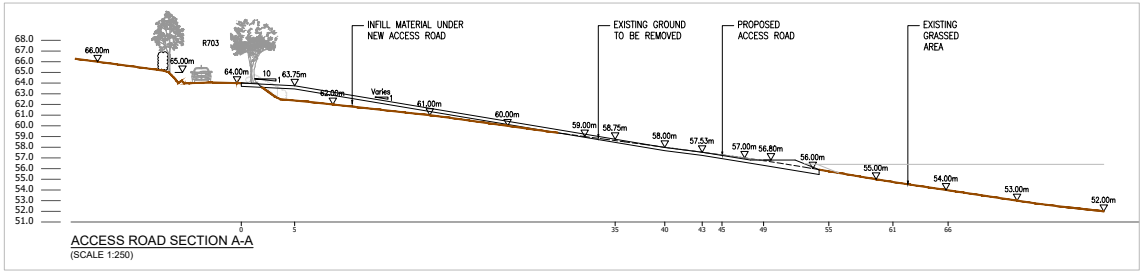
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
UPSTREAM STORAGE AREA – DUISKE RIVER
GA SITE PLAN & SECTIONS

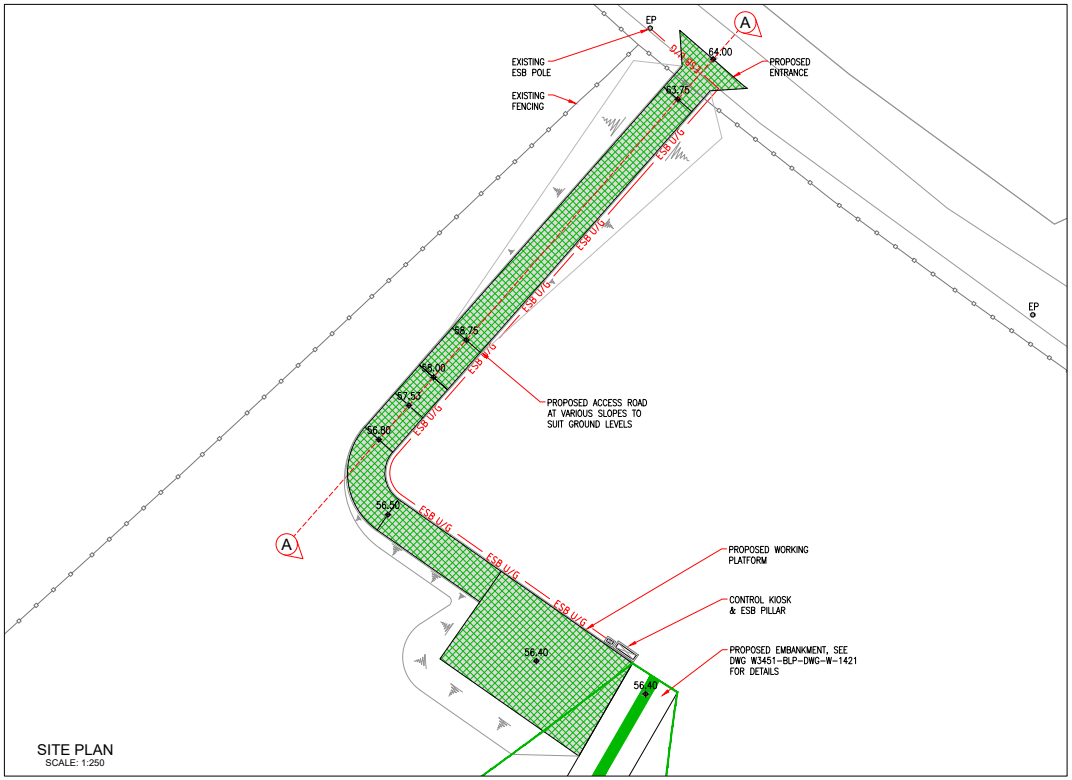
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1421			Rev: 01

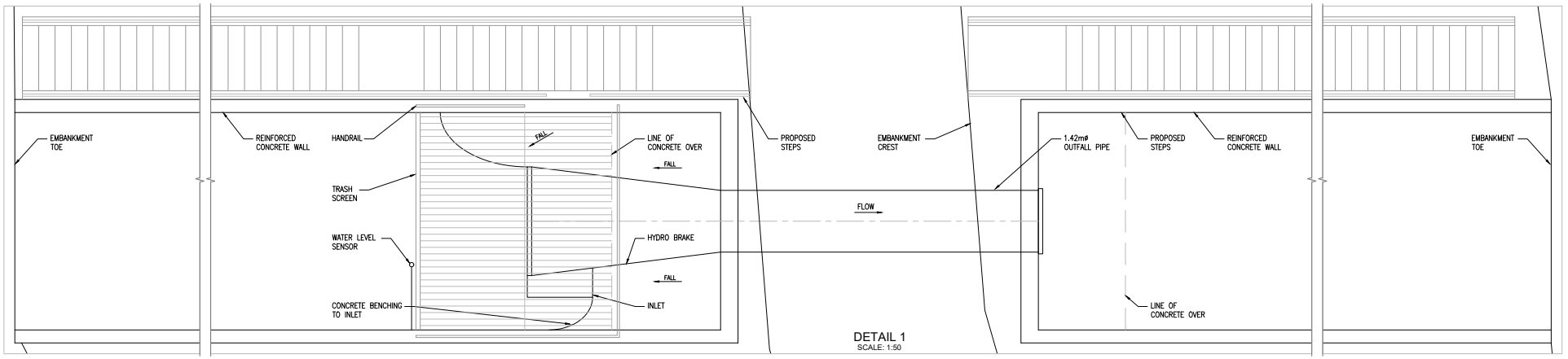
A1



ACCESS ROAD SECTION A-A
(SCALE 1:250)



SITE PLAN
SCALE: 1:250



DETAIL 1
SCALE: 1:50

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE LANDWAY/DRY SIDE OF DEFENCES, EXCEPT RIVER SECTIONS.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.

LEGEND:

EXISTING GROUND LEVEL

NEW FLOOD DEFENCE EMBANKMENT

PROPOSED VEHICLE ACCESS & WORKING PLATFORM

PROPOSED ESB SUPPLY — ESB U/G

Rev	Date	Description	By	Chk	App
02	31.07.25	ISSUE FOR PLANNING	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

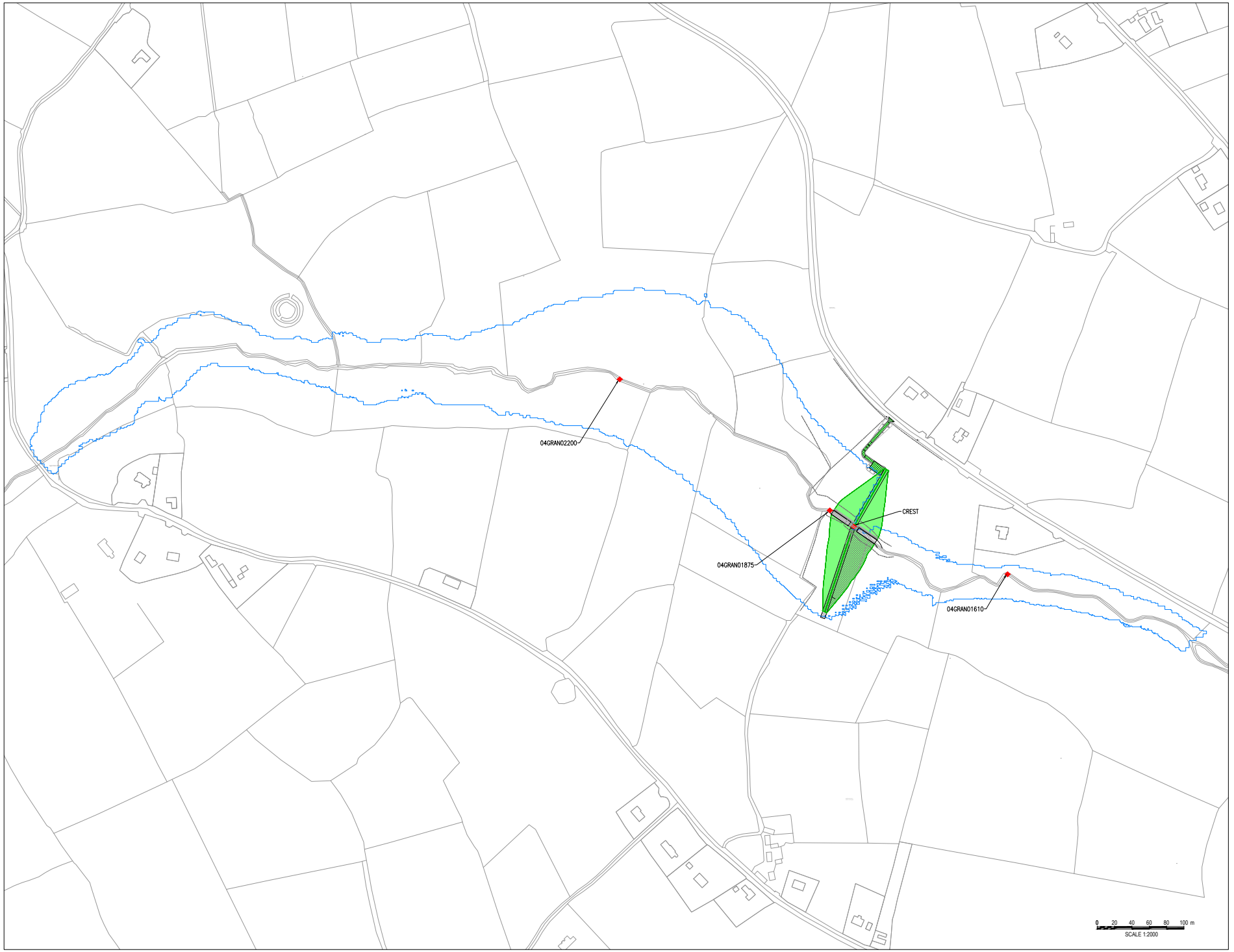
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
UPSTREAM STORAGE AREA – DUISKE RIVER
ACCESS ROAD PLAN & DETAILS

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:250	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1422			Rev: 02

A1



FLOOD EXTENT MAP
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
4. PMF = PROBABLE MAXIMUM FLOOD EXTENT.

LEGEND:

- NEW FLOOD DEFENCE EMBANKMENT
- PROPOSED VEHICLE ACCESS & WORKING PLATFORM
- 1% AEP FLOOD EXTENT
- PROBABLE MAXIMUM FLOOD EXTENT
- 1% AEP BASELINE FLOOD EXTENT
- FLOOD LEVEL NODES ID

PROPOSED FLOOD LEVELS:

1% AEP PRESENT DAY		
ID:	FLOW (m^3/s)	ELEVATION (mOD)
04GRAN02200	7.06	54.06
04GRAN01875	3.22	54.06
CREST	0.00	54.06
04GRAN01610	3.28	43.94

PMF		
ID:	FLOW (m^3/s)	ELEVATION (mOD)
04GRAN02200	94.84	55.65
04GRAN01875	94.74	55.64
CREST	92.19	55.64
04GRAN01610	95.85	45.63

Rev	Date	Description	By	Chk	App
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

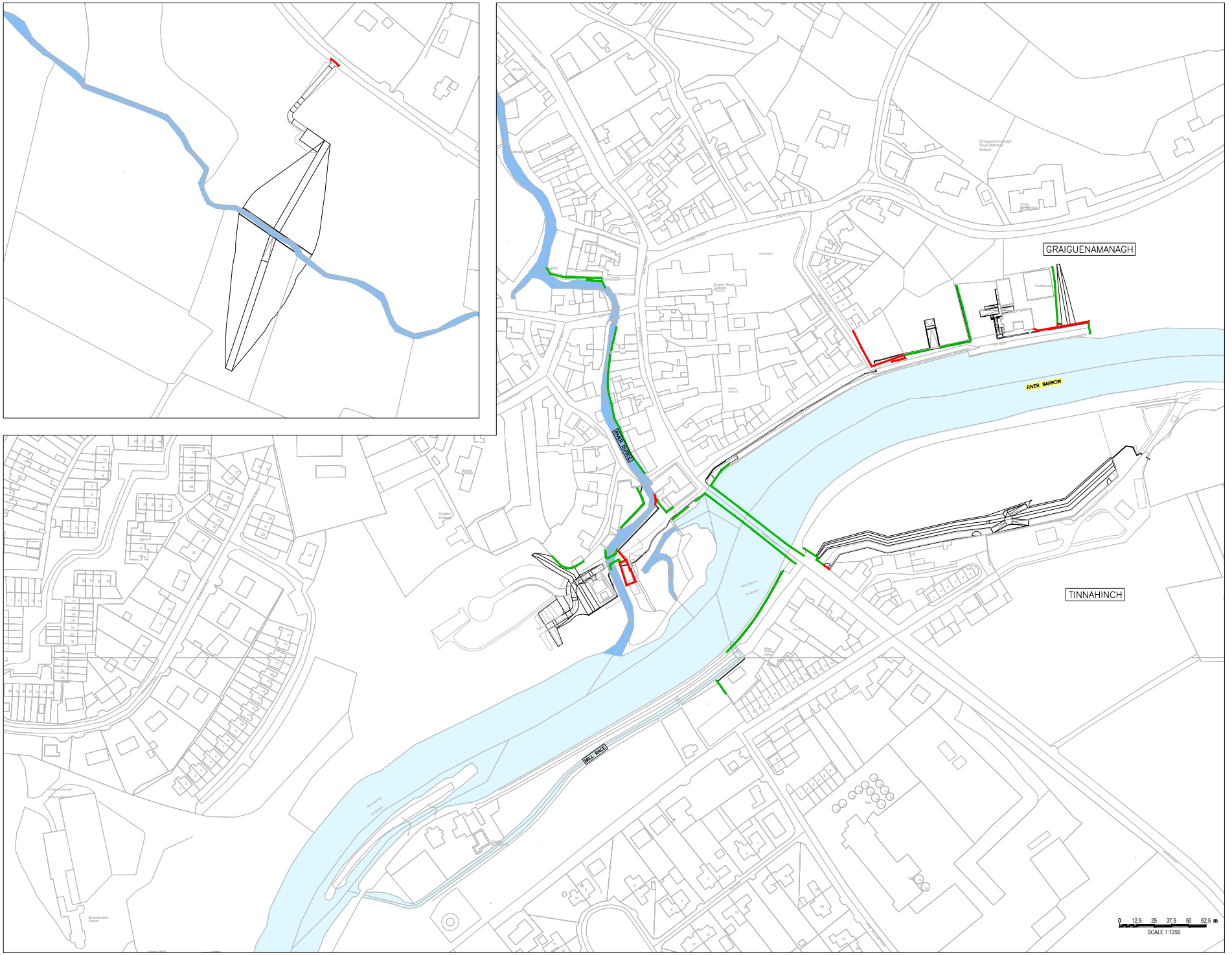
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
UPSTREAM STORAGE AREA – DUISKE RIVER
FLOOD EXTENT MAP OF STORAGE AREA

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:2000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1423			Rev: 01

A1



SITE PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423

LEGEND:

EXISTING WALLS TO BE RETAINED
EXISTING WALLS TO BE REMOVED

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING (EMBANKMENT REVISION)	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

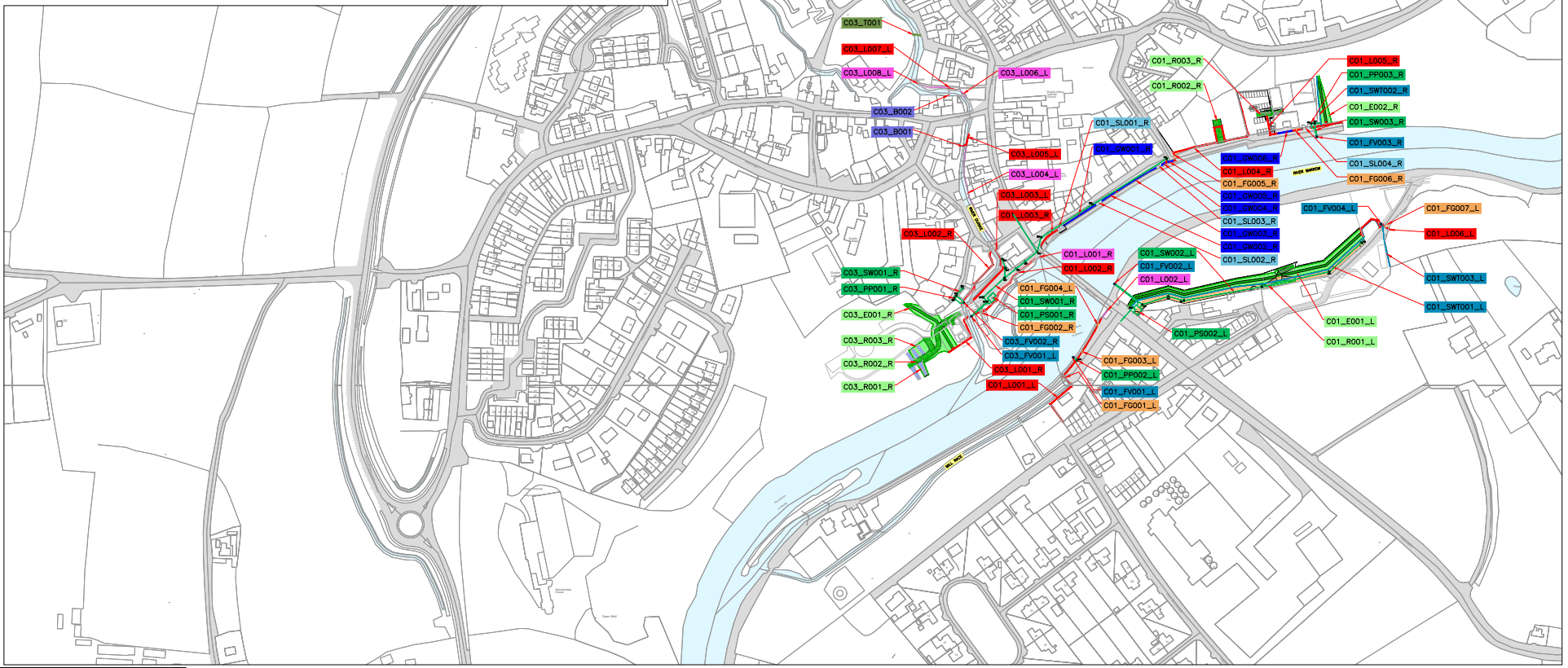
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
TREATMENT OF EXISTING WALLS

STATUS
FOR PLANNING

Date:31.07.24	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1424			Rev: 02

A1



GENERAL NOTES

NOTES:

1. ORDNANCE SURVEY IRELAND LICENCE NUMBER EN 3-3-34.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.

LEGEND:

UPGRADE EXISTING WALL	L
NEW FLOOD DEFENCE WALL	L
GLASS WALL FLOOD DEFENCE	GW
NEW FLOOD/SLUICE GATE, HEADWALL	FG,SG, HW
NEW FLOOD DEFENCE RAMP, EMBANKMENT & RAISED GROUND	E
NEW SLIDING FLOOD GATES	SL
PROPOSED FOOTBRIDGE	B
PROPOSED TRASH SCREEN	T
PROPOSED STORM DRAINAGE	SW
PROPOSED MANHOLES	MH
PROPOSED FILTER/TOE DRAIN	SWT
PROPOSED OUTFALLS	FV
PROPOSED PUMP STATION	PS
PROPOSED PUMP SUMP	PP
PROPOSED VEHICLE ACCESS FOR FLOOD DEFENCES	R
EXISTING VEHICLE PARKING TO BE RETAINED	R

EXISTING CHANNELS:

RIVER BARROW	C01
MILL RACE	C02
RIVER DUISKE	C03

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

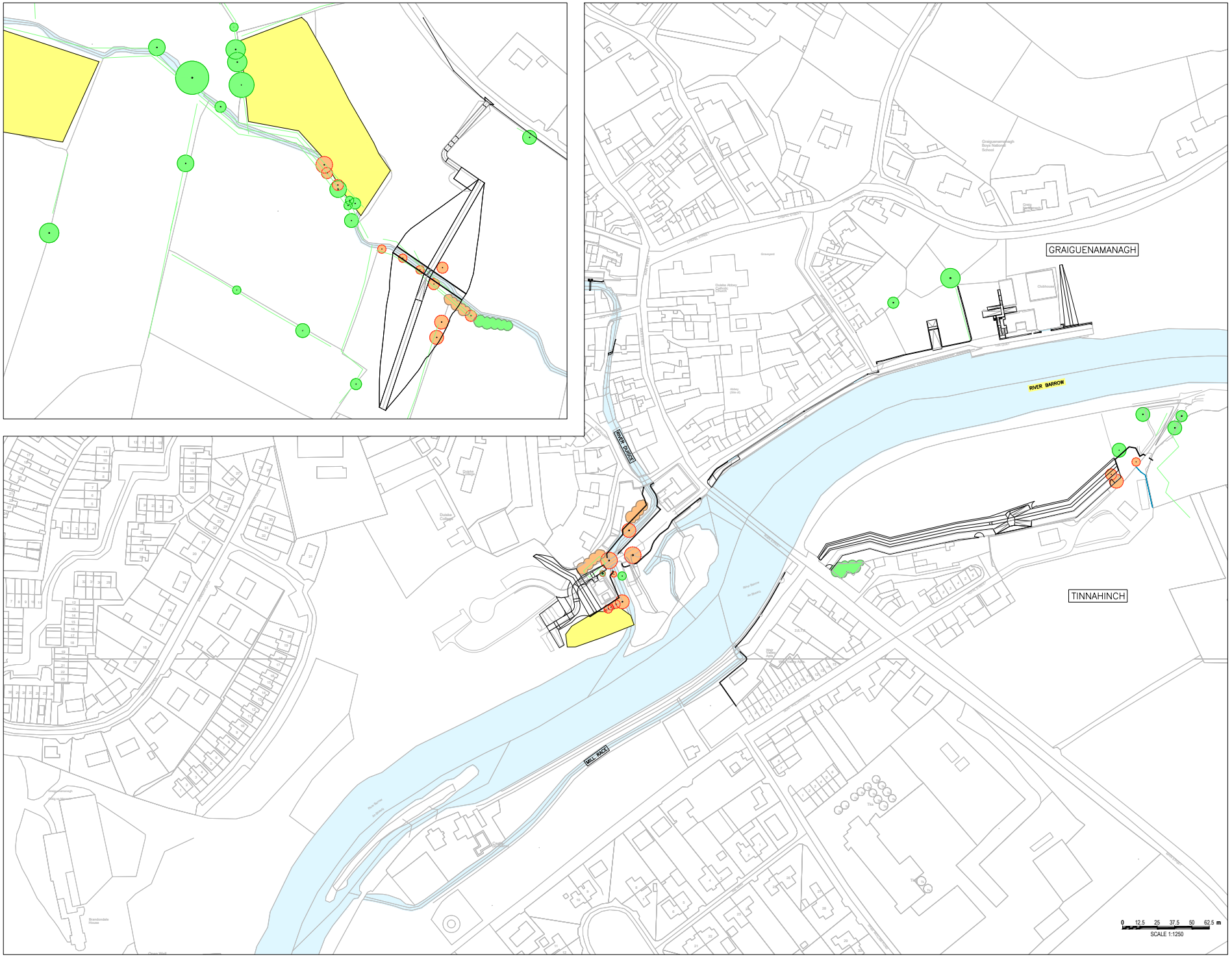
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
FLOOD RELIEF WORKS
FLOOD DEFENCES OVERALL LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale:1:2000	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1425			Rev: 02

A1



SITE PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423.
6. VEGETATION/SCRUB CLEARANCE NOT SHOWN.

LEGEND:

EX. TREES TO BE RETAINED

EX. TREE GROUPING TO BE RETAINED

EX. TREES TO BE REMOVED

EX. ROW OF VEGETATION/TREES TO BE REMOVED

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING (EMBANKMENT REVISION)	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

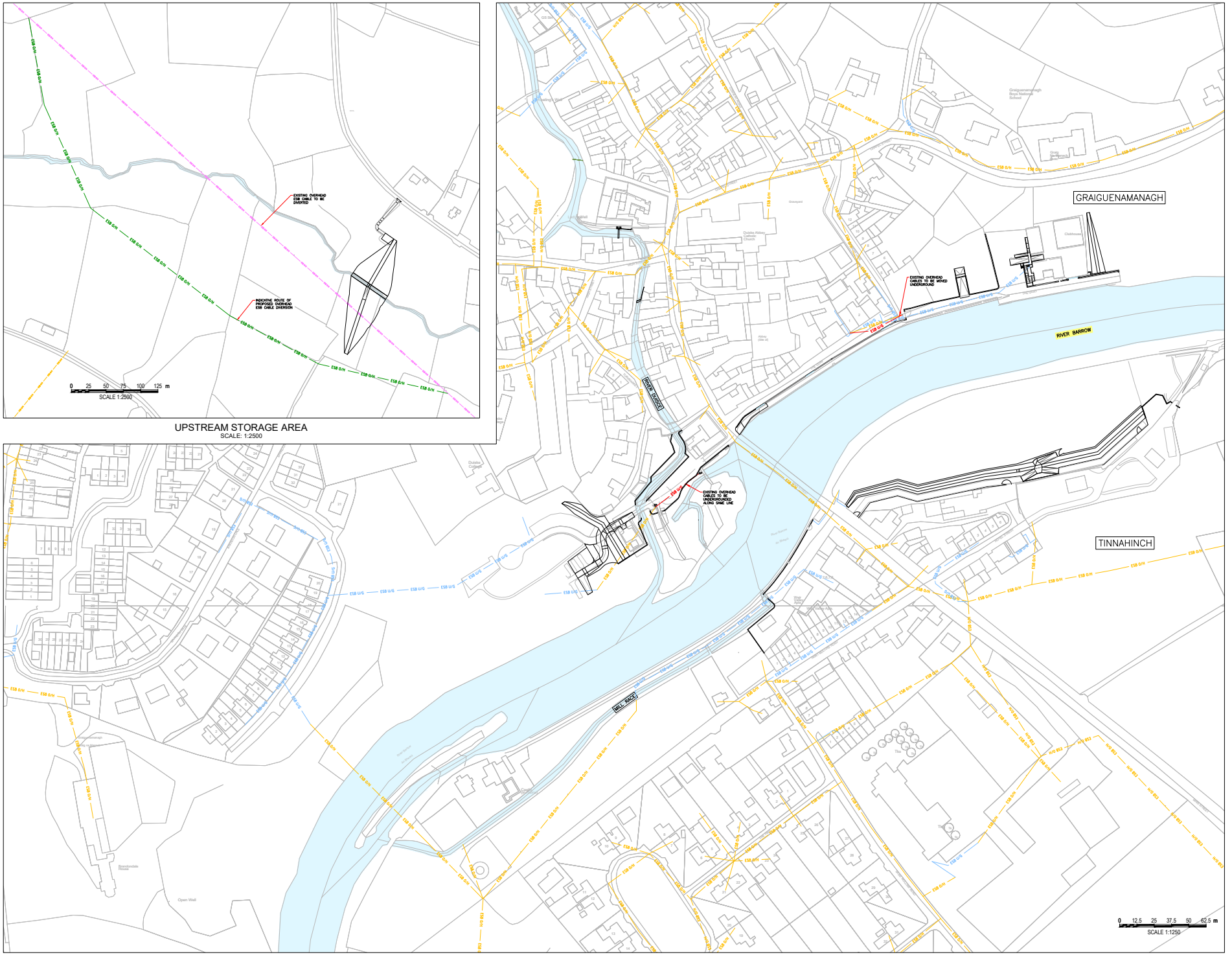
DRAWING TITLE
SITE WORKS
ARBOREAL IMPACT GA LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1426			Rev: 02

A1

UPSTREAM STORAGE AREA
SCALE: 1:2500



SITE PLAN
SCALE: 1:1250

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423

LEGEND:

- EXISTING ESB OVERHEAD M/V — ESB O/H
- EXISTING ESB OVERHEAD H/V — ESB O/H
- EXISTING ESB UNDERGROUND — ESB U/G
- PROPOSED ESB OVERHEAD — ESB O/H
- PROPOSED ESB UNDERGROUND — ESB U/G

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING (EMBANKMENT REVISION)	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

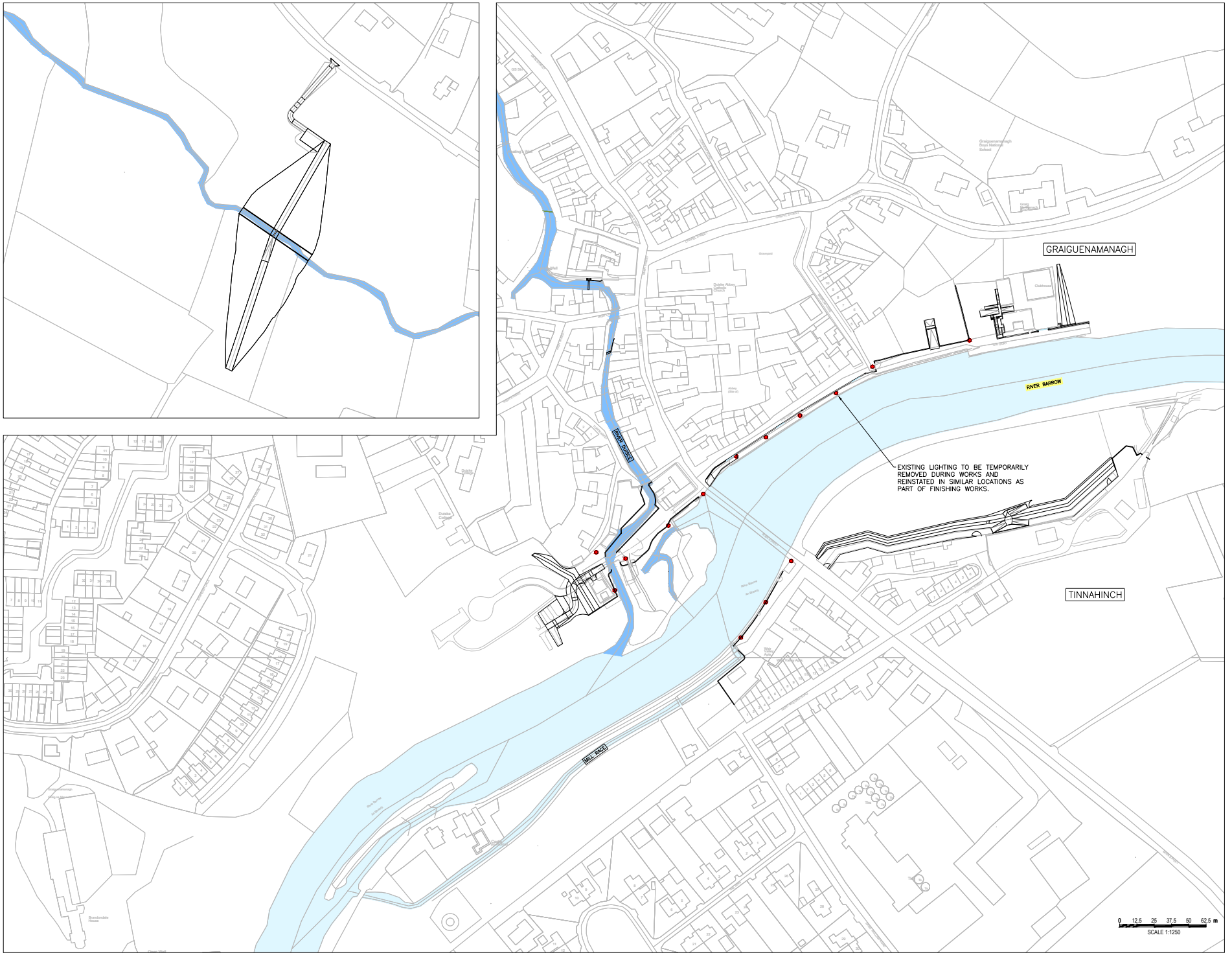
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
ESB DIVERSIONS LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale: AS SHOWN	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1427			Rev: 02

A1



SITE PLAN
SCALE: 1:1250

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423
6. ALL EXISTING LIGHTING POLES TO BE REMOVED & REINSTATED AS PER LANDSCAPING PROPOSAL. GENERAL LOCATIONS TO BE RETAINED.

LEGEND:

EXISTING PUBLIC LIGHTING

Rev	Date	Description	By	Chk	App
02	04.10.25	ISSUE FOR PLANNING (EMBANKMENT REVISION)	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

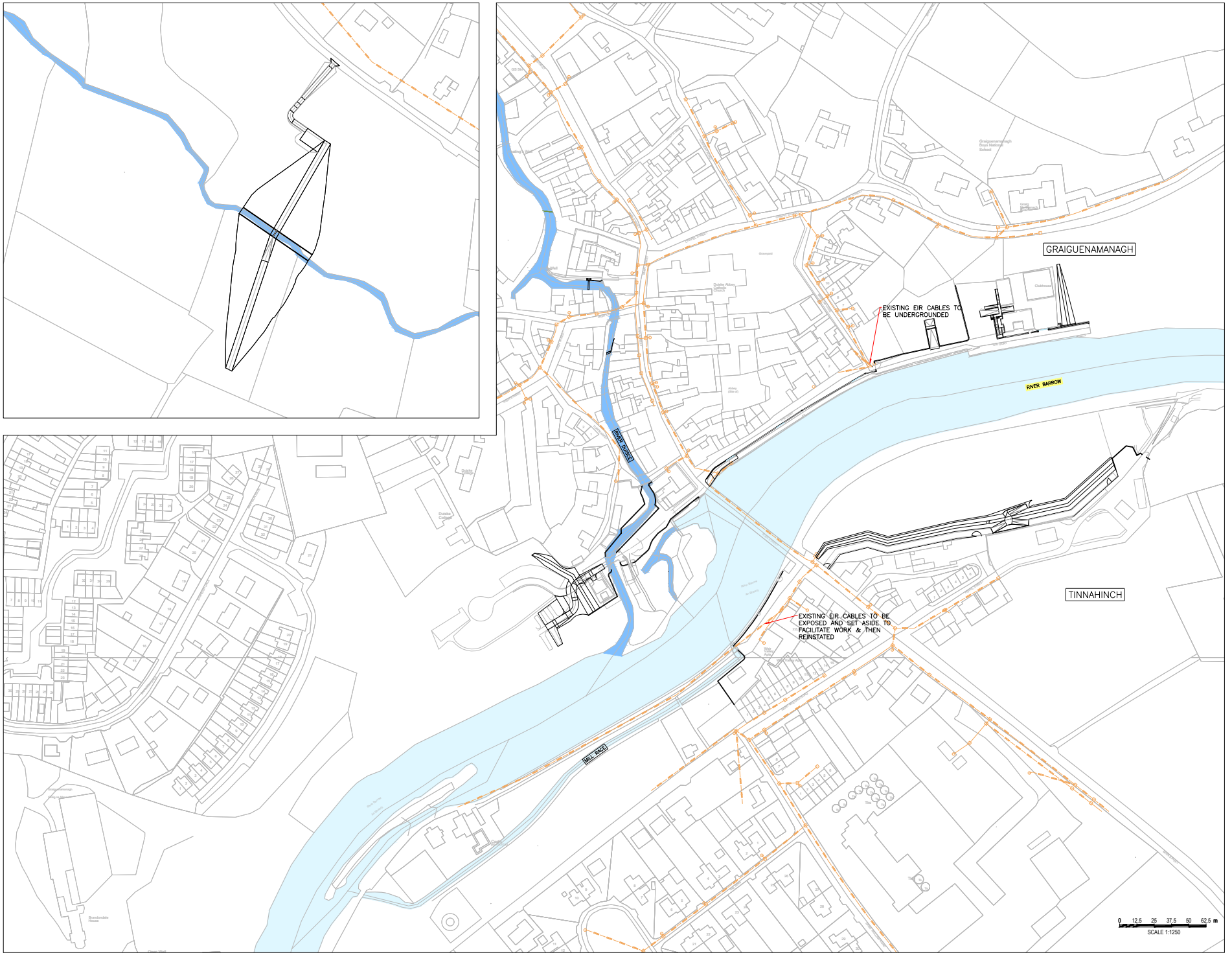
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
PUBLIC LIGHTING DIVERSIONS LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1428			Rev: 02

A1



SITE PLAN
SCALE: 1:1250

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423

LEGEND:

EXISTING EIR LINES

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING (EMBANKMENT REVISION)	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

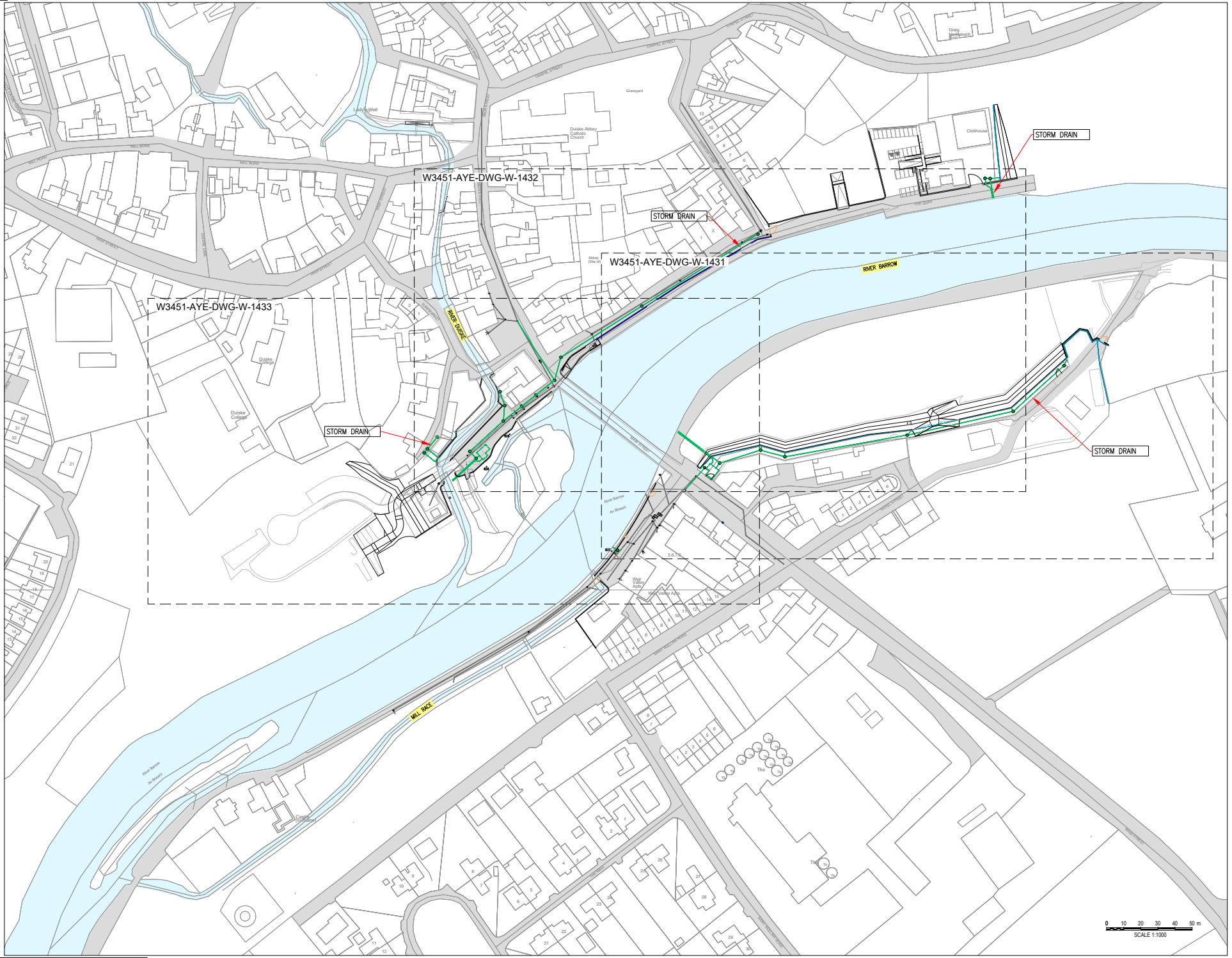
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
EIR DIVERSIONS LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1429			Rev: 02

A1



GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.
4. INVERT LEVELS SUBJECT TO FINAL DESIGN.

LEGEND:

EXISTING SEWER
EXISTING STORM DRAINAGE
PROPOSED STORM DRAINAGE
FILTER/TOE DRAIN

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
01	18.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

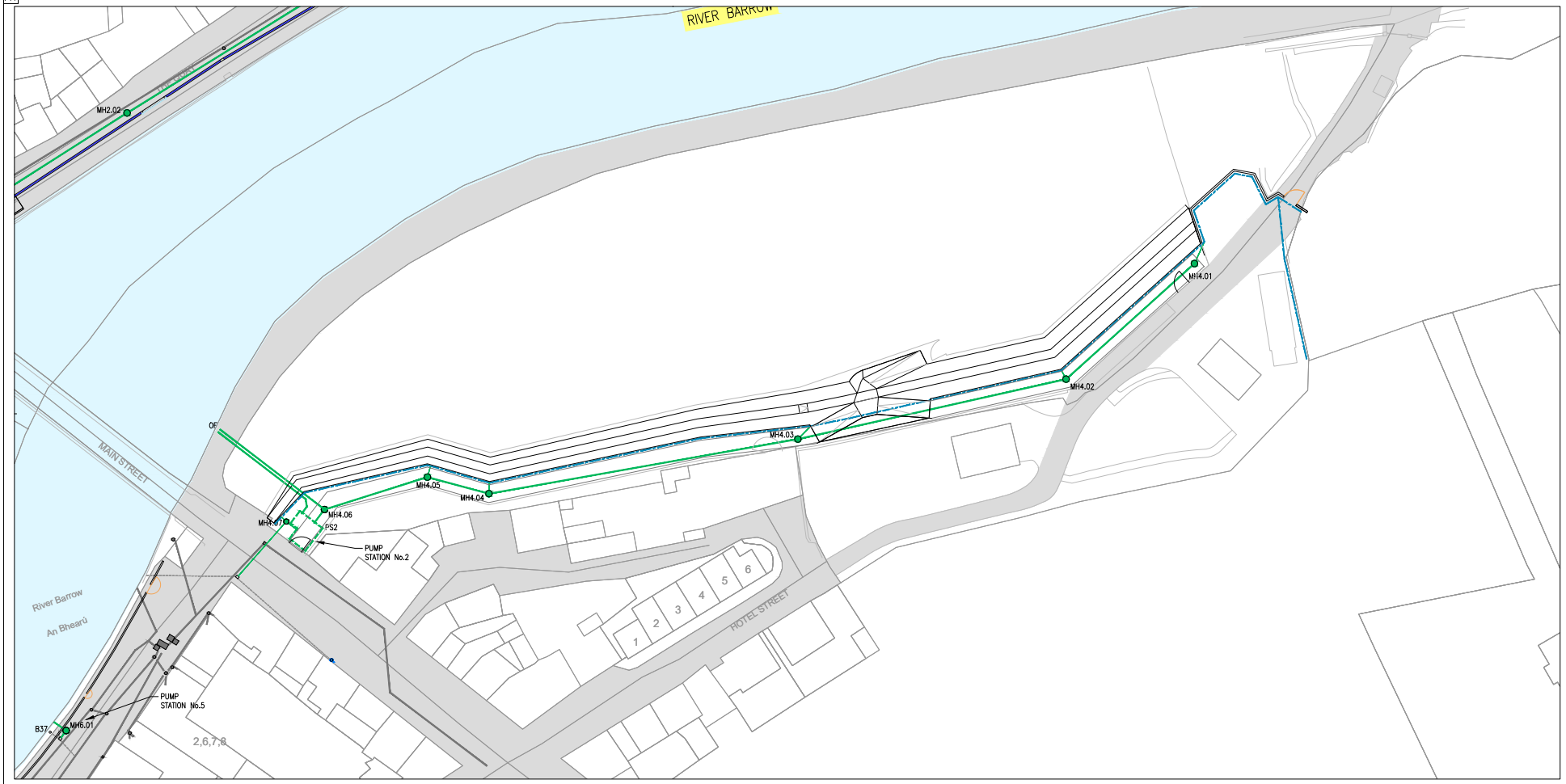
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE
OVERALL LAYOUT PLAN

STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1430			Rev: 02

A1



LAYOUT PLAN
SCALE: 1:500

STORMWATER MANHOLES – TINNAHINCH

MANHOLE REF:	COVER LEVEL (mOD)	INVERT LEVEL (mOD)	PIPE ø (mm)	PIPE LENGTH (m)
MH4.01	11.35	9.800	–	–
MH4.02	11.70	9.670	525	40
MH4.03	11.70	9.458	525	63.65
MH4.04	11.80	9.216	525	72.65
MH4.05	11.90	9.166	525	14.75
MH4.06	12.69	9.081	525	25
OF	–	8.979	525	30.5
MH4.06	12.69	9.606	525	–
PS2	12.90	9.592	525	4
MH4.07	12.90	11.144/9.644	300	–
PS2	12.90	9.633	300	3.3
Ex.	10.77	10.54	–	–
MH6.01	10.76	TBC	100	2
OF	–	–	80	3.2

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.
4. INVERT LEVELS SUBJECT TO FINAL DESIGN.

LEGEND:

EXISTING SEWER
EXISTING STORM DRAINAGE
PROPOSED STORM DRAINAGE
FILTER/TOE DRAIN

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
01	18.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

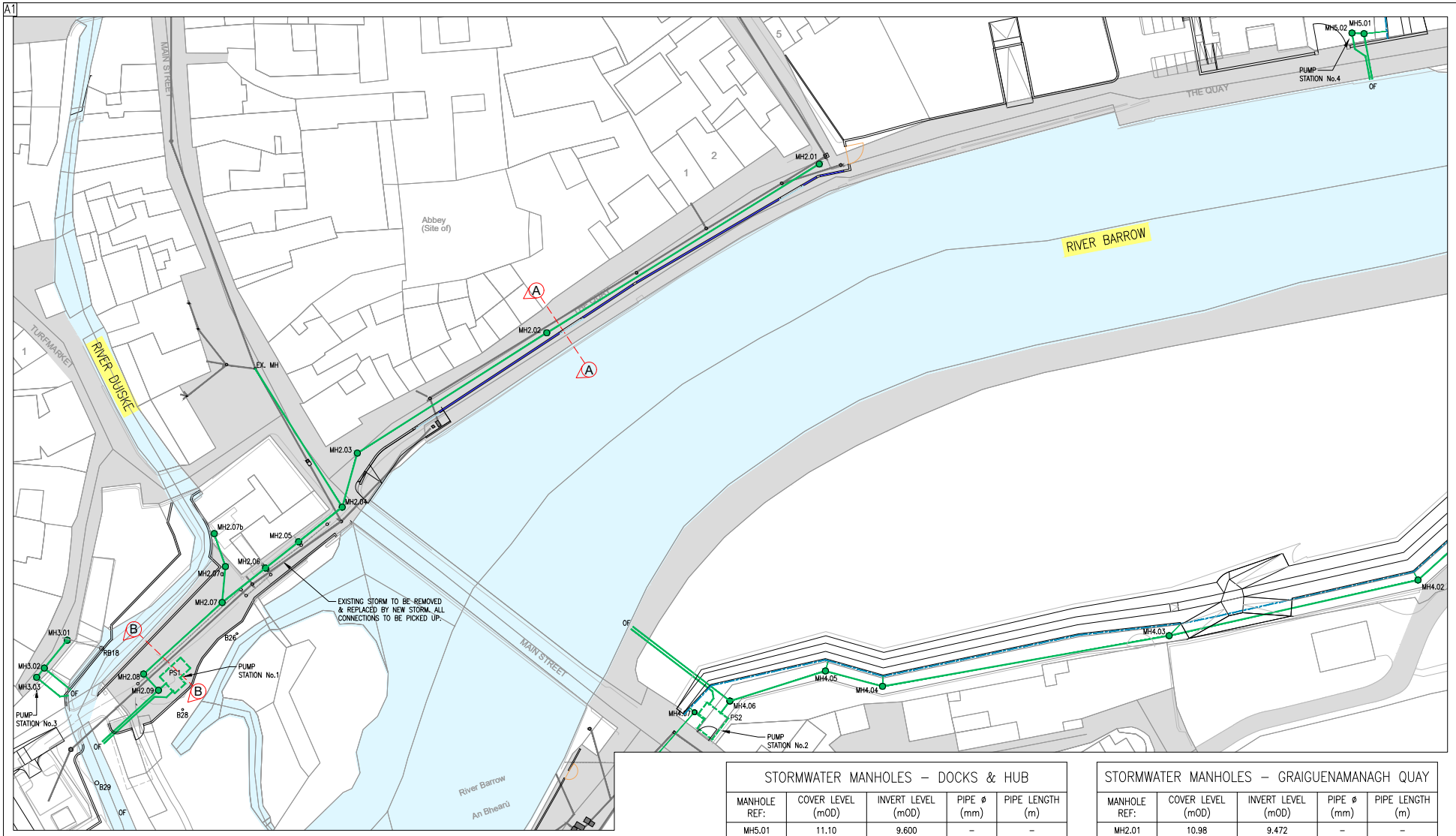
PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE TINNAHINCH HOTEL STREET & QUAY GA LAYOUT

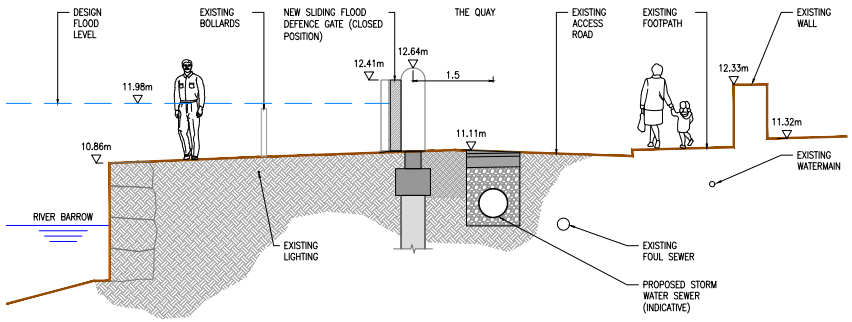
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:500	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1431			Rev: 02

A1



LAYOUT PLAN
SCALE: 1:500



SECTION A-A
(SCALE 1:50)

STORMWATER MANHOLES – DOCKS & HUB

MANHOLE REF:	COVER LEVEL (mOD)	INVERT LEVEL (mOD)	PIPE ø (mm)	PIPE LENGTH (m)
MH5.01	11.10	9.600	–	–
OF	–	9.533	300	10
MH5.01	11.10	9.833	–	–
MH5.02	11.20	9.813	300	3

STORMWATER MANHOLES – GRAIGUENAMANAGH QUAY

MANHOLE REF:	COVER LEVEL (mOD)	INVERT LEVEL (mOD)	PIPE ø (mm)	PIPE LENGTH (m)
MH2.01	10.98	9.472	–	–
MH2.02	11.08	9.312	525	80
MH2.03	11.48	9.125	525	56
MH2.04	12.60	9.079	525	14
MH2.05	11.40	9.023	525	14
MH2.06	11.42	8.981	525	10.5
MH2.07	11.50	8.925	525	13.83
MH2.08	11.40	8.819	525	26.5
MH2.09	11.40	8.797	525	5.5
OF	–	8.721	525	19
MH2.09	11.40	9.322	–	–
PS1	11.40	9.311	525	2.8
Ex	11.46	TBC	–	–
MH2.04	12.60	9.079	525	41
MH2.07b	11.25	8.960	–	–
MH2.07a	11.50	8.943	300	8.67
MH2.07	11.50	8.925	300	9

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.
4. INVERT LEVELS SUBJECT TO FINAL DESIGN.

LEGEND:

EXISTING SEWER
EXISTING STORM DRAINAGE
PROPOSED STORM DRAINAGE
FILTER/TOE DRAIN

Rev	Date	Description	By	Chk	App
01	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

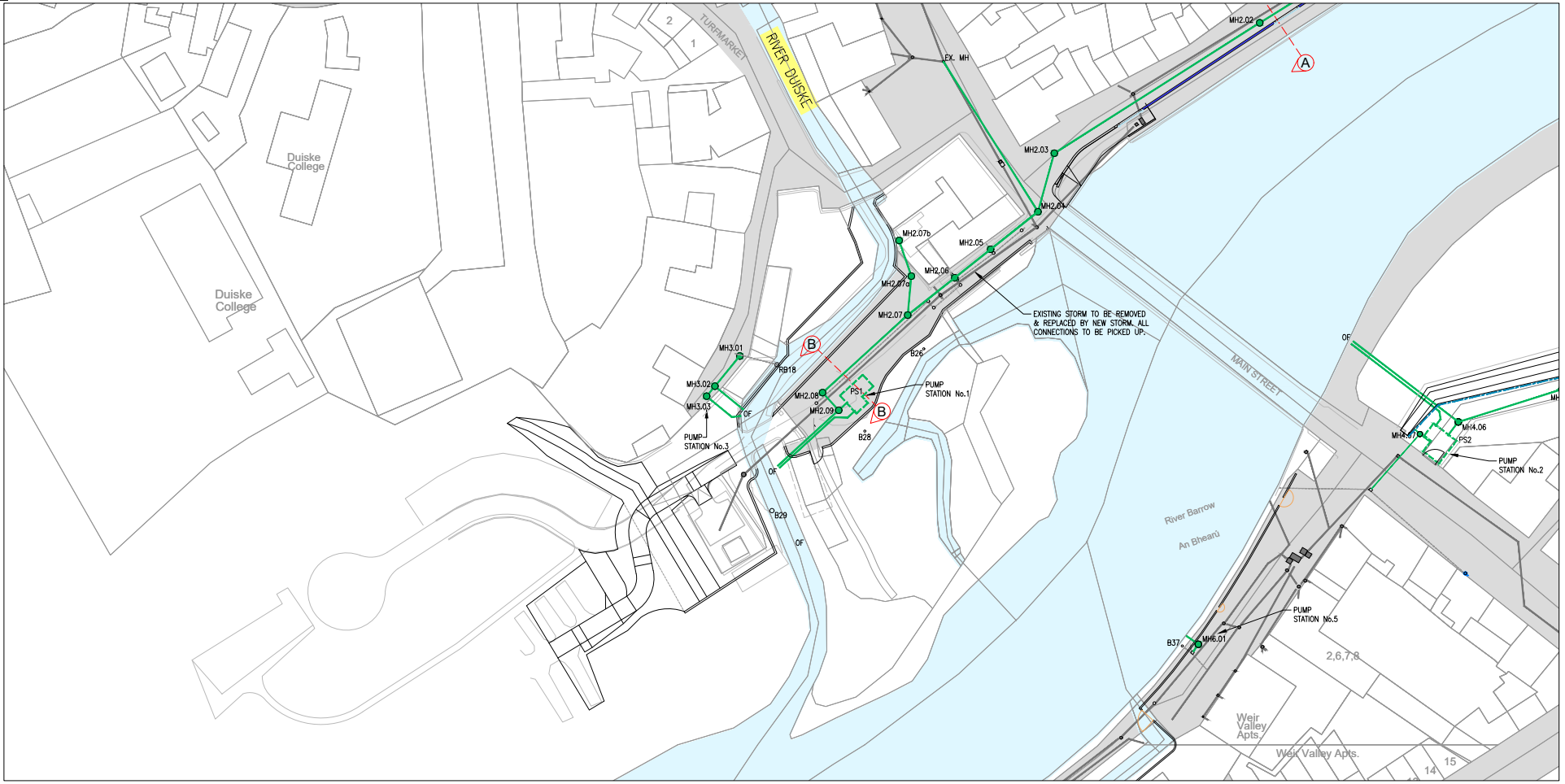
PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE GRAIGUENAMANAGH QUAY GA LAYOUT

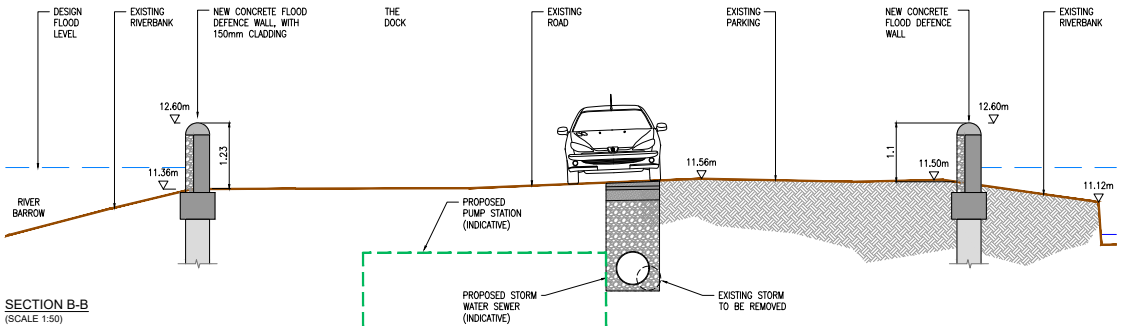
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:500	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1432			Rev: 01

A1



LAYOUT PLAN
SCALE: 1:500



SECTION B-B
(SCALE 1:50)

STORMWATER MANHOLES – THE HUB

MANHOLE REF:	COVER LEVEL (mOD)	INVERT LEVEL (mOD)	PIPE ø (mm)	PIPE LENGTH (m)
MH3.01	11.32	10.505	–	–
MH3.02	11.25	10.405	225	9
OF	11.13	10.322	225	8.5
MH3.02	11.25	10.630	–	–
MH3.03	11.24	10.570	225	3
OF	–	10.100	225	9.6

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.
4. INVERT LEVELS SUBJECT TO FINAL DESIGN.

LEGEND:

EXISTING SEWER
EXISTING STORM DRAINAGE
PROPOSED STORM DRAINAGE
FILTER/TOE DRAIN

Rev	Date	Description	By	Chk	App
01	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

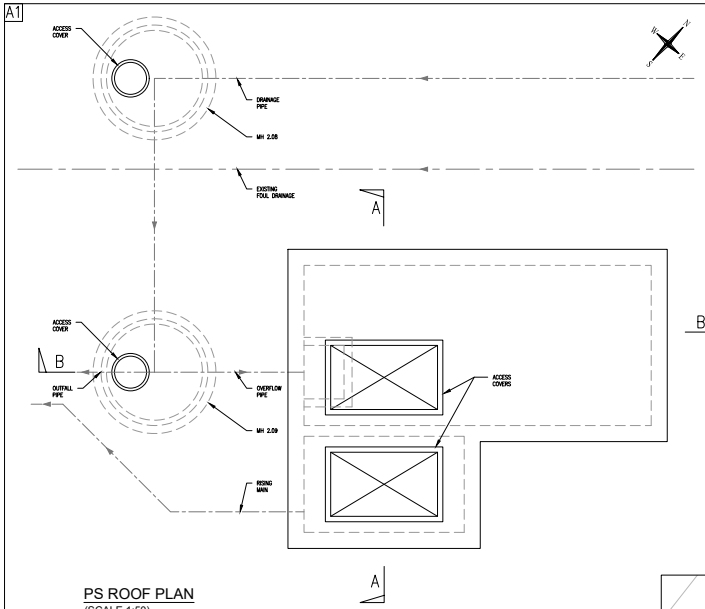
PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE DOCKS & HUB GA LAYOUT

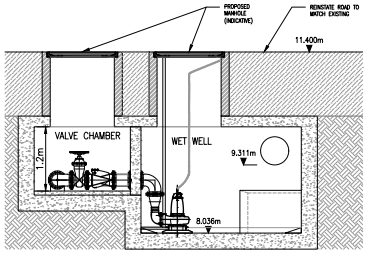
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:500	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1433			Rev: 01

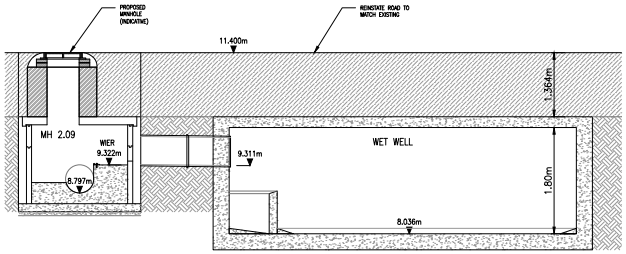
A1



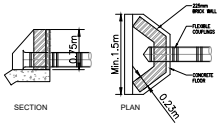
PS ROOF PLAN
(SCALE 1:50)



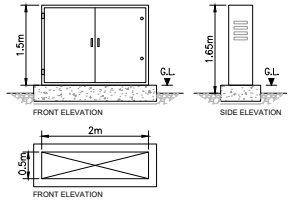
SECTION A-A
(SCALE 1:50)



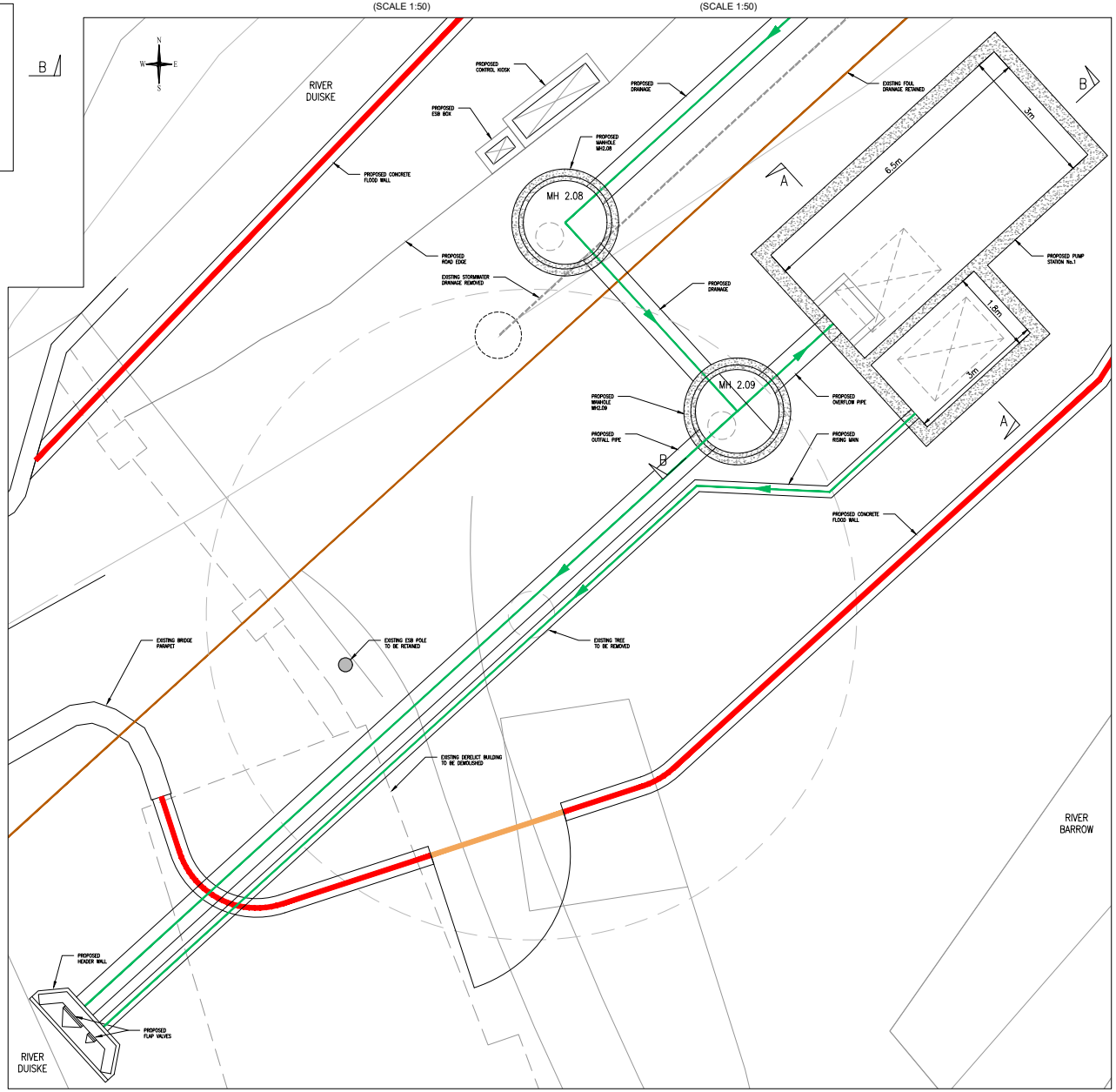
SECTION B-B
(SCALE 1:50)



TYPICAL HEADER WALL
(SCALE 1:50)



CONTROL KIOSK
(SCALE 1:50)



LAYOUT PLAN
SCALE: 1:50

GENERAL NOTES

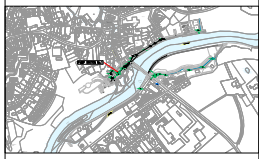
NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.

LEGEND:

- EXISTING SEWER
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- PROPOSED FLOOD DEFENCE WALL
- PROPOSED FLOOD GATE WITHIN FLOOD DEFENCE WALL

KEYPLAN:



Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	OL	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

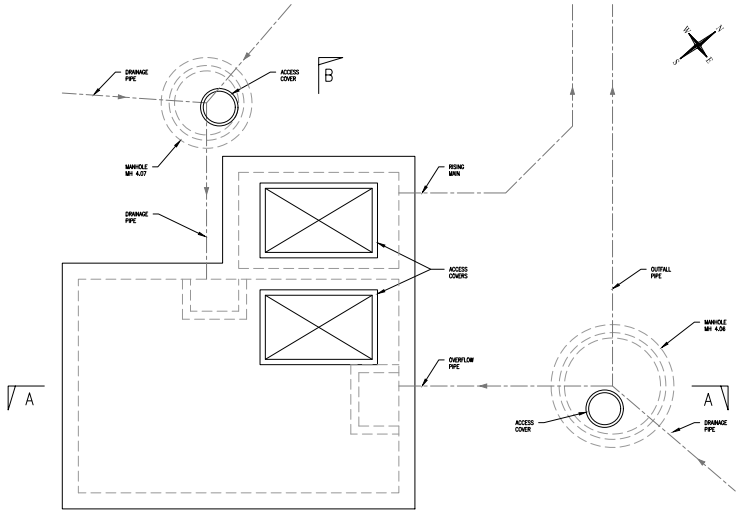
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE
PUMPING STATION NO.1
GA LAYOUT, PLAN & SECTIONS

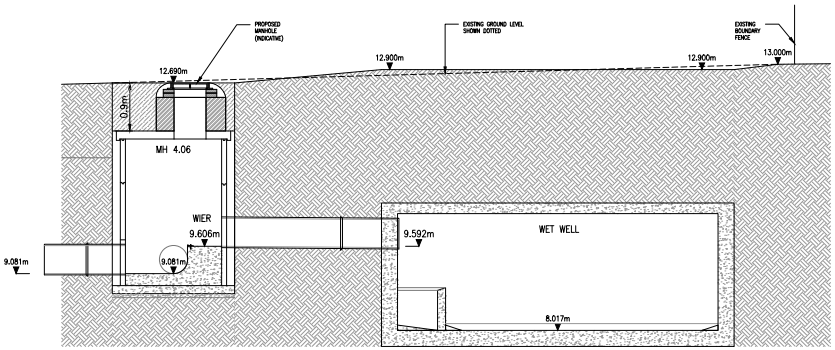
STATUS
FOR PLANNING

Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1434			Rev: 00

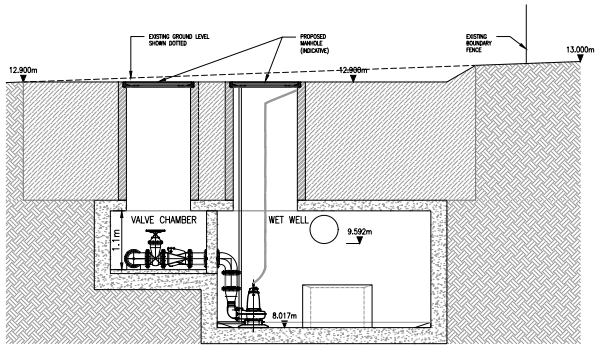
A1



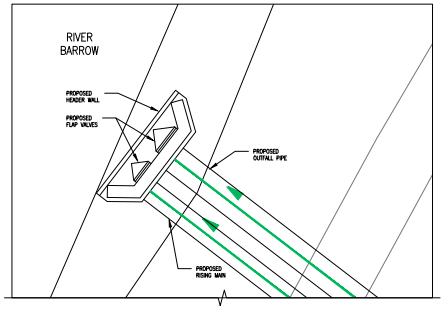
PS ROOF PLAN
(SCALE 1:50)

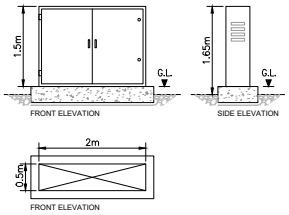


SECTION A-A
(SCALE 1:50)

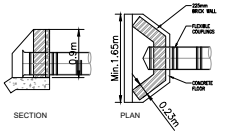


SECTION B-B
(SCALE 1:50)

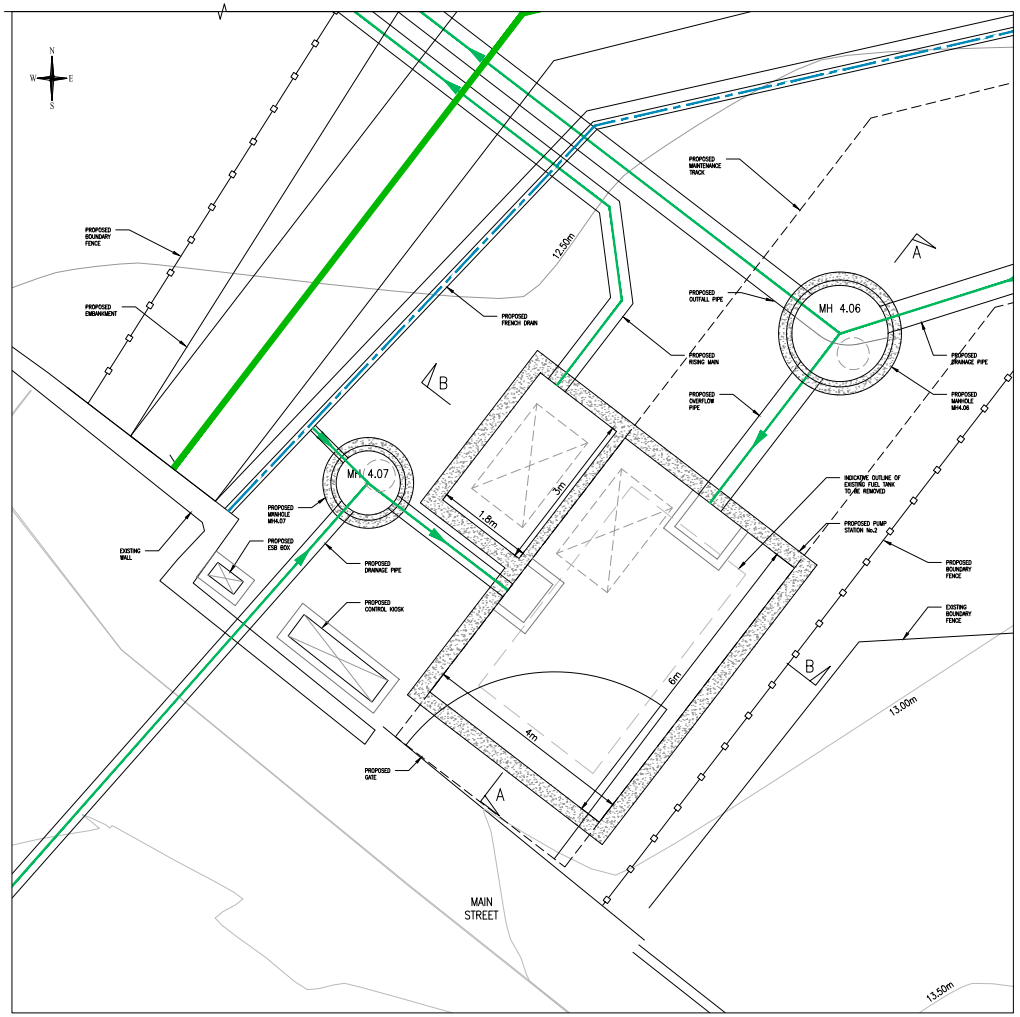




CONTROL KIOSK
(SCALE 1:50)



TYPICAL HEADER WALL
(SCALE 1:50)



LAYOUT PLAN
SCALE: 1:50

GENERAL NOTES

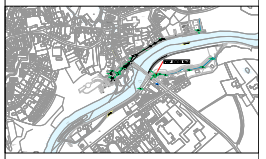
NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.

LEGEND:

- EXISTING SEWER
- EXISTING STORM DRAINAGE
- PROPOSED STORM DRAINAGE
- PROPOSED EMBANKMENT

KEYPLAN:



Rev	Date	Description	By	Chk	App
01	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

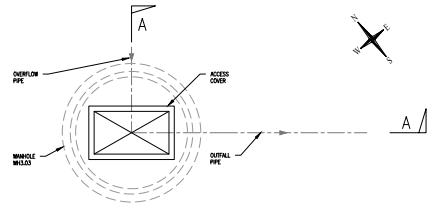
CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

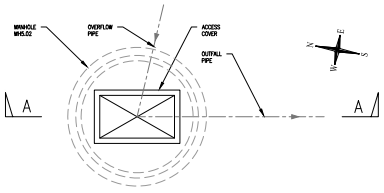
DRAWING TITLE
STORMWATER DRAINAGE
PUMPING STATION NO.2
GA LAYOUT, PLAN & SECTIONS

STATUS
FOR PLANNING

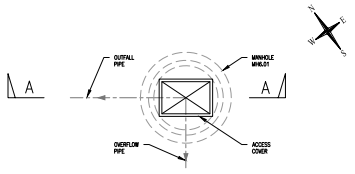
Date: 31.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1435			Rev: 01



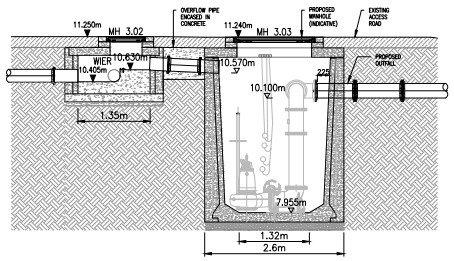
PS ROOF PLAN
(SCALE 1:50)



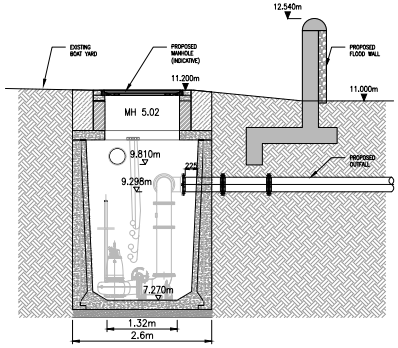
PS ROOF PLAN
(SCALE 1:50)



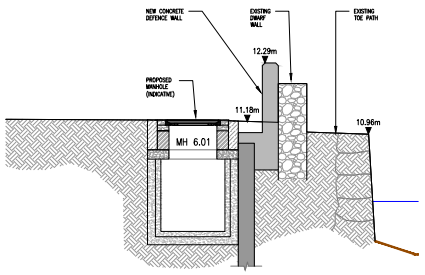
PS ROOF PLAN
(SCALE 1:50)



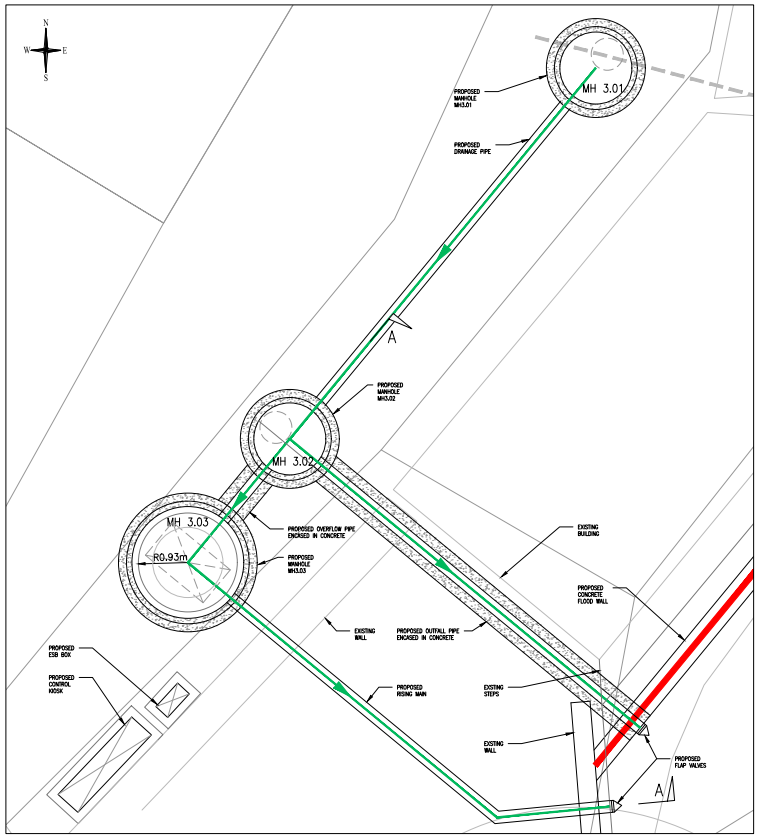
SECTION A-A
(SCALE 1:50)



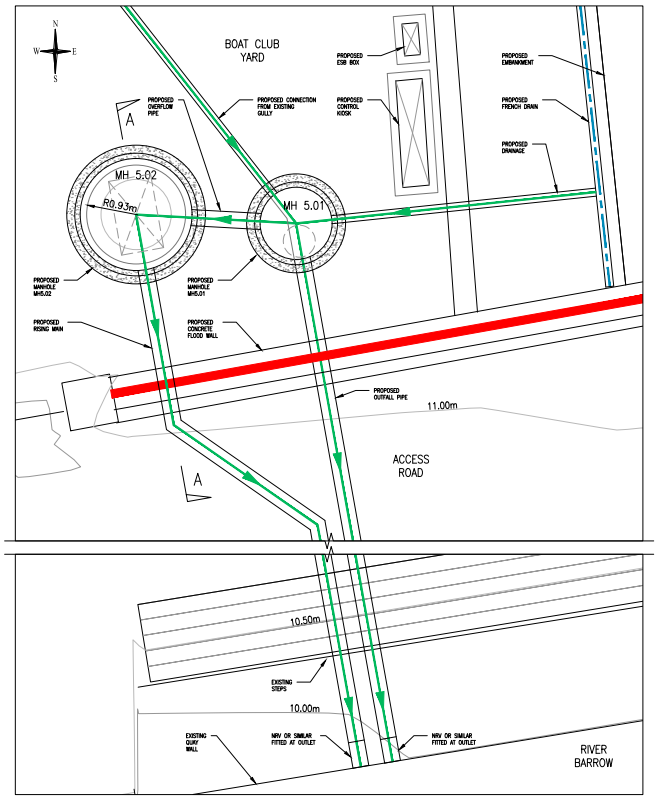
SECTION A-A
(SCALE 1:50)



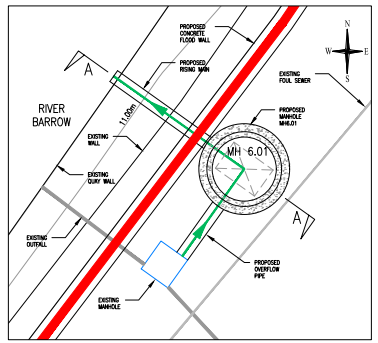
SECTION A-A
(SCALE 1:50)



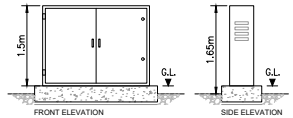
LAYOUT PLAN - PS3
SCALE: 1:50

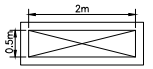


LAYOUT PLAN - PS4
SCALE: 1:50

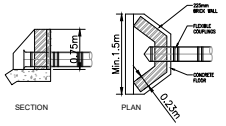


LAYOUT PLAN - PS5
SCALE: 1:50





CONTROL KIOSK
(SCALE 1:50)



TYPICAL HEADER WALL
(SCALE 1:50)

GENERAL NOTES

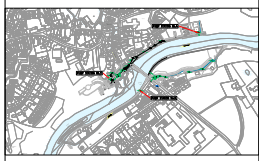
NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. FOR DETAILS OF FLOOD DEFENCES SEE DWGS W3451-AYE-DWG-W-1404 – W3451-AYE-DWG-W-1422.

LEGEND:

EXISTING SEWER
EXISTING STORM DRAINAGE
PROPOSED STORM DRAINAGE
PROPOSED EMBANKMENT

KEYPLAN:



Rev	Date	Description	By	Chk	App
01	04.03.25	ISSUE FOR PLANNING	LT	OL	SH
00	26.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

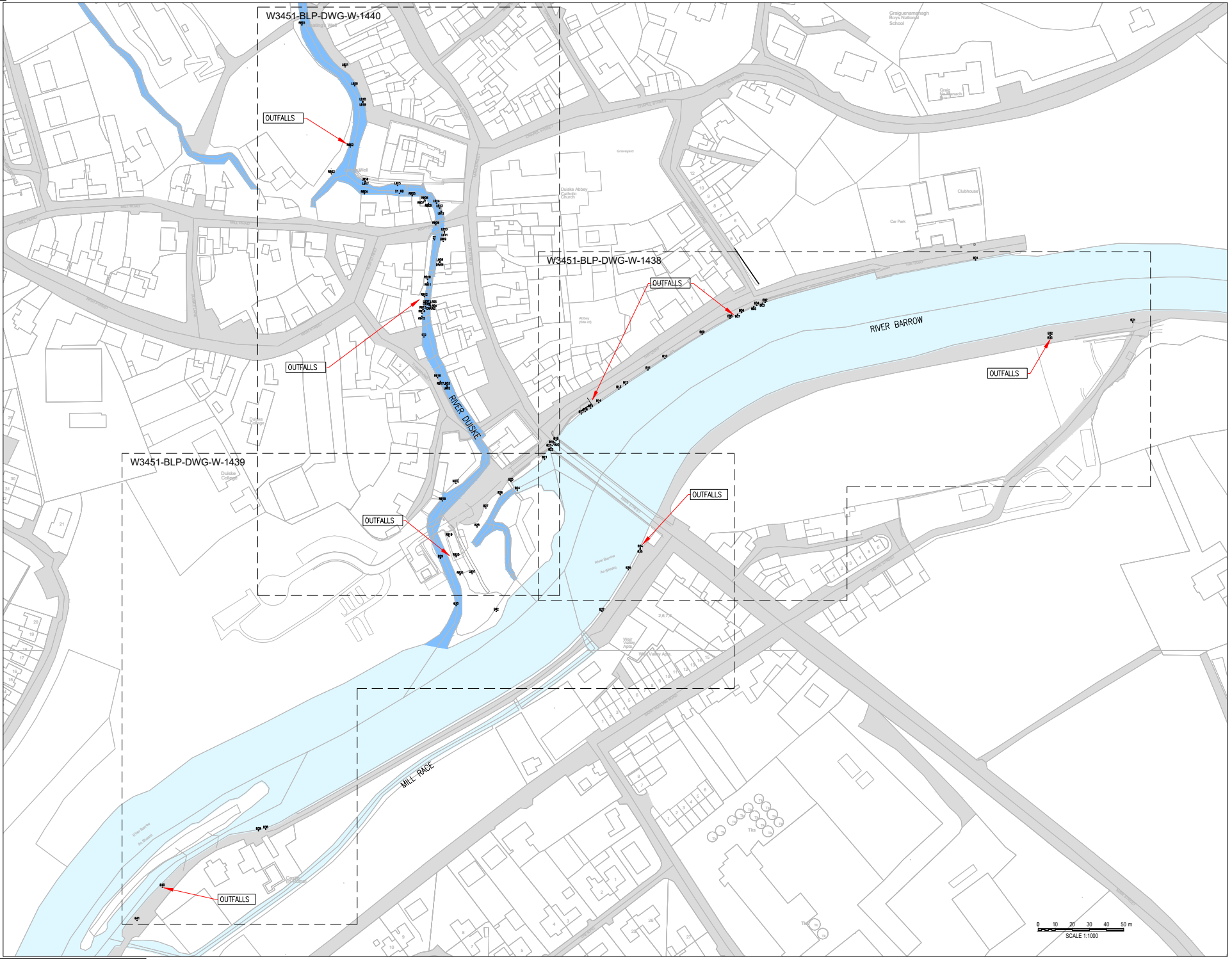
PROJECT
GRAIGUENAMANAGH TINNAHINCH FLOOD RELIEF SCHEME

DRAWING TITLE
STORMWATER DRAINAGE PUMPING STATIONS NO.3 & 4 GA LAYOUT, PLAN & SECTIONS

STATUS
FOR PLANNING

Date: 26.07.24	Scale: 1:50	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1436			Rev: 01

A1



GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.

LEGEND:

NRV – NON RETURN VALVE

Rev	Date	Description	By	Chk	App
00	26.07.24	ISSUE FOR PLANNING	LT	OL	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

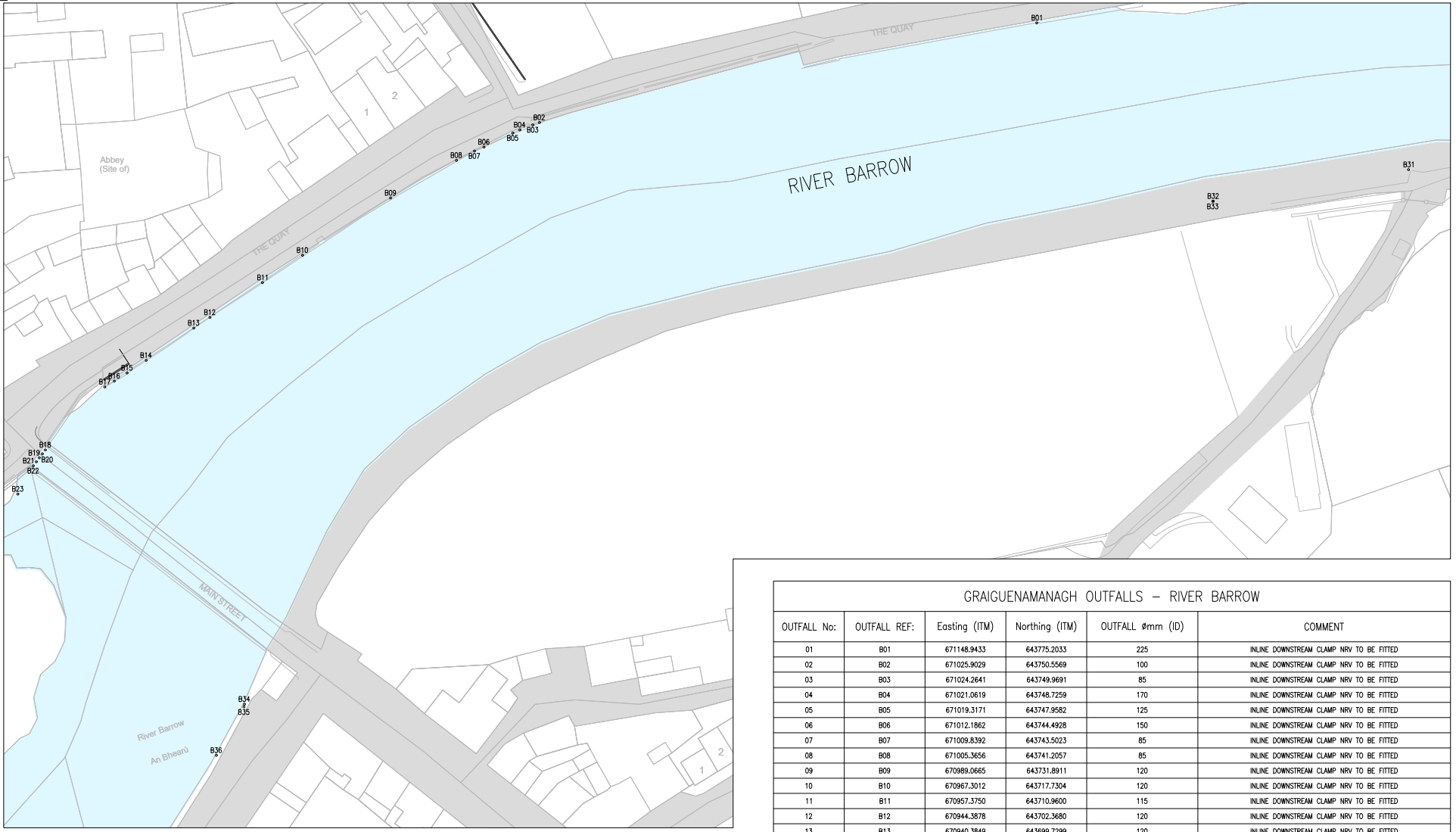
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
OUTFALL WORKS
OVERALL LAYOUT PLAN

STATUS
FOR PLANNING

Date: 02.11.23	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1437			Rev: 00

A1



GRAIGUENAMANAGH OUTFALLS – RIVER BARROW

OUTFALL No:	OUTFALL REF:	Easting (ITM)	Northing (ITM)	OUTFALL Ømm (ID)	COMMENT
01	B01	671148.9433	643775.2033	225	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
02	B02	671025.9029	643750.5569	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
03	B03	671024.2641	643749.9691	85	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
04	B04	671021.0619	643748.7259	170	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
05	B05	671019.3171	643747.9582	125	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
06	B06	671012.1862	643744.4928	150	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
07	B07	671009.8392	643743.5023	85	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
08	B08	671005.3656	643741.2057	85	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
09	B09	670989.0665	643731.8911	120	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
10	B10	670967.3012	643717.7304	120	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
11	B11	670957.3750	643710.9600	115	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
12	B12	670944.3878	643702.3680	120	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
13	B13	670940.3849	643699.7299	120	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
14	B14	670928.6180	643691.7399	115	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
15	B15	670923.8878	643688.6202	360	
16	B16	670920.7284	643686.6192	115	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
17	B17	670918.4069	643685.1672	120	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
18	B18	670903.6632	643669.5836	45	
19	B19	670902.9163	643668.6056	45	
20	B20	670902.1693	643667.6276	45	
21	B21	670901.4223	643666.6496	45	
22	B22	670900.6754	643665.6716	45	
23	B23	670896.8668	643658.6705	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
31	B31	671240.9401	643738.8996	170	
32	B32	671192.6388	643731.1073	90	
33	B33	671192.5184	643731.0765	90	
34	B34	670952.9423	643606.6965	115	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
35	B35	670952.8077	643606.0268	220	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
36	B36	670945.9686	643594.0409	240	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED

GENERAL NOTES

N
W E
S

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.

LEGEND:

NRV – NON RETURN VALVE

Rev	Date	Description	By	Chk	App
00	26.07.24	ISSUE FOR PLANNING	LT	OL	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

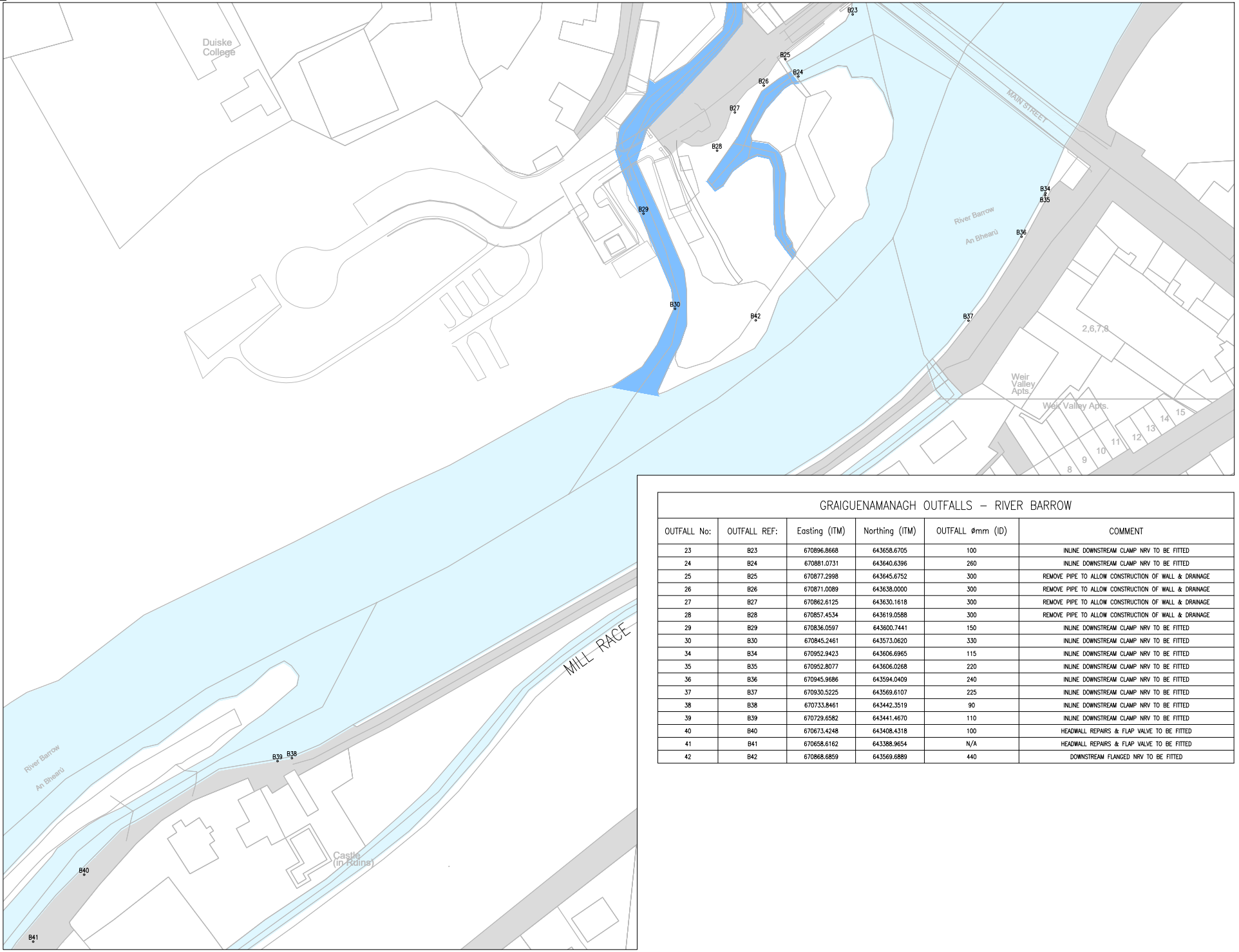
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
OUTFALL WORKS
RIVER BARROW OUTFALLS
SHEET 1

STATUS
FOR PLANNING

Date: 26.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1438			Rev: 00

A1



GRAIGUENAMANAGH OUTFALLS – RIVER BARROW

OUTFALL No:	OUTFALL REF:	Easting (ITM)	Northing (ITM)	OUTFALL Ømm (ID)	COMMENT
23	B23	670896.8668	643658.6705	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
24	B24	670881.0731	643640.6396	260	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
25	B25	670877.2998	643645.6752	300	REMOVE PIPE TO ALLOW CONSTRUCTION OF WALL & DRAINAGE
26	B26	670871.0089	643638.0000	300	REMOVE PIPE TO ALLOW CONSTRUCTION OF WALL & DRAINAGE
27	B27	670862.6125	643630.1618	300	REMOVE PIPE TO ALLOW CONSTRUCTION OF WALL & DRAINAGE
28	B28	670857.4534	643619.0588	300	REMOVE PIPE TO ALLOW CONSTRUCTION OF WALL & DRAINAGE
29	B29	670836.0597	643600.7441	150	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
30	B30	670845.2461	643573.0620	330	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
34	B34	670952.9423	643606.6965	115	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
35	B35	670952.8077	643606.0268	220	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
36	B36	670945.9686	643594.0409	240	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
37	B37	670930.5225	643569.6107	225	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
38	B38	670733.8461	643442.3519	90	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
39	B39	670729.6582	643441.4670	110	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
40	B40	670673.4248	643408.4318	100	HEADWALL REPAIRS & FLAP VALVE TO BE FITTED
41	B41	670658.6162	643388.9654	N/A	HEADWALL REPAIRS & FLAP VALVE TO BE FITTED
42	B42	670868.6859	643569.6889	440	DOWNSTREAM FLANGED NRV TO BE FITTED

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.

LEGEND:

NRV – NON RETURN VALVE

Rev	Date	Description	By	Chk	App
00	26.07.24	ISSUE FOR PLANNING	LT	OL	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

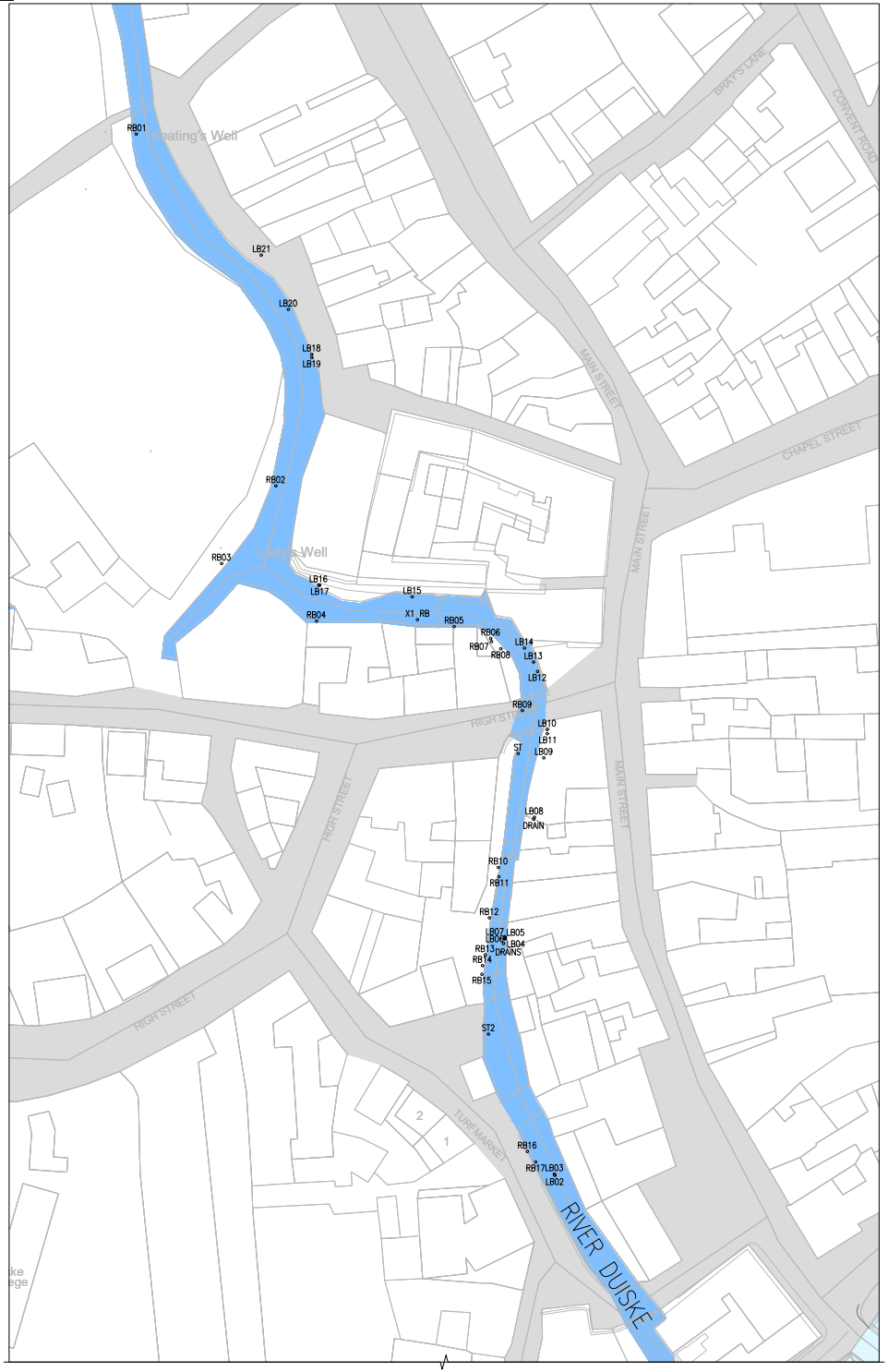
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
OUTFALL WORKS
RIVER BARROW OUTFALLS
SHEET 2

STATUS
FOR PLANNING

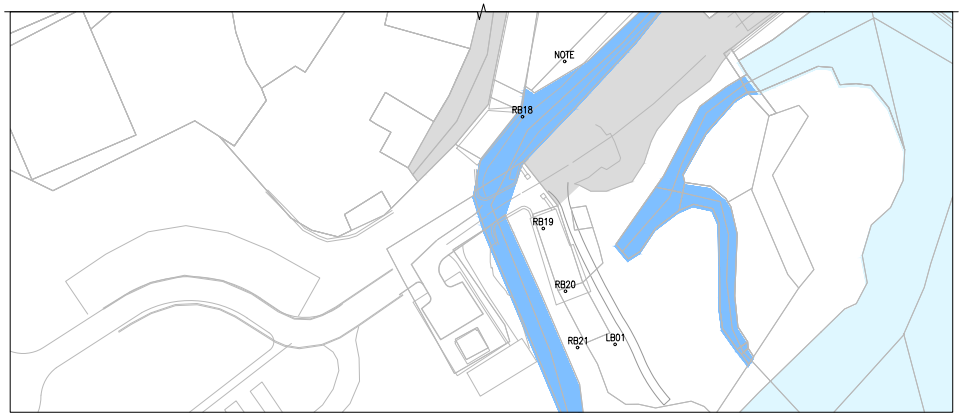
Date: 26.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451–AYE–DWG–W–1439			Rev: 00

A1



GRAIGUENAMANAGH OUTFALLS – RIVER DUISKE

OUTFALL No:	OUTFALL REF:	Easting (ITM)	Northing (ITM)	OUTFALL ⌀mm (ID)	COMMENT
01	RB01	670755.0000	643912.0000	275	NRV TO BE FITTED
02	RB02	670783.0000	643841.0000	100	NRV TO BE FITTED
03	RB03	670772.0000	643825.0000	600x300	NRV TO BE FITTED
04	RB04	670791.0000	643813.0000	100	EXTEND PIPE BY 1m, STRAP TO WALL & FIT INLINE DOWNSTREAM CLAMP NRV
05	RB05	670819.0000	643813.0000	110	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
06	RB06	670826.0000	643810.0000	50	NRV TO BE FITTED
07	RB07	670827.0000	643809.0000	100	UE CONNECTION. REPAIR PIPE & INCLUDE ACCESS TRAP
08	RB08	670828.0000	643808.0000	225	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
09	RB09	670833.0000	643795.0000	225	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
10	RB10	670828.0000	643764.0000	500x300	NRV TO BE FITTED
11	RB11	670828.0000	643762.0000	65	
12	RB12	670826.0000	643754.0000	65	
13	RB13	670825.0000	643746.0000	225	NRV TO BE FITTED
14	RB14	670825.0000	643744.0000	100	NRV TO BE FITTED
15	RB15A	670824.0000	643741.0000	100	NRV TO BE FITTED
16	RB15B	670824.0000	643741.0000	100	NRV TO BE FITTED
17	RB16	670834.0000	643706.0000	100	NRV TO BE FITTED
18	RB17	670836.0000	643704.0000	250	NRV TO BE FITTED
19	RB18	670837.0000	643634.0000	225	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
20	LB02	670839.0000	643702.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
21	LB03	670839.0000	643702.0000	65	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
22	LB04	670829.0000	643749.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
23	LB05	670829.0000	643749.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
24	LB06	670829.0000	643749.0000	50	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
25	LB07	670835.0000	643774.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
26	LB08	670835.0000	643774.0000	40	CONNECT WASTE PIPE TO LARGER PIPE AND PLACE NRV ON LARGER PIPE IN NEW WALL
27	LB09	670837.0000	643786.0000	100	
28	LB10	670838.0000	643792.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
29	LB11	670838.0000	643791.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
30	LB12	670836.0000	643803.0000	375	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
31	LB13	670835.0000	643805.0000	125	NRV TO BE FITTED
32	LB14	670833.0000	643808.0000	100	PIPE REPAIRS, NRV TO BE FITTED
33	LB15	670810.0000	643818.0000	150	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
34	LB16	670791.0000	643821.0000	200	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
35	LB17	670791.0000	643821.0000	200	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
36	LB18	670790.0000	643868.0000	100	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED
37	LB19	670790.0000	643867.0000	150	NRV TO BE FITTED
38	LB20	670785.0000	643877.0000	150	NRV TO BE FITTED
39	LB21	670780.0000	643888.0000	150	INLINE DOWNSTREAM CLAMP NRV TO BE FITTED



GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.

LEGEND:

NRV – NON RETURN VALVE

RB/LBxx

Rev	Date	Description	By	Chk	App
00	26.07.24	ISSUE FOR PLANNING	LT	OL	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

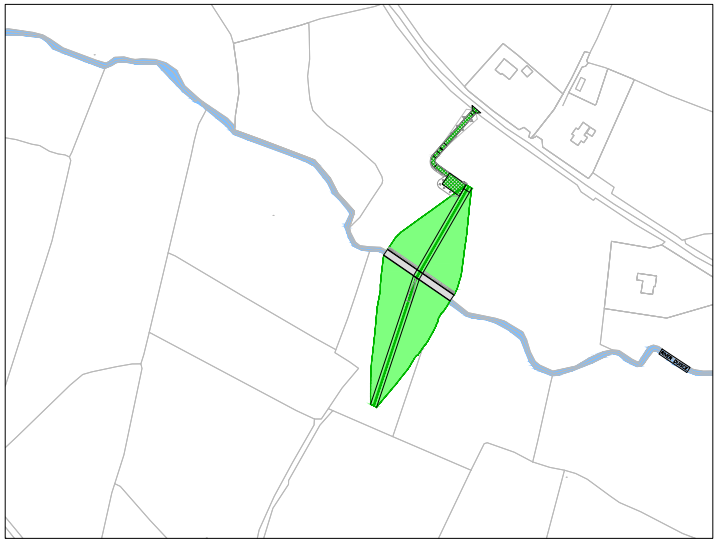
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
OUTFALL WORKS
RIVER DUISKE OUTFALLS

STATUS
FOR PLANNING

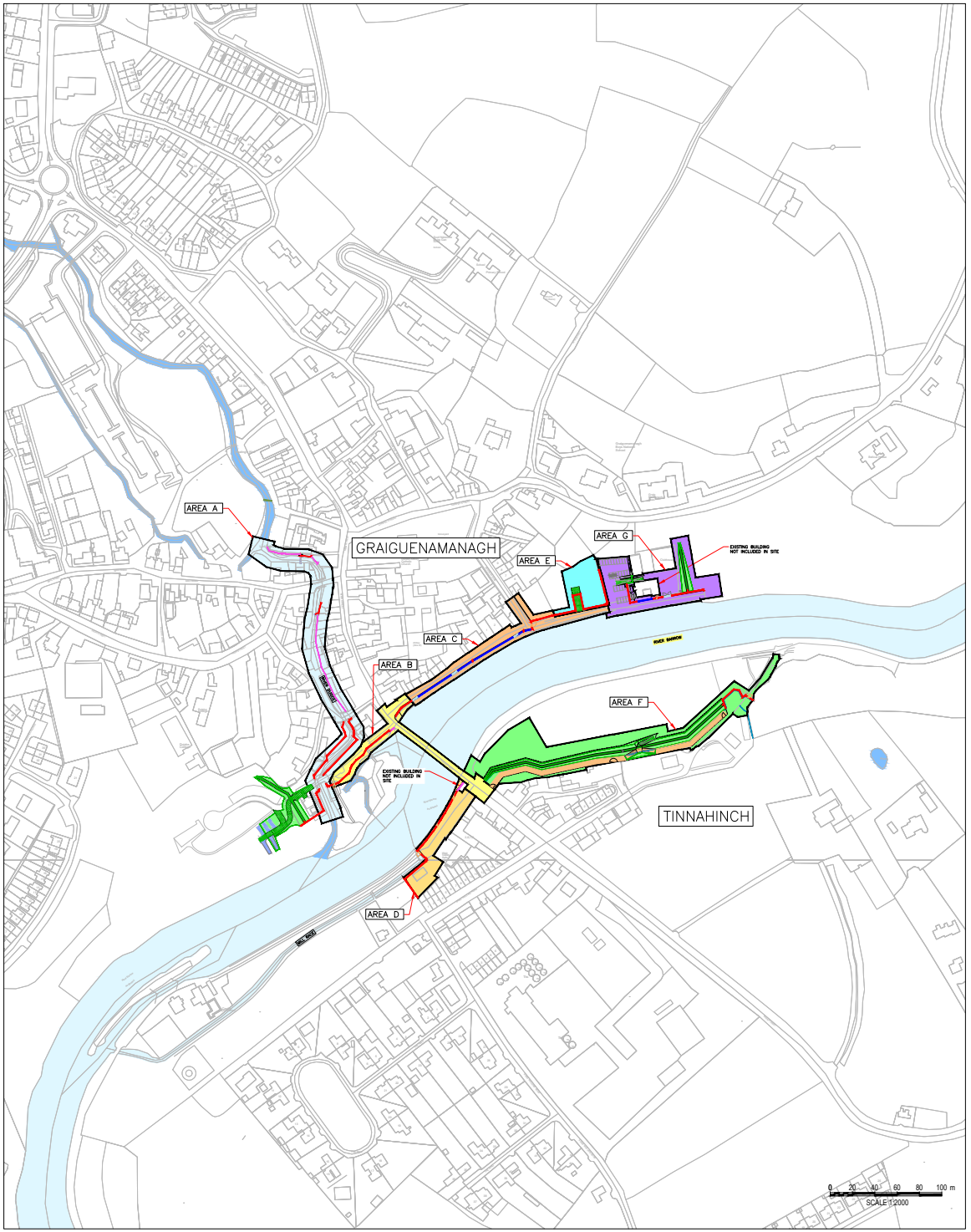
Date: 26.07.24	Scale: 1:1000	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1440			Rev: 00

A1



GRAIGUENAMANAGH–TINNAHINCH FRS – CONSERVATION STRATEGY

AREA TITLE	CHARACTER AREA LOCATION	KEY STRATEGIES
A	RIVER DUISKE CHARACTER AREA	FLOOD RELIEF WORKS TO PROTECT BUILDINGS ARE CARRIED OUT WITHIN AN HISTORIC URBAN RIVERSIDE LANDSCAPE WITH MINIMUM INTERVENTION & FLOOD WALLS ARE CLAD IN RUBBLE LIMESTONE MASONRY INTEGRATING WITH THE CHARACTER OF THE HISTORIC LANDSCAPE
B	GRAIGUENAMANAGH BRIDGE CHARACTER AREA	NO WORKS ARE REQUIRED TO THE BRIDGE BUT ADJOINING WORKS ARE CARRIED OUT TO RETAIN THE SIGNIFICANCE OF THE BRIDGE
C	GRAIGUENAMANAGH QUAY PUBLIC REALM AREA	AN INTERVENTION APPROACH TO THE QUAY WALLS GLAZED PANELS & PUBLIC REALM IS PROPOSED, LED BY THE LANDSCAPE ARCHITECT
D	TINNAHINCH QUAY PUBLIC REALM AREA	THE HISTORIC QUAY WALL & RIVER ACCESS ARE MAINTAINED IN THEIR ORIGINAL STATE WITH NEW WALLS DESIGNED TO BE MUTE WITHIN AN HISTORIC NATIVE LANDSCAPE
E	GLAMPING SITE CHARACTER AREA	EXISTING DWARF WALLS, GATES ARE TO BE CONSERVED & NEW FLOOD WALLS IN RANDOM RUBBLE REFLECT THE HISTORIC CHARACTER
F	TINNAHINCH LANDSCAPE WEST AREA	NO IMPACT IS EXPECTED IN BUILT HERITAGE
G	BOATCLUB CHARACTER AREA	FLOOD WALLS IN THIS AREA IN RANDOM RUBBLE MASONRY, MAINTAINING SIGNIFICANCE OF THE BOAT CLUB



SITE EXTENT PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. OSAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016–A, 5016–B, 5016–C & 5016–D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404–1423.

LEGEND:

- CHARACTER AREA A
- CHARACTER AREA B
- CHARACTER AREA C
- CHARACTER AREA D
- CHARACTER AREA E
- CHARACTER AREA F
- CHARACTER AREA G

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	SH	SH
01	18.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	23.09.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

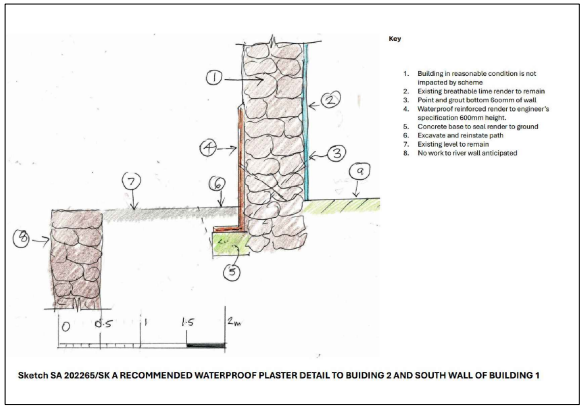
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
CONSERVATION STRATEGY
OVERALL SITE LAYOUT

STATUS
FOR PLANNING

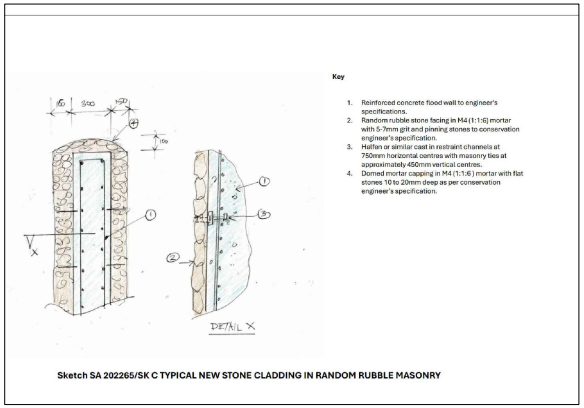
Date:23.09.24	Scale:1:2000	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451–AYE–DWG–W–1441			Rev: 02

A1



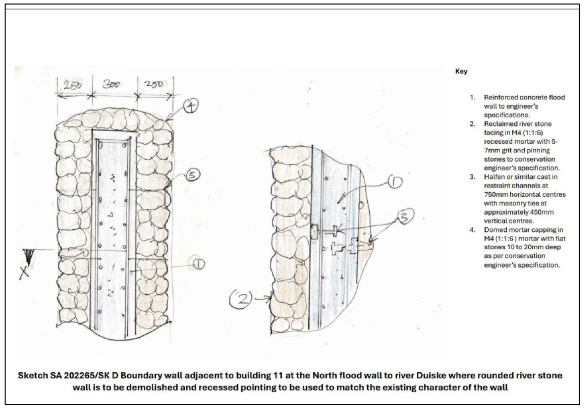
Sketch SA 202265/SK A RECOMMENDED WATERPROOF PLASTER DETAIL TO BUIDING 2 AND SOUTH WALL OF BUILDING 1

SKETCH A
SCALE: NTS



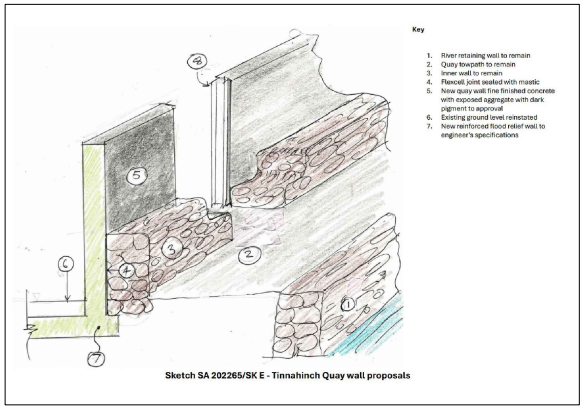
Sketch SA 202265/SK C TYPICAL NEW STONE CLADDING IN RANDOM RUBBLE MASONRY

SKETCH C
SCALE: NTS



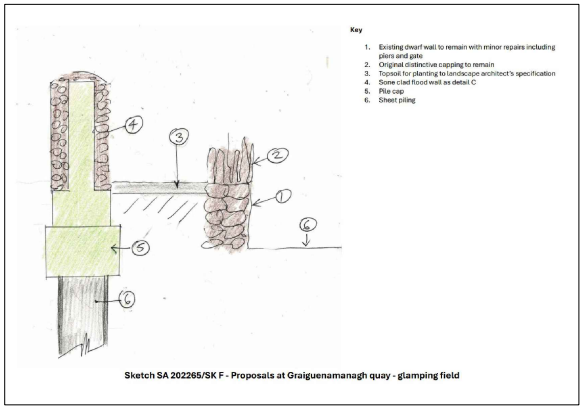
Sketch SA 202265/SK D Boundary wall adjacent to building 11 at the North flood wall to river Duiske where rounded river stone wall is to be demolished and recessed pointing to be used to match the existing character of the wall

SKETCH D
SCALE: NTS



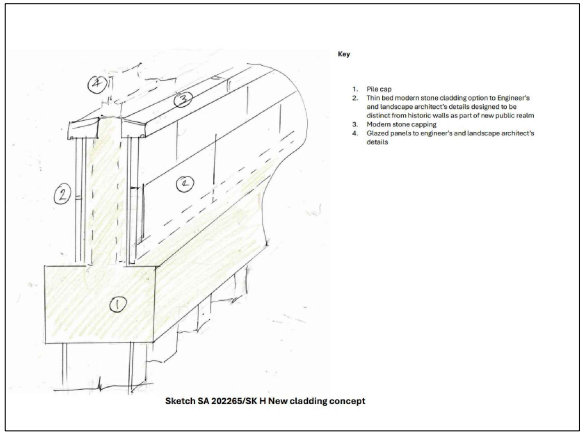
Sketch SA 202265/SK E - Tinnahinch Quay wall proposals

SKETCH E
SCALE: NTS



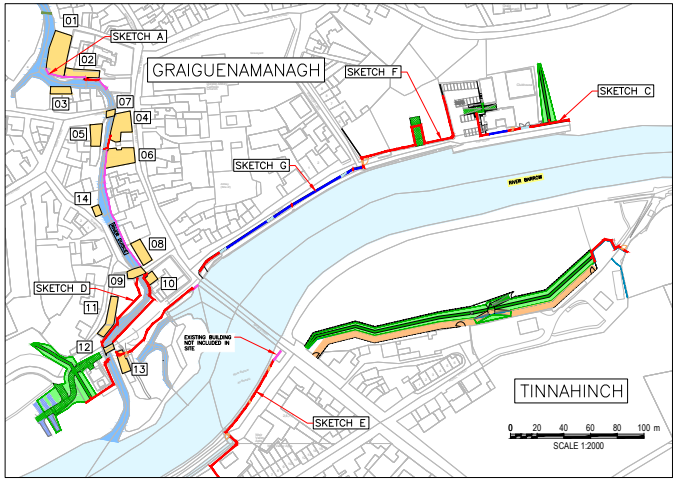
Sketch SA 202265/SK F - Proposals at Graiguenamanagh quay - glamping field

SKETCH F
SCALE: NTS



Sketch SA 202265/SK H New cladding concept

SKETCH H
SCALE: NTS



SITE EXTENT PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. OSAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423.

LEGEND:

CONSERVATION INVESTIGATION AREA

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	SH	SH
01	18.11.24	ISSUE FOR PLANNING	LT	SH	SH
00	23.09.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

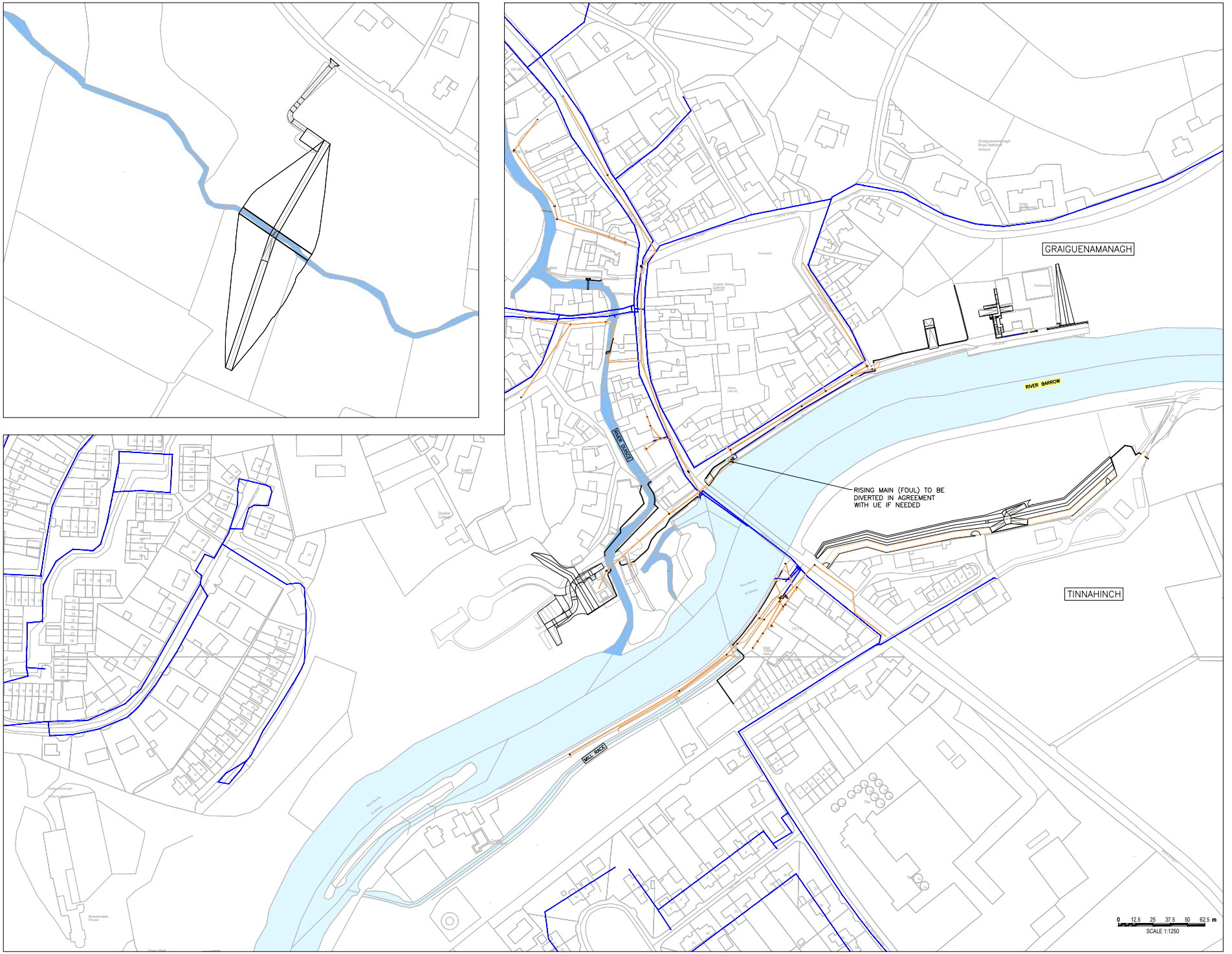
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
CONSERVATION STRATEGY
WALL DETAILS

STATUS
FOR PLANNING

Date: 23.09.24	Scale: AS SHOWN	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1442			Rev: 02

A1



SITE PLAN
SCALE: 1:1250

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423

LEGEND:

EXISTING FOUL SEWER
EXISTING WATER MAIN

Rev	Date	Description	By	Chk	App
02	04.03.25	ISSUE FOR PLANNING	LT	SH	SH
01	21.10.24	ISSUE FOR PLANNING	LT	SH	SH
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

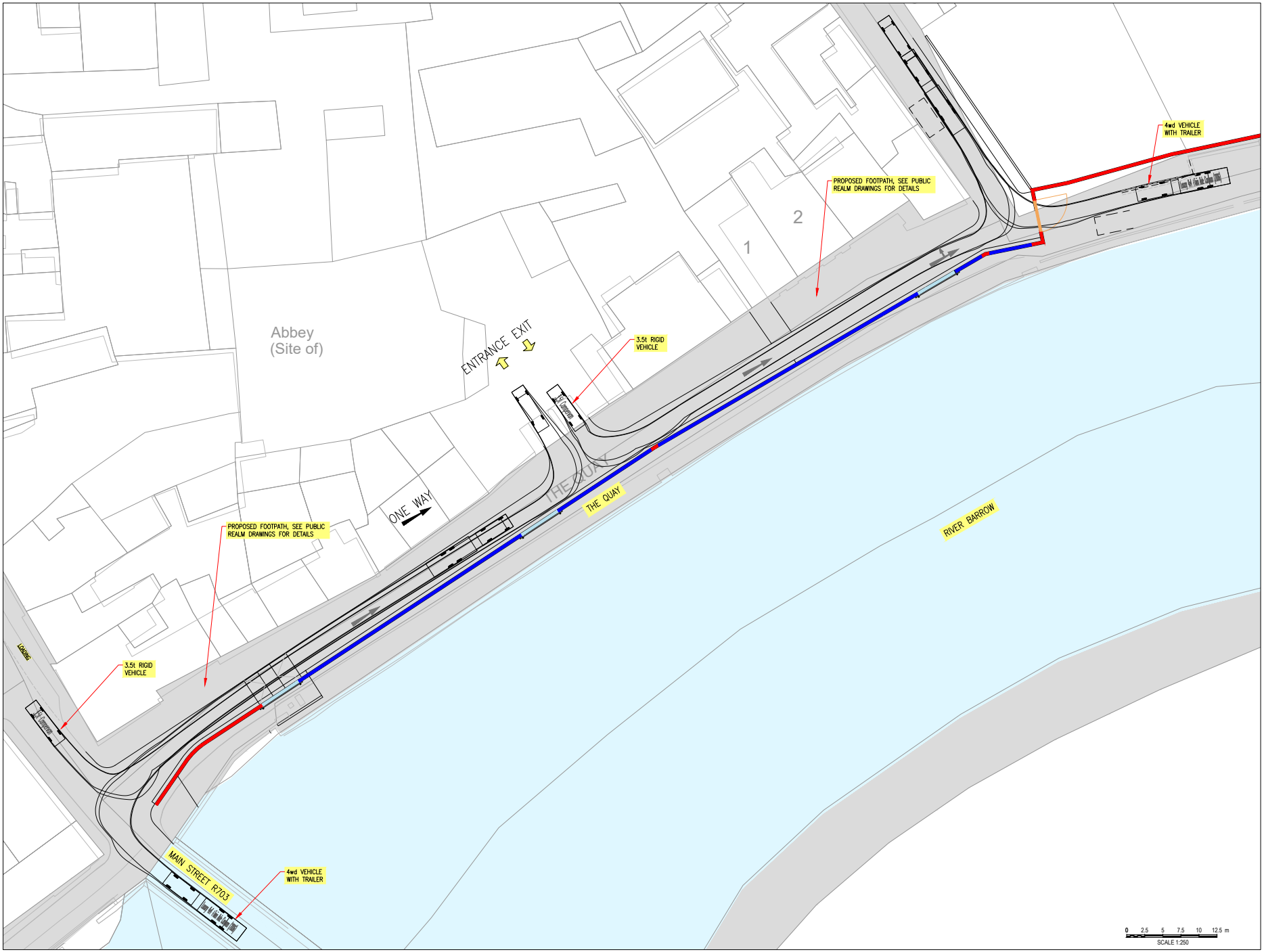
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
UE WATER DIVERSIONS LAYOUT

STATUS
FOR PLANNING

Date:31.07.24	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1443			Rev: 02

A1



SITE PLAN
SCALE: 1:250

GENERAL NOTES

NOTES:

1. CYAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. LONG SECTIONS ARE DEVELOPED SECTIONS FROM THE DIRECTION SHOWN.
4. DESIGN FLOOD LEVEL SHOWN FOR INFO ONLY, AND APPLIES TO WET SIDE ONLY.
5. FREEBOARD:
   HARD DEFENCES: 350mm
   SOFT DEFENCES: 550mm
6. HEIGHT REFERRED TO ARE FROM CENTRELINE OF CREST OF EMBANKMENT/WALL.
7. FOR FLOOD DEFENCES IDENTIFIER LABELS REFER TO DRAWING W3451-AYE-DWG-W-4025.
8. FOR CONSERVATION STRATEGY WALL FINISHES REFER TO SKETCHES F & H, DRAWING W3451-AYE-DWG-W-1442.

LEGEND:

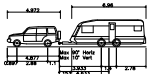
EXISTING GROUND LEVEL
DESIGN FLOOD LEVEL
UPGRADE EXISTING WALL
NEW FLOOD DEFENCE WALL
GLASS WALL FLOOD DEFENCE
NEW FLOOD GATES
NEW SLIDING FLOOD GATES

VEHICLE:

3.5t Campervan

Overall Length	6.700m
Overall Width	1.860m
Overall Body Height	1.919m
Min Body Ground Clearance	0.300m
Max Track Width	1.770m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	5.700m

3.5t RIGID VEHICLE



Luxury 4x4 +Twin Axle Caravan (2006)

Overall Length	12.990m
Overall Width	2.496m
Overall Body Height	4.324m
Min Body Ground Clearance	0.251m
Max Track Width	2.130m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	5.800m

4wd VEHICLE WITH TRAILER

KEYPLAN:

Rev	Date	Description	By	Chk	App
00	31.07.24	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

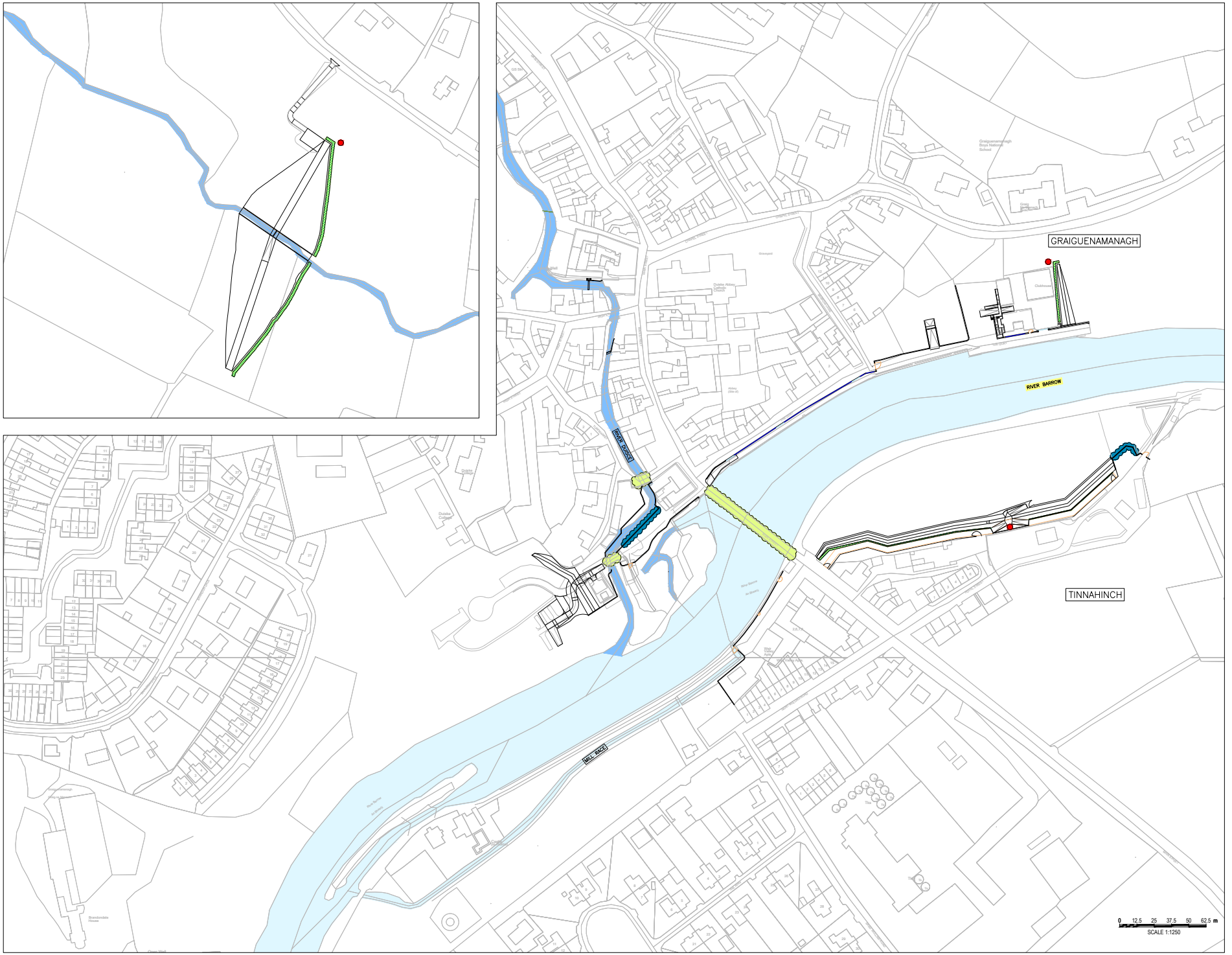
PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
AUTOTRACKING LAYOUT

STATUS
FOR PLANNING

Date: 14.10.24	Scale: 1:250	Drawn: LT	Chk: SH	App: SH
Project No: W3451	Drg. No: W3451-AYE-DWG-W-1444			Rev: 00

A1



SITE PLAN
SCALE: 1:2000

GENERAL NOTES

NOTES:

1. OSAL50338216 © NATIONAL MAPPING DIVISION OF TAILTE EIREANN.
2. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
3. ALL LEVELS ARE IN METRES AND RELATE TO MALIN HEAD ORDNANCE DATUM.
4. TAKEN FROM OS MAPS No. 5016-A, 5016-B, 5016-C & 5016-D.
5. FOR DETAILS OF FLOOD DEFENCES SEE DWGS 1404-1423
6. FOR DETAILS OF BIODIVERSITY ENHANCEMENT MEASURES SEE EAR DOCUMENT, VOLUME II, CHAPTER 10, 'BIODIVERSITY ENHANCEMENT MEASURES GRAIGUENAMANAGH'.

LEGEND:

PROPOSED DRY MEADOWS
PROPOSED ROOSTING HABITAT
PROPOSED BAT BOXES
PROPOSED BEE SCRAPES

Rev	Date	Description	By	Chk	App
00	04.03.25	ISSUE FOR PLANNING	LT	SH	SH

ayesa

CLIENT
KILKENNY COUNTY COUNCIL

PROJECT
GRAIGUENAMANAGH TINNAHINCH
FLOOD RELIEF SCHEME

DRAWING TITLE
SITE WORKS
BIODIVERSITY ENHANCEMENT MEASURES

STATUS
FOR PLANNING

Date:04.03.25	Scale: 1:1250	Drawn:LT	Chk: SH	App: SH

Project No:	Drg. No:	Rev:
W3451	W3451-AYE-DWG-W-1445	00

Appendix B – Top-up Survey Report

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Ecology Surveys 2020-2024

Report No. W3451-AYE-ENV-R015

26th May 2025

Revision 00

Document Control

Project:	Graiguenamanagh-Tinnahinch Flood Relief Scheme
Document:	Ecology Surveys 2020-2024
Client:	Kilkenny County Council
Report Number:	W3451-AYE-ENV-R007
Document Checking:	

Revision	Revision/ Review Date	Details of Issue	Authorised		
			Prepared By	Checked By	Approved By
00	26th May 2025	For Client Review	JB MS	AB	BS
Disclaimer: Please note that this report is based on specific information, instructions, and information from our Client and should not be relied upon by third parties.					

www.ayesaeng.com

www.ayesa.com/en

Contents

1 Introduction

1.1 Project Background

Kilkenny County Council (KCC) and Carlow County Council (CCC) have engaged the services of Ayesa (formerly Byrnelooby) for the Planning/Development Consent of a proposed Flood Relief Scheme (FRS) for the Graiguenamanagh-Tinnahinch Flood Relief Scheme (GTFRS) (the "Scheme").

1.2 Ecology Survey Background

At the conception of the Project in 2020, a series of ecological surveys were conducted to inform the environmental constraints study and optioneering assessment of the Scheme going forward. The surveys conducted are detailed in Table 1-1.

When these initial surveys were completed, they considered the habitat and species that may be impacted by the options identified in the Catchment Flood Risk Assessment and Management (CFRAM) level assessment, which included defences within the environs of the town of Graiguenamanagh-Tinnahinch only. However, since then, the Scheme has been undergoing extensive optioneering and engineering design as well as stakeholder engagement and as such, new design developments have been incorporated. The most notable change was the inclusion of an upstream storage facility along the River Duiske which, through optioneering and stakeholder engagement, was found to have a significant benefit to the Scheme. Since the area proposed for the upstream storage (US) was not initially included in the original ecology surveys, a dedicated set of surveys has been undertaken in 2023 and 2024 to identify important habitats and species in the area proposed for development. These surveys are additionally detailed in Table 1-1.

Alongside, Ayesa reviewed the lifespan of the original ecological surveys conducted in 2020/2021 and, in accordance with available and applicable advice, made recommendations of additional surveys to provide up-to-date baseline information for input into the EIAR. The Advice Note from the Chartered Institute of Ecology and Environmental Management (CIEEM) 'on the Lifespan of Ecological Reports & Surveys' (April 2019) was referenced in making these recommendations. The Report detailing the reasoning behind these recommendations is included in Appendix A and the dates of these surveys are outlined in Table 1-1.

Table 1-1: Ecological Surveys Conducted for the GTFRS 2020 - 2024

Survey Type	**Original Surveys 2020-2021** (completed in the towns of GT only)	**Upstream Storage Area Surveys 2023-2024** (completed at the US area only)	**Top Up Ecology Surveys 2023-2024** (completed in the towns of GT only, to 'top up' the original surveys)
Bat Survey	14-16/09/2020	02/08/2023, 15/08/2023, 16/08/2023 01/09/2023, 05/09/2023, 07/09/2023, 12/09/2023 & 22/09/2023	27/05/2024, 23/06/2024, 18/07/2024, 04/09/2024
Wintering Bird Survey	16-18/02/2021	Visit 1:19-20/12/2023 Visit 2:16-17/01/2024 Visit 3: 22-23/02/2024	Visit 1:19-20/12/2023 Visit 2:16-17/01/2024 Visit 3: 22-23/02/2024
Breeding Bird Survey	02/04/2021	Visit 1: 09-11/09/2023 Visit 2: 28-29/03/2024 Visit 3:26-27/06/2024	Visit 1: 09-11/09/2023 Visit 2: 28-29/03/2024 Visit 3:26-27/06/2024
Mammal Survey (including otter, badger, pine martin, red squirrel).	16-18/02/2021	09-11/09/23	28/29 March 2024
Herpetofauna Survey	16-18/02/2021	28/29 March 2024	*Not required (no suitable habitat identified)*
Flora Survey	16-18/02/2021	Not required (observations made in January 2023 for H&S)	26-27/06/2024
Water Quality & Q-values/ invertebrates Survey	08/02/2021	09 & 10/08/2023	26-27/06/2024
Fish Habitat Survey	10/02/2021	09/08/2023	*Not required (original data suitable)*
Electrofishing Survey	10/02/2021	*Not required (original data suitable)*	*Not required (original data suitable)*
White-Clawed Crayfish	29/04/2021	10/08/2023	*Not required (original data suitable)*
Freshwater Pearl Mussel	30/04/2021	*Not required (original data suitable)*	*Not required (original data suitable)*
Arboricultural Survey	First visit - 23/05/2023 – 25/05/2023 Second visit – 19/12/2023 & 15/11/ 2024		*Not required (survey is not out of date)*

1.3 Purpose of Report

This report details the findings of all ecology surveying completed for the GTFRS between 2020 and 2024, as summarized in Table 1-1.

1.4 Proposed project

The Proposed Scheme consists of a series of raised defences (flood walls and embankments) along the River Duiske and River Barrow. It further includes upstream storage of flood waters (upstream on the River Duiske) to facilitate a reduced extent of flood walls downstream in the built-up area of Graiguenamanagh. The Proposed Scheme will be designed to provide protection to the communities of Graiguenamanagh-Tinnahinch from the 1 in 100-year flood event (1% AEP).

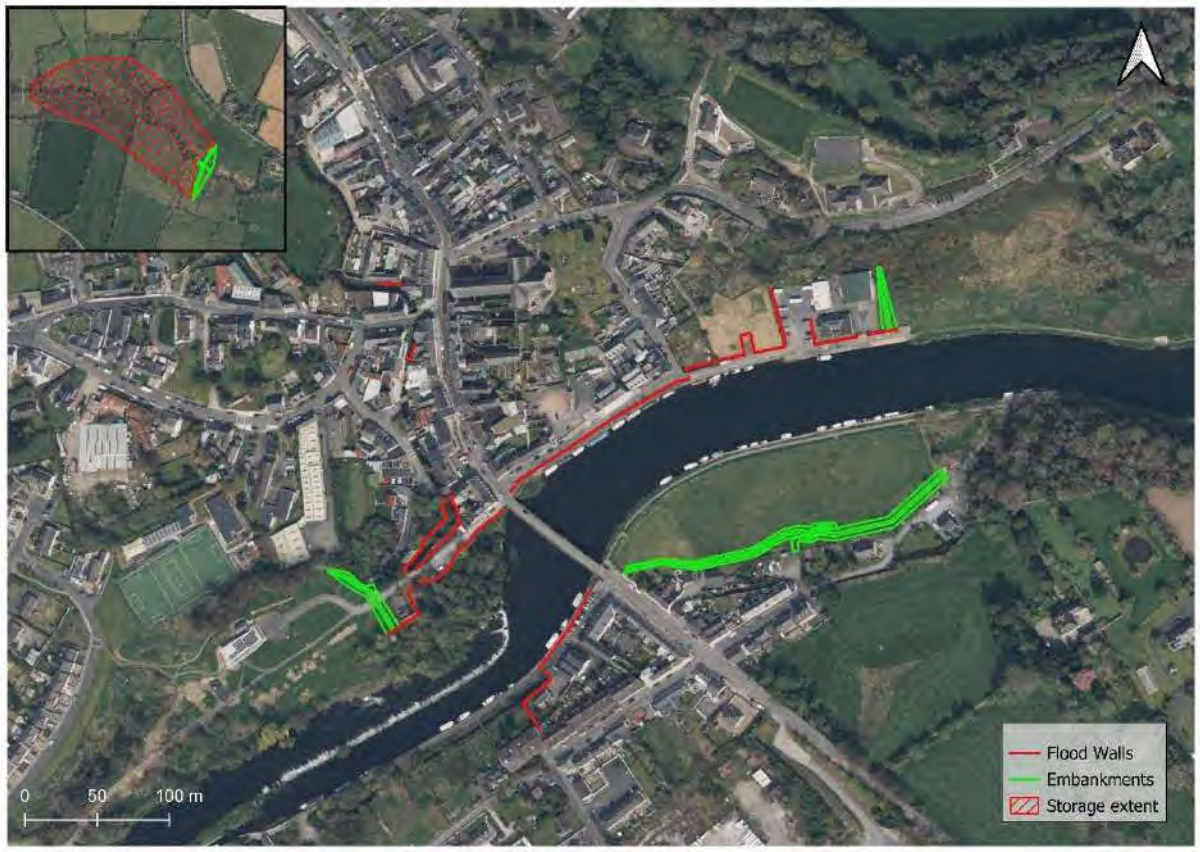


Figure 1-1: Scheme Design

1.5 Qualifications

Table 1-2 provides a summary of the staff involved in the surveying and reporting.

Table 1-2: Ecology Team Qualifications

Title	Name	Role	Qualifications	Years' experience
Director, Environment	Barry Sheridan	Report reviewer	MA Env Sci, HDip Bus/I.T., HDip Env. Eng, HDip Acoustics	20+
Environmental Consultant	Andrea Brogan	Report reviewer	B.A (Hons)	5
Senior Ecologist	Jeff Hean	Survey, Report Preparation	Ph. D in Zoology IES Member	8
Ecologist	Joe Butler	Survey, Report Preparation	BSc (Zoology) MSc (Wildlife Conservation & Management) QCIEEM	5
Graduate Ecologist	Meadhbh Stack	Survey, Report Preparation	BSc (Ecology and Environmental Biology) QCIEEM	1

Some surveys have been conducted by external ecologists, namely AQUAFACT/APEM, Triturus and Veon. The roles and qualifications of the survey teams involved are included in their individual reports.

2 Bat Surveys

2.1 Original CFRAM Survey (2020)

Ayesa's internal ecologist team completed this survey in September 2020. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch. The results of the survey are outlined in the Bat Survey Report included in Appendix B.

2.2 Upstream Storage Area (2023/2024)

This survey was completed externally by Veon in August and September 2023. The results of the survey are included in Veon's survey report, included in Appendix C.

2.3 Top up Survey (2023/2024)

This survey was completed externally by Veon in June 2024. The intention was to 'top up' the original surveys completed in 2020, as outlined above. The results of the survey are included in Veon's survey report, included in Appendix D.

3 Breeding Bird Surveys

3.1 Overview

3.1.1 Original CFRAM Survey (2021)

Ayesa's internal ecologist team completed a single breeding bird observation survey in April 2021. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch.

The results of the survey are outlined in Section 3.3 and Appendix E of this Report.

3.1.2 Upstream Storage Area (2023/2024)

A series of breeding bird surveys were conducted at the upstream storage area by Ayesa's internal ecology team. These were conducted across three visits within the breeding bird survey season, the first in September 2023, the second in March 2024 and the third in June 2024.

The results of these surveys are outlined in Section 3.3 and Appendix E of this Report.

3.1.3 Top up Survey (2023/2024)

A series of breeding bird surveys were conducted by Ayesa's internal ecology team to 'top up' the original CFRAM level surveys outlined above. As with the above, these were conducted across three visits within the breeding bird survey season, the first in September 2023, the second in March 2024 and the third in June 2024.

The results of these surveys are outlined in Section 3.3 and Appendix E of this Report.

3.2 Survey Methodology

3.2.1 Guidelines

The breeding bird survey methodology was designed and undertaken in accordance with guidance described in:

- Countryside Bird Survey: Status and Trends of Common and Widespread Breeding Birds 1998-2016 (Lewis et al., 2019b).
- Breeding Bird Survey: Methodology and Survey Design (BTO, 2023). [Online] Available at: https://www.bto.org/our-science/projects/breeding-bird-survey/research-conservation/methodology-and-survey-design
- I-WeBS Counter Manual: Guidelines for Irish Wetland Bird Survey Counters
- Bird Census Techniques (Bibby, *et al*., 2000)

- 'Field Guide to the Birds of Britain and Europe' by John Gooders (Larousse) - identification
- I-WeBS best practice guidelines of standard techniques for traditional ground surveying are the recommended methods by Bird Watch Ireland.

3.2.2 Ethics Statement

Precautionary measures were taken to ensure minimal/no disturbances were imposed on the feeding/breeding/nesting of breeding birds present. Care was taken at all times to avoid flushing any species within the sampling sites, with previously researched vantage point locations with recommended distances and wintering waterbird species-specific responses to human disturbances.

3.2.3 Survey Method and Locations

3.2.3.1 Original CFRAM Survey (2021)

The survey involved line transects along the routes shown in Figure 3-1. It was carried out early in the morning, approximately 30 minutes after sunrise. Where possible, surveying was avoided during heavy rain, strong winds or poor visibility (e.g. fog). Each transect line was walked by the ecologist, and all avian species observed (visually or aurally) were recorded. Binoculars were used to scan the surrounding landscape during the transect. Direct sightings were recorded in line with the guidance contained in the Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012), which recommends sightings to be grouped into the following distance bands (perpendicular to and either side of the transect line):

- Within 25m
- Between 25m and 100m
- Greater than 100m
- Birds in flight at any distance

Some crossover is possible during these surveys, and this was noted if it occurred. The ecologist used professional judgement as to whether to include a record that may have been recorded in a separate transect. Features of the landscape that were deemed significant for birds (e.g. potential breeding habitats, Kingfisher perches, existing nests etc.) were recorded.

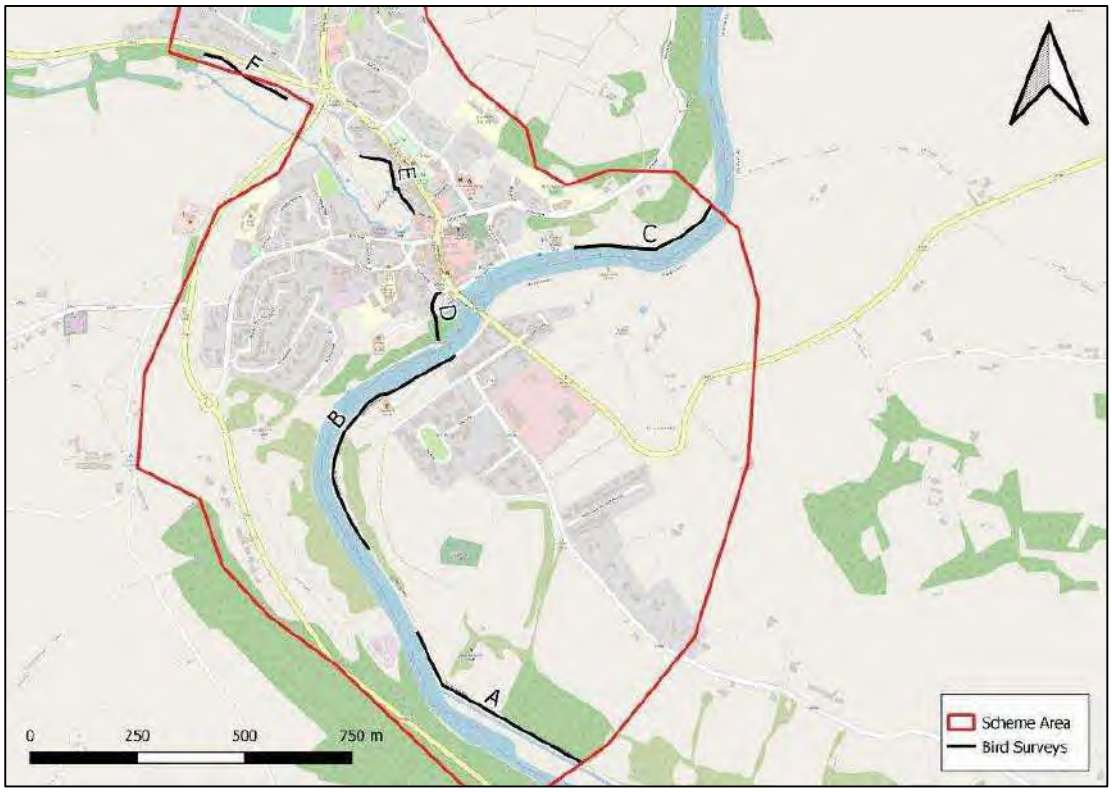


Figure 3-1. Bird Transect Routes

3.2.3.2 Upstream Storage Area & Top Up Surveys, Summer 2023

The Ayesa ecologists identified thirteen stationary vantage points located adjacent to and within the site from which to carry out the point counts/surveys, whilst continuing to record birds between the vantage points. The thirteen stations provided optimal visibility of the Site and surrounding landscape. The River Duiske was given two predefined stationary vantage points to provide maximum visibility upstream of the project site.

Two surveys of the site were carried out between the hours of 6:00 and 9:00 (beginning roughly one hour after dawn) on 10/09/23 and 11/09/23. Visits are timed so that the first is in the early part of the breeding season (April to mid-May) and the second at least four weeks later (mid-May to the end of June). Counts should begin in the early morning, so that they coincide with maximum bird activity, but avoid concentrated song activity at dawn (BTO, 2023).

Weather conditions within the project site were recorded at the time of survey. Activities that occur at the site that are or have the potential to cause disturbance to waterbirds were also recorded, regardless of whether they cause a noticeable disturbance to birds at the time of observation, or not.

The ecologists stayed at each stationary location for 20 minutes continuously scanning the surrounding areas using a pair of binoculars (Celestron 71008 SkyMaster 25 x 70 Binoculars), and all bird species observed were recorded. Information regarding the species of bird, number of birds (of the same species) and the birds' behaviour were similarly noted. The Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012) recommends

sightings to be grouped into distance bands (perpendicular to and either side of the transect line), however this was deemed unnecessary on this occasion as no distance sampling analysis will be undertaken. The primary purpose of this survey is to identify which species utilize the site and the surrounding areas, not to provide accurate counts for population trends as in the CBS.

Aural recordings were also obtained using the app BirdNET (Kahl et al., 2021). BirdNET's in-app machine learning was used to determine species, according to Kahl et al. (2021) BirdNET has a mean average precision of 0.791 for single-species recordings. Despite the high level of confidence, the ecologist compared aural records obtained in the field to existing records to add a higher level of certainty to species identification.

August is considered to be the end of the breeding season for most bird species in Ireland. Consequently, subsequent breeding bird surveys are planned between March and May 2024. Precautionary measures were taken to ensure minimal/no disturbances were imposed on the feeding/breeding/nesting of breeding birds present. Care was taken at all times to avoid flushing any species within the sampling sites, with previously researched vantage point locations with recommended distances and wintering waterbird species-specific responses to human disturbances.

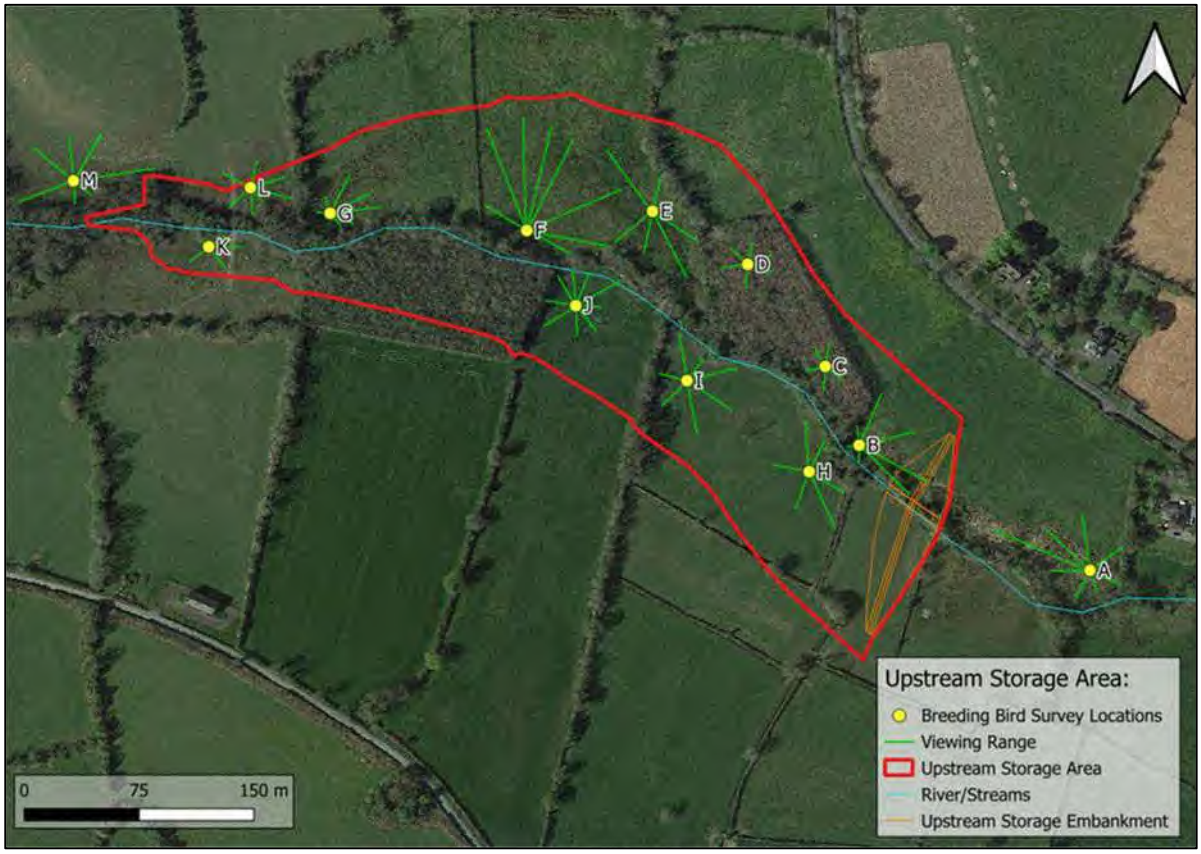


Figure 3-2: Breeding Bird Survey Count Locations and Viewing Ranges (Upstream Storage Area)

3.2.3.3 Upstream Storage Area & Top Up Surveys, Spring/Summer 2024

The ecologists modified the survey methodology carried out in Summer 2024. Instead, the ecologists identified eight stationary vantage points located adjacent to and within the site from

which to carry out the point counts/surveys, whilst continuing to record birds between the vantage points. Five points were located within Graiguenamanagh-Tinnahinch Townlands (Figure 3-2) and the remaining three points were located at the Upstream Storage site (Figure 3-3).

Three surveys of the site were carried out, beginning at approx. 9 am on 28-29/03/2024, 22-23/05/2024, and 26-27/06/2024. Counts should begin in the early morning, so that they coincide with maximum bird activity, but avoid concentrated song activity at dawn (BTO, 2023).

The survey methodology was in line with that utilised in the Breeding Bird surveys 2023.

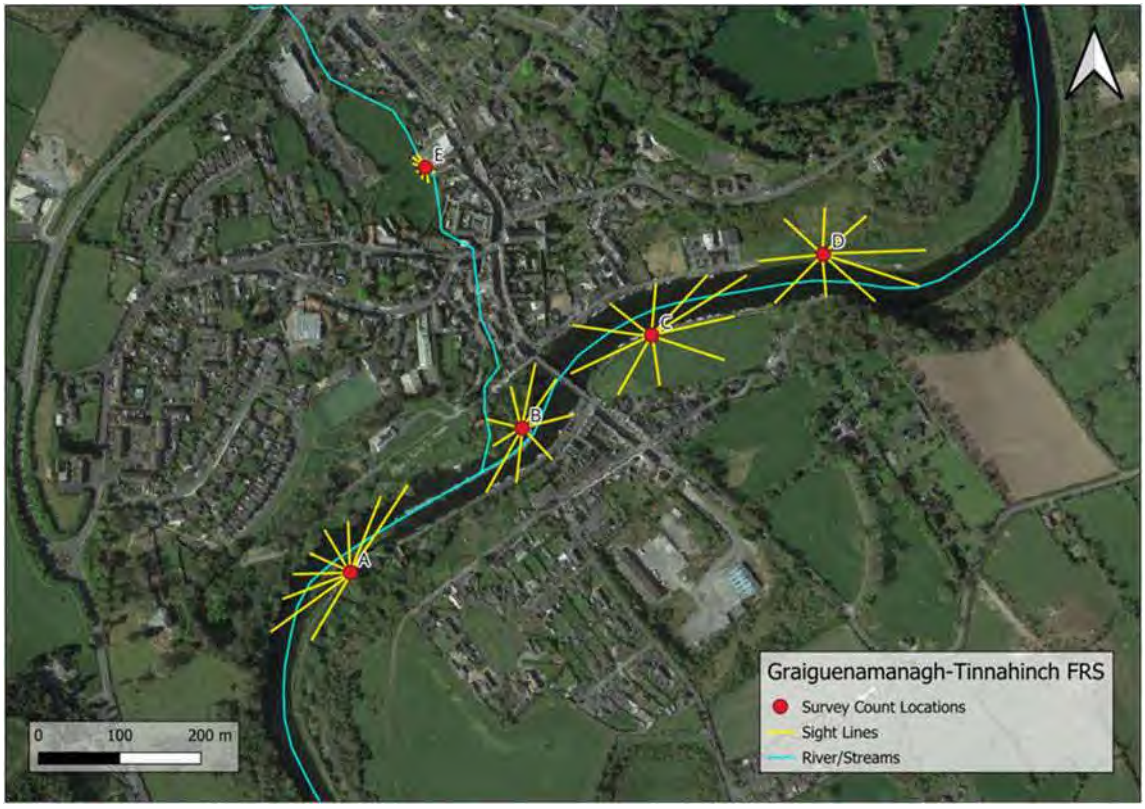


Figure 3-2: Breeding Bird Survey Count Locations and Site Lines – Graiguenamanagh and Tinnahinch Townlands

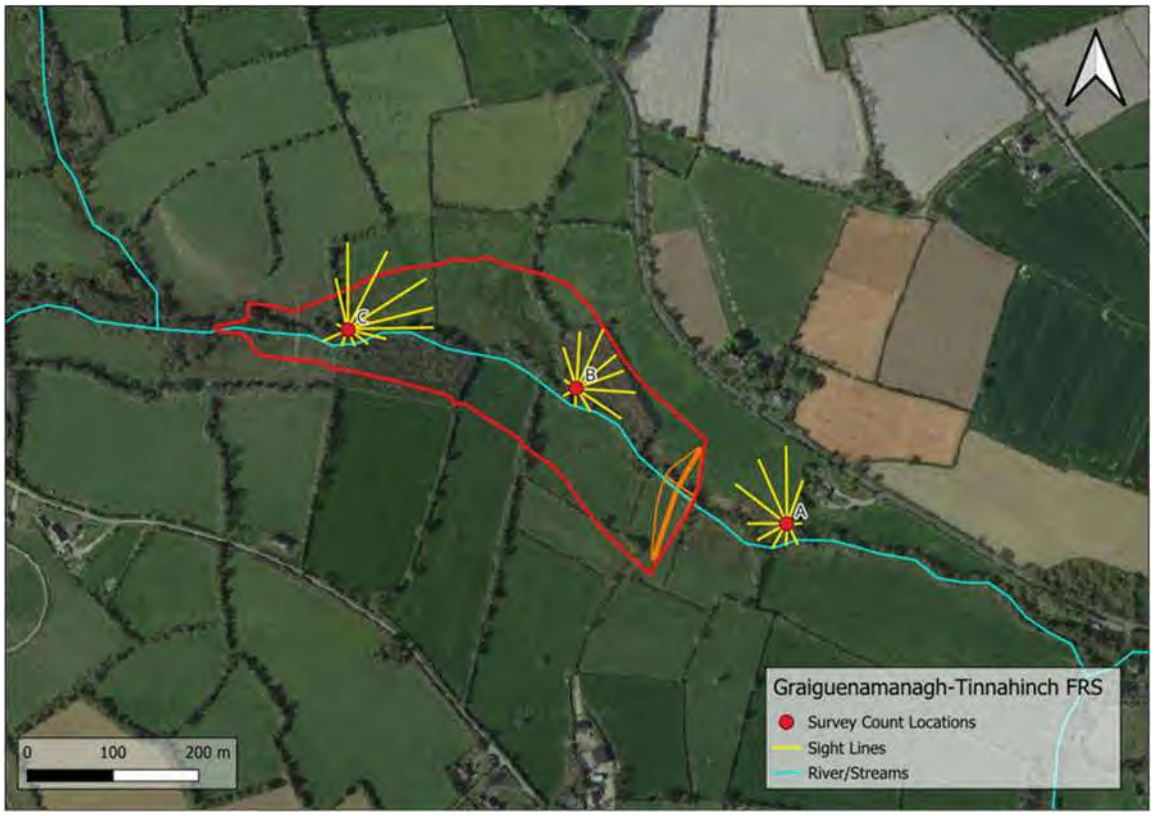


Figure 3-3: Breeding Bird Survey Count Locations and Site Lines – Upstream Storage Area

3.2.4 Results Interpretation

The species observed onsite were cross-referenced with the current list of Birds of Conservation Concern in Ireland (BoCCI), as well as the species listed in the Annexes of the EU Birds Directive (2009/147/EC) (EC, 2009). Based on their observed behaviour and their location in relation to the proposed project footprint, a determination was made as to the nature of their relationship with the site – whether they utilise the site for nesting and/or foraging purposes.

It is noted that all species of wild birds are protected under Section 22 of the Wildlife Act (No. 39 of 1976) and its amendments. In the context of the proposed works, this prohibits the destruction or disturbance of nests and/or eggs of wild birds (in the absence of a derogation licence).

3.2.4.1 Birds of Conservation Concern Ireland (BoCCI)

Based on qualitative data on species populations and distributions, BoCCI comprises lists of priority birds so that resources can be effectively allocated for their conservation. The system follows a traffic light system (i.e. red, amber, and green), with red being the highest conservation priority. Some of the criteria, which may trigger a species to be Red or Amber-listed, reflect global or European status regardless of how the species is faring in Ireland. It is important to have this wider context in status assessments to ensure protection of populations which are declining elsewhere in their range.

3.3 Survey Results

3.3.1.1 Original CFRAM Survey (2021)

The birds recorded during the original Breeding Bird Survey in 2020 are shown in Appendix E of this report. Twenty-five (25) species were recorded, and of these, six (6) are protected under the Wildlife Acts, three (3) are listed on BOCCI's Amber list, and three (3) are listed in Annex II and III of the EU Birds Directive.

Sites deemed suitable for perching Kingfishers were recorded, and are also outlined in Appendix E. In total, 18 Kingfisher perches were recorded across both the breeding and wintering bird surveys conducted in 2021.

3.3.1.2 Upstream Storage Area & Top Up Surveys (2023-2024)

The birds recorded during the Breeding Bird Survey undertaken by the Ayesa ecologists on 9-11/08/2023, 28-29/03/2024, 22-23/05/2024, and 26-27/06/2024 are shown in Appendix E of this report. These results are listed in tables that refer to each stationary point that bird records were taken from in both the Upstream Storage Area and within the Graiguenamanagh-Tinnahinch towns.

Table 3.1 lists out the bird species that were recorded during this breeding survey that carry special protection (Birds of Conservation Concern in Ireland or birds listed in the Annexes of the EU Birds Directive (2009/147/EC) (EC, 2009)).

Photographs of bird species recorded during the survey are shown in Appendix F of this report. These pictures were taken using mobile phone devices; therefore, it was difficult to obtain high quality images of certain species of birds. Several recorded bird species were not captured on camera during the survey (Appendix F). This includes the Kingfisher which moves up and downstream at a fast pace and is difficult to photograph without the use of a high-quality camera.

Table 3-1: Recorded birds listed for special protection – Ayesa, 2023/2024.

Birds of Conservation Concern in Ireland (BoCCI)	**EU Birds Directive – Annexed Species**
Amber Listed:	Annex I:
House Sparrow (*Passer domesticus*)	
Starling (*Sturnus vulgaris*)	Annex II:
Wood Pigeon (*Columba palumbus*)	House Sparrow (*Passer domesticus*)
	Mallard (*Anas platyrhynchos*)
	Wood Pigeon (*Columba palumbus*)
	Annex III:
	House Sparrow (*Passer domesticus*)
	Mallard (*Anas platyrhynchos*)
Red Listed:	Wood Pigeon (*Columba palumbus*)

The habitats located within and surrounding the scheme area includes scrub, treelines, hedgerows, and woodland. These habitats are considered suitable nesting habitat for various passerine species. This includes the bird species that were recorded during the Birdwatch

Ireland, and Ayesa surveys. This is significant in the context of all nests and eggs being protected under Section 22 of the Wildlife Acts.

4 Wintering Bird Surveys

4.1 Overview

4.1.1 Original CFRAM Survey (2021)

Ayesa's internal ecologist team completed a single wintering bird observation survey in February 2021. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch.

The results of the survey are outlined in Section 4.3 and Appendix G of this Report.

4.1.2 Upstream Storage Area (2023/2024)

A series of wintering bird surveys were conducted at the upstream storage area by Ayesa's internal ecology team. These were conducted across three visits within the wintering bird survey season, the first in December 2023, the second in January 2024 and the third in February 2024. The survey methodology was in line with that utilised in the Breeding Bird surveys 2023 and 2024.

The results of these surveys are outlined in Section 4.3 and Appendix G of this Report.

4.1.3 Top up Survey (2023/2024)

A series of wintering bird surveys were conducted by Ayesa's internal ecology team to 'top up' the original CFRAM level surveys outlined above. As with the above, these were conducted across three visits within the wintering bird survey season, the first in December 2023, the second in January 2024 and the third in February 2024.

The survey methodology was in line with that utilised in the Breeding Bird surveys 2023 and 2024.

The results of these surveys are outlined in Section 4.3 and Appendix G of this Report.

4.2 Survey Methodology

4.2.1 Guidelines

The wintering bird survey methodology was designed and undertaken in accordance with guidance described in:

- Low tide waterbird surveys: survey methods and guidance notes (Lewis and Tierney, 2014); and
- I-WeBS Counter Manual: Guidelines for Irish Wetland Bird Survey Counters
- Bird Census Techniques (Bibby, *et al*., 2000)

- 'Field Guide to the Birds of Britain and Europe' by John Gooders (Larousse) – identification
- I-WeBS best practice guidelines of standard techniques for traditional ground surveying are the recommended methods by Bird Watch Ireland.

4.2.2 Ethics Statement

Precautionary measures were taken to ensure minimal/no disturbances were imposed on the feeding/roosting of wintering birds present. Care was taken at all times to avoid flushing any species within the sampling sites, with previously researched vantage point locations with recommended distances and wintering waterbird species-specific responses to human disturbances.

4.2.3 Survey Method and Locations

4.2.3.1 Original CFRAM Survey (2021)

The same methodology was employed as with the breeding bird survey. See Section 3.2.3.1 for details.

4.2.3.2 Upstream Storage Area

The ecologists identified eight stationary vantage points located adjacent to and within the site from which to carry out the point counts/surveys, whilst continuing to record birds between the vantage points. Five points were located within Graiguenanamagh and Tinnahinch Townlands (Figure 4-1) and the remaining three points were located at the Upstream Storage site (Figure 4-2).

Three surveys of the site were carried out, beginning at approx. 9 am on 19-20/12/23, 16-17/01/24, and 22-23/02/24. Counts should begin in the early morning, so that they coincide with maximum bird activity, but avoid concentrated song activity at dawn (BTO, 2023).

Weather conditions within the project site were recorded at the time of survey. Activities that occur at the site that are or have the potential to cause disturbance to waterbirds were also recorded, regardless of whether they cause a noticeable disturbance to birds at the time of observation, or not.

The ecologists stayed at each stationary location for 30 minutes continuously scanning the surrounding areas using a pair of binoculars (Celestron 71008 SkyMaster 25 x 70 Binoculars), and all bird species observed were recorded. Information regarding the species of bird, number of birds (of the same species) and the birds' behaviour were similarly noted. The Countryside Bird Survey (CBS) Manual (Birdwatch Ireland, 2012) recommends sightings to be grouped into distance bands (perpendicular to and either side of the transect line), however this was deemed unnecessary on this occasion as no distance sampling analysis will be undertaken. The primary purpose of this survey is to identify which species utilize the site and the surrounding areas, not to provide accurate counts for population trends as in the CBS.

Aural recordings were also obtained using the app BirdNET (Kahl et al., 2021). BirdNET's in-app machine learning was used to determine species, according to Kahl et al. (2021) BirdNET has a mean average precision of 0.791 for single-species recordings. Despite the high level of confidence, the ecologist compared aural records obtained in the field to existing records to add a higher level of certainty to species identification.

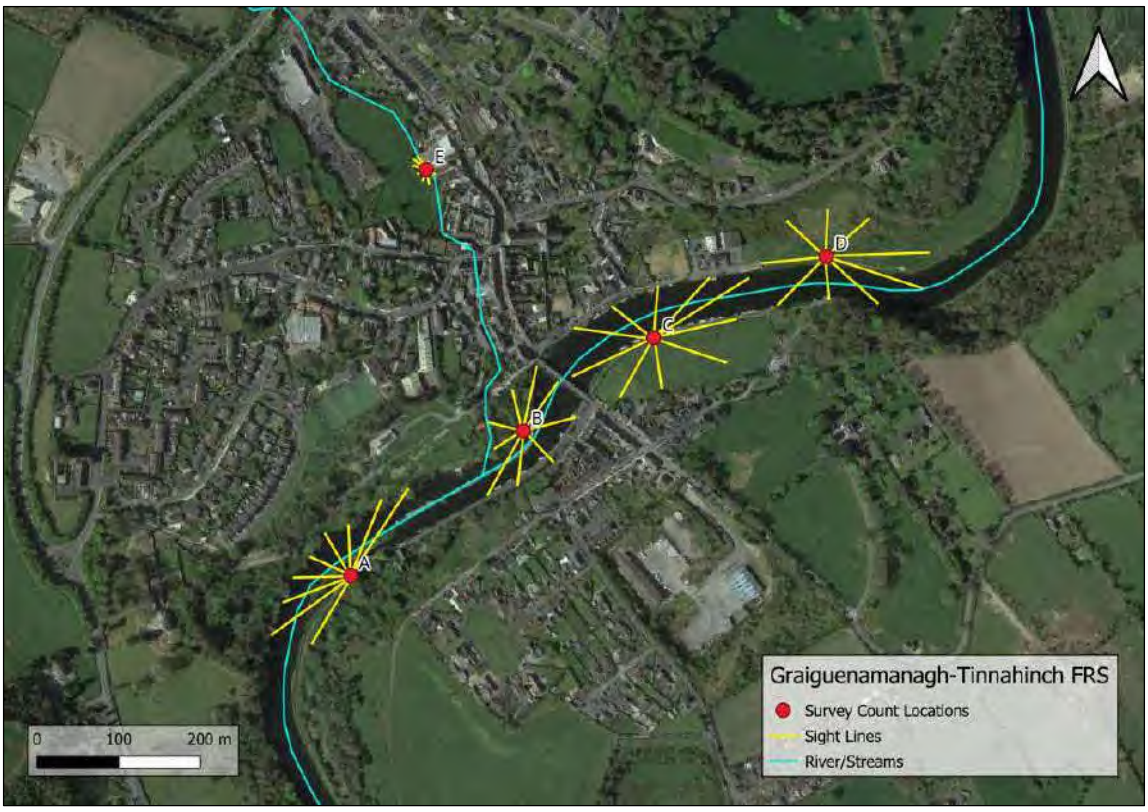


Figure 4-1: Wintering Bird Survey Count Locations and Site Lines – Graiguenamanagh-Tinnahinch Townlands

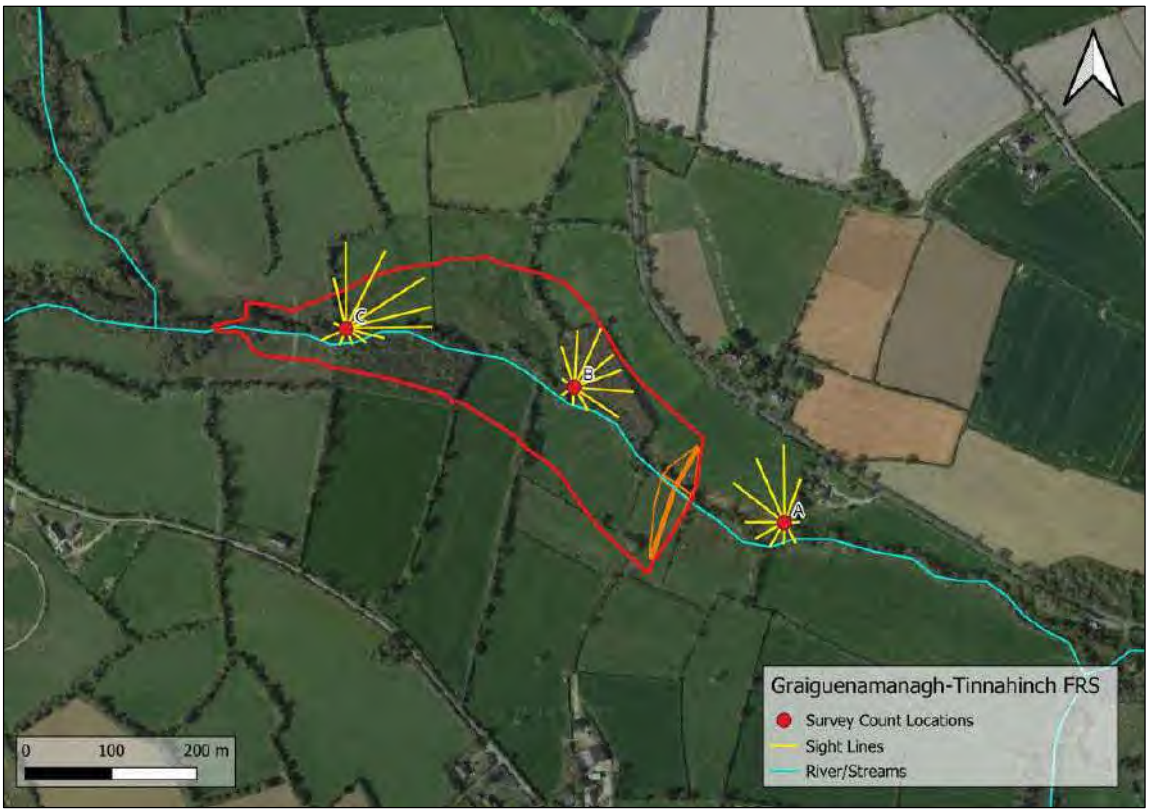


Figure 4-2: Wintering Bird Survey Count Locations and Site Lines – Upstream Storage Area

4.2.4 Results Interpretation

The species observed onsite were cross-referenced with the current list of Birds of Conservation Concern in Ireland (BoCCI), as well as the species listed in the Annexes of the EU Birds Directive (2009/147/EC) (EC, 2009). Based on their observed behaviour and their location in relation to the proposed project footprint, a determination was made as to the nature of their relationship with the site – whether they utilise the site for nesting and/or foraging purposes.

It is noted that all species of wild birds are protected under Section 22 of the Wildlife Act (No. 39 of 1976) and its amendments. In the context of the proposed works, this prohibits the destruction or disturbance of nests and/or eggs of wild birds (in the absence of a derogation licence).

4.2.4.1 Birds of Conservation Concern Ireland (BoCCI)

Based on qualitative data on species populations and distributions, BoCCI comprises lists of priority birds so that resources can be effectively allocated for their conservation. The system follows a traffic light system (i.e. red, amber, and green), with red being the highest conservation priority. Some of the criteria, which may trigger a species to be Red or Amber-listed, reflect global or European status regardless of how the species is faring in Ireland. It is important to have this wider context in status assessments to ensure protection of populations which are declining elsewhere in their range.

4.3 Survey Results

4.3.1.1 Original CFRAM Survey (2021)

The birds recorded during the original Wintering Bird Survey in 2021 are shown in Appendix G of this report. Twenty-one (21) species were recorded, and of these, five (5) are protected under the Wildlife Acts, three (3) are listed on BOCCI's Amber list, and two (2) are listed in Annex II and III of the EU Birds Directive.

Sites deemed suitable for perching Kingfishers were recorded, and are outlined in Appendix E. In total, 18 Kingfisher perches were recorded across both the breeding and wintering bird surveys conducted in 2021.

4.3.1.2 Upstream Storage Area & Top Up Surveys (2023-2024)

The birds recorded during the Wintering Bird Survey undertaken by the Ayesa ecologists on 19-20/12/2023, 16-17/01/2024 and 22-23/02/2024 are shown in Appendix G of this report. These results are listed in tables that refer to each stationary point that bird records were taken from in both the Upstream Storage Area and within the Graiguenamanagh-Tinnahinch towns.

Table 4.1 lists out the bird species that were recorded during this wintering bird survey that carry special protection (Birds of Conservation Concern in Ireland or birds listed in the Annexes of the EU Birds Directive (2009/147/EC) (EC, 2009)).

Photographs of bird species recorded during the survey are shown in Appendix H of this report. These pictures were taken using mobile phone devices; therefore, it was difficult to obtain high quality images of certain species of birds. Several recorded bird species were not captured on camera during the survey (Appendix H). This includes the Kingfisher which moves up and downstream at a fast pace and is difficult to photograph without the use of a high-quality camera.

Table 4.1: Recorded birds listed for special protection – Ayesa, 2023/2024.

Birds of Conservation Concern in Ireland (BoCCI)	**EU Birds Directive – Annexed Species**
Amber Listed:	Annex I:
Common Kingfisher (*Alcedo atthis*)	Common Kingfisher (*Alcedo atthis*)
Common Starling (*Sturnus vulgaris*)	
Great Black-Backed Gull (*Larus marinus*)	
Great Cormorant (*Phalacrocorax carbo*)	Annex II:
Wood Pigeon (Columba palumbus)	Wood Pigeon (*Columba palumbus*)
	Annex III:
	Mallard (*Anas platyrhynchos*)
	Wood Pigeon (*Columba palumbus*)

Overwintering birds also use the project footprint and its surroundings for feeding and shelter.

5 Mammal Surveys

5.1 Overview

5.1.1 Original CFRAM Survey (2021)

Ayesa's internal ecologist team completed a single mammal observation survey in February 2021. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch. The results of the survey are outlined in Section 5.3 of this Report.

5.1.2 Upstream Storage Area (2023/2024)

A mammal survey was undertaken by Ayesa's internal ecology team in August 2023 and March 2024. The results of this surveys are outlined in Section 5.3 of this Report.

5.1.3 Top up Survey (2023/2024)

A mammal survey was undertaken by Ayesa's internal ecology team in March 2024. The intention was to 'top up' the original CFRAM level surveys outlined above. The results of this survey are outlined in Section 5.3 of this Report.

5.2 Survey Methodology

5.2.1 Guidelines

The mammal surveys were undertaken in accordance with the following guidelines:

- Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (NRA, 2008)
- Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (NRA, 2006)
- A Guide to Identifying Evidence of Pine Martens in Wales (Vincent Wildlife Trust, 2017)
- Practical Techniques for Surveying and Monitoring Squirrels (Gurnell et al., 2009, for the Forestry Commission)

5.2.2 Survey Method and Locations

5.2.2.1 Top Up Survey Methodology (2023/2024)

A mammal survey was carried out in March 2024 by Ayesa's internal ecology team. The intention was to 'top up' the original CFRAM level surveys outlined previously. Mammals

were surveyed through the detection of field signs and direct observations. Target notes were also taken, providing supplementary information on ecological features which were significant to specific construction proposals, or features that were too small to map.

Mammals evidence was looked for in the below original scheme area shown in Figure 5.1.

Figure 5-1. Original CFRAM Schem Area surveyed for the presence of mammals in 2021 and March 2024

5.2.2.2 Upstream Storage Area Survey Methodology 2023/2024

Site visits were carried out by Ayesa ecologists on 9th - 11th of August 2023 and 27th - 29th March 2024 to conduct specialist mammal surveys. Mammals were surveyed through the detection of field signs, mammal footprint tunnels, and by direct observations. The mammal footprint tunnels were subsequently collected on the 11th August 2023 and 29th March, and data stored for analysis. These field surveys were carried out using the methodology outlined below.

Target notes were also taken, providing supplementary information on ecological features which were significant to specific construction proposals, or features that were too small to map.

Figure 5-2 below, provides an overview of the area extent that was surveyed for tracks and signs of mammals.

Figure 5-2: Mammal Survey Extent – Upstream Storage Area

5.2.2.3 Walkover Surveys

The ecologist noted features of interest during the field survey. In practice, the approach to this type of survey is one whereby certain features of interest are searched for and recorded as part of the mammal survey. Any features of interest were photographed, and their GPS location were recorded. Features of interest for this project were non-volant mammals, particularly otters, deer, badgers, pine martens, red squirrels, hedgehogs, Irish stoat, Irish mountain hare and pygmy shrews.

The ecologist searched and took note of the following evidence (if observed):

- Direct sightings of mammals (live or dead)
- Burrows, setts, dens, dreys, day nests, holts, and otter couches
- Prints, hair traces
- Prey/food remains
- Faeces

- Scratching posts at the base of tree trunks
- Snuffle holes (small scrapes where badgers have searched for insects, earthworms, and plant tubers)
- Trails, paths, runs.

For badgers, pine marten, Irish stoat, red squirrel, hedgehog, and Irish hare the search area comprised all land within the Site boundary and surrounding agricultural grasslands and along both sides of the River Duiske, 600m stretch along the banks, where possible.

For otter, the search comprised all land within the Site boundary, surrounding agricultural grasslands and along both sides of the River Duiske, 600m stretch along the banks, where possible. The following guidance documents were consulted when carrying out these surveys:

- Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes (NRA, 2008)
- Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (NRA, 2006)
- A Guide to Identifying Evidence of Pine Martens in Wales (Vincent Wildlife Trust, 2017)
- Practical Techniques for Surveying and Monitoring Squirrels (Gurnell et al., 2009, for the Forestry Commission)
- Guidelines for Ecological Impact Assessment in the UK and Ireland; Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2018)
- Lundy, M.G., Aughney, T., Montgomery, W.I., & Roche, N., (2011) Landscape conservation for Irish bats & species-specific roosting characteristics. Bat Conservation Ireland.

5.2.2.4 Mammal Footprint Tunnel Survey

The mammal footprint tunnel provides a non-invasive and effective presence/absence survey method for small mammals, particularly hedgehogs and other elusive/nocturnal mammals. For this survey, the tunnels were specifically used were to determine Otter presence. The ecologists used corrugated plastic/Corri board sheets to construct the tunnels into a triangular shape. Separately, Corri board was cut into thin trays to fit the middle section of the tunnel i.e., the bait tray (Figure 5-3). A shallow plastic bowl was secured to the centre of the bait tray and two pieces of ink pads (wash cloth cut in half) were attached either side of the bowl doused in a mix of black acrylic paint and washing up liquid (long lasting ink).

Additionally, strips of masking tape were also used to serve as ink pads by pouring the ink on top of the tape placed on either side of the bowl. Two labelled A4 sheets were secured onto the bait tray at either end to be used as the tracking paper (Figure 5-4). Dog food pouches in jelly/gravy was used as bait for the mammal tunnels. Once the bait trays were set up, they were slid back into the triangular tunnel and pegged into position using camping

pegs in suitable sheltered locations, namely along hedgerows and riverbanks. The tunnels were left in place for one week.

Note: The mammal walks into the tunnel over the tracking sheets and then the inkpads to the shallow bowl of dog food. When the mammal exits the tunnel their pawprint now covered in ink marks the tracking paper upon exiting the tunnels, leaving the ecologists with decipherable and distinctive prints for identification.

The labelled tracking papers were then removed from the baiting trays and photographed. The ecologists used a ruler to measure the dimensions of the various footprints and used online resources to narrow down and identify which animals the tracks belong to.

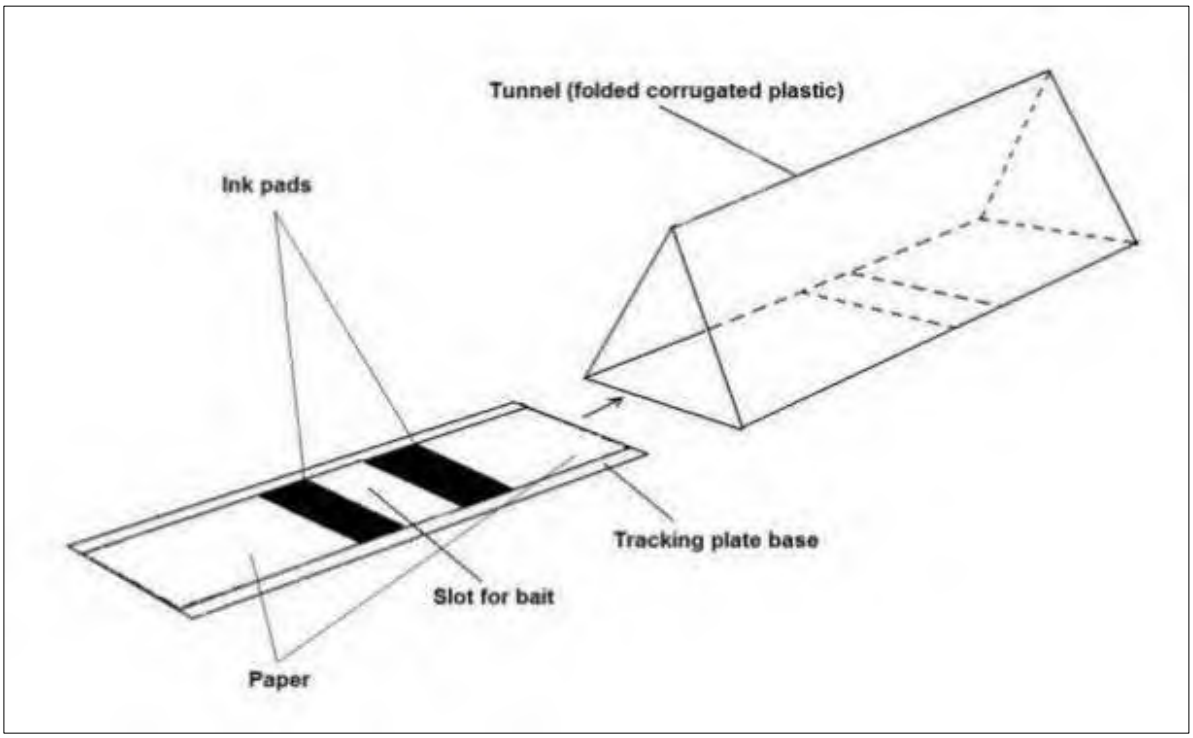


Figure 5-3: Design of the tracking tunnels and sliding baiting tray with ink pads and tracking paper used to capture the footprints of small mammals.

Figure 5-4: Mammal Footprint Tunnels - setup and results three days later.

Figure 5-5 overleaf shows the locations of the mammal footprint tunnels. Several tunnels were installed on the righthand side of the riverbank over a stretch of over 600 metres, this accounts for areas of the river located upstream and downstream within the proposed scheme area. These tunnels' locations can give a good representation of otter activity in the area by recording areas close to the River Duiske, which the otter depends upon for feeding and travel. Other mammals such as mink (which are semi-aquatic) may also use this stretch of the river for feeding.

The tunnels were installed during daylight hours on 9th of August 2023 and were collected on the morning of 11th August 2023. Therefore, the prints recorded from the tunnels are representing two full nights of mammal activity (most mammal activity (foraging etc.) occurs during the night).

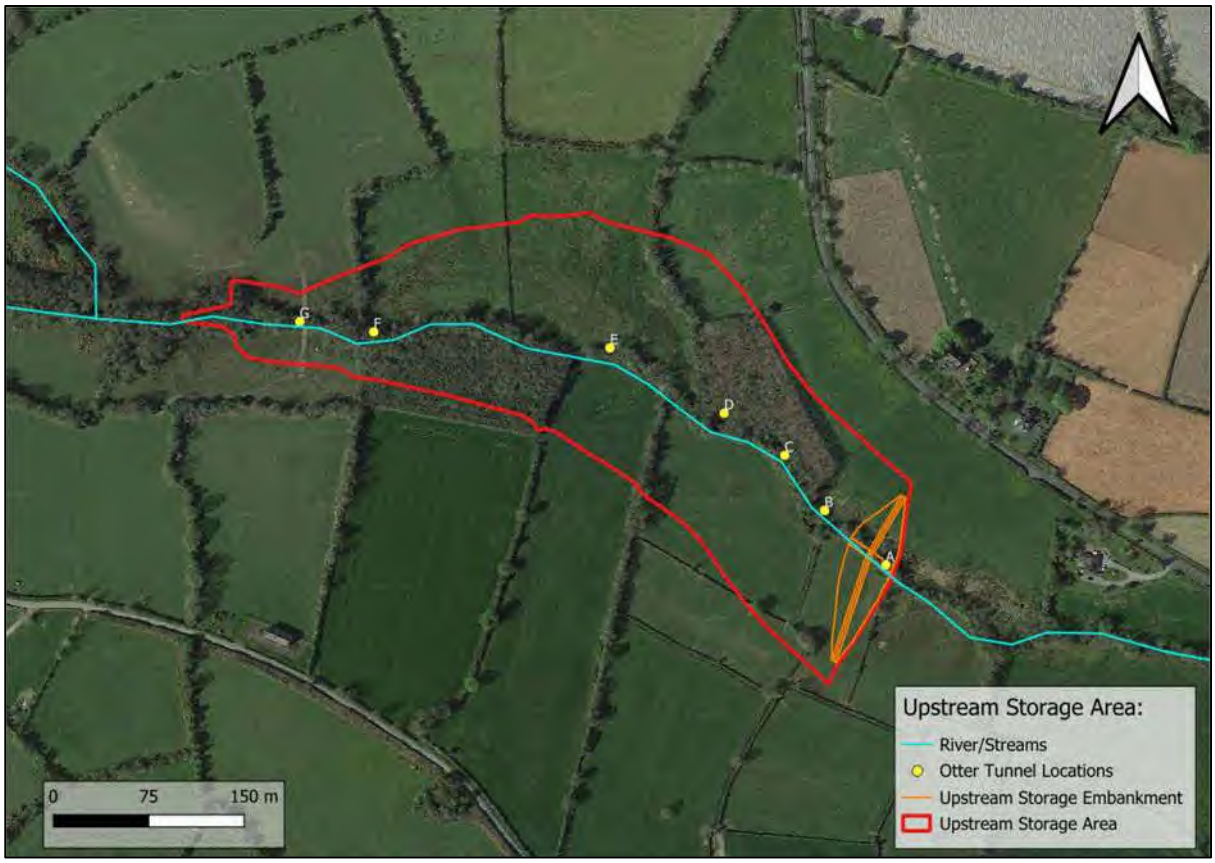


Figure 5-5: Location of Mammal Footprint Tunnels.

The following guidance documents were used when identifying footprints recorded in the tunnels:

- How to Read Prints from Tracking Tunnels – MothNet (2018)
- Pest Detective (Culprits). Available online at: https://www.pestdetective.org.nz/culprits/
- Identify-tracks (The Wildlife Trust, 2023). Available online at: https://www.wildlifetrusts.org/how-identify/identify-tracks

5.2.2.5 Survey/Data Limitations/Constraints

The following limitations are recognised:

- Nocturnal and/or rare and cryptic mammals such as otter, badger, Irish stoat (though not strictly nocturnal, much of their hunting occurs at night), hedgehog, and pine marten (largely nocturnal) cannot be enumerated by direct observations. True representation of species presence/absence and abundance cannot be achieved as a result of this limitation.
- Ecological survey timing and seasonal constraints providing limited or preliminary data –many protected faunal species are also seasonally constrained with survey timing; potential limitations included periods of hibernation, seasons of low activity (certain

species only emerging in certain seasons), and outside the breeding season (high activity).

- Areas that were inaccessible during the mammal surveys; e.g., certain portions of the the banks along the River Duiske. Therefore, species may have been present on-site but were missed as the Site walkover was difficult to access for assessment/evaluation.

- As mammals are highly mobile species, covering large ranges for hunting/foraging, evidence/live sightings of the species such as the deer, badger, pine marten, otter, etc. may have been missed.

- Data limitations of the biological records may not be relied upon as a present-day/updated representation of presence/absence and/or distribution of species. The records can provide indications of the likely presence/absence of species within the Site and the surrounds. However, it should be noted the absence of records for protected species does not equate to evidence of their absence from the area. In addition, variability can occur in the accuracy of online records, and their point counts/observations are often georeferenced to the nearest 1km grid square.

Despite the above-mentioned limitations, a robust understanding of the site's ecology from the mammal survey was obtained.

5.3 Survey Results

5.3.1.1 Original CFRAM Survey (2021)

Evidence of otter was observed during the 2021 survey, presented in the table and figure below. Photographic evidence is included in Appendix I.

Table 5-1. Field Survey - Evidence of Otters

ID	Coordinates (ITM)	Notes
1	670659, 643367	Potential holts on the River Barrow. Located where mill race goes under the R705 near Aldi. This area is extremely dry due to the shelter of the overpass – there is very little vegetation, and the soil is very loose. There are a number of scars in the embankment where it seems otters have attempted to burrow, but the soil was too unstable to sustain a solid tunnel and kept collapsing. For this reason, the BL ecologists note that it is unclear if any of these were ever viable holts (see Figure 6.5).
2	670526, 644040	Potential couch on Duiske River – adjacent to where the mill race joins the canal by Tinnahinch Castle (see Figure 6.4).
3	670624, 643195	Potential spraint on the River Barrow. It had a grainy texture common with otter spraints, but had a pale colour that suggested that it may simply be dog faeces. Located on a clump of grass on the riverbank (see Figure 6.6).

Figure 5-6. Locations of Otter Evidence

Faeces of the Eurasian rabbit (*Oryctolagus cuniculus*) were observed in the field adjoining the Killeen Stream at the northern end of the scheme area.
No evidence of red squirrel (*Sciurus vulgaris*), pine marten (*martes martes*) or badger (*meles meles*) activity was observed during the field surveys.

5.3.2 Upstream Storage Area (2023)

Evidence of non-volant mammals was observed in several locations throughout the site. Images of mammal evidence is shown in Appendix I. Primarily, there was evidence to suggest the presence of badger, as observed through the presence of scat and footprints (see Appendix I). There was no evidence of otter, fox, mink, pine martin or other small carnivorous mammals observed throughout the proposed development site, however. The above-mentioned evidence of mammal activity is mapped in Figure 5.7 below.

5.3.3 Top Up Survey (2024)

Evidence of non-volant mammals was observed in several locations throughout the site. Images of mammal evidence is shown in Appendix I. Primarily, there was evidence to suggest the presence of badger, as observed through the presence of footprints (see Appendix I). Fish remains were seen on the bank of the River Barrow close to the town centre. This may be as result of an otter or mink foraging in the area. There was no evidence of fox, pine martin or other small carnivorous mammals observed throughout the proposed development site, however. The above-mentioned evidence of mammal activity is mapped in Figure 5.7 below.

Figure 5-7. Mammal evidence within the upstream storage area and the original Graiguenamanagh/Tinnahinnch CFRAM scheme area 2023/2024

6 Herpetofauna Surveys

6.1 Overview

6.1.1 Original CFRAM Survey (2021)

Ayesa's internal ecologist team completed a single herpetofauna observation survey in February 2021. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch. The results of the survey are outlined in Section 6.3 of this Report.

6.1.2 Upstream Storage Area (2023/2024)

A herpetofauna survey was undertaken by Ayesa's internal ecology team in March 2024. The results of this surveys are outlined in Section 6.3 of this Report.

6.1.3 Top up Survey (2023/2024)

A survey was not recommended within the towns of Graiguenamanagh and Tinnahinch, as no suitable habitat was noted. This recommendation is detailed further in the report contained under Appendix A.

However, given historical observations made in 2021, the Environmental Impact Assessment Report (EIAR) will assume presence of spring-spawning herpetofauna within the project area, and will include appropriate pre-construction mitigation as a matter of course.

6.2 Survey Methodology

This survey relied on the field on the identification of amphibian populations at their breeding sites. Reliably detecting amphibian populations in terrestrial habitats away from their breeding sites or at other times of year requires a substantial amount of survey effort (and is simply not possible during the hibernation period) and therefore should be avoided wherever possible. Key cards were used onsite to help identify any amphibians and/or their associated spawn during the survey.

6.3 Survey Results

6.3.1.1 Original CFRAM Survey (2021)

Evidence of common frog was observed upstream of Graiguenamanagh Bridge, as presented in the table and figures below.

Table 6-1: Field Records - Common Frog

ID	Coordinates (ITM)	Notes
1	671192, 643714	Frogspawn. Located in small area of reed swamp (see section 4.1.4). See photograph – Figure 6.11
2	671349, 643713	Frogspawn. Located on leaf litter, creeping buttercup and cleavers – not in standing water (see Figure 6.12)

Figure 6-1: Locations of common frog spawn sightings

Figure 6-2: Frogspawn (ID-1) – 16.02.21

Figure 6-3: Frogspawn (ID-2) – 16.02.21

6.3.2 Upstream Storage Area (2024)

No evidence of amphibians and/or their associated spawn was found in the upstream storage area during the 2024 survey. There was also a lack of potential spawning habitat observed within this area.

7 Flora Surveys

7.1 Overview

7.1.1 Original CFRAM Survey (2021)

Ayesa's internal ecologist team completed a single flora observation survey in February 2021. The original survey was undertaken with the CFRAM Study Area extent in mind, within the towns of Graiguenamanagh and Tinnahinch. The results of the survey are outlined in Section 7.3 of this Report.

7.1.2 Upstream Storage Area (2023/2024)

A dedicated survey for flora was not considered a requirement for the upstream storage area, however observations were made as part of a Habitats and Species Walkover in January 2023. The results of the survey are outlined in Section 7.3 of this Report.

7.1.3 Top up Survey (2023/2024)

A flora survey was undertaken by Ayesa's internal ecology team in June 2024. The intention was to 'top up' the original CFRAM level surveys outlined above. The results of this survey are outlined in Section 7.3 of this Report.

7.2 Survey Methodology

A complete inventory was made of all flora species observed within the survey areas. Each species was cross-referenced with the Third Schedule of the Birds and Natural Habitats Regulations (invasive species), the Flora (Protection) Order, 2022, and Ireland Red List No. 10: Vascular Plants (Wyse Jackson et al., 2015).

7.3 Survey Results

7.3.1 Original CFRAM Survey (2021)

No flora species of conservation interest were observed. This includes all species listed in Schedules A and B of the Flora (Protection) Order 2015 (S.I. No. 356/2015).

Plant species observed in the survey area are outlined in the table below.

Table 7-1: Plant Species Present in Survey Area

Common Name	Scientific Name
TREES	
Sycamore	*Acer pseudoplatanus*
Horse chestnut	*Aesculus hippocastanum*
Alder	*Alnus glutinosa*

Common Name	Scientific Name
Silver birch	*Betula pendula*
Downy birch	*Betula pubescens*
Birch species	*Betula sp.*
Cypress species	*Chamaecyparis sp.*
Hawthorn	*Crataegus monogyna*
Beech	*Fagus sylvatica*
Ash	*Fraxinus excelsior*
Blackthorn	*Prunus spinosa*
Sessile oak	*Quercus petraea*
Pedunculate oak	*Quercus robur*
Oak species	*Quercus sp.*
Willow species	*Salix sp.*
Grey willow	*Salix cinerea*
Crack willow	*Salix fragilis*
Yew	*Taxus baccata*
Irish Yew	*Taxus baccata* 'fastigiata'
SHRUBS	
Butterfly bush	*Buddleja davidii*
Holly	*Ilex aquifolium*
Cherry Laurel	*Prunus laurocerasus*
Bramble	*Rubus fruticosus agg.*
Gorse	*Ulex europaeus*
Rose species	*Rosa* spp.
Box	*Buxus sempervirens*
CLIMBERS	
Hedge Bindweed	*Calystegia sepium*
Old man's beard	*Clematis vitalba*
Ivy	*Hedera helix*
Honeysuckle	*Lonicera periclymenum*
GRASSES	
Common bent	*Agrostis capillaris*
Cock's-foot	*Dactylis glomerata*
Yorkshire fog	*Holcus lanatus*
Perennial rye grass	*Lolium perenne*
Common reed	*Phragmites australis*
Annual meadow grass	*Poa annua*
RUSHES	
Soft rush	*Juncus effusus*
AQUATIC PLANTS	
Crowfoot species	*Ranunculus* sp.
HERBS	
Ground elder	*Aegopodium podagraria*
Wild cabbage	*Brassica oleracea*
Wild turnip	*Brassica rapa*
Ivy-leaved toadflax	*Cymbalaria muralis*
Wild angelica	*Angelica sylvestris*
Cow parsley	*Anthriscus sylvestris*
Lords-and-ladies	*Arum maculatum*
Daisy	*Bellis perennis*
Wavy bitter-cress	*Cardamine flexuosa*

Common Name	Scientific Name
Hairy bitter-cress	*Cardamine hirsuta*
Common mouse-ear	*Cerastium fontanum*
Rosebay willowherb	*Chamerion angustifolium*
Opposite-leaved golden-	*Chrysosplenium oppositifolium*
Creeping thistle	*Cirsium arvense*
Marsh thistle	*Cirsium paluste*
Foxglove	*Digitalis purpurea*
Great willowherb	*Epilobium hirsutum*
Broad-leaved willowherb	*Epilobium montanum*
Square-stalked willowherb	*Epilobium tetragonum*
Japanese knotweed	*Fallopia japonica*
Meadowsweet	*Filipendula ulmaria*
Cleavers	*Galium aparine*
Dove's foot crane's bill	*Geranium molle*
Herb-robert	*Geranium robertianum*
Wood avens	*Geum urbanum*
Giant rhubarb	*Gunnera tinctoria*
Hogweed	*Heracleum sphondylium*
Bluebell	*Hyacinthoides non-scripta*
Hamalyan balsam	*Impatiens glandulifera*
Yellow iris	*Iris pseudacorus*
Red dead-nettle	*Lamium purpureum*
Great woodrush	*Luzula sylvatica*
Water forget-me-not	*Myosotis scorpioides*
Forget-me-not species	*Myosotis* spp.
Hemlock water-dropwort	*Oenanthe crocata*
Ribwort plantain	*Plantago lanceolata*
Silverweed	*Potentilla anserina*
Creeping cinquefoil	*Potentilla reptans*
Primrose	*Primula vulgaris*
Selfheal	*Prunella vulgaris*
Winter heliotrope	*Petasites pyrenaicus*
Meadow buttercup	*Ranunculus acris*
Lesser celandine	*Ranunculus ficaria*
Creeping buttercup	*Ranunculus repens*
Common sorrel	*Rumex acetosa*
Curled dock	*Rumex crispus*
Broad-leaved dock	*Rumex obtusifolius*
Water figwort	*Scrophularia auricularia*
Common ragwort	*Senecio jacobaea*
Groundsel	*Senecio vulgaris*
Smooth sow-thistle	*Sonchus oleraceus*
Russian comfrey	*Symphytum x uplandicum*
Dandelion	*Taraxacum officinalis agg.*
White clover	*Trifolium repens*
Navelwort	*Umbilicus rupestris*
Common nettle	*Urtica dioica*
Brooklime	*Veronica beccabunga*
Germander speedwell	*Veronica chamaedrys*
Wood speedwell	*Veronica montana*
Common vetch	*Vicia sativa*

Common Name	Scientific Name
Bush vetch	*Vicia sepium*
Dog violet	*Viola riviniana*
FERNS & ALLIES	
Scaly male fern	*Dryopteris affinis*
Southern polypody	*Polypodium cambricum*
Polypody	*Polypodium vulgare*
Bracken	*Pteridium aquilinum*
Water horsetail	*Equisetum fluviatile*
MOSSES *	
Brachythecium species	
Grimmia pulvinata	
Tortula muralis	

* This represents those species positively identified by surveyors and is not intended to provide a complete list.

Invasive species, including Himalayan Balsam, Japanese Knotweed and Giant Rhubarb were observed.

7.3.2 Top Up Survey (2024)

No flora species of conservation interest were observed. This includes all species listed in Schedules A and B of the Flora (Protection) Order 2015 (S.I. No. 356/2015).

Plant species observed in the survey area are outlined in the table below.

Table 7-2. Plant Species Present in Survey Area

Common Name	Scientific Name
Trees	
Sycamore	*Acer pseudoplatanus*
Horse chestnut	*Aesculus hippocastanum*
Alder	*Alnus glutinosa*
Silver birch	*Betula pendula*
Downy birch	*Betula pubescens*
Lime	*Tilia cordata*
Cypress species	*Chamaecyparis sp.*
Hawthorn	*Crataegus monogyna*
Beech	*Fagus sylvatica*
Ash	*Fraxinus excelsior*
Blackthorn	*Prunus spinosa*
Sessile oak	*Quercus petraea*

Pedunculate oak	*Quercus robur*
Rowan	*Sorbus aucuparia*
Grey willow	*Salix cinerea*
Crack willow	*Salix fragilis*
Bay Willow	*Salix pentandra*
Hazel	*Corylus avellana*
Eastern Hornbeam	*Ostrya virginiana*
Italian Alder	*Alnus cordata*
Scots Pine	*Pinus sylvestris*
Shrubs	
Butterfly bush	*Buddleja davidii*
Holly	*Ilex aquifolium*
Cherry Laurel	*Prunus laurocerasus*
Bramble	*Rubus fruticosus agg.*
Gorse	*Ulex europaeus*
Rose species	*Rosa* spp.
Box	*Buxus sempervirens*
Climbers	
Hedge Bindweed	*Calystegia sepium*
Old man's beard	*Clematis vitalba*
Ivy	*Hedera helix*
Honeysuckle	*Lonicera periclymenum*
Virginia Creeper	Parthenocissus quinquefolia
Grasses	
Common bent	*Agrostis capillaris*
Cock's-foot	*Dactylis glomerata*
Yorkshire fog	*Holcus lanatus*
Perennial rye grass	*Lolium perenne*
Common reed	*Phragmites australis*
Annual meadow grass	*Poa annua*
Rushes	
Soft rush	*Juncus effusus*
Great Wood	
Herbs	
Ground elder	*Aegopodium podagraria*
Wild cabbage	*Brassica oleracea*
Wild turnip	*Brassica rapa*

Navelwort	*Umbilicus rupestris*
Ivy-leaved toadflax	*Cymbalaria muralis*
Wild angelica	*Angelica sylvestris*
Cow parsley	*Anthriscus sylvestris*
Lords-and-ladies	*Arum maculatum*
Daisy	*Bellis perennis*
Wavy bitter-cress	*Cardamine flexuosa*
Hairy bitter-cress	*Cardamine hirsuta*
Common mouse-ear	*Cerastium fontanum*
Rosebay willowherb	*Chamerion angustifolium*
Opposite-leaved golden-saxifrage	*Chrysosplenium oppositifolium*
Creeping thistle	*Cirsium arvense*
Marsh thistle	*Cirsium paluste*
Foxglove	*Digitalis purpurea*
Great willowherb	*Epilobium hirsutum*
Broad-leaved willowherb	*Epilobium montanum*
Square-stalked willowherb	*Epilobium tetragonum*
Japanese knotweed	*Fallopia japonica*
Meadowsweet	*Filipendula ulmaria*
Cleavers	*Galium aparine*
Herb-robert	*Geranium robertianum*
Wood avens	*Geum urbanum*
Hogweed	*Heracleum sphondylium*
Bluebell	*Hyacinthoides non-scripta*
Yellow iris	*Iris pseudacorus*
Water forget-me-not	*Myosotis scorpioides*
Hemlock water-dropwort	*Oenanthe crocata*
Ribwort plantain	*Plantago lanceolata*
Silverweed	*Potentilla anserina*
Creeping cinquefoil	*Potentilla reptans*
Primrose	*Primula vulgaris*
Selfheal	*Prunella vulgaris*
Winter heliotrope	*Petasites pyrenaicus*
Meadow buttercup	*Ranunculus acris*
Lesser celandine	*Ranunculus ficaria*
Creeping buttercup	*Ranunculus repens*
Common sorrel	*Rumex acetosa*

Curled dock	*Rumex crispus*
Broad-leaved dock	*Rumex obtusifolius*
Water figwort	*Scrophularia auricularia*
Common ragwort	*Senecio jacobaea*
Groundsel	*Senecio vulgaris*
Smooth sow-thistle	*Sonchus oleraceus*
Russian comfrey	*Symphytum x uplandicum*
Dandelion	*Taraxacum officinalis agg.*
White clover	*Trifolium repens*
Navelwort	*Umbilicus rupestris*
Common nettle	*Urtica dioica*
Brooklime	*Veronica beccabunga*
Germander speedwell	*Veronica chamaedrys*
Wood speedwell	*Veronica montana*
Common vetch	*Vicia sativa*
Bush vetch	*Vicia sepium*
Dog violet	*Viola riviniana*
Common Reed	*Phragmites australis*
Meadow sweet	*Filipendula ulmaria*
Ragwort	*Jacobaea vulgaris*
Himalayan Balsam	*Impatiens glandulifera*
Winter Heliotrope	*Petasites pyrenaicus*
Field Mustard	*Brassica rapa*
Bearberry cotoneaster	*Cotoneaster dammeri*
Large leaf spindle	*Euonymus europaeus*
Water horsetail	*Equisetum fluviatile*
Scarlet pimpernel	*Anagallis arvensis*
Rugosa rose	*Rosa rugosa*
Common forget - me - not	*Myosotis scorpioides*
Mallow Common	*Malva sylvestris*
Field horsetail	*Equisetum arvense*
Snowberry	*Symphoricarpos albus*
Fushia	*Fuchsia magellanica*
Honeysuckle	*Lonicera periclymenum*
Pineapple weed	*Matricaria discoidea*
Aquatic Plants	
Water Crowfoot	*Ranunculus aquatilis*
Ferns	

Maidenhair spleenwort	*Asplenium trichomanes*
Scaly male fern	*Dryopteris affinis*
Southern polypody	*Polypodium cambricum*
Polypody	*Polypodium vulgare*
Bracken	*Pteridium aquilinum*
Hart's-tongue fern	*Asplenium scolopendrium*
Mosses	
	Brachythecium species
	Grimmia pulvinata
	Tortula muralis

8 Water Quality / Q-Value Surveys

8.1 Overview

8.1.1 Original CFRAM Survey (2021)

This survey was completed externally by AQUAFACT in February 2021. The results of the survey are outlined in AQUAFACT's survey report, included in Appendix J.

8.1.2 Upstream Storage Area (2023)

This survey was completed externally by APEM in August 2023. The results of the survey are outlined in APEM's survey report, included in Appendix K.

8.1.3 Top Up Survey (2024)

A Q-value survey was undertaken by Ayesa's internal ecology team in June 2024. The intention was to 'top up' the original CFRAM level surveys outlined above. The results of this survey are outlined in Section 8.3 of this Report.

8.2 Survey Methodology

Five kick samples were taken, see Figure 8.1 and Table 8.1. Stream morphology at each station can be seen in Table 8.2. The two-minute kick and one minute stone wash sampling method was employed to collect samples of macroinvertebrates for analysis. This involved placing a standard hand net of pore size 500µm in the river, facing upstream and disturbing the riverbed in front of the net mouth. The ecologist then moved in a diagonal direction upstream to ensure that different micro-habitats were included in the sample. The kick method dislodges macroinvertebrates from the substrates and submerged plant material. This was continued for approximately two minutes and followed by one minute of stone washing.

The resulting sample was transferred from the net to a plastic bucket, then placed into a white sorting tray allowing for the bankside assessment to take place. The freshwater invertebrates were then assigned to the suitable indicator group. The derived species list was then used to assign a Biotic Index value (Q-Value) to the sampled streams.

Due to the depth of the River Barrow in the “Upstream” location that Aquafact performed a kick sample in 2021, it was not possible to use this station for the top-up survey. This section of river was also in flood and could not be sampled for health and safety reasons.

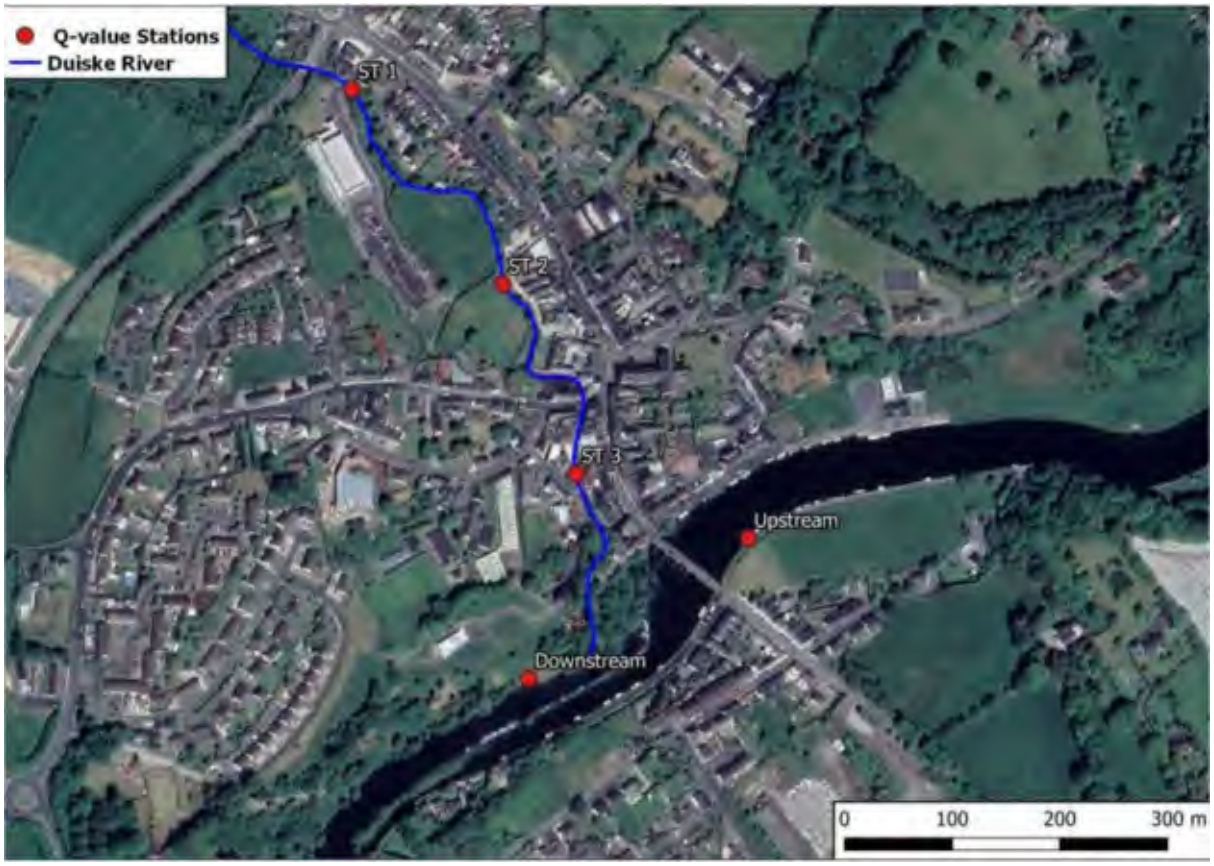


Figure 8.1. Graiguenamanagh Q-value station locations.

Table 8-1. Q-value station coordinates for Graiguenamanagh.

Station	GPS Coordinate
ST1	52.543472, -6.958914
ST2	52.541958, -6.956879
ST3	52.540334, -6.955860
Downstream	52.538656, -6.955710

Table 8-2. Stream Morphology

Station	Width (m)	Depth (cm)	Substrate	Flow
ST1	2.8	49	Cobbles	Flood
ST2	3.4	44	Cobbles	Flood
ST3	5.2	36	Cobbles	Flood
Downstream	56	>120	Mud	Flood

8.3 Survey Results

8.3.1 Original CFRAM Survey (2021)

Included in Appendix J.

8.3.2 Upstream Storage Area (2023)

Included in Appendix K.

8.3.3 Top Up Survey (2024)

Photographs and examples species recorded at each station are included in Appendix L. Stations 1 to 3 were taken from the Duiske River. Station 1 located to the north of Graiguenamanagh town recorded a Q-value of 3, which was the lowest of any of the stations. Stations 2 and 3 both recorded an intermediate Q3-4. One station was sampled in the River Barrow, station 4 located downstream of the weir. Station 4 recorded an intermediate Q-value of 4-5 (Table 8.2). All species recorded where typical of the habitats sampled. Species composition recorded at station 2 and 3 is as expected for a slightly polluted status with only a few sensitive species present and in low numbers.

Table 8.2. Biological sampling results.

Station	Q-Value
ST 1	Q3
ST 2	Q3-4
ST 3	Q3-4
Downstream	Q4-5

9 Fisheries Surveys

9.1.1 Original CFRAM Survey (2021)

An electrofishing survey was completed externally by AQUAFACT in February 2021. The results of the survey are outlined in APEM's survey report, included in Appendix M.

9.1.2 Upstream Storage Area (2023)

A fish habitat survey was completed externally by APEM in August 2023. The results of the survey are included in APEM's survey report, included in Appendix K.

Given the availability of electrofishing data both collected as part of the Scheme, and available from Inland Fisheries Ireland (IFI), the conduct of electrofishing surveys was not considered a requirement. This decision was accepted by IFI, as outlined in the report in Appendix K.

9.1.3 Top Up Survey

No notable qualitative changes to any habitats in the study area have been noted and, from secondary review, no significant pollution events occurred in either river since 2021. For this reason, and the availability of recent electrofishing data, additional fish habitat and electrofishing surveys were not considered a requirement. This recommendation is detailed further in the report contained under Appendix A.

10 White-Clawed Crayfish Surveys

10.1.1 Original CFRAM Survey (2021)

A white-clawed crayfish survey (including trapping, hand-searching, sweep-netting, snorkeling and eDNA analysis) was completed externally by Triturus Environmental Ltd. in April 2021. The results of the survey are outlined in Triturus Environmental Ltd.'s survey report, included in Appendix N.

10.1.2 Upstream Storage Area (2023)

A white-clawed crayfish survey (including trapping and hand-searching) was completed externally by APEM in August 2023. The results of the survey are included in APEM's survey report, included in Appendix K.

10.1.3 Top Up Survey

In the original survey completed in 2021, no white-clawed crayfish were recorded via hand-searching/sweep netting and eDNA samples returned a negative result for white-clawed crayfish and crayfish plague eDNA. Therefore, additional surveys were not considered a requirement. This recommendation is detailed further in the report contained under Appendix A.

11 Freshwater Peal Mussel Surveys

11.1 Original CFRAM Survey (2021)

A freshwater pearl mussel survey (including bathyscope surveying, snorkeling and SCUBA diving techniques and eDNA analysis) was completed externally by Triturus Environmental Ltd. in April 2021. The results of the survey are outlined in Triturus Environmental Ltd.'s survey report, included in Appendix O.

11.2 Upstream Storage Area

During the original survey completed in 2021, no live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling and eDNA samples returned a negative result for freshwater pearl mussel eDNA. Therefore, dedicated surveys for the upstream storage area were not considered a requirement. This recommendation is detailed further in the report contained under Appendix A.

11.3 Top Up Survey

As above.

12 Arboreal Surveys

An arboreal survey was completed at both the upstream storage area and within the towns of Graiguenamanagh and Tinnahinch in May 2023 and November/December 2023/2024 by Veon. The methodology and results of the survey are included in Veon's survey report, included in Appendix P.

13 Conclusion

This ecological survey report for Graiguenamanagh FRS has provided up to date ecological information of the site regarding bats, birds, mammals, herpetofauna, flora, and aquatic surveys that have been undertaken as part of the scheme. This has ensured that the environmental assessment has been carried out with reliable up-to-date baseline information, and that any concerns from stakeholders (namely NPWS) are considered as part of the EIAR.

Appendix A: Report on the Requirement for Ecology ‘Top Up’ Surveys (BL/AQUAFACT, 2023)

BYRNELOOBY
AN ayesa COMPANY

Technology | Engineering | Consulting

Graiguenamanagh-Tinnahinch Flood Relief Scheme

Report on the Requirement for Ecology 'Top Up' Surveys

Kilkenny County Council

Report No. W3451-ENV-R013
18 October 2023
Revision 00

CARLOW COUNTY COUNCIL
Kilkenny County Council
Comhairle Chontae Chill Chainnigh
OPW
Tionscadal Éireann 2040

Document Control

Project:	Graiguenamanagh-Tinnahinch Flood Relief Scheme
Document:	Report on the Requirement for Ecology 'Top Up' Surveys
Client:	Kilkenny County Council
Report Number:	W3451-ENV-R013

Document Checking:

Revision	Revision/ Review Date	Details of Issue	Authorised		
			Prepared By	Checked By	Approved By
00	18 October 2023	Issued for Client Review	Brendan O'Connor	Jackelyn Wren Sean Harrington	Barry Sheridan
Disclaimer: Please note that this report is based on specific information, instructions, and information from our Client and should not be relied upon by third parties.					

BYRNELOOBY
AN ayesa COMPANY

www.byrnelooby.com

www.ayesa.com/en

Produced by

AQUAFACT International Services Ltd

On behalf of

Byrne Looby

October 2023

AQUAFACT INTERNATIONAL SERVICES LTD.,
12 KILKERRIN PARK,
GALWAY .
www.aquafact.ie

info@aquafact.ie

tel +353 (0) 91 756812

Table of Contents

1. Introduction & Context

1.1. Project History

Kilkenny County Council (KCC), through partnership with the Office of Public Works (OPW) and Carlow County Council (CCC), is progressing the Graiguenamanagh-Tinnahinch Flood Relief Scheme (GTFRS) (hereafter referred to as the 'Proposed Scheme'). KCC progressed the scheme to address the high levels of flood risks in Graiguenamanagh and Tinnahinch, under the EC Directive on the Assessment and Management of Flood Risks 2007 and the EU Floods Directive, as implemented in Ireland by SI 122 of 2010 EC Regulations 2010 and SI 495/2015.

KCC has commissioned ByrneLooby (BL) to develop and implement the GTFRS. AQUAFACT is on board as the lead ecologist on the Project and previously carried out a set of ecological surveys for the Proposed Scheme in 2020 and 2021 along and within the River Barrow and River Duiske within the Scheme Area (see Figure 1 and AQUAFACT reports 2020/2021).

Figure 1. Scheme Area

1.2. Objectives of this Report

From the conduct of the original set of surveys in 2020/2021, the Proposed Scheme has been undergoing extensive optioneering and engineering design as well as stakeholder engagement and as such, has delayed the delivery of the Planning Application and therefore Environmental Impact Assessment Report (EIAR). As a result, ByrneLooby is currently reviewing the lifespan of a series of ecological surveys conducted for the Proposed Scheme in 2020/2021 in order to determine whether, in accordance with available and applicable advice, additional surveys are required to provide up-to-date baseline information for input into the EIAR. Given the lack of national guidance and/or legislation on the matter, the Advice Note from the Chartered Institute of Ecology and Environmental Management (CIEEM) 'on the Lifespan of Ecological Reports & Surveys' (April 2019) has been referenced. Here, for surveys that are 18 months to 3 years old (as is the case for the majority of surveys for the Proposed Scheme, see Table 1 below), the following is advised:

'A professional ecologist will need to undertake a site visit and may also need to update desk study information (effectively updating the Preliminary Ecological Appraisal) and then review the validity of the report, based on the factors listed below. Some or all of the other ecological surveys may need to be updated. The professional ecologist will need to issue a clear statement, with appropriate justification, on:

- *The validity of the report;*
- *Which, if any, of the surveys need to be updated; and*
- *The appropriate scope, timing and methods for the update survey(s).*

The likelihood of surveys needing to be updated increases with time and is greater for mobile species or in circumstances where the habitat or its management has changed significantly since the surveys were undertaken. Factors to be considered include (but are not limited to):

- *Whether the site supports, or may support, a mobile species which could have moved on to site, or changed its distribution within a site (see scenario 1&2 examples);*
- *Whether there have been significant changes to the habitats present (and/or the ecological conditions/functions/ecosystem functioning upon which they are dependent) since the surveys were undertaken, including through changes to site management (see scenario 3 example);*

- *Whether the local distribution of a species in the wider area around a site has changed (or knowledge of it increased), increasing the likelihood of its presence.'*

AQUAFACT has therefore been commissioned to provide the above services, including a re-survey in same section of the river by means of a walk over (to determine if there were any substantial visual changes in ecological conditions), to review historical surveys undertaken and their respective reports and to make recommendations as to whether or not these require re-survey, given the passage of time since they were carried out. The surveys undertaken previously are outlined in the table below.

Survey Type	Survey Date	Age (CIEEM, 2019)
Bat Survey	14-16/09/2020	>3 years
Wintering Bird Survey	16-18/02/2021	18 months – 3 years
Breeding Bird Survey	02/04/2021	18 months – 3 years
Mammal Survey (including otter, badger, pine martin, red squirrel).	16-18/02/2021	18 months – 3 years
Herpetofauna Survey	16-18/02/2021	18 months – 3 years
Flora Survey	16-18/02/2021	18 months – 3 years
Q values/invertebrates Survey	08/02/2021	18 months – 3 years
Electrofishing Survey	10/02/2021	18 months – 3 years
White-Clawed Crayfish (eDNA sampling and testing)	29/04/2021	18 months – 3 years
Freshwater Pearl Mussel (eDNA sampling and testing)	30/04/2021	18 months – 3 years
Trees	June 2023	<12 months

Table 1. Survey History for the Proposed Scheme

When these initial surveys were completed in 2020/2021, the options identified in the CFRAM level assessment included defences within the environs of the town of Graiguenamanagh-Tinnahinch and therefore, all surveys were undertaken within the study area identified in Figure 1 only. Through project level optioneering and engineering and stakeholder engagement, the inclusion of an upstream storage facility was identified as a benefit to the scheme. The area that this is proposed to encompass is currently (summer 2023) undergoing ecology surveying for mammals, breeding birds, bats, herpetofauna, Q-value and invertebrates, water quality and fisheries habitat. Therefore, the recommendations made in this report are only in relation to those historical surveys undertaken within the town.

With regard to alien species, AQUAFACT was instructed not to comment on these as there is regular on-going treatment with concurrent reporting, in accordance with a specific Invasive Alien Species Management Plan.

This report documents the main findings of the abovementioned walkover, and comments upon the requirement to re-survey specific specialised ecology. The walkover and provision of recommendations in this report have been carried out by Dr. Brendan O'Connor who has 38 years' experience as an ecologist.

1.3. Brief Scheme Description

A scheme option was identified at the CFRAM level of assessment. Following this, a project-level options assessment has been conducted to reassess and consider all possible measure to reduce flood risk, not just those in the CFRAM assessment. Development was based on more detailed information than was available for the CFRAM, including detailed hydrological assessment, hydraulic modelling studies and environmental studies.

Five (nos. 5) options were identified and assessed through Multi-Criteria Assessment (MCA) and engineering optioneering and were presented for public and stakeholder engagement in August 2022. Combining objective analysis and professional judgement, with reference to the information gathered through the environmental assessment and public consultation, the preferred option was determined.

The Proposed Scheme consists of a series of raised defences (stone/glass barriers and embankments) along the River Duiske and the River Barrow. It further includes upstream storage of flood waters (upstream on the River Duiske) to facilitate a reduced extent of flood walls downstream in the built-up area of Graiguenamanagh.

2. Site Walkover (2023)

As mentioned, an updated walkover survey was conducted by Brendan O'Connor on August 9th, 2023. Weather on the day was mostly cloudy also but with some sunny spells. There was no rain. The walkover survey involved examining and recording the habitats and flora and fauna that are present along the riverbank and photographing representative elements of these. All floral identifications were made in the field and binoculars were used to identify birds.

2.1. General Observations

The August 2023 walkover survey in Graiguenamanagh did not document any noticeable differences between what habitats and their conspicuous species were recorded along the riverbanks of the Barrow and the Duiske in the 2021 site survey. Much of the riverbanks are either within or close to the built environment of the town or are management grassland walkways and quay walls.

3. Review & Recommendations

3.1. Bats

3.1.1. Previous Survey (2020)

ByrneLooby carried out a two-day bat survey in September 2020, commencing with an initial walkover survey of the site during daylight hours to gain an overview of the site with regard to its potential use by bats. Potential roost sites were revisited at dawn and dusk on the following two nights/mornings to establish whether they were being used as roosts by bats. Bat activity was monitored using a heterodyne bat detector (Magenta Bat5), with which it was possible to identify species based on their echolocation frequency.

The common pipistrelle, soprano pipistrelle and Dubenton's bats were recorded in the area. The presence of the Rivers Barrow and Duiske, as well as numerous patches of scrub, hedgerows, treelines and woodland, cumulatively offer attractive foraging and commuting habitats for several species of bats. Two of the potential roost sites identified during the daytime survey showed evidence of roosting soprano pipistrelles. Bat activity (in the form of fly-bys) was recorded at all potential roost sites, which indicates that the area as a whole is an important resource for foraging and/or commuting bats.

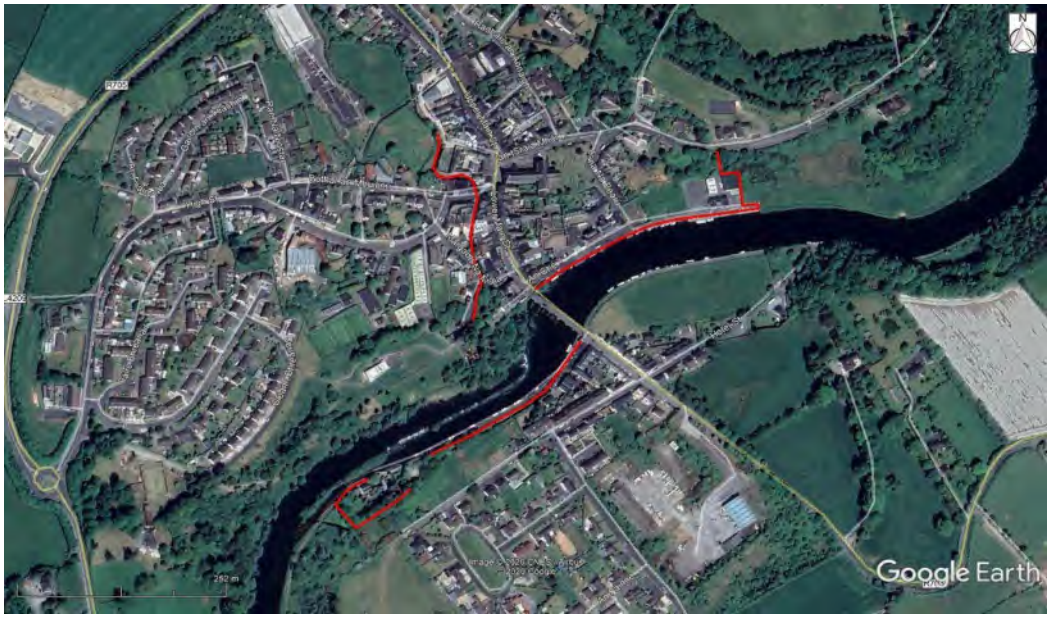


Figure 2. Previous Bat Survey Routes (2020 Survey)

3.1.2. Re-Survey Recommendations

Note that it will have been three years (as of 14th September 2023) since the initial survey was conducted in 2020 and in accordance with the CIEEM Advise Note, a re-survey is suggested to be a requirement once this time period is reached. Further, recent communications from the NPWS (dated 27/06/2023) in response to the submission of the Environmental Impact Assessment (EIA) Scoping Report highlights that several of the specialist ecological survey methods vary from accepted good practice and take place outside of the optimal survey season or do not meet the required number of survey visits. Bats have been included in the list of surveys recommended to be repeated by NPWS, with appropriate Guidance listed. Note our disagreement with this statement, as the 2020 bat survey undertaken within the optimal survey season (May to September), and in accordance with the guidelines suggested by NPWS. Nevertheless, a re-survey is recommended due to the time lapse since the previous survey, and the fact that the Project will likely cause some impact to bat species through tree felling, noise and light.

Trees with suitable holes and spaces can provide summer roost sites for bats and as some trees are required to be felled, they might provide suitable summer bat roosts. A tree survey has been carried out and several trees have been identified by the arborist as having bat roost potential.

It is therefore recommended that an ecologist complete a dedicated roost suitability survey focusing on those trees likely to be impacted by the Scheme. Further, roost suitability surveys and complementary dawn/dust survey are recommended along the initial transect routes surveyed in 2020 (see Figure 2), incorporating bridges to be impacted by the scheme (i.e., bridge downstream from High Street). Additional survey transects will be required where changes to the scheme have been made since the 2020 survey was completed, including along the embankment proposed at Hotel Street and along the riverside treeline at the Hub. The intention is to identify whether the same species and density of bats are recorded in the areas of works and to comment upon the likely impact of the scheme to these species from activities such as tree felling, production of artificial light and noise, and alterations to/within proximity to bridges with roost potential. The surveys would need to be undertaken within the survey season from April to September.

3.2. Breeding & Wintering Birds

3.2.1. Previous Survey (2021)

A wintering bird survey was undertaken between 16th – 18th February 2021 and breeding birds survey on 2nd of April 2021. Both surveys involved line transects along identified routes in the study area, carried out early in the morning, approximately 30 minutes after sunrise. Features of the landscape that were deemed significant for birds (*e.g.*, potential breeding habitats, Kingfisher perches, existing nests *etc*.) were also recorded.

A total of 32 bird species were recorded at the site between the wintering survey and breeding survey, 21 species during the winter survey and 25 during the breeding survey. Of the species identified, 8 are protected under the Wildlife Acts, 5 are listed on BOCCI's Amber list, and 3 are listed in Annex II and III of the EU Birds Directive. Eighteen sites suitable for Kingfisher perches were identified in the study area. These should not be allowed to be impacted by the construction of the scheme.

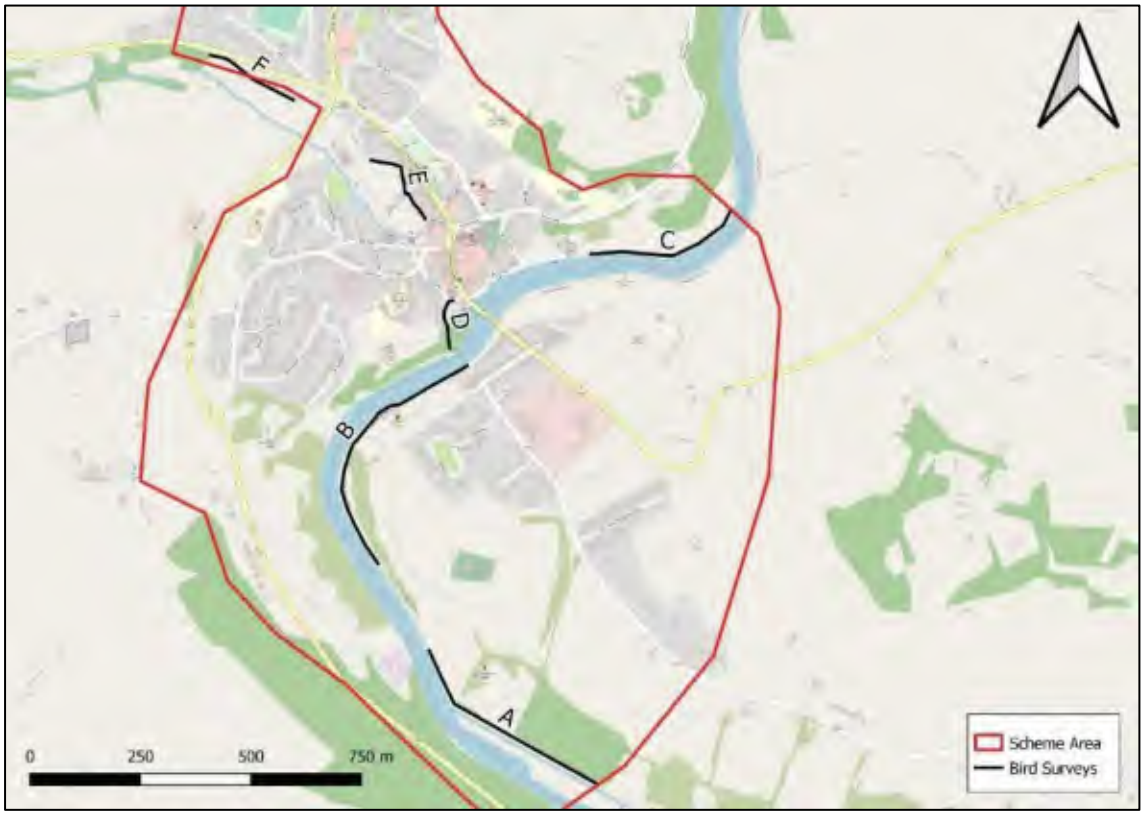


Figure 3. Previous Bird Transect Survey Locations (2021 Survey)

3.2.1. Re-Survey Recommendations

During the August 2023 site walkover survey, a Heron was recorded roosting on a Scot's Pine on the eastern riverbank, south of the Tinnahinch lock gates. Other species recorded include Rook, Jackdaw, Swallow, Mute swan, Blue tit, Mallard, House martin, Chaffinch and House sparrow. The site walkover highlighted the importance of the area for breeding and wintering birds.

Recent communications from the NPWS (dated 27/06/2023) in response to the submission of the EIA Scoping Report highlights that several of the specialist ecological survey methods vary from accepted good practice and take place outside of the optimal survey season or do not meet the required number of survey visits. Breeding and wintering birds have been included in the list of surveys recommended to be repeated by NPWS, with appropriate Guidance listed. Whilst the survey season was optimal for both previous surveys, the comment from NPWS is likely in relation to the numbers of visits. The previous surveys included only for the collection of data across a single visit survey, whereby guidance from the Breeding Bird Survey methodology from the British Trust for Ornithology (BTO)[1] recommends two visits at least. Furthermore, the date of the last round of bird surveys will be approaching 3 years in February 2024.

Breeding bird species are well documented in the study area, and the likely impact to these species will be as a result of vegetation and tree removal to facilitate the scheme, resulting in displacement from roosting and nesting habitat. Birds are volant creatures and can use various habitats for foraging, nesting and roosting within the town and surrounding areas of Graiguenamanagh. Overwintering birds may be present along the banks of the River Barrow outside of the most built-up areas of the town, including the areas of transect A, B and C (see Figure 3). Many of the online records of birds and those recorded during the previous bird survey, overwinter in Ireland. Whilst overwintering birds may not be directly impacted on by the proposed works in the town, it is likely that they could be impacted by noise which would displace them from their overwintering habitat.

Therefore, an updated survey with a list of wintering birds and wintering visitors is recommended and should be undertaken in accordance with up-to-date guidance from the Breeding Bird Survey methodology from the British Trust for Ornithology (BTO). The previous survey transects (see Figure 3) will be reviewed and only those relevant to provide meaningful assessment of the Proposed Scheme as it currently stands, will be surveyed. This will involve a removal of Survey Transect A

[1] https://www.bto.org/our-science/projects/breeding-bird-survey/research-conservation/methodology-and-survey-design

(given the distance from the scheme), alterations to B (shortening) and establishment of an additional transect along Hotel Street, upstream of the bridge.

3.3. Mammals

3.3.1. Previous Survey (2021)

A survey of mammals, including otter, red squirrel, pine marten and badger, was undertaken between 16th – 18th February 2021. This involved the completion of a walkover survey with observations made by qualified ecologists as to the presence of mammals through sightings or evidence (*i.e.,* spraint, holts, setts, tracks, slides *etc.*). Evidence of otter was noted, including a potential couch, a potential holt and a potential spraint. The potential holt was recorded in a section of the River Duiske upstream from Graiguenamanagh Town, and the potential couch and spraint were recorded downstream from the Tinnahinch Castle along the River Barrow. These sightings however were not conclusive.

3.3.1. Re-Survey Recommendations

Note that the date of previous mammal survey will be approaching 3 years in February 2024.

A re-survey of mammals is recommended, including the deployment of mammal tunnels for the recording of tracks. The previous surveys included only for the collection of incremental sightings during a daylight walkover. Observations of any setts and holts should be made, given the time lapse since the previous survey, with notes made on their likely activity and use. These surveys are recommended to inform the EIA and CEMP, with additional surveys recommended as part of the mitigation pre-construction.

As squirrel and pine marten require areas of forest, it is considered that these species will not be present within Graiguenamanagh and further surveys are therefore not required.

3.4. Herpetofauna

3.4.1. Previous Survey (2021)

A herpetofauna survey was undertaken in February 2021. Two separate observations of Common Frog spawn were made, adjacent to the private entrance on the upstream end of Hotel Street, Tinnahinch. The embankment proposed here will be in proximity to these historical observations.

3.4.2. Re-Survey Recommendations

As mentioned previously, recent communications from the NPWS (dated 27/06/2023) in response to the submission of the EIA Scoping Report highlights that several of the specialist ecological survey methods vary from accepted good practice and take place outside of the optimal survey season or do not meet the required number of survey visits. Herpetofauna surveys were mentioned in this response, however observations made during the initial walkover survey and the August 2023 visit did not record any pools/ponds within the survey area. For this reason, an additional herpetofauna survey is not considered a requirement at this stage. However, given historical observations, the EIAR will assume presence of spring-spawning herpetofauna within the project area, and will include appropriate pre-construction mitigation as a matter of course.

3.5. Flora

3.5.1. Previous Survey (2021)

A survey of terrestrial flora was undertaken in February 2021. No floral species of conservation interest were observed; however, there is a significant limitation with regard to the timing of the survey as it was carried out in the winter period when the great majority of plants would have died back.

3.5.2. Re-Survey Recommendations

Note that the date of the previous survey will be approaching 3 years in February 2024.

With this in mind, as well as the previous survey limitations, it is recommended that a floral survey be carried out between May and September to properly document plant species in the area.

3.6. Q values & Invertebrates

3.6.1. Previous Survey (2021)

These surveys involved carrying out an analysis of aquatic invertebrates and computing an evaluation of the quality based on the Q-value provides a valuable synopsis of water quality. In February 2021, Q-value surveys were undertaken at five locations. Q values ranged from 3 to 4 at the five locations sampled. The Q-value rating is assigned based on the relative percentages of pollution-sensitive and tolerant species to less pollution sensitive and more tolerant.

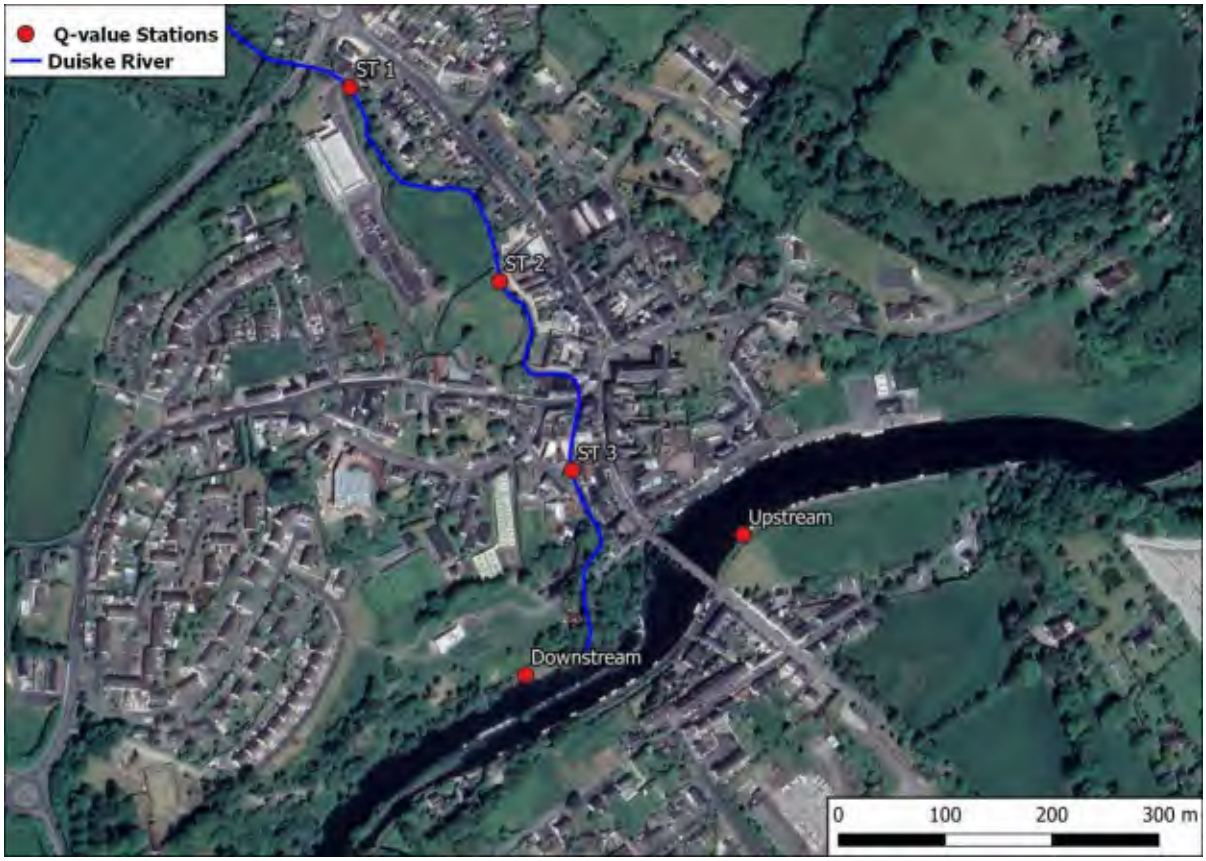


Figure 4. Q-value Survey Locations (2021 Survey)

3.6.2. Re-Survey Recommendations

A review of the latest Environmental Planning Authority (EPA) Q-value monitoring data was completed in preparation of this report; however, it is noted that no monitoring was undertaken in the reporting period for 2022 at any stations located within the study area.

As mentioned previously, recent communications from the NPWS (dated 27/06/2023) in response to the submission of the EIA Scoping Report highlights that several of the specialist ecological survey methods vary from accepted good practice and take place outside of the optimal survey season or do not meet the required number of survey visits. Sampling for invertebrates was mentioned in this response, however it is the opinion of the Lead Ecologist that this survey was undertaken within the optimal survey season and in accordance with practised guidelines.

The August 2023 walkover did not record any notable qualitative changes to any habitats in the study area, and from secondary review, no significant pollution events occurred in either river since 2021. For this reason, additional Q value surveys are not recommended. However, it is recommended that prior to construction, the same 5 sites as sampled in the initial survey are re-

surveyed and reported on and that any additional surveys reported via Inland Fisheries Ireland (IFI) and/or EPA are included in that report.

3.7. Electrofishing

3.7.1. Previous Survey (2021)

Electrofishing surveys were undertaken in 2021 at three sites within the River Duiske. The River Barrow was considered unsuitable for the conduct of electrofishing surveys due to its size. Five species were encountered, namely, brook lamprey (*Lampetra planeri)*, Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta)*, European Eel (*Anguilla anguilla)* and stone loach (*Barbatula barbatula*).

Figure 5. Electrofishing Survey Locations (2021 Survey)

3.7.2. Re-Survey Recommendations

The August 2023 walkover did not record any notable qualitative changes to any habitats in the study area and, from secondary review, no significant pollution events occurred in either river since 2021. For this reason, and the availability of recent electrofishing data, additional electrofishing

surveys are not recommended. However, it is recommended that prior to construction, the same sites as sampled in the initial survey are re-surveyed and reported on and that any additional surveys reported via IFI are included in that report.

3.8. Other Aquatic Fauna

3.8.1. Previous Surveys (2021)

Triturus Environmental Ltd conducted a Stage 1 Freshwater Pearl Mussel Survey (FWPM) and eDNA sampling on the Duiske River in April 2021 *ca.* 350m downstream of the proposed works area. No live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling and eDNA samples returned a negative result for freshwater pearl mussel eDNA.

In addition, White-clawed Crayfish Surveys (WCC) and eDNA sampling were undertaken on the Duiske River in April 2021 *ca.* 350m downstream of the proposed works area. No white-clawed crayfish were recorded via hand-searching/sweep netting and eDNA samples returned a negative result for white-clawed crayfish and crayfish plague eDNA.

3.8.2. Re-Survey Recommendations

Given the results of the previous surveys in 2021, a re-survey is not required.

3.9. Trees

A comprehensive tree survey and Arboricultural Impact Assessment has been undertaken by qualified arborists in June 2023 (with updates required in October 2023), with observations made on the suitability of trees for bat roost potential. This survey will be sufficient for the EIAR submission in 2024. As noted above in the section on bats, a dedicated roost-suitability survey of trees that will be felled as part of the Proposed Scheme is recommended.

4. Summary

The historical 2020/2021 ecological surveys undertaken in the towns of Graiguenamanagh and Tinnahinch have been reviewed by Dr. Brendan O'Connor, and recommendations made for where survey repeats/top ups are suggested. The overall intention is to ensure that the environmental

assessment is carried out with reliable and up-to-date baseline information, and that any concerns from stakeholders (namely NPWS) are considered as part of the EIAR.

The following ecological surveys are recommended:

- **Bats:** A Bat Roost suitability survey is recommended with a focus on trees to be felled to facilitate the proposed scheme and at the bridge downstream from High Street (River Duiske), where minor works are proposed. Further, dawn/dust transect surveys are suggested, to identify whether the same species and density of bats are recorded in the areas of proposed felling. The original transect lines should be surveyed, as well as two additional areas where scheme works have since been proposed. These surveys are required to be undertaken with the period April and September 2024.
- **Breeding and wintering birds:** Full breeding and wintering bird surveys are recommended in line with BTO guidance (at least 2 visits for each). The breeding bird season is April – September and wintering bird season is October – March. The original transect lines will require some alteration to make the survey meaningful to the scheme as it currently stands.
- **Flora:** A floral survey during a summer or late spring month is recommended, given the survey season limitations of the previous survey in 2021.
- **Mammals:** A re-survey of mammals is recommended, including the deployment of mammal tunnels for the recording of tracks. Species of particular focus should be otters and badgers.

Additional surveys of herpetofauna, fisheries, Q-values and invertebrates can be addressed in pre-construction surveys, depending on the findings of the EIAR.

As mentioned, the area that this is proposed to encompass the upstream storage of flood water is currently (summer 2023) undergoing ecology surveying (including for breeding and winter birds, herpetofauna, mammal, invertebrates and Q-Values, fisheries habitats and White-Clawed Crayfish) and therefore no further recommendations have been made with regard to the ecological assessment of this area.

Appendix B: Bat Survey Report (Original CFRAM Level Survey) (Ayesa, 2020)

E

BYRNELOOBY

Office of Public Works

Graiguenamanagh/Tinnahinch Flood Relief Scheme

Bat Survey Report

Report No. W3451-ENV-R001

20 October 2020

Issue 00

Document Control

Document: Bat Survey Report

Project: Graiguenamanagh/Tinnahinch Flood Relief Scheme

Client: Office of Public Works

Report Number: W3451-ENV-R001

File Origin: \\BL-SV02001\Data\Jobs\W\W3000\W3400s\W3451_Graiguenamanagh Tinnahinch FRS\6 Incoming\06e Team Members & Other Advisors\104_Bat survey report

Document Checking:

Revision	Revision/ Review Date	Details of Issue	Authorised		
			Prepared By	Checked By	Approved By
00	20 October 2020	For Approval	Steven Tooher	Fiona Symes	Fiona Symes
Disclaimer: Please note that this report is based on specific information, instructions and information from our Client and should not be relied upon by third parties.					

www.ByrneLooby.com

Contents

1 Introduction

1.1 Overview

ByrneLooby has been appointed by The Office of Public Works (OPW) for the development and implementation of a flood relief scheme (FRS) for a section of the River Barrow that flows through Graiguenamanagh-Tinnahinch. Periods of high rainfall have resulted in parts of the town being flooded frequently in recent years. Graiguenamanagh (Co. Kilkenny) is situated on the northern side of the Barrow, while Tinnahinch (Co. Carlow) is situated on the southern side. For the purpose of this report, and in line with the nomenclature used for the FRS as a whole, the locality is referred to as Graiguenamanagh-Tinnahinch. The overall scheme study area is shown in Figure 1.1.

Figure 1.1. Overall Scheme Study Area

All Irish bats are protected under national and EU legislation. Both the animals themselves and their roosts are protected and it is an offence to disturb or interfere with them without a licence. Such a derogation (which must be given by the Minister for the Environment, Heritage and Local Government) can only be sanctioned where there is no satisfactory alternative and where it will not be detrimental to the favourable conservation status of the species concerned.

With due cognisance of the protection of all bat species, ByrneLooby were requested to carry out a survey of the development area to ascertain if the proposed development area was being used, or had the potential to be used, by bats. See Figure 1.2 for an overview of the survey area. The results of this survey will form part of a constraints study for the proposed project.

This report details the findings of a bat survey of the development area carried out in September 2020 by Steven Tooher MSc.

1.2 Statement of Authority

Steven Tooher has been working as a professional ecologist since July 2015. He has experience in a wide variety of aquatic and terrestrial surveys. He has a BSc. (Hons.) in Zoology from University College Cork, and a MSc. In Environmental Resource Management from University College Dublin.

He has considerable experience undertaking protected species surveys in Ireland, including plants, bats and bird surveys for a variety of public and private entities.

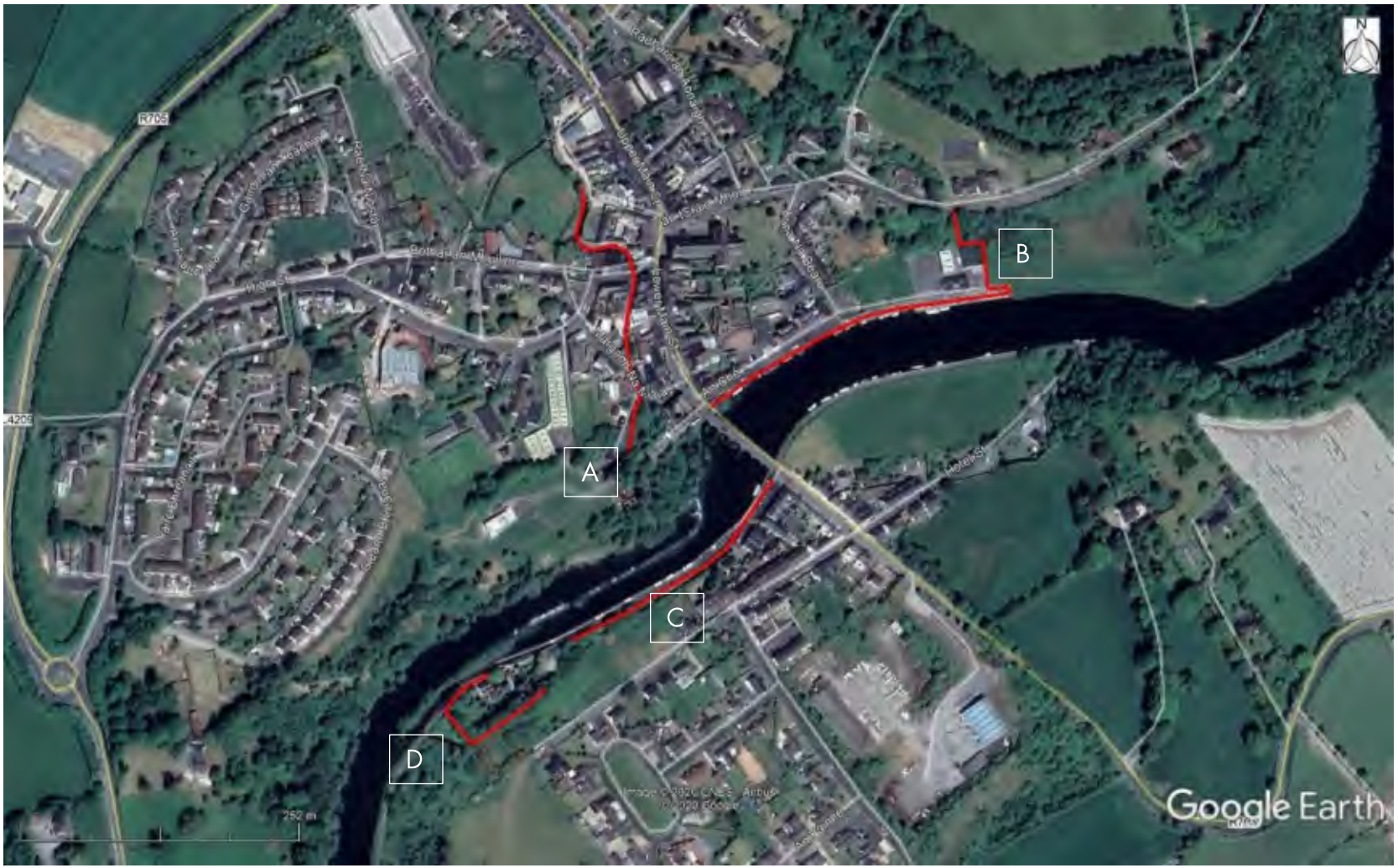


Figure 1.2. Graiguenamanagh-Tinnahinch Bat Survey Routes (shown as red lines)

2 Methodology

2.1 Guidance and background information

This report has been prepared with reference to the following European Directives, national legislation and guidance on bat mitigation.

- Bat Conservation Trust (2015). Bat Surveys for Professional Ecologists – Good Practice Guidelines (3rd edition).
- Council Directive (92/43/EEC) of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna.
- Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- National Roads Authority (2005). Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin.
- Wildlife Acts 1976 to 2018.

2.2 Study Area

The survey area focused on the areas shown in Figure 1.2 where works are proposed to be implemented (as per correspondence from the OPW).

2.3 Survey Methodology

A desk assessment of potential bat habitats in the wider geographical area was conducted. Existing records of historical bat sightings were obtained from the National Bat Database of Ireland, which is maintained by Bat Conservation Ireland (BCI) and available from the National Biodiversity Data Centre (NBDC).

An initial survey of the site was carried out during daylight hours on 14th of September 2020 to gain an overview of the site with regard to its potential use by bats. Sites deemed to be suitable for roosting bats were noted and recorded on a handheld GPS device (Garmin GPSMAP 64S). Notes were taken on the habitats and general appearance of the environment along the entire survey route. The information gathered during the daytime survey is presented in Section 4.

Potential roost sites were revisited at dawn and dusk on the following two nights/mornings to establish whether they were being used as roosts by bats. Bat activity was monitored using a heterodyne bat detector (Magenta Bat5), with which it was possible to identify species based on their echolocation frequency. The results of this survey are presented in Section 5.

3 Description of the Study Area and Survey Routes

Graiguenamanagh-Tinnahinch is located on the border between counties Kilkenny and Carlow, where the River Barrow and the River Duiske converge. The town is known for its attractive examples of 18th and 19th-Century civil engineering structures and architecture. The survey routes A, B, C and D (as shown in Figure 1.2) are described below. All potential roost locations are shown in Figure 3.1 at the end of this section.

3.1 Survey Route A

This route starts at the southern end of a lane known as Turf Market. Further south is a recreational area that is frequently occupied by caravans. At the bottom of Turf Market there is a pair of old stonework buildings that were erected c. 1800. They are separated by a narrow passageway known as Peg Washington's Lane, which connects Turf Market to a narrow footpath alongside the River Duiske. Both buildings were considered to have potential as bat roosts, due to their old stonework and abandoned appearance. There were potential entry/exit points on both buildings. These potential roosts were labelled PR1 and PR2 respectively.

The River Duiske at this location is approximately 2 metres wide and flows over cobbles and boulders. Flow at the time of surveying was considered to be moderate. Immediately upstream there is some mixed broadleaved woodland, which has foraging potential. No obvious potential bat roosting sites were observed in this area.

Further upstream, Route A passes by some modern bridges and a weir before encountering another old stone building with an abandoned appearance. From examining the 25-inch OSI maps available online, it appears that this building may have been a smithy. It is partially-overgrown with *Hedera helix* (ivy) and *Parthenocissus quinquefolia* (Virginia creeper). This was also considered a potential roost site (PR3).

Further north, domestic dwellings are crowded along both sides of the River Duiske. One of the buildings appeared to be in disuse - window panes were absent and the interior appeared to have been undisturbed for some time. A stockpile of refuse bags and other miscellaneous items were being stored inside, and there appeared to be sufficient shelter so as to be another potential roost site (PR4). Some bramble and willow scrub was noted along the opposite side of the river.

It is possible to access the Duiske further upstream via a historic feature known as the Bianconi Archway. This leads to a small patio, flowerbed and a small assembly of chairs and tables. It has the appearance of belonging to the adjacent pub (Mick Doyle's). This area looks out onto the Duiske, and to its rear is another old building with similarly old stonework. It is unclear what the present use of the building is, but it is suggested that stables existed here when Mick Doyle's pub used to be a hotel and stopping point for horse-drawn 'Bianconi Cars' in the 19th and early

20th Century. Some slit openings exist along the riverside wall, which along with its disused appearance, contributes to the building's potential as another roost site (PR5).

3.2 Survey Route B

Starting at the northern end of the bridge, travelling east.

The majority of this route consists of a tarmacked road, with buildings on one side and a quay on the other. The quay was populated with pleasure craft (barges etc.) at the time of the site visit. The quay wall dates from c. 1900[1] and is constructed with stone blocks. Concrete bollards line the edge of the quay. There is very little vegetation along this stretch, with the exception of a small marshy/grassy area by the bridge. This area is fringed by *Typha latifolia*, but grades into grasses towards the roadside. Several specimens of *Impatiens glandulifera* (Himalayan balsam) were noted. A couple of *Salix cinerea* (grey willow) shrubs were also noted.

At the eastern end of Route B, the survey route winds its way up a hill behind a scout hall and rowing club. The low-lying parts of this section are occupied by semi-natural grassland and bramble scrub, but a mixed broadleaved woodland sits at the top of the hill. The woodland was easiest accessed from Chapel Street to the north. It is home to several large specimens of *Fraxinus excelsior* (ash) and *Acer pseudoplatanus* (sycamore), and had a notable coverage by *Clematis vitalba*.

The riverside portion of Survey Route B is considered generally unsuitable for roosting bats. Whilst there may be crevices etc. in old stonework along the quay walls, the frequent boat activity in this area is sufficient to deter bats from roosting. The willow shrubs are too young to have any of the characteristics that make an attractive vegetative roost (cracks, hollows etc.). The woodland up the hill behind the scout centre and rowing club contains some large trees that may have these physical properties (cracks, hollows etc.). This site was therefore noted as a potential roost (PR6).

3.3 Survey Route C

Starting at the southern end of the bridge, moving west.

Much like Route B above, the southern embankment of the river along Route C is tarmacked and built up as a quayside. Pleasure craft lined much of Route C at the time of the survey. It is the site of a former towpath; a canal exists further west. The height of the quay wall has been recently increased in this area to provide some degree of flood protection to the adjacent residential properties. The landward side of Route C is at first residential, comprising mostly modern buildings. After ~150 metres a small stream is apparent – this may have been a mill race for an old starch works that operated on the quayside between 1842-1919. The landward

[1] https://www.buildingsofireland.ie/buildings-search/building/12318002/graiguenamanagh-county-kilkenny

habitat from this point on along Route C is dominated by a hedgerow, which can be called a treeline in some areas where trees are >5m in height. Species noted were:

Acer pseudoplatanus (Sycamore)
Salix cinerea (Grey willow)
Crataegus monogyna (Hawthorn)
Impatiens glandulifera (Himalayan balsam)
Fraxinus excelsior (Ash)
Hedera helix (Ivy)
Lonicera periclymenum (Honeysuckle)
Sambuca nigra (Elder)

This area was noted as potential foraging habitat, but was not considered a likely roosting area for bats. There were no potential roost sites noted along Survey Route C.

3.4 Survey Route D

Continuing west from the end of Route C and looping around Tinnahinch Castle.

The former towpath approaches small group of buildings; one of these is Tinnahinch Castle, which was constructed in 1615 and has been in ruins since approximately 1700. It is possible to access the interior of the castle walls, which are all that remains of the structure. Several ash shrubs form a partial canopy 3-4 metres in height. The old stonework and abandoned nature of the building suggest that this is a potential roost (PR9).

A canal lock exists further west along the former towpath. The bankside wall was lined with 1m^2-sandbags in this area. A ~1m-wide strip of common reeds (*Phragmites australis*) extends into the watercourse along the bankside wall – this is no longer a mooring point for boats. A grey heron (*Ardea cinerea*) was observed standing in this area. A treeline begins opposite the lock on the landward side of the towpath. A large cypress tree (*Cupressus* sp.) was considered large enough to have features compatible with potential bat roosts (cracks, hollows etc. inside which bats can crawl) (PR7). Approximately 25 metres further west, a mature horse chestnut was observed (*Aesculus hippocastanum*), the top of which appears to have fallen or broken off (evidenced by a jagged break line, distinct from a clean chainsaw cut). This was also considered a potential bat roost (PR8). The proximity of PR7 and PR8 to each other meant that it would later be possible to survey this small stretch of treeline as one potential roost site (i.e. PR7/8).

The remainder of this treeline, which extends south and east around Tinnahinch castle, was not accessible on foot. This treeline does contain other examples of large mature trees, all of which have potential as foraging grounds or commuting routes for bats, and some of which may also have features attractive to roosting bats.

All potential roost locations identified during the daytime walkover are shown in Figure 3.1 overleaf.

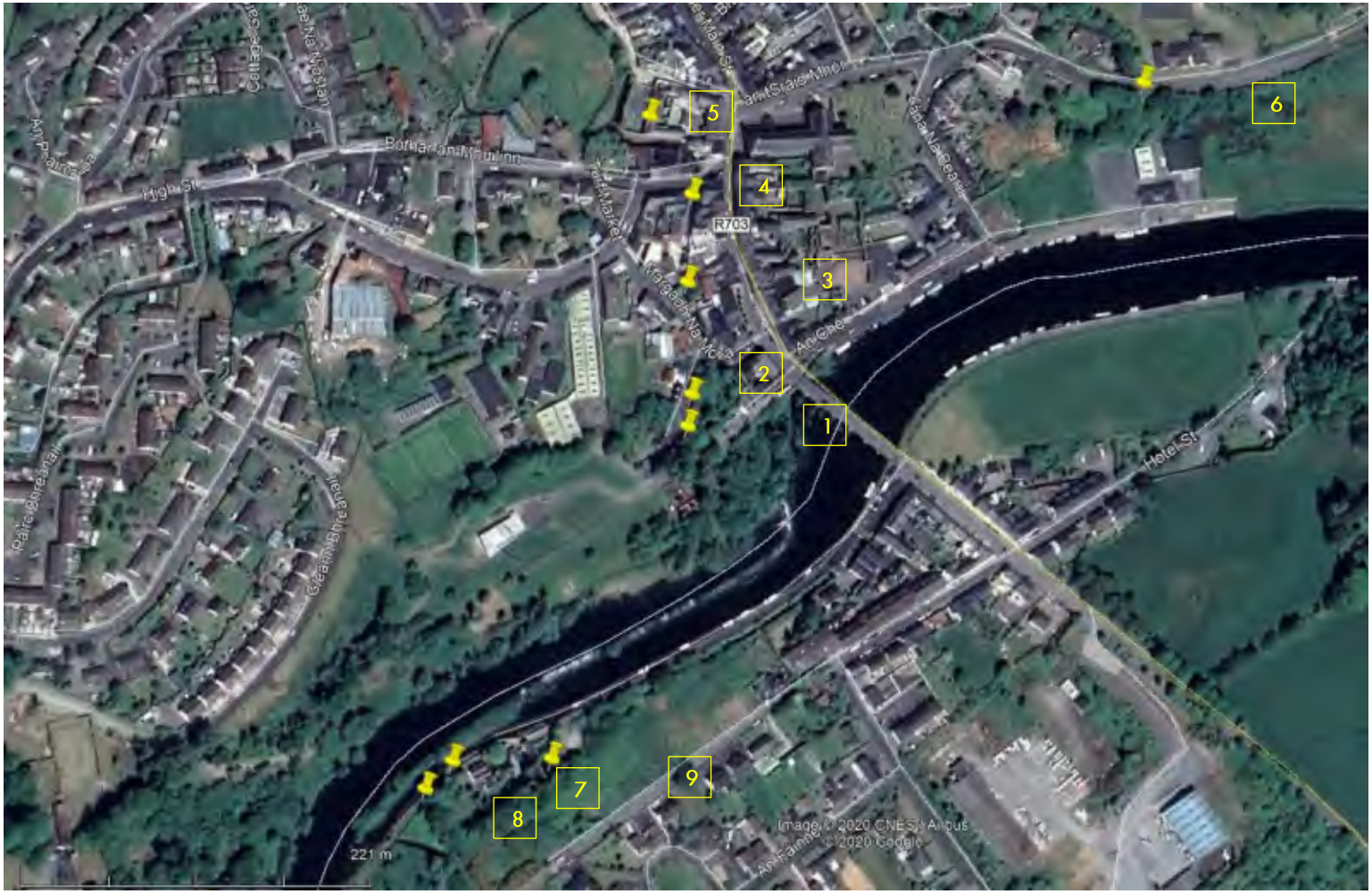


Figure 3.1. Potential Roost Sites

4 Results

This section provides the results of the desk-based study exercise and the site surveys.

4.1 Existing Data

4.1.1 Habitat Suitability

The National Biodiversity Data Centre (NBDC) has compiled data on the suitability of areas as habitats for bats. The table below provides a 'suitability index' for all bats, as well as each individual species known in Ireland. The suitability index is a number between 0 and 100, with 0 being least suitable and 100 being most suitable. The data in Table 4.1 pertains to a 6 x 6 km square, as shown in Figure 4.1.

Table 4.1. Suitability Indeces for bats in the 6km square in which the study area is located

Scientific Name	Common Name	Suitability Index
All bats		31.67
Pipistrellus pygmaeus	Soprano pipistrelle	38
Plecotus auritus	Brown long-eared bat	47
Pipistrellus pipistrellus	Common pipistrelle	48
Rhinolophus hipposideros	Lesser horseshoe bat	5
Nyctalus leisleri	Leisler's bat	38
Myotis mystacinus	Whiskered bat	33
Myotis daubentonii	Daubenton's bat	29
Pipistrellus nathusii	Nathusius' pipistrelle	1
Myotis nattereri	Natterer's bat	46

Figure 4.4.1. Location of the NBDC's 6-km square, to which the data in Table 4.1 relates

The above data suggests that the site and its surroundings generally have a moderate-to-high habitat suitability for bat usage. The area is deemed most suitable for brown long-eared bats and common pipistrelles. The surrounding landscape is reasonably diverse, comprising a mixture of agricultural grassland, silviculture and urban land-uses, which are punctuated by a network of criss-crossing treelines/hedgerows and a river system. The diverse landscape, as well as the presence of ecological corridors (in the form of hedgerows/treelines and rivers) are what drives the high habitat suitability index for bats in this area.

4.2 National Bat Database of Ireland

Nationwide records of bat observations are collected and maintained by Bat Conservation Ireland. The data come from a number of different surveys, some of which have been undertaken by BCI and their members. With regard to Graiguenamanagh-Tinnahinch, bats have been recorded in the locations shown in Figure 4.2. For the purpose of this report, the locations have been labelled A-D. The data are summarised in the table below.

Table 4.2. Existing records

Location	Species	Date(s) recorded
A	*Myotis daubentonii*	27 times between 2006-2014
B	*Myotis daubentonii*	07/03/2003
C	*Pipistrellus pygmaeus*	08/04/2000
		04/06/2012
	Pipistrellus pipistrellus	04/06/2012
	Nyctalus leisleri	04/06/2012
	Plecotus auritus	04/06/2012
D	*Nyctalus leisleri*	08/03/2000
	Pipistrellus pipistrellus	08/03/2000

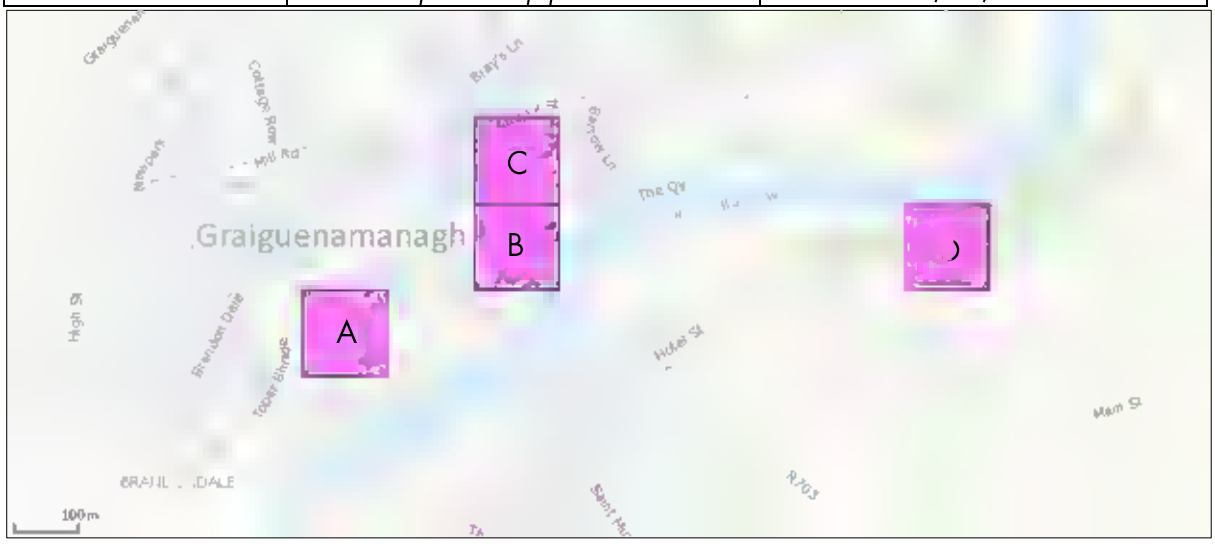


Figure 4.4.2. Locations of existing bat records (Source: NBDC, 2020)

4.3 Dawn/Dusk Surveys

Dawn and dusk surveys were carried out during September 2020 as summarised in Table 4.3.

Table 4.3 Survey dates and times

Survey and Date	Sunrise/Sunset	Start time	End time	Weather
Dusk (14/09/2020)	19:44 (Sunset)	19:25	21:29	Overcast, dry
Dawn (15/09/2020)	07:03 (Sunrise)	05:10	07:05	Overcast, dry
Dusk (15/09/2020)	19:43 (Sunset)	19:30	21:25	Clear, dry
Dawn (16/09/2020)	07:05 (Sunrise)	05:12	07:09	Clear, dry

The first two surveys focused on potential roost sites PR1-PR6. The ecologist moved between them continuously for the duration of the survey. Five minutes were spent at each site before moving onto the next one, where the process was repeated. The bat detector was used to detect evidence of bats emerging from or returning to a roost. Records of any foraging or commuting bats were also made. The last two surveys focused on potential roost sites PR7-PR9. The results are presented in Table 4.4 below.

Table 4.4 Dawn/Dusk Survey Results

Potential Roost ID	GPS		Surveys (Dawn/Dusk) – Positive or Negative for Emerging or Returning Bats				Comments – species etc.
	X	Y	Dusk 14/09/20	Dawn 15/09/20	Dusk 15/09/20	Dawn 16/09/20	
PR1	-6.955894	52.539381	-ve	-ve			No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Piipstrelles and Daubenton's bat.
PR2	-6.955857	52.539562	+ve	+ve			See comments overleaf. Fly-bys of foraging Soprano Pipistrelles
PR3	-6.955904	52.540196	-ve	-ve			No bats observed in, emerging from or returning to this structure. Fly-by of foraging Common Pipistrelle
PR4	-6.955866	52.540692	-ve	-ve			No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles
PR5	-6.956265	52.541137	-ve	-ve			No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles and Daubenton's bat.
PR6	-6.951671	52.541341	-ve	-ve			No bats observed in, emerging from or returning to this structure. Fly-bys of foraging Soprano Pipistrelles
PR7	-6.958062	52.537479			-ve	-ve	7 and 8 are close enough so that they can be observed simultaneously from the same vantage point. No bats observed in, emerging from or returning to these structures.
PR8	-6.958316	52.537321			-ve	-ve	

							Almost constant foraging activity from Soprano Pipistrelle. Fly-bys of Daubenton's bats also observed.
PR9	-6.957142	52.537495			+ve	+ve	See comments overleaf.

4.4 Evidence of Roosting Bats

There was sufficient evidence to suggest that bat species (Soprano Pipistrelles) were roosting at PR 2 and PR 9 as follows:

PR2 – During the dusk survey, soprano pipistrelles appeared to be circling inside the building (frequent pulses were recorded on detector, suggesting bats were flying past the window). During the dawn survey the following morning, a number of Soprano Pipistrelles (clearest at ~55 kHz, erratic flight patterns) were observed circling before disappearing from view towards the northern end of the building. The exact point of exit/entry was not observed.

PR9 – During the dusk survey (observing from inside the castle walls), Soprano Pipistrelles were observed emerging over the top of the northern wall. Some descended into the castle and circled for a short time before leaving. The dawn survey yielded a similar pattern, with Soprano Pipistrelles circling before disappearing from view over the northern wall. The exact point of exit/entry was not observed.

5 Discussion

5.1 Overview of the Species Recorded

The **common pipistrelle** (*Pipistrellus pipistrellus*) is widespread throughout the country and commonly encountered during bat surveys. The most recent estimates suggest a population size in the order to 1-2 million animals, making it one of the most common mammals in Ireland. It is very general in its habitat preference, foraging in woodland, riparian habitats and parkland, along linear features in farmland, and in towns and cities. Maternity roosts of this species are often in buildings, typically in the attics of dwelling houses, although it is occasionally found roosting under bridges and in trees. Recent monitoring by NPWS has reported that there is no evidence of any decline in the range or habitat for this species in Ireland and that the population is increasing. The available NPWS reporting notes that there is no indication of any major pressures currently impacting populations of this species. Overall, the species is assessed as "Favourable" and the overall trend is demonstrating an on-going increase (NPWS, 2019).

The **soprano pipistrelle** (*Pipistrellus pygmaeus*) is the most widespread bat species on the island of Ireland, occurring in all counties including the extreme north, west and south. It is the second most commonly encountered species in the national bat monitoring programme, although its abundance is variable across the island with no particular north-south or east-west pattern apparent. Summer roosts are usually in buildings, including modern suburban houses, old abandoned mansions, churches, amenity buildings and farm sheds. Soprano pipistrelles normally roost in very confined spaces, such as behind window sashes, under tiles and weather-boards, behind fascia and soffits, and within the cavities of flat roofs. Roosts of >1,500 individuals are known. The species is thought to hibernate in buildings and trees, but has seldom been recorded in winter. Although this bat is known to forage in a broad range of habitats, it shows some preference for aquatic habitats – riparian woodland, rivers and lakes. The population of this species has been increasing significantly and steadily in recent years. Given the widespread distribution and very large population present in the country, no threats or pressures are considered significant (NPWS, 2019).

The **Daubenton's bat** (*Myotis daubentonii*) is found throughout Ireland. It forages over water and is particularly associated with slow-moving rivers and with lakes. It favours waterways with riparian vegetation, particularly broadleaf woodlands, and is positively associated with good water quality and invertebrate diversity. It is less likely to be present where there are street lights. This species forages over the surface of water bodies, gaffing aquatic insects such as non-biting midges, caddis-flies and mayflies. The majority of roosts known for this species are in masonry bridges and stone buildings such as castles and ruins. The Daubenton's bat is widespread across Ireland and its population is showing signs of increase. The species exploits a habitat niche which is widely available in Ireland and despite some local reductions in quality (e.g. due to light pollution) there appears to be sufficient suitable habitat going forward. The NPWS reporting notes that Light pollution is a particular concern for Myotis bats such as Daubenton's

bat. Removal of riparian vegetation, bridge repairs and drainage works may also provide some cause for concern for this species and these issues merit further study.

However, there is no current evidence to date of an impact on Daubenton's bat distribution due to these issues (NPWS, 2019).

5.2 Overview of Bat Use of the Survey Site

Graiguenamanagh-Tinnahinch is an old town that has retained much of its centuries-old stonework. The presence of the Rivers Barrow and Duiske, as well as numerous patches of scrub, hedgerows, treelines and woodland, cumulatively offer attractive foraging and commuting habitats for several species of bats. These observations are supported by the existing data available online from the National Biodiversity Data Centre and Bat Conservation Ireland.

Two of the potential roost sites identified during the daytime survey showed evidence of roosting soprano pipistrelles. Bat activity (in the form of fly-bys) was recorded at all potential roost sites, which indicates that the area as a whole is an important resource for foraging and/or commuting bats. Light pollution is more notable on the northern side of the River Barrow (i.e. PR1-6), which is where the bulk of the town centre is located.

It is noted that the project is in early stages of planning, and specific structural details of the proposed flood defence measures are not yet available. The significance of these potential roost sites in relation to the proposed works is therefore currently unclear.

5.2.1 Recommendations for Further Study

Once more detail becomes available pertaining to the proposed structural alterations to the site (including the proposed methods of construction), the site should be re-visited for the purpose of:

- Surveying key locations (e.g. where it is known that potential roosting habitat will be removed or disturbed)
- Obtaining more detailed information about any potential bat roosts (i.e. whether it is a maternity roost, hibernaculum etc.)

This information will inform any considerations of mitigation measures that may need to be implemented.

As all Irish bats and their roosts are protected under national and EU legislation it is an offence to disturb or interfere with them without a licence. Such a derogation (which must be given by the Minister for the Environment, Heritage and Local Government) can only be sanctioned where there is no satisfactory alternative and where it will not be detrimental to the favourable conservation status of the species concerned. Therefore, any falling of trees or work on bridges

which provide suitable roost habitat for bats should be sought in advance of any development that may interfere with such roost sites.

6 References

Bat Conservation Trust (2015). *Bat Surveys for Professional Ecologists – Good Practice Guidelines* (3rd edition). London.

Council Directive (92/43/EEC) of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna.

Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Marnell, F., Kingston, N. & Looney, D. (2009) Ireland Red List No. 3: Terrestrial Mammals, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

National Biodiversity Data Centre (2020). Biodiversity Maps. [Online] Available at: https://maps.biodiversityireland.ie/ (accessed 19/10/2020)

National Roads Authority (2005). Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes. National Roads Authority, Dublin

NPWS (2019). 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

Wildlife Acts 1976 to 2018.

7 Appendix I - Photographs

Survey Route A

Figure 7.1. PR1 – note potential entry/exit point near top of gable end (14/09/20).

Figure 7.2. Laneway between PR1 (right) and PR2 (left) (14/09/20)

Figure 7.3. PR3 (14/09/20)

Figure 7.4. PR4 (14/09/20)

Figure 7.5. PR5 (14/09/20)

Survey Route B

Figure 7.6. Survey Route B - looking east from the bridge (14/09/20)

Figure 7.7. Survey Route B - Looking west from Scout Hall. (14/09/20)

Figure 7.8. Scout hall and rowing club (14/09/20)

Figure 7.9. Mixed broadleaved woodland (from Chapel St.) (PR6) (14/09/20)

Survey Route C

Figure 7.10. Looking west from bridge (14/09/20)

Figure 7.11. Looking east approximately halfway along Route C (14/09/20)

Survey Route D

Figure 7.12. PR7/8 (14/09/20)

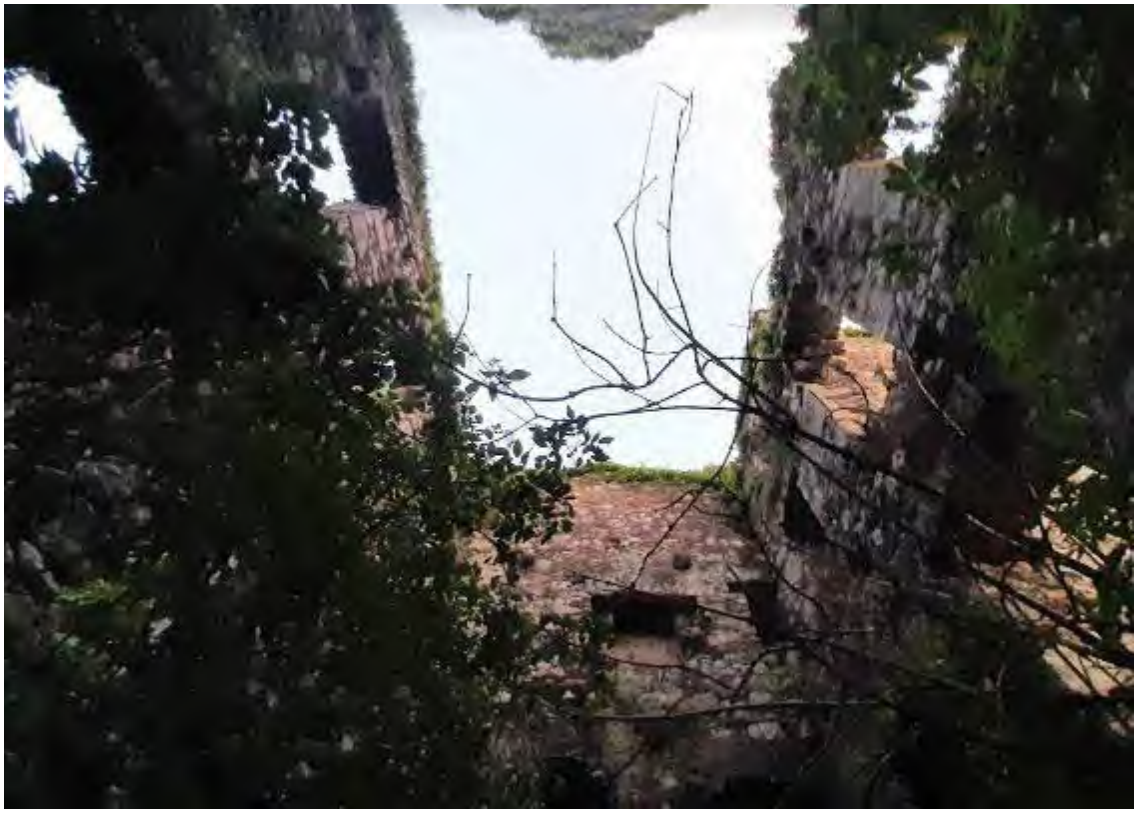


Figure 7.13. PR9 - Tinnahinch Castle (14/09/20)

Figure 7.14. Treeline along western edge of Route D. (14/09/20)

Appendix C: Bat Survey Report (Upstream Storage Area) (VEON, 2024)

Forestry, Ecology & Environment

Bat Survey Report

Proposed Graiguenamanagh-Tinnahinch Upstream Storage Area

Compiled by: Veon Ecology

Table of Contents

SUMMARY

Site: Townlands of Graiguenamanagh in County Kilkenny. Part of the settlement, known as Tinnahinch, is on the County Carlow side of the river, and Carlow County Council refers to the whole village as "Graiguenamanagh-Tinnahinch.

Proposed works:

Due to repeated and increasingly common flood events, a Flood Relief Scheme (FRS) for Graiguenamanagh town, is proposed. The objective of the Graiguenamanagh-Tinnahinch Flood Relief Scheme project is the identification, design, and construction of a Flood Relief Scheme, that is technically, socially, environmentally, and economical acceptable, to alleviate the risk of flooding to the community of Graiguenamanagh.

As part of the constraints study, a number of options in relation to flood relief works have been proposed. These flood relief route options were used to form the basis for the bat survey. The flood relief measures put forward for Graiguenamanagh included a combination of hard defences (both flood walls and embankments), flood gates, debris traps, and alterations/removal of bridges. These are proposed on the River Barrow and the River Duiske within the towns of Graiguenamanagh and Tinnahinch. It additionally includes for the attenuation of flood waters within an upstream storage area, located approximately 2km upstream on the River Duiske from the confluence with the River Barrow in the town of Graiguenamanagh and Tinnahinch.

Considering the nature of project, potential significant effects on ecologically sensitive receptors such as bats cannot be ruled out. Large-scale development entailing changes to, or removal of existing vegetation and structures may adversely affect bats through loss of breeding/resting places or commuting/foraging features, displacement, and injury. It is essential therefore that a study of protected species such as bats is undertaken in such cases to identify any conflict zones and hence to avoid and/or reduce impacts to bats through mitigation.

Surveyed by: Donnachadh Powell, BSc (Hons) Ecology and Environmental Biology, CIEEM, Lead Ecologist, David McGillycuddy, BSc (Hons) Wildlife Biology, CIEEM, Ecologist, Jason Cahill, BSc (Hons) Wildlife Biology, Ecologist, Sara Sheridan MSc BSc CIEEM, Ecologist and Anna Paula Moreira B.Sc. (Hons) in Environmental Science, Ecologist, Veon Ecology.

Survey effort:

As part of a wider ecological constraints assessment of the proposed flood relief scheme, Veon Ecology was commissioned to undertake a specific assessment of bat activity within the study area. Preliminary Roost Assessments were carried out on the relevant trees within the survey area where possible to determine the presence of roosting bats. Transect walks were conducted on and around the proposed works locations to further characterise bat activity levels and species present. A low to moderate level of bat activity was recorded on site.

Potential bat corridors in the vicinity of the area were also assessed. The bat activity surveys involved active acoustic sampling using handheld bat detectors at predetermined points. To ensure there is no negative impact on bats as a result of the proposed works, surveys were undertaken in all areas identified as having bat roosting, commuting and foraging potential.

Activity surveys were carried out on site on the following dates in 2023, August 2nd, August 15th, August 16th, September 1st, September 5th, September 7th, September 12th and September 22nd. These surveys involved dusk emergence surveys and transect surveys. Daytime inspection of trees for potential bat roosts were also carried out prior to bat activity surveys.

Section 1: INTRODUCTION

1.1 Aims of the Report

Veon Ltd. (Veon Ecology) was commissioned by ByrneLooby (BL) on behalf of Kilkenny County Council (KCC) to undertake a survey for bats within a Survey Area affected by the proposed Graiguenamanagh -Tinnahinch Upstream Storage Area hereafter referred to as the proposed Scheme. The Survey Area for bat activity surveys can be seen in Figure 2.1 below.

The overarching aims of the bat surveys were as follows:

- To identify the areas and habitats within the Survey Area that are being used by bats (including flight paths/commuting routes and foraging areas).
- Collect robust data following good practice guidelines to allow an assessment of the potential impacts of the proposed project on local bat populations, both on and off-site (where possible).
- To identify the species of bats using the Survey Area.
- Provide baseline information with which the results of post-construction monitoring surveys can be compared to, where appropriate.
- To identify, where possible, any bat roosts within the Survey Area and the environs of the scheme;
- Facilitate the design of mitigation, enhancement and monitoring strategies for local bat populations recorded; and,
- Facilitate the conservation of local bat populations.

The bat surveys were completed during August to September 2023. This also informed the assessment of potential roost sites for bats. The Survey Area for this baseline assessment focussed within a 200m – 400m wide corridor of suitable habitat which encompasses the location of the proposed Scheme. Bat surveys focussed on suitable roosting and foraging habitat within the Zone of Influence (ZoI) such as watercourses, woodlands, treelines, hedgerows, grasslands and Riparian woodland along sections of the DUISKE_020 and BARROW_230 and tributaries which shall be directly impacted by the proposed works.

1.2 Relevant Legislation

All Irish bat species are protected under the Wildlife Act (1976) and Wildlife Amendment Acts (2000 and 2010). Also, the EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive 1992), seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken.

All Irish bats are listed in Annex IV of the Habitats Directive and the Lesser horseshoe bat (*Rhinolophus hipposideros*) is further listed under Annex II.

Across Europe, they are further protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982), which, in relation to bats, exists to conserve all species and their habitats.

The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Also, under existing legislation, the destruction, alteration, or evacuation of a known bat roost is a notifiable action, and a derogation licence must be obtained from the National Parks and Wildlife Service (NPWS) before works can commence.

Any works interfering with bats and especially their roosts, may only be carried out under a licence to derogate from Regulation 23 of the Habitats Regulations 1997 and Regulation 54 of the European Communities (Birds and Natural Habitats) Regulations 2011 (which transposed the EU Habitats Directive into Irish law), issued by NPWS.

The details with regards to appropriate assessments, the strict parameters within which derogation licences may be issued and the procedures by which and the order in relation to the planning and development regulations such licences should be obtained, are set out in Circular Letter NPWS 2/07 "Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 - strict protection of certain species/applications for derogation licences" issued on behalf of the Minister of the Environment, Heritage and Local Government on the 16th of May 2007.

1.3 Bat Species in Ireland

There are eleven recorded bat species in Ireland, nine of which are considered Resident, two as Vagrant, namely:

1. Common pipistrelle (*Pipistrellus pipistrellus*)
2. Soprano pipistrelle (*Pipistrellus pygmaeus*)
3. Nathusius' pipistrelle (*Pipistrellus nathusii*)
4. Leisler's bat (*Nyctalus leisleri*)
5. Brown long-eared bat (*Plecutus auratus*)
6. Natterer's bat (*Myotis nattereri*)
7. Whiskered bat (*Myotis mystacinus*)
8. Daubenton's bat (*Myotis daubentonii*)
9. Lesser horseshoe bat (*Rhinolophus hipposideros*)
10. Brandt's bat (*Myotis brandtii*) (**Vagrant**)
11. Greater horseshoe bat (*Rhinolophus ferrumerquinum*) (**Vagrant**)

Eight of the nine resident bat species and one of the vagrant bat species are 'Vesper' bats. All vespertilionid bats have a tragus (cartilaginous structure inside the pinna of the ear). Vesper bats are distributed throughout the island.

The Lesser horseshoe bat (*Rhinolophus hipposideros*), belongs to the Rhinolophidea and has a complex nose leaf structure on the face, distinguishing it from the Vesper bats. This species' current distribution is confined to the western seaboard counties of Mayo, Galway, Clare, Limerick, Kilkenny, and Cork.

Only one confirmed record (corroborated by DNA testing) of the Brandt's bat (*Myotis brandtii*) has occurred in Ireland to-date. All other records have not been genetically confirmed. The Brandt's bat is very similar to the Whiskered bat (*Myotis mystacinus*), so it remains possible that the two have been confused in Ireland in the past. As such, the Brandt's bat is considered a vagrant.

The Greater horseshoe bat (*Rhinolophus ferrumerquinum*) was only recorded for the first time in February 2013 in County Wexford and is therefore also considered to be a vagrant species.

1.4 Guidance Documents

This report will draw on guidelines already available in Europe and will use the following documents:

- National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.
- National Roads Authority Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, and During the Construction of National Road Schemes.
- Kelleher, C & Marnell, F. (2006). Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Hundt, L. 2012 Bat Surveys: Best Practice Guidelines (2nd edition). Bat Conservation Trust, London.
- Collins, J. (Editor) 2016 Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). Bat Conservation Trust, London.

- McAney, K. (2006) A conservation plan for Irish vesper bats, Irish Wildlife Manual No. 20 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- The status of EU protected habitats and species in Ireland: Conservation status in Ireland of habitats and species listed in the European Council Directive on the Conservation of Habitats, Flora, and Fauna 92/43/EEC. National Parks and Wildlife Service, Department of Environment, Heritage, and Local Government.

Collins (2016) is the principal document used to provide guidance in relation to survey effort required however the level of surveying is assessed on a case-by-case basis taking into consideration the historical bat records for the survey area, presence of built structures and trees potentially suitable for roosting bats.

Impacts on bats can arise from activities that may result in the following:

- Lighting disturbance.
- Noise disturbance e.g. use of machinery, increase human presence etc.
- Physical disturbance of bat roosts e.g. destruction or renovation of buildings.
- Loss of roosts e.g. destruction or renovation of buildings.
- Loss of foraging habitats.
- Modifications of commuting or foraging habitats.
- Severance or fragmentation of commuting routes.

It is recognised that any development may have an impact on the receiving environment, but the significance of the impact will depend on the value of the ecological features that would be affected. Such ecological features will be those that are important and potentially affected by the proposed development.

The guidelines consulted recommend that the potential impacts of a proposed development on bats are assessed as early as possible in the design stage to determine any areas of conflicts.

Section 2: PROJECT DESCRIPTION

2.1 Site Location

The surveyed area is located approximately 2km from Graiguenamanagh town and specifically encompasses a proposed upstream storage area. The study area, which served as the foundation for the bat surveys, includes the river BARROW_230 and waterbody DUISKE_020. Figure 2.1 below illustrates a map of the proposed works locations and the survey area. The waterbody DUISKE_020 flows in a south-eastward direction towards Graiguenamanagh town, ultimately meeting river BARROW_230 at the coordinates 52.538580, -6.955742.

The River Barrow is considered a Freshwater Pearl Mussel (FPM) sensitive area. Water quality in the River Barrow is generally classified as poor under the WFD. There are significant polluting sources within the survey area including Benzo(g,h,i)perylene and Benzo(k)fluoranthene.

The survey area supports a variety of habitats including hedgerows, treelines, grasslands, woodland, and scrub. Land-usage in the wider landscape is primarily for livestock agriculture, residential and forestry. of these habitats provide suitable foraging areas for bats, as well as opportunities for roosting sites.

The survey area overlaps or is in close proximity to the following Natura 2000 sites (Figure **2.2**):

- River Barrow and River Nore SAC (002162)
- Thomastown Quarry SAC (002252)
- Slaney River Valley SAC (000781)
- Blackstairs Mountains SAC (000770)
- River Nore SPA (004233)

River Barrow and River Nore SAC (002162) is very important for the presence of a number of E.U. Habitats Directive Annex II animal species including Freshwater Pearl Mussel (both *Margaritifera margaritifera* and *M. m. durrovensis*), White-clawed Crayfish, Salmon, Twaite Shad, three lamprey species – Sea Lamprey, Brook Lamprey and River Lamprey, the tiny whorl snail Vertigo moulinsiana and Otter. This is the only site in the world for the hard water form of the Freshwater Pearl Mussel, *M. m. durrovensis*, and one of only a handful of spawning grounds in the country for Twaite Shad.

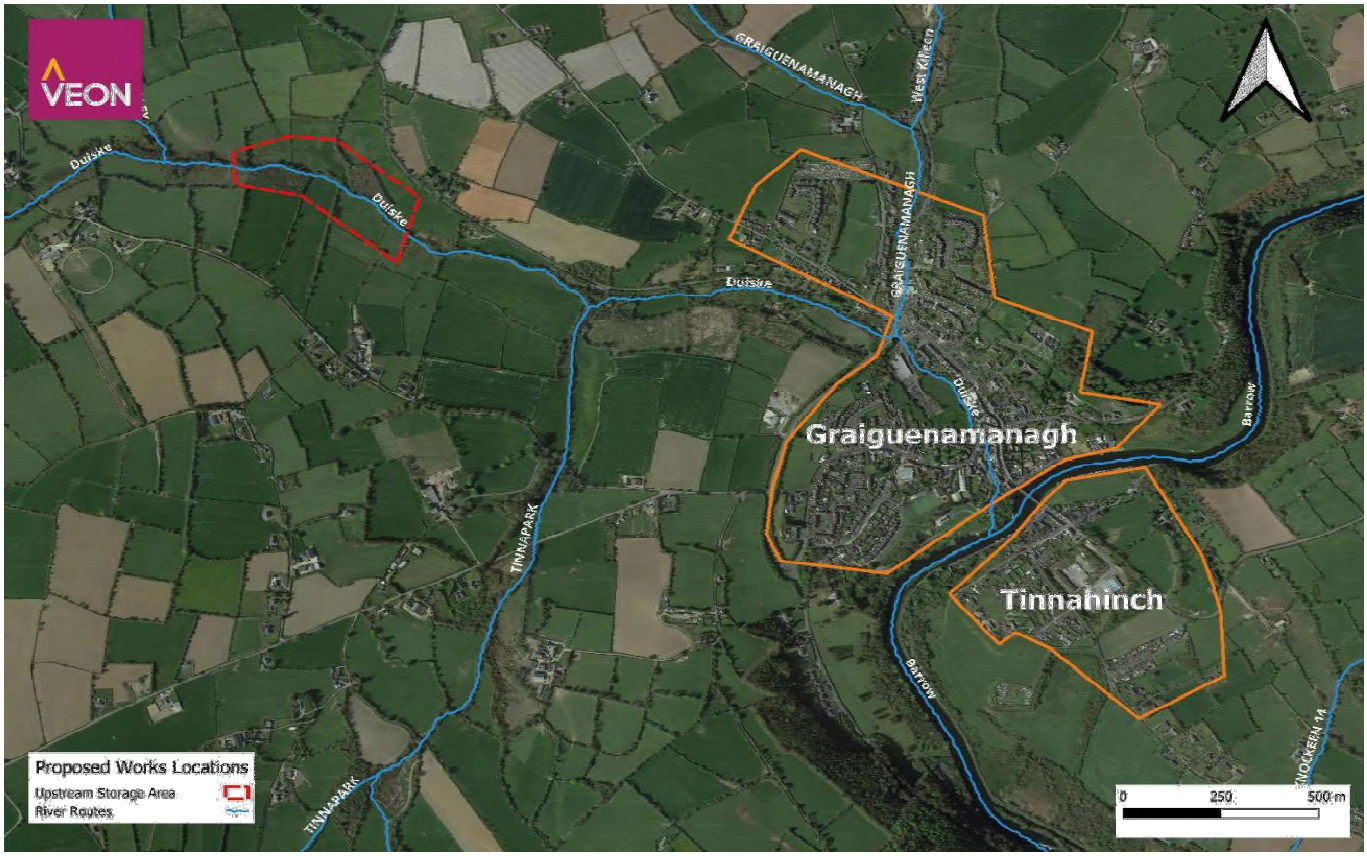


Figure 2.1: Proposed Works Locations/ Bat Survey Area and relevant watercourses Map.

Figure 2.2: Natura Sites within 15km

2.2 Project Description

The Office of Public Works (OPW) completed Catchment Flood Risk Assessment and Management (CFRAM) studies covering the entire country reviewing flood-prone sites. Graiguenamanagh-Tinnahinch was identified during the study as one of the areas at risk to flooding. The plan set out the measures and policies to be pursued in order to achieve the most cost effective and sustainable management of flood risk.

The objective of the Graiguenamanagh-Tinnahinch Flood Relief Scheme project is the identification, design and construction of a Flood Relief Scheme, that is technically, socially, environmentally and economical acceptable, to alleviate the risk of flooding to the community of Graiguenamanagh-Tinnahinch (Source: floodinfo.ie).

The proposed project is at an early stage of the planning process, so detailed designs have not yet been prepared. As part of the constraints study, a number of options in relation to flood relief works have been proposed. These flood relief route options were used to form the basis for the bat survey.

The flood relief measures put forward for Graiguenamanagh-Tinnahinch included a combination of hard defences (both flood walls and embankments), flood gates, debris traps, and alterations/removal of bridges. These are proposed on the River Barrow and the River Duiske within the towns of Graiguenamanagh and Tinnahinch. It additionally includes for the attenuation of flood waters within an upstream storage area, located approximately 2km upstream on the River Duiske from the confluence with the River Barrow in the town of Graiguenamanagh.

Section 3: METHODOLOGY

Initially, a desktop assessment of aerial photographs along the route of the proposed flood relief scheme was undertaken to identify existing habitats, buildings and structures which may be favourable for bat use within the potential works locations.

Bat surveys are comprised of many different types and may differ from site to site depending on the aims of the survey. The surveys deemed suitable for a particular project is determined on a case-by-case basis.
To fulfil the Survey brief, the following activities were carried out:

- Daytime walkover survey of the site and immediate area.
- Daytime inspection of the relevant building(s)/structure(s) directly.
- Active acoustic surveys in the study area during night hours.
- Review of historical bat surveys conducted within the vicinity of the site.
- Desktop study of the National Biodiversity Data Centre (NBDC) Bat Suitability Index.

3.1 Bat Habitat and Commuting Routes

The survey site was assessed during daytime walkover surveys, in relation to potential bat foraging habitat and potential bat commuting routes. Bat habitats and commuting routes identified are considered in relation to the wider landscape to determine landscape connectivity for local bat populations through the examination of aerial photographs.

All areas were surveyed on foot, mainly along hard-surfaced roads, grassland, built land and along the river corridor.

3.2 Survey for presence/absence of Bat roosts

A preliminary roost assessment (PRA) was carried out during daylight hours (exterior and interior) to identify any evidence of roosting bats, current or historic. Potential roosting features (PRFs) were recorded at these buildings/structures during daytime visual inspections. A bat activity survey was carried out to confirm the presence or absence of roosting bats at these buildings/structures. Surveys followed guidelines outlined in Collins (2016).

3.2.1 Preliminary Roost Assessment

The relevant buildings, structures and trees within the survey area were investigated during daylight hours to record any signs of current and/or historic bat presence, such as droppings, brown staining from urine, feeding remains and surfaces smoothed around entrance holes. Kelleher & Marnell (2006) provide guidance on assessing the potential for structures to support roosting bats. This guidance identifies a variety of factors that increase or decrease the potential of a structure to function as a bat roost, namely:

Increase Potential

Disused or little used; largely undisturbed; Large roof void with unobstructed flying spaces; Large dimension roof timbers with cracks, joints, and holes; Uneven roof covering with gaps, though not too draughty; Entrances that bats can fly in through; Hanging tiles or wood cladding, especially on south-facing walls; Rural setting; Close to woodland and/or water; Pre-20th century or early 20th century construction; Roof warmed by the sun.

Decrease Potential

Urban setting or highly urbanised area with few feeding places; Small or cluttered roof void; Heavily disturbed; Modern construction with few gaps around soffits or eaves; Prefabricated with steel sheet materials; Active industrial premises; Roof shaded from the sun; High internal day time light levels.

The day-time inspections focused on identifying any suitable ingress and egress points for bats into any relevant structures and a thorough search of all exterior areas of the relevant buildings. Internal inspections of buildings including the roof and attic spaces are also completed, where safe access is possible.

The following equipment was used during the PRA and activity surveys:

- Wildlife Acoustics Echometer Touch 2 Bat Detector (Android).
- High-powered Maglite© hand torch and LED head torch.
- Endoscope (Explorer Premium) Wireless inspection camera.

3.2.2 Activity Surveys

Bat emergence/re-entry surveys are typically undertaken at dusk or dawn between April and September to identify whether bats are present within a structure and provide additional confidence in any negative survey results from preliminary roost assessment surveys conducted if the buildings, structures and/or trees are identified as medium or high potential for a roost to be present.

Activity surveys were carried out on site on the following dates in 2023, August 2nd, August 15th, August 16th, September 1st, September 5th, September 7th, September 12th and September 22nd. These surveys involved dusk emergence surveys and transect surveys.

Dusk surveys were started from 10 minutes before sunset to at least 100 minutes post sunset (extended survey period times occurred in relation to walking transects).

Conducting an Emergence Bat survey allows surveyors to identify:

- Whether bats are present in a structure, the species, and number involved.
- Entrance and exit points for the roost.

- Any actions needed to be taken to ensure legal compliance.
- The type of roost, i.e.:

    - Day roosts: individual bats, or small groups of males, are using the area for shelter during daylight hours.
    - Feeding roosts: whereby bats, particularly Brown Long-Eared and Horseshoe species feed during the night.
    - Night roost: where bats rest or shelter between feeding sessions.
    - Hibernation roost: where bats hibernate over the winter periods.
    - Transitional or occasional roost: where bats gather at a temporary site before and after hibernation.
    - Mating site: Males and females gather in late summer to early winter.
    - Maternity roost: where babies are born and raised until they're independent.
    - Satellite roost: where breeding females roost close to the main nursery colony in the breeding season.
    - Swarming site: where bats gather in large numbers from late summer to autumn.

Bats rely heavily on buildings for roosting. Average maternity colony sizes are about 50 bats although most roosts are much smaller. Larger roosts are not uncommon among particular species. A maternity or nursery roost is where females gather to give birth in the summer. Bats typically roost in buildings during the summer months, leaving in autumn to seek a site with a more stable temperature regime for hibernation.

As a standard approach, all emerging or re-entering bats observed at a structure are recorded along with their flight path, their species, and the time of flight. Vegetation, habitat, and relevant environmental factors are also detailed, where applicable and appropriate.

Walking transects involve the surveyor(s) walking the survey area, noting the time, location and bat species encountered. The Wildlife Acoustics Echo Meter Touch 2 (Android) recordings are mapped using QGIS with the produces WAV files. The validation of bat records is completed by the principal bat surveyor prior to mapping.

3.2.3 Tree Potential Bat Roost (PBRs) Inspection

Trees that may provide a roosting space for bats are classified using the Bat Tree Habitat Key (BTHK, 2023)1 and the classification system used is from Collins (2016). The Potential Roost Features (PRFs) listed in this guide are used to determine the PBR value of trees.

It can be challenging to ascertain the absence of roosts in trees, even if no bats are detected. Therefore, precautionary measures may be necessary during tree felling and pruning activities. If a tree is deemed to be a roost site, then further surveying involving dusk and dawn surveys of the actual trees may be recommended to determine what bat species are present etc. If bats or a bat roost is identified, it is imperative to contact the NPWS (National Parks and Wildlife Service). Before commencing felling activities, obtaining a derogation license from NPWS is mandatory.

Table 3.1: Tree Bat Roost Category Classification System (Collins, 2016).

	Tree Bat Roost Classification System:
Tree Category	**Description**
1 (High)	Trees with multiple, highly suitable features (Potential Roosting Features = PRFs) capable of supporting larger roosts.
2 (Moderate)	Trees with definite bat potential but supporting features (PRFs) suitable for use by individual bats.
3 (Low)	Trees have no obvious potential although the tree is of a size and age that elevated surveys may result in cracks or crevices being found or the tree supports some features (PRFs) which may have limited potential to support bats.
4 (Negligible)	Trees have no potential.

3.3 Desk Study

In addition to surveys carried out on site, a detailed desktop study was carried out using information from publicly available databases such as NWPS and NBDC to further characterise the local bat ecology and potential significant effects on bat communities which may be present in the area but were not recorded during on site surveys.

3.3.1 National Biodiversity Data Centre (NBDC)

A review of National Biodiversity Data Centre (NBDC) historical records was undertaken. The proposed development site area falls within No. 2 separate 10km^2 data grid squares (S64 & S74) (See **Figure 3.1**). The NBDC Map Viewer has a 'Bat Suitability Index' (Source: NBDC & Lundy et al. 2011). This will be referred to where applicable and appropriate in this current survey.

Figure 3.1: The 10km^2 data grid squares (S64 & S74) overlapping the survey area (Source: NBDC).

[1] BTHK (2023) Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals.

Section 4: SURVEY RESULTS

The surrounding landscape of Graiguenamanagh, Co. Kilkenny is primarily agricultural land with treelines and hedgerows. There is a high level of connectivity in the landscape which makes it suitable for commuting and foraging bat populations.

The town of Graiguenamanagh has extensive streetlights which reduces its suitability for foraging and commuting bats considered to be light sensitive (e.g. Daubenton's bats).

4.1 Preliminary Roost Assessment

The daytime Preliminary Roost Assessment (PRA) survey was carried out on the relevant buildings and structures.

Signs of roosting bats, i.e. visible bats and droppings were not identified within the upstream storage area. PRFs were identified within some trees which have the potential to support at least small numbers or individual roosting bats. Examples of PRFs recorded on site include:

- Bark tear outs and small cavitites.
- Thick interweaving ivy steams.

4.1.1 Buildings & Structures Inspection Results

The semi-mature trees within the study area provide some potential roosting opportunities for. Trees were surveyed where possible and no roosting bats or signs of roosting bats, current or historic, were recorded. On no occasion were any species of bats seen re-entering or emerging from trees during surveys.

Mature trees within the survey area were inspected to determine their Potential Bat Roost (PBR) value. An initial BS tree survey report was undertaken by Veon and identified a number of trees that had bat roost potential. The following trees listed in **Table 4.1** were deemed to have a PBR. All of the trees/tree groups listed below have a Category 2 PBR rating because they have some suitable features that can provide roosting sites for bats.

Table 4.1: Tree PBR inspection results.

Tree PBR inspection results:				
Tree Code	**Tree Species**	**PRFs**	**Bat Usage**	**Value**
T1	Oak, Beech	Moderate number crevices and spilt limbs.	bats recorded foraging in vicinity of this treeline.	Moderate Value
T2	Beech, Sycamore, Oak	Moderate number crevices and spilt limbs.	bats recorded commuting and foraging in vicinity of this woodland.	Moderate Value
T3	Oak, Holly, Birch	Moderate number of tree holes and dead wood.	bats recorded foraging in vicinity of this woodland.	Moderate Value
T4	Oak, Ash, Sycamore	Moderate number of tree holes and dead wood.	bats recorded foraging in vicinity of this treeline.	Moderate Value
T5	Ash, Birch, Holly	Moderate number of tree holes and dead wood.	bats recorded foraging in vicinity of this treeline.	Moderate Value

4.2 Activity Surveys

Where it was safe to do so, transects were walked along the study area to identify any bat hot spots and corridors. No bats were recorded emerging from any structures during any of the activity surveys.

The Transect surveys involved Active acoustic sampling using handheld bat detectors (Wildlife Acoustics Echometer Touch 2 Bat Detector). Hot spots of bat activity were found south of the study area. Common

pipistrelles and soprano pipistrelles were recorded frequently commuting along hedgerows that form the border of fields south of the study area.

Foraging opportunities within the townland were sparse in sections and of low suitability (low insect abundance) which lowers the ecological value of certain sections of the site to Irish bat species.
No. 3 species of bat were recorded foraging in the vicinity of the study area. These include the following: Soprano pipistrelle, Common pipistrelle and Leisler's bat.

Common pipistrelle and Leisler's bats were the most frequently recorded bat species. Leisler's bats were particularly recorded foraging at height in the hot spot areas south of the redline boundary of the study area. The Common Pipistrelles were more associated with dense trees.

In summary, little bat activity was recorded associated with the Duiske river running through the study area. The majority of bat activity was associated with the hedgerows and open fields outside the study area, with a low to moderate level of activity recorded within the study area.

4.2.1 Bat Activity Indices

During transects, the number of times a bat was encountered is described as the number of bat passes. The number of bat passes recorded are used as the standard measure to create a relative index of bat activity. This is either expressed as the number of bat passes per hour or per survey night. A contact ("bat pass"), as recorded in the results from these surveys, describes a bat observed by the surveyor.

This contact can range from a commuter passing quickly to a foraging bat circling a feature lasting for several minutes. Bat contacts do not equate to numbers of bats as individual bats of the same species cannot be differentiated. A single bat continuously foraging in proximity to the detector can generate a large number of contacts in one night. In addition, variability occurs in the likelihood of detection between species.

The same bat may be recorded in several contacts throughout the night. This survey type cannot estimate abundance of bats, rather activity; the amount of uses bats make of an area/feature. Where multiple visits for a transect are required, the start and end points of transect walks were alternated between visits to intersperse time and location (i.e., to prevent bias due to certain areas always being surveyed close to dusk).

During the walked transect surveys a low–moderate level of bat activity was observed within the survey area, with a total of No. 558 bat passes, from three different bat species, being recorded. These included common pipistrelle (n = 355), soprano pipistrelle (n = 103), Leisler's bat (n = 100).

4.3 Local Bat Records

The desk and field-based assessments undertaken of the habitats within the proposed development area revealed High potential for bat roosting features.

The woodland habitats within the survey area provide foraging and commuting potential for bats. The majority of trees within the survey area were semi-mature. The majority of these trees did not support large crevices, apertures or dense ivy growth that could provide suitable roosting habitat for bats. Some trees did however support ivy growth, suggesting moderate suitability to support roosting bats.

The review of existing bat records within the study area (sourced from NBDC) reveals that No. 8 of the No. 9 recorded Irish species have been observed locally. The overall suitability of the area for bat activity was

High (31.67). The habitat suitability index for 'All bats' and for each individual species of bat is presented below (**See Table 4.2 below**). The index ranges from 0 to 100, with 100 being most suitable for bats.

Table 4.2: Bat Suitability Index for the site and its surrounding area (NBDC, 2023).

Suitability index for different bat species:		
Common Name	**Scientific Name**	**Suitability Score**
Soprano pipistrelle	*Pipistrellus pygmaeus*	38
Brown long-eared bat	*Plecotus auritus*	47
Common pipistrelle	*Pipistrellus pipistrellus*	48
Lesser horseshoe bat	*Rhinolophus hipposideros*	5
Leisler's bat	*Nyctalus leisleri*	38
Whiskered bat	*Myotis mystacinus*	33
Daubenton's bat	*Myotis daubentonii*	29
Nathusius' pipistrelle	*Pipistrellus nathusii*	1
Natterer's bat	*Myotis nattereri*	46
Total Score for All Bat Species		31.67

The area is deemed as favourable for bat activity with local areas of abundance present due to the suitable habitats surrounding and within the survey area. Thus, bats use the site for foraging and/or commuting through the site or along its boundaries, particularly along the hedgerows and treelines.

Table 4.3: Records of all bats available from the NBDC within 2km^2 grid squares S64X, S64W, S74B and S74C.

Species	Record Count	Date of Last Record	Designation
Brown Long-eared Bat (*Plecotus auritus*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Daubenton's Bat (*Myotis daubentonii*)	28	22/08/2014	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Leisler's bat (*Nyctalus leisleri*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Soprano Pipistrelle (*Pipistrellus pygmaeus*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts

Historic records of bats were recorded within the 10km^2 grid squares (S64 & S74) in which the study area is located and includes the following species: Brown Long-eared Bat (*Plecotus auritus*), Daubenton's Bat (*Myotis daubentonii*), Leisler's bat (*Nyctalus leisleri*), Nathusius's Pipistrelle (*Pipistrellus nathusii*), Natterer's Bat (*Myotis nattereri*), Common Pipistrelle (*Pipistrellus pipistrellus sensu lato*) and Soprano Pipistrelle (*Pipistrellus pygmaeus*).

4.4 Summary of Results

Surveys were undertaken using a range of techniques and covered the peak period of bat activity between May and September. This provides a robust dataset to support a future impact assessment.

Table 4.4: Bat Surveys Completed (Indicated by ticked box).

Surveys Completed:			
Endoscope Inspection	☑	Daytime Building Inspection	☑
Walking Transect	☑	Daytime Bridge Inspection	☑
Dusk Bat Survey	☑	Trapping / Mist Netting	☐
Dawn Bat Survey	☑	Driving Transect	☐
Static Detector Survey	☐	IR Camcorder filming	☐
Tree PBR Survey	☑	Trapping / Mist Netting	☐
Emergence Survey	☑	Other	☐

The survey area and its environs offer foraging and commuting habitat for bats. A total of No. 3 bat species have been recorded foraging across the survey area on a regular basis. The habitats of highest value to bats within the survey area were considered to be the mature woodlands, the Duiske and tributaries, hedgerows, treelines, grassland and

scrub. The spatial distribution of all species recorded was not uniform: bats were recorded in highest numbers in the vicinity of trees and hedgerows, and lowest in areas of built land with artificial lighting. This is unsurprising, as bats often prefer to feed along linear habitats such as woodland edges or hedgerows. Overall, the survey results demonstrate the value of the study area as a foraging and commuting habitat for bats. No bat roosts were recorded within the survey area.

Table 4.5: Bat Survey Results Overview.

Overview of Results:			
Bat Species	**Commuting**	**Foraging**	**Roosts**
Soprano pipistrelle *Pipistrellus pygmaeus*	☑	☑	
Brown long-eared bat *Plecotus auritus*			
Common pipistrelle *Pipistrellus pipistrellus*	☑	☑	
Lesser horseshoe bat *Rhinolophus hipposideros*			
Leisler's bat *Nyctalus leisleri*	☑	☑	
Whiskered bat *Myotis mystacinus*			
Daubenton's bat *Myotis daubentonii*			
Nathusius' pipistrelle *Pipistrellus nathusii*			
Natterer's bat *Myotis nattereri*			

Section 5: IMPACT ASSESSMENT & MITIGATION

5.1 Potential Impacts

Bat species within the area of the proposed development will likely be affected by both the construction phase and subsequent existence of new structures such as embankments and walls which may require the removal of mature trees.

Surveys of bats in the immediate area indicate that a diverse range of bat species use the site and surrounding area. The key impacts on bats as part of the proposed works arise through potential roost loss, loss of feeding areas and disruption of commuting routes.

5.2 Mitigation Measures

As the Graiguenamanagh -Tinnahinch Upstream Storage Area project is still in the early stages, the current information on the proposed works is limited and therefore detailed mitigation measures are not provided. The following general measures should be adhered to when selecting the preferred route and for the detailed design and construction of any flood relief scheme:

- Minimise the potential impact of proposed works on mature trees, treelines, and hedgerows.
- Retain trees where possible and protect trees and their roots from proposed works.
- Any trees that required to be felled should be assessed for the Potential Bat Roost (PBR) level prior to felling and alternative roosting sites should be provide (e.g. bat boxes).
- Undertake additional bat survey work on any buildings that may be impacted by proposed works.
- Any works undertaken on bridges/culverts requires bat mitigation measures.
- Restrict the usage of artificial lighting in work zones and ensure that such are turned off during the hours of darkness.
- Any removal of hedgerows and treelines requires landscape replacement (native tree and shrub species).

Standard mitigation measures as would apply to any large-scale development, should be adopted in the construction of the proposed Graiguenamanagh Upstream Storage Area. These include limiting season of disturbance to trees and vegetation to reduce impacts on breeding species, to provide for habitat replacement and to implement measures to avoid and/or control pollution and sedimentation into watercourses during construction and operation phases. Specific measures will be required to protect bats onsite, and these are detailed further below.

5.2.1 Lighting

All European bat species, including Irish bat species, are nocturnal. They usually hide in roosts during the daytime, while fly to feeding areas or drinking sites using commuting routes during the night. Annually bats will hibernate in the winter, swarm in the autumn, and give birth in the summer months.

In all aspects of the bat lifestyle, Artificial Light at Night (ALAN) may significantly change their natural behaviour in relation to roosting, commuting, and feeding. While bats are naturally exposed only to very low lighting levels produced by moonlight, starlight and low intensity twilight, light levels greater than natural light levels can impact on the lifestyle of bats.

Construction Phase Lighting

Where construction lighting is required, light spill should be minimised as much as possible. This can be achieved by the use of directional lighting (i.e. lighting which only shines on the proposed works and not nearby countryside) to prevent overspill. This should be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres, and shields to direct the light to the intended area only. Lighting should be minimised in potential foraging

and commuting areas, and the times during which the lighting is on should be limited to provide some dark periods. Lights should be positioned to avoid sensitive areas and restricted so that there are dark areas. The timing of lights should be restricted to avoid bat activity (i.e. from dusk until dawn).

Operational Phase Lighting

The following specifications have been recommended for the lighting to be installed:

- 4000k colour temperature
- 0% ULR
- Full cut off visor

5.2.2 Trees to be retained

Where possible, mature trees and treelines that are located immediately adjacent to planned work areas or are not directly impacted should be avoided and retained intact. Overall impacts on these sites should be reduced through modified design and sensitivity during works. Retained trees should be protected from root damage by machinery by an exclusion zone of at least c. 7 metres or equivalent to canopy height. Such protected trees should be fenced off by adequate temporary fencing prior to other works commencing.

5.2.3 Removal of Trees

Should any mature broadleaved tree(s) be scheduled for removal as part of the proposed development plans, it should be surveyed for bat presence by a suitably experienced specialist immediately prior to felling. If bats are found, an application for a derogation licence should be made to the National Parks and Wildlife Service to allow its legal removal. Such trees should ideally be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per National Roads Authority (NRA) guidelines and also to avoid the bird breeding seasons. Tree felling should be completed by mid-November at the latest as bats roosting in trees are vulnerable to disturbance during their hibernation period (November - April). If trees are to be removed outside of these periods extra care should be taken prior to felling to ensure no protected species are present. Trees with ivy-cover, once felled, should be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

5.2.4 Boundary Vegetation

Linear features such as treelines and hedgerows serve as commuting corridors for bats (and other wildlife). The onsite boundary vegetation especially that bordering the Finnihy River should be retained and/or replaced once construction ends. Native species should be chosen in all landscaping schemes. Planting schemes should attempt to link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.

5.3 Residual Impact

The construction phase of the proposed Graiguenamanagh -Tinnahinch Upstream Storage Area may displace certain bat species through disruption of commuting routes however, this is expected to be temporary. If the recommended mitigation measures outlined above to safeguard bats are implemented, preserving the present nature of the site and river corridor, the residual impact of the development on bats is expected to be negligible and all bat species recorded in the area should persist.

Section 6: SURVEY CONCLUSION

In general (according to Lundy *et al,* 2011), the landscape in which the proposed project is situated is of high suitability for common pipistrelle, soprano pipistrelle, brown long-eared bat, lesser horseshoe bat, leisler's bat and Natterer's bat, moderate suitability for, daubenton's bat and whiskered bat, and low for nathusius' Pipistrelle.

A total of No. 3 species of bat were recorded commuting and foraging within the survey area. The following bat species were recorded during this bat survey: common pipistrelles, soprano pipistrelles and Leisler's bats. This represents No. 3 of the No. 9 resident bat species known to Ireland.

The most abundant species was common pipistrelle, followed by Leisler's bat and soprano pipistrelle, this is a typical species assemblage for rural sites in Ireland. Bat activity was broadly distributed throughout the Site, with no obvious clustering of activity at any specific locations. Activity levels appeared to be slightly higher at some of the sampling points that were near linear habitat features (e.g. a road lined with treelines, or a partial hedgerow).

The ecological value of the Site can be categorised using the valuation system of the CIEEM Guidelines (2018). As the majority of the study area is used on a regular basis by common bat species, it is considered to be of *Local Ecological Value*. Nonetheless, it is noted that all bats and their roosts receive legal protection from destruction or disturbance under the *European Communities (Birds and Natural Habitats) Regulations 2011* (as amended).

The Overriding Purpose of the project is to provide flood defences in Graiguenamanagh Town to the standards of the EU Directive on the Assessment and Management of Flood Risk (Floods Directive 2007/60/EC) transposed into Irish Law as SI 122 of 2010. The proposed flood defences to include an allowance for freeboard (300mm for walls, 500mm for embankments) as per the OPW guidelines and to address Environmental, Social and Health and Safety concerns.

The Graiguenamanagh -Tinnahinch Upstream Storage Area was assessed in relation to potential impact on local bat populations. Due to the fact that the majority of bat activity was recorded along linear features such as treelines and hedgerows within the study area, any works which involve loss of treelines and hedgerows will impact on local bat populations due to the removal of commuting routes and foraging habitat.

Therefore, in consideration of the conservation of local bat populations, the application of the proposed mitigation measures outlined above in **Section 5** aims to ensure the implementation of safeguards for bats. By preserving the current nature of the site and river corridor, it is anticipated that the impacts of the development on bats will be negligible, and all bat species recorded in the area should persist.

Section 7: BIBLIOGRAPHY

Abbott, I. M., Berthinessen, A., Stone, E., Booman, M., Melber, M. and Altringham, J. (2015) Bats and Roads, Chapter 5, pp/ 290-299. In: Handbook of Road Ecology. Editors: R. Van der Ree., D. J. Smidt and C. Grilo. Wiley Blackwell.

Abbott, I. M., Butler, F. And Harrison, S. (2012) When flyways meet highways – the relative permeability of different motorway crossing sites to functionality diverse bat species. Landscape and Urban Planning 106 (4): 293-302.

Altringham, J. And Kerth, G. (2016) Bats and Roads, Chapter 3. In: Bats in the Anthropocence: Conservation of Bats in a Changing World. Editors: C. C. Voigt and T. Kingston. Springer Open.

Altringham, J. D. (2013) British Bats. Collins New Naturalist Library, Volume 93. Harper Collins, London.

Aughney, T., Roche, N., & Langton, S (2018) The Irish Bat Monitoring Programme 2015-2017. *Irish Wildlife Manuals*, No. 103. National Parks and Wildlife Service, Department of Cultural heritage and the Gaeltacht, Ireland.

Barratt, E. M., Deauville, R., Burland, T. M., Bruford, M. W., Jones, G., Racey, P. A., & Wayne, R. K. (1997). DNA answers the call of pipistrelle bat species. *Nature* 387: 138 - 139.

Bat Conservation Ireland (2015) BATLAS 2020 Pilot Project 2015: Volunteer Survey Manual. Version 01. www.batconservationireland.org.

Bat Conservation Trust (2018) Bats and artificial lighting in the UK: bats and the built environment series. Guidance Note 08/2019. BCT, London.

BTHK (2018) Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals. Exeter: Pelagic Publishing.

CIEEM (2016) Guidelines for Ecological impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd Edition). CIEEM, Winchester.

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

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

Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1982.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.

Dietz, C., Helversen, O. and Dietmar, N. (2011) Bats of Britain, Europe & Northweat Africa. A&C Black, London.

EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive) 1992.

Fossitt, J. A. (2000) A guide to habitats in Ireland. The Heritage Council.

Gunnell, K., Grant, G. and Williams, C (2012) Landscape and urban design for bats and biodiversity. The Bat Conservation Trust, London.

Hopkirk, A. and Russ, J. (2004) Pre-hibernal and hibernal activity and dispersal of Leisler's bat, *Nyctalus leisleri*, in Northern Ireland. Hopkirk & Russ Bat Ecology.

Hundt, L. (2012) Bat Surveys: Good Practice Guidelines (2nd Edition). The Bat Conservation Trust, London.

Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Lundy, M.G., Montgomery, I.W., Roche, N. & Aughney, T. (2011). *Landscape Conservation for Irish Bats & Species-Specific Roosting Characteristics* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Lysaght, L. and Marnell, F. (eds) (2016) Atlas of Mammals in Ireland 2010-2015, National Biodiversity Data Centre, Waterford.

Marnell, F., Kingston, N. & Looney, D. (2009) *Ireland Red List No. 3: Terrestrial Mammals*, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

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

Mathews, F., Roche, N., Aughney, T., Jones, N,m Day, J., Baker, J. and Langton, S. (2015) Barriers and benefits: implications of artificial night-lighting for the distribution of common bats in Britain and Ireland. *Philosphical Transactions of the Royal Society of London B* 370 (1667), doi: 10.1098/rstb.2014.0124.

McAney, K., O'Mahony, C., Kelleher, C., Taylor, A. & Biggane, S. (2013). *The Lesser Horseshoe Bat in Ireland: Surveys by The Vincent Wildlife Trust*. Belfast, Northern Ireland: Irish Naturalists' Journal.

National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.

Nelson, B., Cummins, S., Fay, L., Jeffrey, R., Kelly, S., Kingston, N., Lockhart, N., Marnell, F., Tierney, D. and Wyse Jackson, M. (2019) Checklists of protected and threatened species in Ireland. *Irish Wildlife Manual*s, No. 116. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Norberg U.M. and Rayner J.M.V. (1987). Ecological morphology and flight in bats (Mammalia; Chiroptera): wing adaptations, flight performance, foraging strategy and echolocation. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences.* 316: 335-427.

NPWS (2018) Conservation objectives supporting document – lesser horseshoe bat (Rhinolophus hipposideros) Version 1. Conservation Objectives Supporting Document Series. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland.

O'Sullivan, P. (1994). *Bats in Ireland.* Special supplement to the Irish Naturalists' Journal.

Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). *Irish Bats in the 21st Century.* Bat Conservation Ireland, Cavan, Ireland.

Roche, N., Langton, S. & Aughney, T. (2012). *Lesser Horseshoe Bat: Population, Trends and Threats 1986 to 2012* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Russ, J. (2012) British Bat Calls: A guide to species identification. Pelagic Publishing, Exeter.

Rydell J. (2006). Bats and their insect prey at streetlights. In C. Rich and T. Longcore (eds.) Ecological Consequences of Artificial Night Lighting. 43-60.

Schofield, H. (2008). *The Lesser Horseshoe Bat Conservation Handbook*. Herefordshire, England: The Vincent Wildlife Trust.

Wildlife Act 1976 and Wildlife [Amendment] Act 2000. Government of Ireland.

Section 8: APPENDICES

Appendix 1. MAPS & FIGURES

Figure 8.1: Site Location Map.

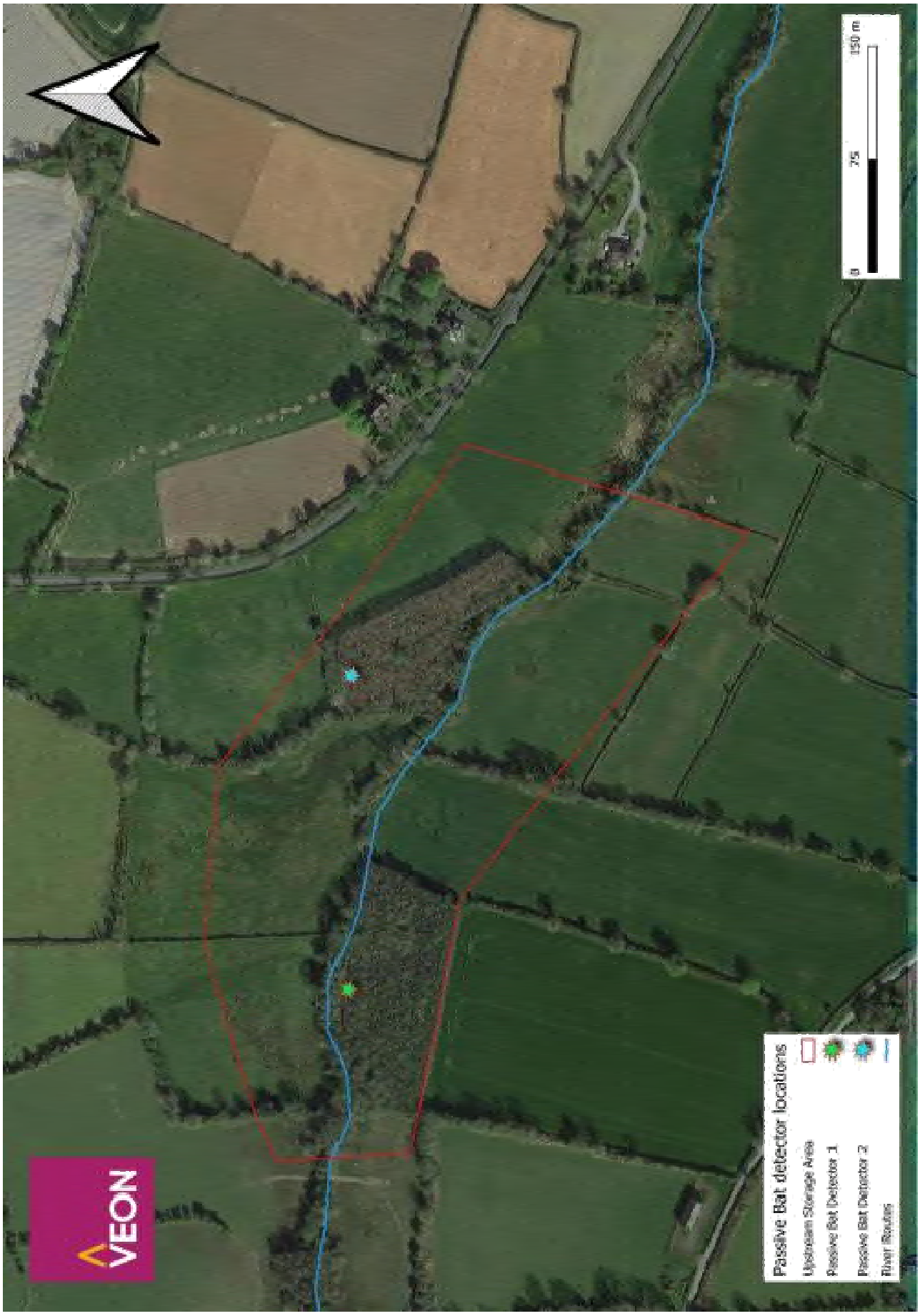


Figure 8.2: Passive Bat detector locations within the study area.

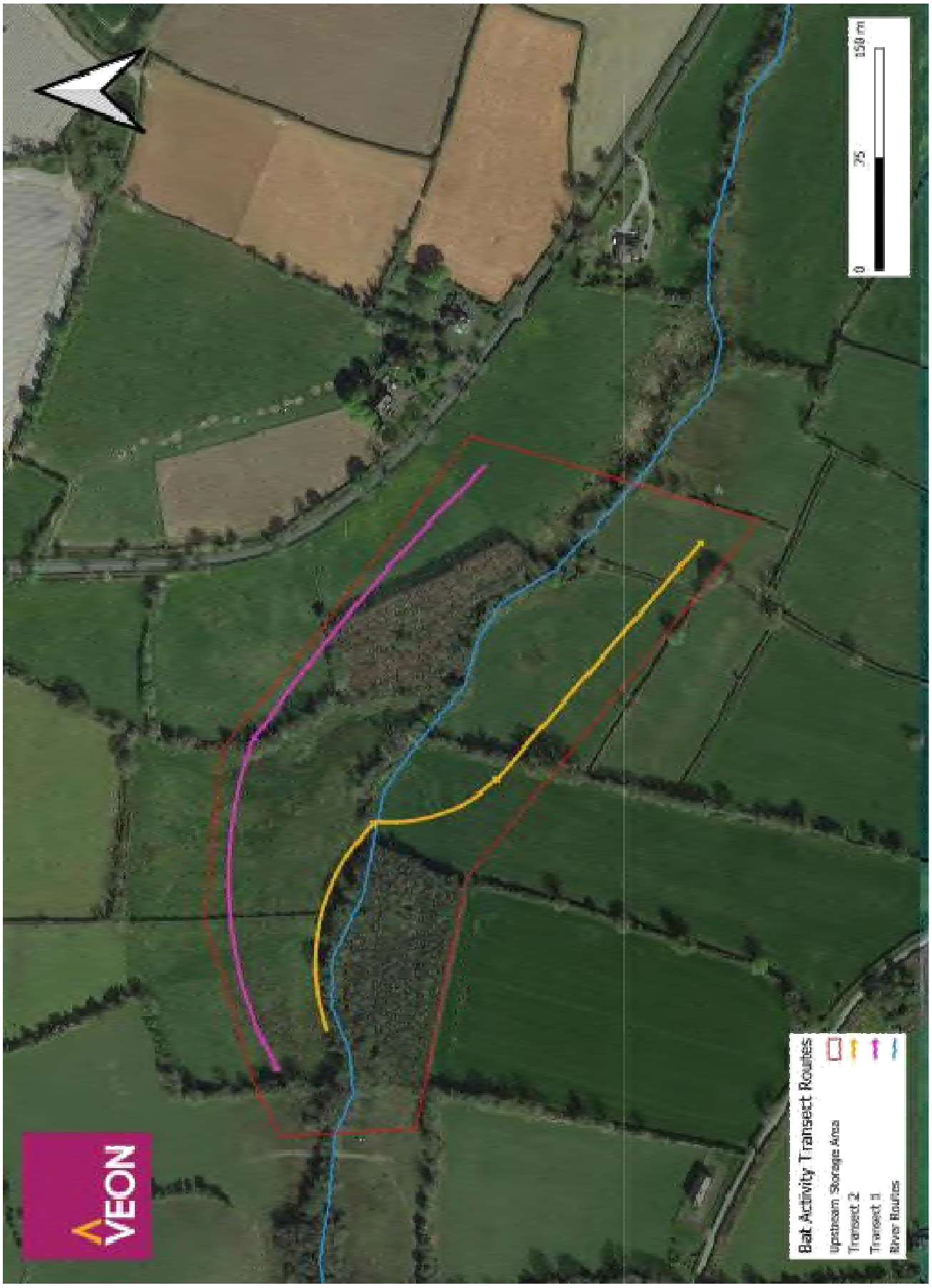


Figure 8.3: Bat Activity Transect Route.

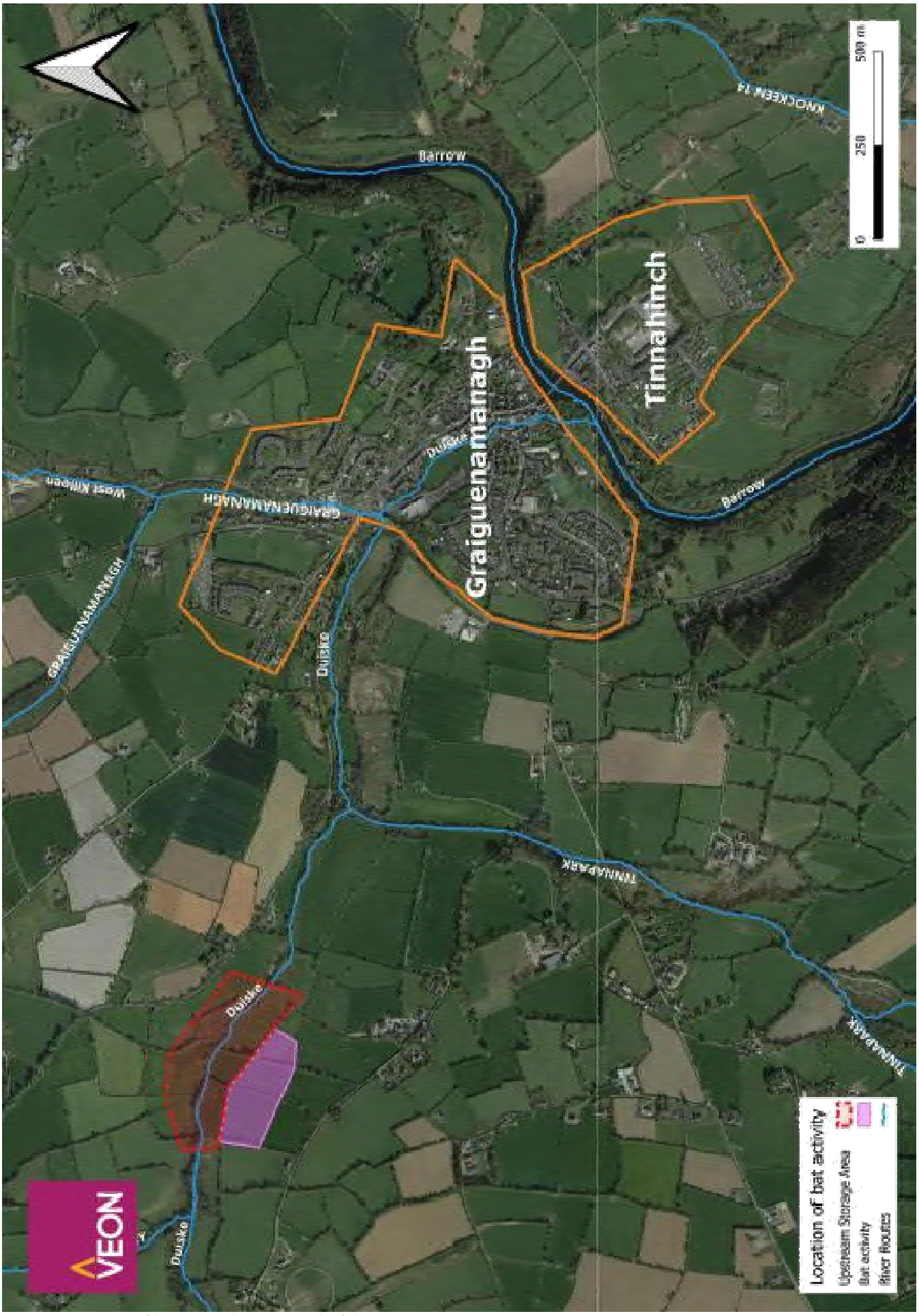


Figure 8.4: Location of bat activity hot spot south of the study area.

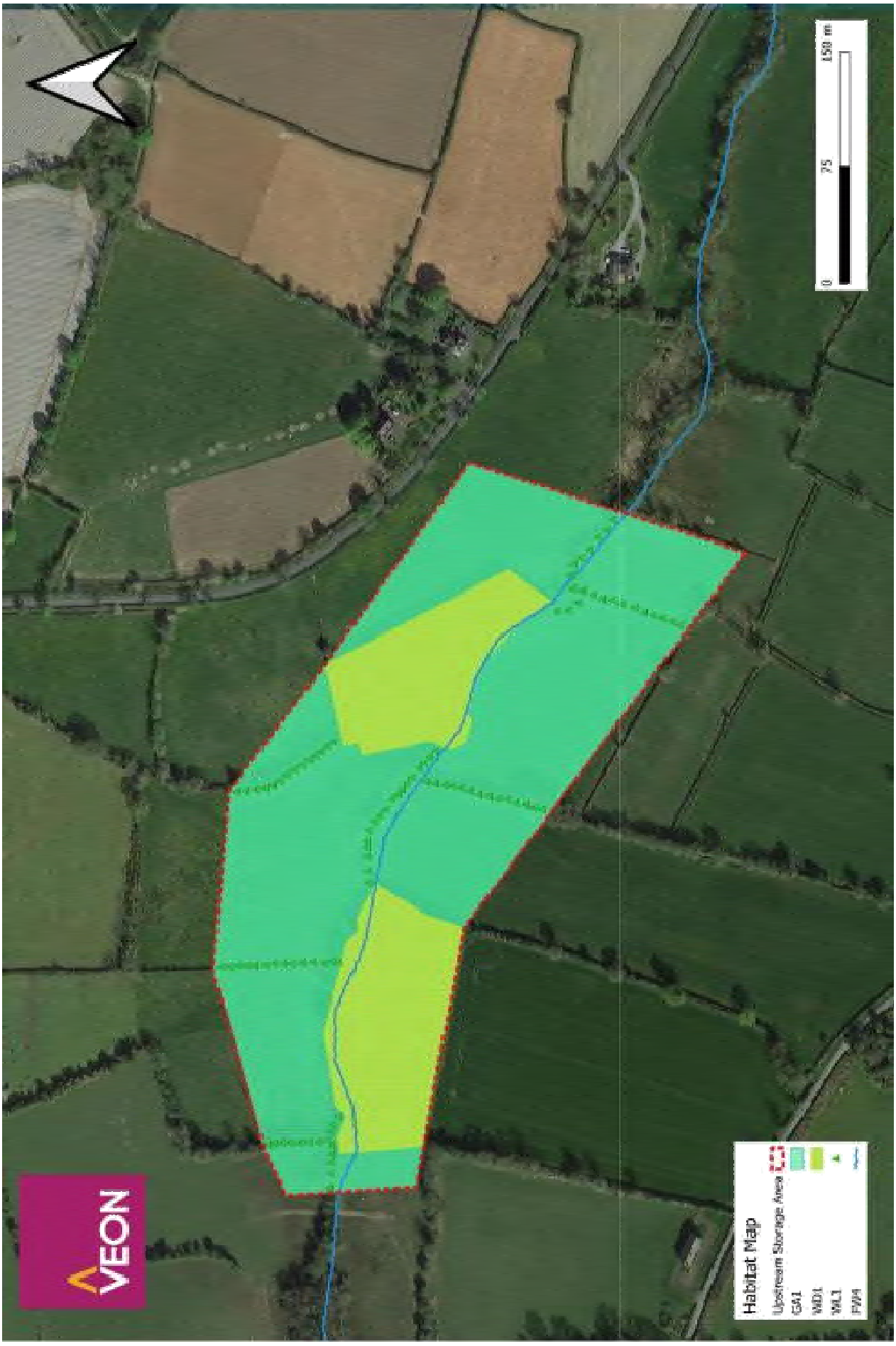


Figure 8.5: Habitats recorded on site.

Appendix 2. BAT SPECIES PROFILES

Ireland has No. 9 known established bat species from two distinct families. Each is briefly described below. For a more comprehensive overview see Roche et al (2014). The conservation status of each species is derived from NPWS (2019).

Vespertilionidae:

Leisler's bat (*Nyctalus leisleri*)

This species is Ireland's largest bat, with a wingspan of up to 320mm; it is also the third most common bat, preferring to roost in buildings, although it is sometimes found in trees and bat boxes. It is the earliest bat to emerge in the evening, flying fast and high with occasional steep dives to ground level, feeding on moths, caddisflies and beetles. The echolocation calls are sometimes audible to the human ear being around 15 kHz at their lowest. The audible chatter from their roost on hot summer days is sometimes an aid to location. The conservation status of this species is Favourable.

Ireland's population is deemed of international importance and the paucity of knowledge of roosting sites, makes this species vulnerable. However, it is widespread across the island. The modelled Core Area for Leisler's bats is a relatively large area that covers much of the island of Ireland (52,820km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the Leisler's bat habitat preference has been difficult to define in Ireland. Habitat modelling for Ireland shows an association with riparian habitats and woodlands (Roche *et al.,* 2014). The landscape model emphasised that this is a species that cannot be defined by habitats preference at a local scale compared to other Irish bat species but that it is a landscape species and has a habitat preference at a scale of 20.5km. In addition, of all Irish bat species, Leisler's bats have the most specific roosting requirements. It tends to select roosting habitat with areas of woodland and freshwater.

The principal concerns for Leisler's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats.
- Relative to the population estimates, the number of roost sites is poorly recorded.
- Tree felling, especially during autumn and winter months.
- Increasing urbanisation.

Common pipistrelle (*Pipistrellus pipistrellus*)

The common pipistrelle's echolocation calls peak at 45 kHz. The species forages along linear landscape features such as hedgerows and treelines as well as within woodland. This species is generally considered to be the most common bat species in Ireland. The species is widespread and is found in all provinces. The modelled Core Area for common pipistrelles is a large area that covers much of the island of Ireland (56,485km^2) which covers primarily the east and southeast of the area (Roche *et al.,* 2014). The Bat Conservation Ireland Irish Landscape Model indicates that the Common pipistrelle selects areas with broadleaf woodland, riparian habitats and low-density urbanization (<30%) (Roche *et al.,* 2014). The conservation status of this species is Favourable.

Principal concerns for Common pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosting requirements.
- This species has complex habitat requirements in the immediate vicinity of roosts. Therefore, careful site-specific planning for this species is required in order to ensure all elements are maintained.
- Renovation or demolition of derelict buildings.
- Tree felling .
- Increasing urbanisation (e.g. increase in lighting).

Soprano pipistrelle (*Pipistrellus pygmaeus*)

The soprano pipistrelle's echolocation calls peak at 55 kHz, which distinguishes it readily from the common pipistrelle on detector. The pipistrelles are the smallest and most often seen of our bats, flying at head height, and taking small prey such as midges and small moths. Summer roost sites are usually in buildings, but tree holes and heavy ivy are also used. Roost numbers can exceed 1,500 animals in mid-summer. The conservation status of this species is Favourable.

This species is generally considered to be the second most common bat species in Ireland. The species is widespread and is found in all provinces, with concentration along the western seaboard. The modelled Core Area for soprano pipistrelle is a large area that covers much of the island of Ireland (62,020km^2). The Bat Conservation Ireland Irish Landscape Model indicates that the soprano pipistrelle selects areas with broadleaf woodland, riparian habitats and low-density urbanisation (Roche *et al.,* 2014).

Principal concerns for Soprano pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosts.
- Renovation or demolition of structures.
- Tree felling.
- Increasing urbanisation (e.g. increase in lighting).

Nathusius' pipistrelle (*Pipistrellus nathusii*)

Nathusius' pipistrelle is a recent addition to the Irish fauna and has mainly been recorded from the north-east of the island in Counties Antrim and Down (Richardson, 2000) and in Fermanagh, Longford and Cavan. It has also been recorded in Counties Cork and Kilkenny (Kelleher, 2005). However, the known resident population is enhanced in the autumn months by an influx of animals from Scandinavian countries. It is not known whether the Irish population migrates within or from Ireland to another country to overwinter, although there is evidence that Nathusius' pipistrelle bats migrate from Britain to overwinter on continental Europe. The Nathusius' pipistrelle often forages over water or along forest tracks. The conservation status of this species is Favourable.

Natterer's bat (*Myotis nattereri*)

There are three species included in the Myotis species family and their echolocation calls are very similar across these three species. One of the rarer Irish bat species, the Natterer's bat likes woodland, mature hedgerow and pasture habitats. The Natterer's bat has broad wings so it can fly with great manoeuvrability among trees and around hedgerows. It sometimes gleans insects or even spiders from foliage and may eat larger prey at a feeding perch. Its usual roost sites are in tree holes, old stone buildings such as churches and barns, and under bridges. This species has a fringe of stiff bristles along the trailing edge of its tail membrane, which may help to hold or trap its prey.

This species has a slow to medium flight, usually over trees but sometimes over water. It usually follows hedges and treelines to its feeding sites, consuming flies, moths, caddisflies and spiders. The Natterer's bat is one of our least studied species and further work is required to establish its status in Ireland. The conservation status of this species is Favourable.

The modelled Core Area for Natterer's bats is a relatively large area that covers much of the island of Ireland (52,864km^2). The Bat Conservation Ireland Irish Landscape Model indicates that the Natterer's bat selects areas with broadleaf woodland, riparian habitats, and areas with larger scale provision of mixed forest (Roche et al., 2014).

Brown long-eared bat (*Plecotus auritus*)

This species of bat is a 'gleaner', hunting amongst the foliage of trees and shrubs, and hovering briefly to pick a moth or spider off a leaf, which it then takes to a sheltered perch to consume. They often land on the ground to capture

their prey. Using its nose to emit its echolocation, the long-eared bat 'whispers' its calls so that the insects, upon which it preys, cannot hear its approach (and hence, it needs oversize ears to hear the returning echoes). As this is a whispering species, it is extremely difficult to monitor in the field as it is seldom heard on a bat detector. Furthermore, keeping within the foliage, as it does, it is easily overlooked. It prefers to roost in old buildings. The conservation status of this species is Favourable.

This species is generally considered to be widespread across the island. The modelled Core Area for Brown long-eared bats is a relatively large area that covers much of the island of Ireland (52,820km^2) with preference suitable areas in the southern half of the island. The Bat Conservation Ireland Irish Landscape Model indicates that the Brown long-eared bat habitat preference is for areas with broadleaf woodland and riparian habitats on a small scale of 0.5km emphasising the importance of local landscape features for this species (Roche *et al.,* 2014).

Principal concerns for brown long-eared bats are poorly known in Ireland, but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats.
- Lack of knowledge of winter roosts.
- Loss of woodland, scrub and hedgerows.
- Tree surgery and felling.
- Increasing urbanisation.
- Light pollution.

Daubenton's bat (*Myotis daubentonii*)

This bat species prefers feeding close to the surface of smooth water, either over rivers, canals, ponds, lakes, or reservoirs but it can also be found foraging in woodlands. Flying at 15 kilometres per hour, it gaffs insects with its over-sized feet as they emerge from the surface of the water - feeding on caddis flies, moths, mosquitoes, midges etc. It is often found roosting beneath bridges or in tunnels and makes use of hollows in trees. The conservation status of this species is Favourable.

The modelled Core Area for Daubenton's bats is a relatively large area that covers much of the island of Ireland (41,285km^2) reflecting the distribution of sizeable river catchments. The Bat Conservation Ireland Landscape Model indicates that the Daubenton's bat habitat preference is for areas with broadleaf woodland, riparian habitats and low-density urbanisation (Roche *et al.,* 2014).

Principal concerns for Daubenton's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Potential roost loss due to bridge works.
- Loss of woodland and forest clearance.
- Loss of woodland, scrub, and hedgerows.
- Tree surgery and felling.
- Increasing urbanisation.
- Light pollution.

Whiskered bat (*Myotis mystacinus*)

This species, although widely distributed, has been rarely recorded in Ireland. It is often found in woodland, frequently near water. Flying high, near the canopy, it maintains a steady beat and sometimes glides as it hunts. It also gleans spiders from the foliage of trees. Whiskered bats prefer to roost in buildings, under slates, lead flashing or exposed beneath the ridge beam within attics. However, they also use cracks and holes in trees and sometimes bat boxes. The conservation status of this species is Favourable.

Rhinolophidae:

Lesser horseshoe bat (*Rhinolophus hipposideros*)

This species is the only representative of the Rhinolophidae or horseshoe bat family in Ireland. It differs from our other species in both habits and looks, having a unique nose leaf with which it projects its echolocation calls. It is also quite small and, at rest, wraps its wings around its body. Lesser horseshoe bats feed close to the ground, gleaning their prey from branches and stones. It often carries its prey to a perch to consume, leaving the remains beneath as an indication of its presence.

The echolocation call of this species is of constant frequency and, on a heterodyne bat detector, sounds like a melodious warble. The species is confined to six counties along the Atlantic seaboard: Mayo, Galway, Clare, Limerick, Kilkenny and Cork. The current Irish national population is estimated at 12,500 – 14,000 individuals. This species is listed on Annex II of the EC Habitats Directive and 41 Special Areas of Conservation have been designated in Ireland for its protection, of which 9 have also been selected for the Annex I habitat 'Caves not open to the public'. Where it occurs, it is often found roosting within farm buildings. In Ireland, the overall conservation status of lesser horseshoe bat is assessed as Favourable.

Lesser horseshoe bats forage on flying insects predominantly in deciduous woodland and riparian vegetation normally within a couple of kilometres of their roosts. The bats rely on linear landscape features (e.g. treelines, stonewalls and hedgerows) to navigate and commute from roosts to feeding sites and they are reluctant to fly out in the open.

Lesser horseshoe bats are sensitive to disturbance and normally do not occupy the same buildings as humans. Loss of roosting sites due to deterioration or renovation of old buildings, loss of commuting routes linking roosts to foraging sites and unsympathetic management of foraging sites are the major threats to this species.

Lesser horseshoe bats are very sensitive to light pollution and will avoid brightly lit areas. Artificial light at night at or near roosts may impact bats in a number of ways, for example, delaying emergence time after dusk, causing abandonment of roosts when exits are lit at night and/or reducing reproductive success.

Appendix D: Bat Survey Report (Top Up Survey, Graiguenamanagh-Tinnahinch) (VEON, 2024)

VEON Forestry, Ecology & Environment

Bat Survey Report

Graiguenamanagh Tinnahinch Flood Relief Scheme
Graiguenamanagh, Co. Kilkenny

Table of Contents

SUMMARY

Site: Townlands of Graiguenamanagh in County Kilkenny. Part of the settlement, known as Tinnahinch, is on the County Carlow side of the river, and Carlow County Council refers to the whole village as "Graiguenamanagh-Tinnahinch.

Proposed works:

Due to repeated and increasingly common flood events, a Flood Relief Scheme (FRS) for Graiguenamanagh town, is proposed. The objective of the Graiguenamanagh Flood Relief Scheme project is the identification, design and construction of a Flood Relief Scheme, that is technically, socially, environmentally and economical acceptable, to alleviate the risk of flooding to the community of Graiguenamanagh (Source: floodinfo.ie).

Considering the nature of project, potential significant effects on ecologically sensitive receptors such as bats cannot be ruled out. Large-scale development entailing changes to, or removal of existing vegetation and structures may adversely affect bats through loss of breeding/resting places or commuting/foraging features, displacement and injury. It is essential therefore that a study of protected species such as bats is undertaken in such cases to identify any conflict zones and hence to avoid and/or reduce impacts to bats through mitigation.

Surveyed by: Donnachadh Powell, BSc (Hons) Ecology and Environmental Biology, CIEEM, Lead Ecologist, David McGillycuddy, BSc (Hons) Wildlife Biology, CIEEM, Ecologist, Jason Cahill, BSc (Hons) Wildlife Biology, Ecologist, Sara Sheridan MSc BSc CIEEM, Ecologist and Anna Paula Moreira B.Sc. (Hons) in Environmental Science, Ecologist, Veon Ecology.

Survey effort:

As part of a wider ecological constraints assessment of the proposed flood relief scheme, Veon Ecology was commissioned to undertake a specific assessment of bat activity within the study area. Preliminary Roost Assessments were carried out on the relevant structures within the survey area and tree surveys were also conducted where possible to determine the presence of roosting bats. Transect walks were conducted on and around the proposed works locations to further characterise bat activity levels and species present. A moderate level of bat activity was recorded on site, likely due to a lack of foraging/roosting opportunities and high levels of sustained disturbances associated with anthropogenic activity such as artificial lighting.

Potential bat corridors in the vicinity of the area were also assessed. The bat activity surveys involved active acoustic sampling using handheld bat detectors at predetermined points. To ensure there is no negative impact on bats as a result of the proposed works, surveys were undertaken on all relevant buildings identified as having bat roosting potential.

Activity surveys were carried out on site. These surveys involved dusk emergence surveys and transect surveys.

Section 1: INTRODUCTION

1.1 Aims of the Report

Veon Ltd. (Veon Ecology) was commissioned by Ayessa on behalf of Kilkenny County Council (KCC) to undertake a survey for bats within a Survey Area affected by the proposed Graiguenamanagh Flood Relief Scheme hereafter referred to as the proposed Scheme. The Survey Area for bat activity surveys can be seen in **Figure 2.1** below.

The overarching aims of the bat surveys were as follows:

- To identify the areas and habitats within the Survey Area that are being used by bats (including flight paths/commuting routes and foraging areas);
- Collect robust data following good practice guidelines to allow an assessment of the potential impacts of the proposed project on local bat populations, both on and off-site (where possible);
- To identify the species of bats using the Survey Area;
- Provide baseline information with which the results of post-construction monitoring surveys can be compared to, where appropriate;
- To identify, where possible, any bat roosts within the Survey Area and the environs of the scheme;
- Facilitate the design of mitigation, enhancement and monitoring strategies for local bat populations recorded; and,
- Facilitate the conservation of local bat populations.

The bat surveys were completed during May to September 2024. This also informed the assessment of potential roost sites for bats. The Survey Area for this baseline assessment focussed within a 200m – 400m wide corridor of suitable habitat which encompasses the location of the proposed Scheme. Bat surveys focussed on suitable roosting and foraging habitat within the Zone of Influence (ZoI) such as watercourses, woodlands, treelines, hedgerows, grasslands and Riparian woodland along sections of the DUISKE_020 and BARROW_230 and tributaries which shall be directly impacted by the proposed works.

1.2 Relevant Legislation

All Irish bat species are protected under the *Wildlife Act (1976) and Wildlife Amendment Acts (2000 and 2010)*. Also, the EC Directive on *The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive 1992)*, seeks to protect rare species, including bats, and their habitats and requires that appropriate monitoring of populations be undertaken.

All Irish bats are listed in Annex IV of the Habitats Directive and the Lesser horseshoe bat (*Rhinolophus hipposideros)* is further listed under Annex II.

Across Europe, they are further protected under the *Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982)*, which, in relation to bats, exists to conserve all species and their habitats.

The *Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983)* was instigated to protect migrant species across all European boundaries. The Irish government has ratified both these conventions.

Also, under existing legislation, the destruction, alteration, or evacuation of a known bat roost is a notifiable action, and a derogation licence has to be obtained from the National Parks and Wildlife Service (NPWS) before works can commence.

Any works interfering with bats and especially their roosts, may only be carried out under a licence to derogate from Regulation 23 of the Habitats Regulations 1997 and Regulation 54 of the European Communities (Birds and Natural Habitats) Regulations 2011 (which transposed the EU Habitats Directive into Irish law), issued by NPWS.

The details with regards to appropriate assessments, the strict parameters within which derogation licences may be issued and the procedures by which and the order in relation to the planning and development regulations such licences should be obtained, are set out in *Circular Letter NPWS 2/07 "Guidance on Compliance with Regulation 23 of the Habitats Regulations 1997 - strict protection of certain species/applications for derogation licences*" issued on behalf of the Minister of the Environment, Heritage and Local Government on the 16th of May 2007.

1.3 Bat Species in Ireland

There are eleven recorded bat species in Ireland, nine of which are considered Resident, two as Vagrant, namely:

1. Common pipistrelle (*Pipistrellus pipistrellus*)
2. Soprano pipistrelle (*Pipistrellus pygmaeus*)
3. Nathusius' pipistrelle (*Pipistrellus nathusii*)
4. Leisler's bat (*Nyctalus leisleri*)
5. Brown long-eared bat (*Plecutus auratus*)
6. Natterer's bat (*Myotis nattereri*)
7. Whiskered bat (*Myotis mystacinus*)
8. Daubenton's bat (*Myotis daubentonii*)
9. Lesser horseshoe bat (*Rhinolophus hipposideros*)
10. Brandt's bat (*Myotis brandtii*) (**Vagrant**)
11. Greater horseshoe bat (*Rhinolophus ferrumerquinum*) (**Vagrant**)

Eight of the nine resident bat species and one of the vagrant bat species are 'Vesper' bats. All *vespertilionid* bats have a tragus (cartilaginous structure inside the pinna of the ear). Vesper bats are distributed throughout the island.

The Lesser horseshoe bat (*Rhinolophus hipposideros)*, belongs to the *Rhinolophidea* and has a complex nose leaf structure on the face, distinguishing it from the Vesper bats. This species' current distribution is confined to the western seaboard counties of Mayo, Galway, Clare, Limerick, Kilkenny and Cork.

Only one confirmed record (corroborated by DNA testing) of the Brandt's bat (*Myotis brandtii*) has occurred in Ireland to-date. All other records have not been genetically confirmed. The Brandt's bat is very similar to the Whiskered bat (*Myotis mystacinus*), so it remains possible that the two have been confused in Ireland in the past. As such, the Brandt's bat is considered a vagrant.

The Greater horseshoe bat (*Rhinolophus ferrumerquinum)* was only recorded for the first time in February 2013 in County Wexford and is therefore also considered to be a vagrant species.

1.4 Guidance Documents

This report will draw on guidelines already available in Europe and will use the following documents:

- National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.
- National Roads Authority Guidelines for the Protection and Preservation of Trees, Hedgerows and Scrub Prior to, and During the Construction of National Road Schemes.
- Kelleher, C & Marnell, F. (2006). Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Hundt, L. 2012 Bat Surveys: Best Practice Guidelines (2nd edition). Bat Conservation Trust, London.

- Collins, J. (Editor) 2016 Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). Bat Conservation Trust, London.
- McAney, K. (2006) A conservation plan for Irish vesper bats, Irish Wildlife Manual No. 20 National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- The status of EU protected habitats and species in Ireland: Conservation status in Ireland of habitats and species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

Collins (2016) is the principal document used to provide guidance in relation to survey effort required however the level of surveying is assessed on a case-by-case basis taking into consideration the historical bat records for the survey area, presence of built structures and trees potentially suitable for roosting bats.

Impacts on bats can arise from activities that may result in the following:

- Lighting disturbance.
- Noise disturbance e.g. use of machinery, increase human presence etc.
- Physical disturbance of bat roosts e.g. destruction or renovation of buildings.
- Loss of roosts e.g. destruction or renovation of buildings.
- Loss of foraging habitats.
- Modifications of commuting or foraging habitats.
- Severance or fragmentation of commuting routes.

It is recognised that any development may have an impact on the receiving environment, but the significance of the impact will depend on the value of the ecological features that would be affected. Such ecological features will be those that are considered to be important and potentially affected by the proposed development.

The guidelines consulted recommend that the potential impacts of a proposed development on bats are assessed as early as possible in the design stage to determine any areas of conflicts.

Section 2: PROJECT DESCRIPTION

2.1 Site Location

The study area that formed the basis of the bat surveys includes the river BARROW_230 and waterbody DUISKE_020. Additional areas of Graiguenamanagh town were also surveyed. A map of the proposed works locations and survey area is illustrated in **Figure 2.1** below. The waterbody DUISKE_020 flows south-eastwards to Graiguenamanagh town and meets river BARROW_230 (Lat Lon coordinate: *52.538580, -6.955742*).

The River Barrow is considered a Freshwater Pearl Mussel (FPM) sensitive area. Water quality in the River Barrow is generally classified as poor under the WFD. There are significant polluting sources within the survey area including Benzo(g,h,i)perylene and Benzo(k)fluoranthene.

The survey area supports a variety of habitats including hedgerows, treelines, grasslands, woodland and scrub. Land-usage in the wider landscape is primarily for livestock agriculture, residential and forestry. The habitats within the survey area provide suitable foraging areas for bats, as well as opportunities for roosting sites.

The survey area overlaps or is in close proximity to the following Natura 2000 sites:

- River Barrow and River Nore SAC (002162)
- Thomastown Quarry SAC (002252)
- Slaney River Valley SAC (000781)
- Blackstairs Mountains SAC (000770)
- River Nore SPA (004233)

River Barrow and River Nore SAC (002162) is very important for the presence of a number of E.U. Habitats Directive Annex II animal species including Freshwater Pearl Mussel (both *Margaritifera margaritifera* and *M. m. durrovensis*), White-clawed Crayfish, Salmon, Twaite Shad, three lamprey species – Sea Lamprey, Brook Lamprey and River Lamprey, the tiny whorl snail Vertigo moulinsiana and Otter. This is the only site in the world for the hard water form of the Freshwater Pearl Mussel, *M. m. durrovensis*, and one of only a handful of spawning grounds in the country for Twaite Shad.

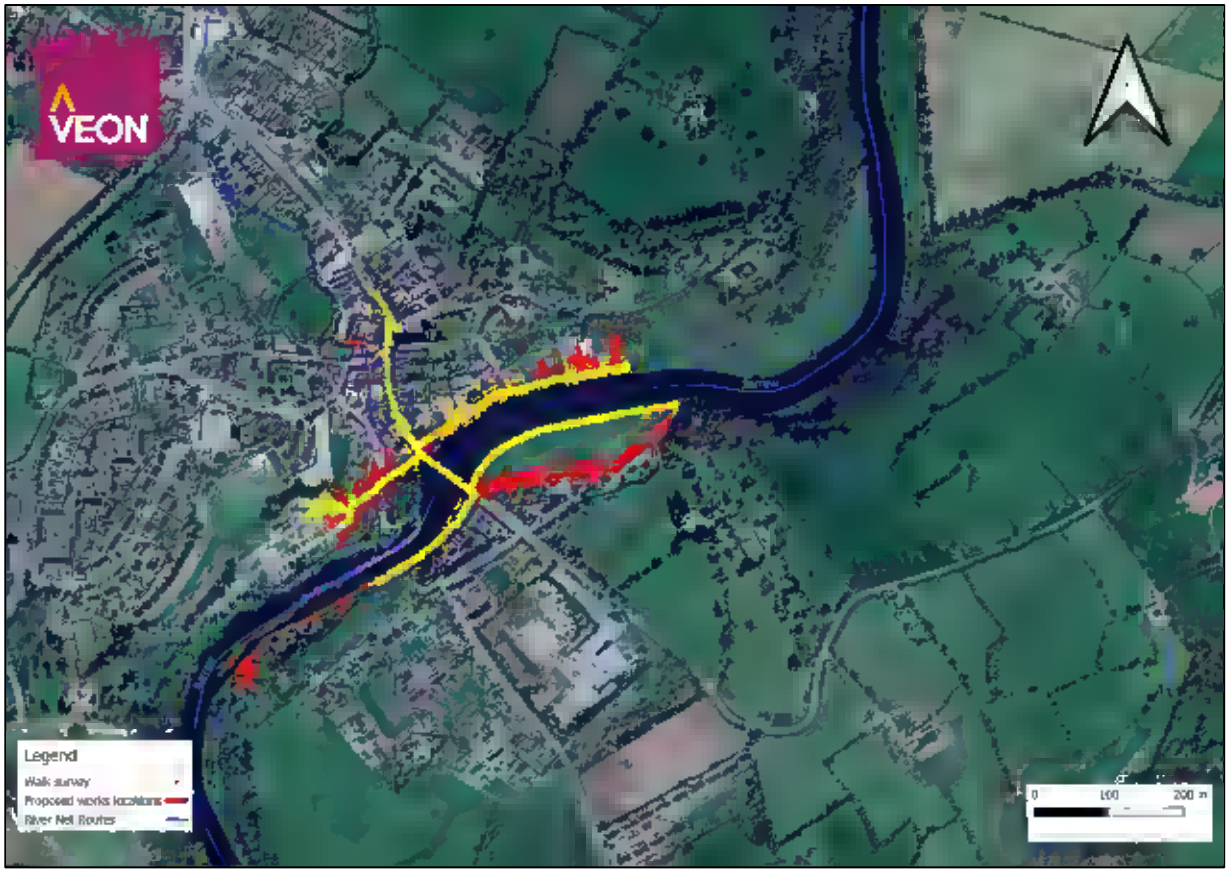


Figure 2.1: Proposed Works Locations/ Bat Survey Area and relevant watercourses Map.

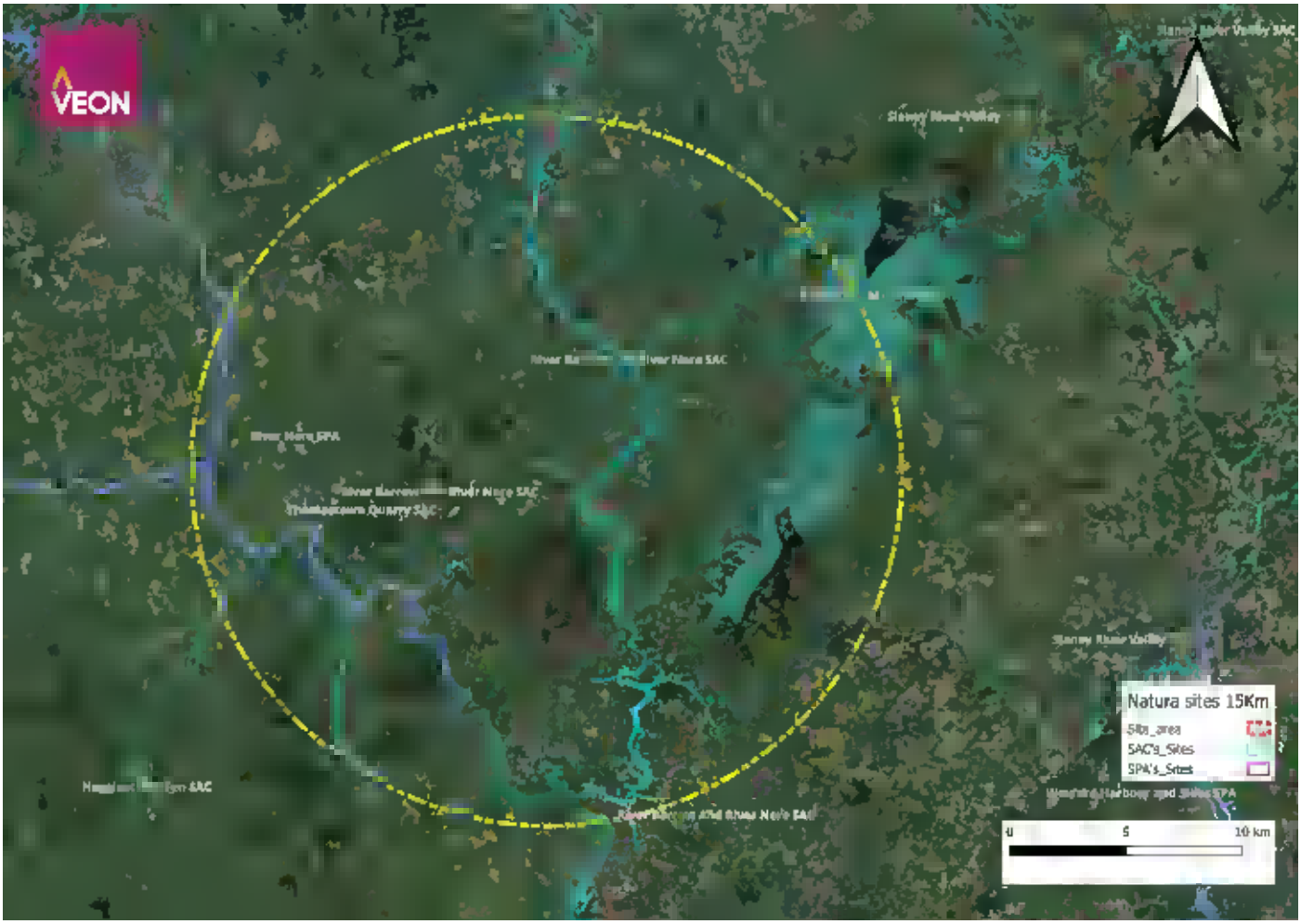


Figure 2.2: Natura Sites within 15km of the possible works locations.

2.2 Project Description

The Office of Public Works (OPW) completed Catchment Flood Risk Assessment and Management (CFRAM) studies covering the entire country reviewing flood-prone sites. Graiguenamanagh-Tinnahinch was identified during the study as one of the areas at risk to flooding. The plan set out the measures and policies to be pursued in order to achieve the most cost effective and sustainable management of flood risk.

The objective of the Graiguenamanagh Tinnahinch Flood Relief Scheme project is the identification, design and construction of a Flood Relief Scheme, that is technically, socially, environmentally and economical acceptable, to alleviate the risk of flooding to the community of Graiguenamanagh Tinnahinch (Source: floodinfo.ie).

Survey areas were based on the final preliminary design of the proposed flood defence works. The preliminary design is illustrated in **Figure 2.1**.

Section 3: METHODOLOGY

Initially, a desktop assessment of aerial photographs along the route of the proposed flood relief scheme was undertaken to identify existing habitats, buildings and structures which may be favourable for bat use within the potential works locations.

Bat surveys are comprised of many different types and may differ from site to site depending on the aims of the survey. The surveys deemed suitable for a particular project is determined on a case-by-case basis.

To fulfil the Survey brief, the following activities were carried out:

- Daytime walkover survey of the site and immediate area.
- Daytime inspection of the relevant building(s)/structure(s) directly.
- Active acoustic surveys in the study area during night hours.
- Review of historical bat surveys conducted within the vicinity of the site.
- Desktop study of the National Biodiversity Data Centre (NBDC) Bat Suitability Index.

3.1 Bat Habitat and Commuting Routes

The survey site was assessed during daytime walkover surveys, in relation to potential bat foraging habitat and potential bat commuting routes. Bat habitats and commuting routes identified are considered in relation to the wider landscape to determine landscape connectivity for local bat populations through the examination of aerial photographs.

All areas were surveyed on foot, mainly along hard-surfaced roads, grassland, built land and along the river corridor.

3.2 Survey for presence/absence of Bat roosts

A preliminary roost assessment (PRA) was carried out during daylight hours (exterior and interior) to identify any evidence of roosting bats, current or historic. Potential roosting features (PRFs) were recorded at these buildings/structures during daytime visual inspections. A bat activity survey was carried out to confirm the presence or absence of roosting bats at these buildings/structures. Surveys followed guidelines outlined in Collins (2016).

3.2.1 Preliminary Roost Assessment

The relevant buildings, structures and trees within the survey area were investigated during daylight hours to record any signs of current and/or historic bat presence, such as droppings, brown staining from urine, feeding remains and surfaces smoothed around entrance holes. Kelleher & Marnell (2006) provide guidance on assessing the potential for structures to support roosting bats. This guidance identifies a variety of factors that increase or decrease the potential of a structure to function as a bat roost, namely:

Increase Potential
Disused or little used; largely undisturbed; Large roof void with unobstructed flying spaces; Large dimension roof timbers with cracks, joints, and holes; Uneven roof covering with gaps, though not too draughty; Entrances that bats can fly in through; Hanging tiles or wood cladding, especially on south-facing walls; Rural setting; Close to woodland and/or water; Pre-20th century or early 20th century construction; Roof warmed by the sun.

Decrease Potential
Urban setting or highly urbanised area with few feeding places; Small or cluttered roof void; Heavily disturbed; Modern construction with few gaps around soffits or eaves; Prefabricated with steel sheet materials; Active industrial premises; Roof shaded from the sun; High internal day time light levels.

The day-time inspections focused on identifying any suitable ingress and egress points for bats into any relevant structures and a thorough search of all exterior areas of the relevant buildings. Internal inspections of buildings including the roof and attic spaces are also completed, where safe access is possible.

The following equipment was used during the PRA and activity surveys:

- Wildlife Acoustics Echometer Touch 2 Bat Detector (Android).
- High-powered Maglite© hand torch and LED head torch.
- Endoscope (Explorer Premium) Wireless inspection camera.

3.2.2 Activity Surveys

Bat emergence/re-entry surveys are typically undertaken at dusk or dawn between April and September to identify whether bats are present within a structure and provide additional confidence in any negative survey results from preliminary roost assessment surveys conducted if the buildings, structures and/or trees are identified as medium or high potential for a roost to be present.

Dusk surveys were started from 10 minutes before sunset to at least 100 minutes post sunset (extended survey period times occurred in relation to walking transects).

Conducting an Emergence Bat survey allows surveyors to identify:

- Whether bats are present in a structure, the species, and number involved.
- Entrance and exit points for the roost.
- Any actions needed to be taken to ensure legal compliance.
- The type of roost, i.e.:
    - Day roosts: individual bats, or small groups of males, are using the area for shelter during daylight hours.
    - Feeding roosts: whereby bats, particularly Brown Long-Eared and Horseshoe species feed during the night.
    - Night roost: where bats rest or shelter between feeding sessions.
    - Hibernation roost: where bats hibernate over the winter periods.
    - Transitional or occasional roost: where bats gather at a temporary site before and after hibernation.
    - Mating site: Males and females gather in late summer to early winter.
    - Maternity roost: where babies are born and raised until they're independent.
    - Satellite roost: where breeding females roost close to the main nursery colony in the breeding season.
    - Swarming site: where bats gather in large numbers from late summer to autumn.

Bats rely heavily on buildings for roosting. Average maternity colony sizes are about 50 bats although most roosts are much smaller. Larger roosts are not uncommon among particular species. A maternity or nursery roost is where females gather to give birth in the summer. Bats typically roost in buildings during the summer months, leaving in autumn to seek a site with a more stable temperature regime for hibernation.

As a standard approach, all emerging or re-entering bats observed at a structure are recorded along with their flight path, their species, and the time of flight. Vegetation, habitat, and relevant environmental factors are also detailed, where applicable and appropriate.

Walking transects involve the surveyor(s) walking the survey area, noting the time, location and bat species encountered. The Wildlife Acoustics Echo Meter Touch 2 (Android) recordings are mapped using QGIS with the produces WAV files. The validation of bat records is completed by the principal bat surveyor prior to mapping.

3.2.3 Building & Structure Inspection

Structures, buildings and other likely places that may provide a roosting space for bats were inspected during the daytime for evidence of bat usage. Evidence of bat usage is in the form of actual bats (visible or audible), bat droppings, urine staining, grease marks (oily secretions from glands present on stonework) and claw marks. Inspections were undertaken visually with the aid of a strong torch beam (High-powered Maglite© hand torch and LED head torch) and endoscope (Explorer Premium). Bat surveys should ideally be carried out during summer when bats are most active, unless the site is thought to be important for hibernating bats in which case a survey during cold weather in winter may be required.

Bridge structures and similar stone structures were assessed (where possible) using a 4-point classification system designed for bridges by Billington & Norman (1997)[1] as follows:

Table 3.1: Bridge and Stone Structure Bat Roost Classification System.

Bridge Bat Roost Classification System:	
Bridge Category	**Description**
0	No potential (i.e. no suitable crevices for roosting bats).
1	Low potential (i.e. crevices present that may be of use to bats).
2	High potential (i.e. crevices ideal for roosting bats but no evidence of usage during inspections).
3	Roost (evidence of bats roosting either because bats are present or other evidence is recorded during inspection (e.g. bat droppings).

3.2.4 Tree Potential Bat Roost (PBRs) Inspection

Trees that may provide a roosting space for bats are classified using the Bat Tree Habitat Key (BTHK, 2023)[2] and the classification system used is from Collins (2016). The Potential Roost Features (PRFs) listed in this guide are used to determine the PBR value of trees.

It can be challenging to ascertain the absence of roosts in trees, even if no bats are detected. Therefore, precautionary measures may be necessary during tree felling and pruning activities. If a tree is deemed to be a roost site then further surveying involving dusk and dawn surveys of the actual trees may be recommended to determine what bat species are present etc. If bats or a bat roost is identified, it is imperative to contact the NPWS (National Parks and Wildlife Service). Before commencing felling activities, obtaining a derogation license from NPWS is mandatory.

Table 3.2: Tree Bat Roost Category Classification System (Collins, 2016).

Tree Bat Roost Classification System:	
Tree Category	**Description**
1 (High)	Trees with multiple, highly suitable features (Potential Roosting Features = PRFs) capable of supporting larger roosts.
2 (Moderate)	Trees with definite bat potential but supporting features (PRFs) suitable for use by individual bats.
3 (Low)	Trees have no obvious potential although the tree is of a size and age that elevated surveys may result in cracks or crevices being found or the tree supports some features (PRFs) which may have limited potential to support bats.
4 (Negligible)	Trees have no potential.

[1] Billington, G.E. & Norman, G.M. (1997), The Conservation of Bats in Bridges Project.
[2] BTHK (2023) Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals.

3.3 Desk Study

In addition to surveys carried out on site, a detailed desktop study was carried out using information from publicly available databases such as NWPS and NBDC to further characterise the local bat ecology and potential significant effects on bat communities which may be present in the area but were not recorded during on site surveys.

3.3.1 National Biodiversity Data Centre (NBDC)

A review of National Biodiversity Data Centre (NBDC) historical records was undertaken. The proposed development site area falls within No. 2 separate 10km^2 data grid squares (S64 & S74) (See **Figure 3.1**). The NBDC Map Viewer has a 'Bat Suitability Index' (Source: NBDC & Lundy et al. 2011). This will be referred to where applicable and appropriate in this current survey.

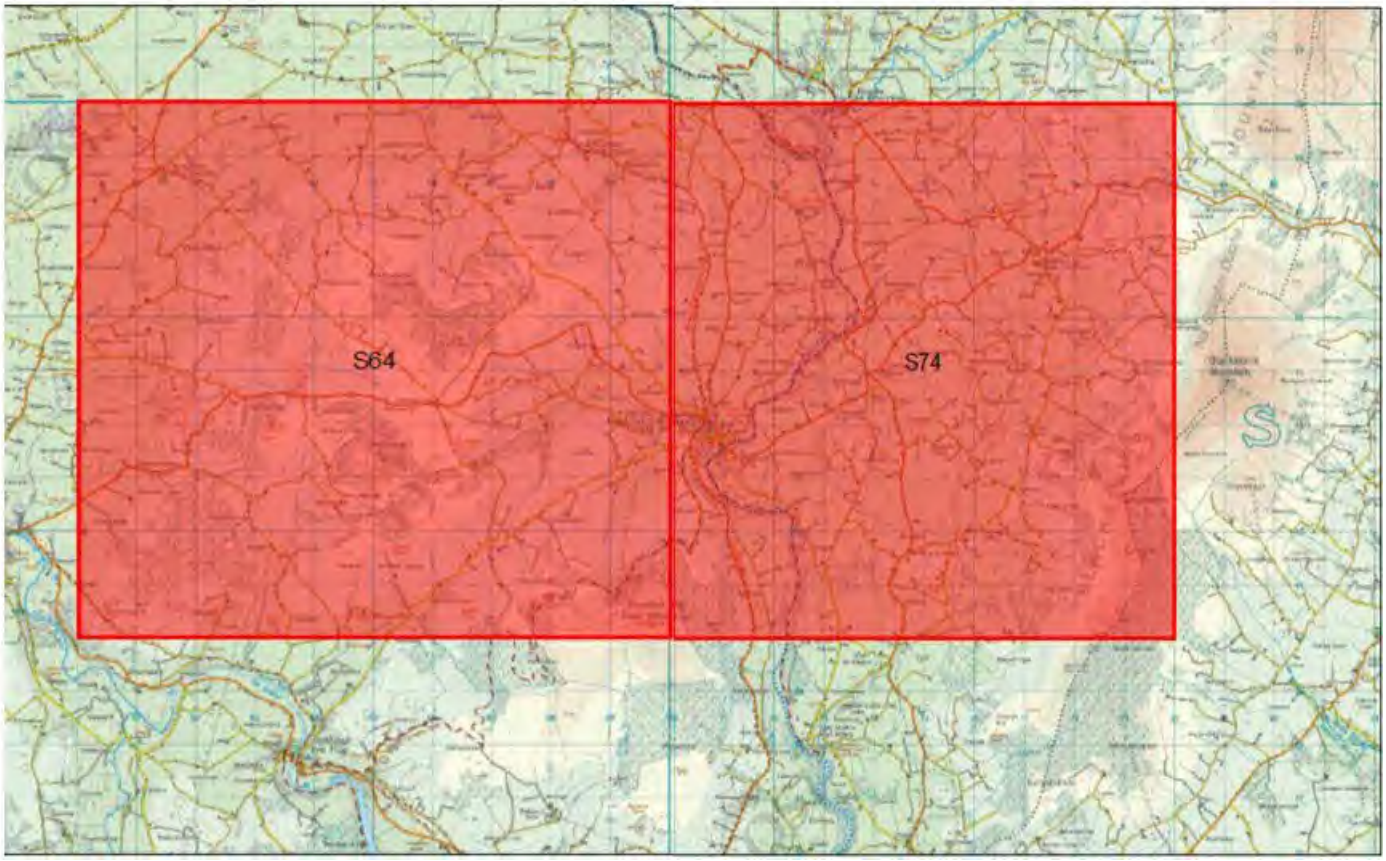


Figure 3.1: The 10km^2 data grid squares (S64 & S74) overlapping the survey area (Source: NBDC).

3.3.2 Photographic Record

A photographic record was completed for the survey and is presented throughout the text where applicable, and in **Section 8, Appendix 2**.

Section 4: SURVEY RESULTS

The surrounding landscape of Graiguenamanagh, Co. Kilkenny is primarily agricultural land with, treelines and hedgerows. There is a high level of connectivity in the landscape which makes it suitable for commuting and foraging bat populations.

The town of Graiguenamanagh is subjected to artificial lighting at night which reduces its suitability for foraging and commuting bats considered to be light sensitive (e.g. Daubenton's bats).

4.1 Preliminary Roost Assessment

The daytime Preliminary Roost Assessment (PRA) survey was carried out on the relevant buildings and structures.

Signs of roosting bats were not recorded during surveys. PRFs were identified on some trees and buildings which have the potential to support at least small numbers or individual roosting bats. Examples of PRFs recorded on site include:

- Gaps between brickwork.
- Small cavities within the walls of structures.
- Small cavities/bark tear-outs on trees

No roosts were identified site within the survey area.

4.1.1 Buildings & Structures Inspection Results

The relevant buildings/structures within the study area provide some potential roosting opportunities for bats. Structures were surveyed where possible, and signs of roosting bats were recorded. On no occasion were any species of bats seen re-entering or emerging from the buildings or structures during surveys. It should be noted that there are several buildings in the town have potential to support roosting bats. Common Pipistrelles were recorded at their average emergence time in close proximity to some buildings located near the river. Emergence surveys were carried out in areas where bats were recorded during their average emergence time. However, no bats were directly observed emerging from the target buildings. Several PRFs were observed on most buildings within the town, and bats may occupy these buildings occasionally.

Bridges and culverts within the survey area were inspected to determine their potential/ suitability for bat roosts. These structures surveyed have a Category 0 rating because they have no suitable features that can provide roosting sites for bats.

4.1.2 Tree Potential Bat Roost (PBRs) Inspection Results

The semi-mature trees within the study area provide some potential roosting opportunities for bats. Trees were surveyed where possible and no roosting bats or signs of roosting bats, current or historic, were recorded. On no occasion were any species of bats seen re-entering or emerging from trees during surveys.

Mature trees within the survey area were inspected to determine their Potential Bat Roost (PBR) value. All of the trees/tree groups surveyed have a Category 2 PBR rating because they have some suitable features that can provide roosting sites for bats.

4.2 Activity Surveys

Where it was safe to do so, transects were walked along the study area to identify any bat hot spots and corridors. No bats were recorded emerging from any structures during any of the activity surveys.

The Transect surveys involved Active acoustic sampling using handheld bat detectors (Wildlife Acoustics Echometer Touch 2 Bat Detector). Hot spots of bat activity were found across the study area, mostly near the river and near areas

of woodland outside the boundary of proposed works (see Appenidix). Common pipistrelles and soprano pipistrelles were recorded frequently commuting near the treelines close to the river.

There are high levels of sustained disturbances associated with human activity throughout the survey area, such as traffic and artificial lighting. Foraging opportunities within the townland were sparse in sections and of low suitability (low insect abundance, high levels of artificial lighting), which lowers the ecological value of certain sections of the site to Irish bat species.

No. 4 species of bat were recorded foraging in the survey area. These include the following: Soprano pipistrelle, Daubenton's bat, Common pipistrelle and Leisler's bat.

Common pipistrelle and Leisler's bats were the most frequently recorded bat species. The remaining bat species were more associated with dense tree lines and dark areas away from artificial lighting within Town.

In summary, little bat activity was recorded associated with the river running through the town. The majority of bat activity was associated with the dense treelines located within study area, mostly in the eastern side of the survey area, on the south side of the river.

4.2.1 Bat Activity Indices

During transects, the number of times a bat was encountered is described as the number of bat passes. The number of bat passes recorded are used as the standard measure to create a relative index of bat activity. This is either expressed as the number of bat passes per hour or per survey night. A contact ("bat pass"), as recorded in the results from these surveys, describes a bat observed by the surveyor. This contact can range from a commuter passing quickly to a foraging bat circling a feature lasting for several minutes. Bat contacts do not equate to numbers of bats as individual bats of the same species cannot be differentiated. A single bat continuously foraging in proximity to the detector can generate a large number of contacts in one night. In addition, variability occurs in the likelihood of detection between species. The same bat may be recorded in several contacts throughout the night. This survey type cannot estimate abundance of bats, rather activity; the amount of uses bats make of an area/feature. Where multiple visits for a transect are required, the start and end points of transect walks were alternated between visits to intersperse time and location (i.e., to prevent bias due to certain areas always being surveyed close to dusk).

4.3 Local Bat Records

The desk and field-based assessments undertaken of the habitats within the proposed development area revealed High suitability for potential bat roosting features (e.g. bark tear-outs, cavities from storm damage etc.).

The woodland habitats surrounding the survey area provide the greatest foraging and commuting potential for bats. The majority of trees within the survey area were juvenile and semi-mature. The majority of these trees did not support large crevices, apertures or dense ivy growth that could provide suitable roosting habitat for bats. Some trees did however support ivy growth, suggesting moderate suitability to support roosting bats.

The review of existing bat records within the study area (sourced from NBDC) reveals that No. 8 of the No. 9 recorded Irish species have been observed locally. The overall suitability of the area for bat activity was High (31.67). The habitat suitability index for 'All bats' and for each individual species of bat is presented below (See **Table 4.4** below). The index ranges from 0 to 100, with 100 being most suitable for bats.

Table 4.1: Bat Suitability Index for the site and its surrounding area (NBDC, 2023).

Suitability index for different bat species:		
Common Name	**Scientific Name**	**Suitability Score**
Soprano pipistrelle	*Pipistrellus pygmaeus*	38
Brown long-eared bat	*Plecotus auritus*	47
Common pipistrelle	*Pipistrellus pipistrellus*	48
Lesser horseshoe bat	*Rhinolophus hipposideros*	5
Leisler's bat	*Nyctalus leisleri*	38
Whiskered bat	*Myotis mystacinus*	33
Daubenton's bat	*Myotis daubentonii*	29
Nathusius' pipistrelle	*Pipistrellus nathusii*	1
Natterer's bat	*Myotis nattereri*	46
Total Score for All Bat Species		31.67

The area is deemed as favourable for bat activity with local areas of abundance present due to the suitable habitats surrounding and within the survey area. Thus, bats use the site for foraging and/or commuting through the site or along its boundaries, particularly along the hedgerows and treelines.

Table 4.2: Records of all bats available from the NBDC within 2km² grid squares S64X, S64W, S74B and S74C.

Species	Record Count	Date of Last Record	Designation
Brown Long-eared Bat (*Plecotus auritus*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Daubenton's Bat (*Myotis daubentonii*)	28	22/08/2014	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Leisler's bat (*Nyctalus leisleri*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Pipistrelle (*Pipistrellus pipistrellus sensu lato*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts
Soprano Pipistrelle (*Pipistrellus pygmaeus*)	2	04/06/2012	EU Habitats Directive - Annex IV Protected Species: Wildlife Acts

Historic records of bats were recorded within the 10km² grid squares (S64 & S74) in which the study area is located and includes the following species: Brown Long-eared Bat (*Plecotus auritus*), Daubenton's Bat (*Myotis daubentonii*), Lesser Horseshoe Bat (*Rhinolophus hipposideros*), Leisler's bat (*Nyctalus leisleri*), Nathusius's Pipistrelle (*Pipistrellus nathusii*), Natterer's Bat (*Myotis nattereri*), Common Pipistrelle (*Pipistrellus pipistrellus sensu lato*) and Soprano Pipistrelle (*Pipistrellus pygmaeus*) (See **Figures 4.5 – 4.8**).

4.4 Summary of Results

Surveys were undertaken using a range of techniques and covered the peak period of bat activity. Surveys were carried out during suitable weather conditions favourable to bats, on 27th May 2024, 23rd June2024, 18th July 2024 and September 4th 2024. This provides a robust dataset to support a future impact assessment as bat activity was assessed over a

Table 4.3: Bat Surveys Completed (Indicated by ticked box).

Surveys Completed:			
Endoscope Inspection	☑	Daytime Building Inspection	☑
Walking Transect	☑	Daytime Bridge Inspection	☑
Dusk Bat Survey	☑	Trapping / Mist Netting	☐
Dawn Bat Survey	☑	Driving Transect	☐
Static Detector Survey	☐	IR Camcorder filming	☐
Tree PBR Survey	☑	Trapping / Mist Netting	☐
Emergence Survey	☑	Other	☐

The survey area and its environs offer foraging and commuting habitat for bats. A total of No. 4 bat species have been recorded foraging across the survey area on a regular basis. The habitats of highest value to bats within the survey area were considered to be the mature woodlands, the River Barrow and tributaries, hedgerows, treelines, grassland and scrub. The spatial distribution of all species recorded was not uniform: bats were recorded in highest numbers in the vicinity of trees and hedgerows, and lowest in areas of built land with artificial lighting. This is unsurprising, as bats often prefer to feed along linear habitats such as woodland edges or hedgerows. Overall, the survey results demonstrate the value of the study area as a foraging and commuting habitat for bats.

Table 4.4: Bat Survey Results Overview.

Overview of Results:			
Bat Species	**Commuting**	**Foraging**	**Roosts**
Soprano pipistrelle *Pipistrellus pygmaeus*	☑	☑	
Brown long-eared bat *Plecotus auritus*			
Common pipistrelle *Pipistrellus pipistrellus*	☑	☑	
Lesser horseshoe bat *Rhinolophus hipposideros*			
Leisler's bat *Nyctalus leisleri*	☑	☑	
Whiskered bat *Myotis mystacinus*			
Daubenton's bat *Myotis daubentonii*	☑	☑	
Nathusius' pipistrelle *Pipistrellus nathusii*			
Natterer's bat *Myotis nattereri*			

Section 5: IMPACT ASSESSMENT & MITIGATION

5.1 Potential Impacts

Bat species within the area of the proposed development will likely be affected by both the construction phase and subsequent existence of new structures such as embankments and walls which may require the removal of mature trees.

Surveys of bats in the immediate area indicate that a diverse range of bat species use the site and surrounding area. The key impacts on bats as part of the proposed works arise through potential roost loss, loss of feeding areas and disruption of commuting routes.

5.2 Mitigation Measures

As the Graiguenamanagh Flood Relief Scheme project is still in the early stages, the current information on the proposed works is limited and therefore detailed mitigation measures are not provided. The following general measures should be adhered to when selecting the preferred route and for the detailed design and construction of any flood relief scheme:

- Minimise the potential impact of proposed works on mature trees, treelines, and hedgerows.
- Retain trees where possible and protect trees and their roots from proposed works.
- Any trees that required to be felled should be assessed for the Potential Bat Roost (PBR) level prior to felling and alternative roosting sites should be provide (e.g. bat boxes).
- Undertake additional bat survey work on any buildings that may be impacted by proposed works.
- Any works undertaken on bridges/culverts requires bat mitigation measures.
- Restrict the usage of artificial lighting in work zones and ensure that such are turned off during the hours of darkness.
- Any removal of hedgerows and treelines requires landscape replacement (native tree and shrub species).

Standard mitigation measures as would apply to any large-scale development, should be adopted in the construction of the proposed Graiguenamanagh FRS. These include limiting season of disturbance to trees and vegetation to reduce impacts on breeding species, to provide for habitat replacement and to implement measures to avoid and/or control pollution and sedimentation into watercourses during construction and operation phases. Specific measures will be required to protect bats onsite, and these are detailed further below.

5.2.1 Lighting

All European bat species, including Irish bat species, are nocturnal. They usually hide in roosts during the daytime, while fly to feeding areas or drinking sites using commuting routes during the night. Annually bats will hibernate in the winter, swarm in the autumn, and give birth in the summer months.

In all aspects of the bat lifestyle, Artificial Light at Night (ALAN) may significantly change their natural behaviour in relation to roosting, commuting, and feeding. While bats are naturally exposed only to very low lighting levels produced by moonlight, starlight and low intensity twilight, light levels greater than natural light levels can impact on the lifestyle of bats.

Construction Phase Lighting

Where construction lighting is required, light spill should be minimised as much as possible. This can be achieved by the use of directional lighting (i.e. lighting which only shines on the proposed works and not nearby countryside) to prevent overspill. This should be achieved by the design of the luminaire and by using accessories such as hoods, cowls, louvres, and shields to direct the light to the intended area only. Lighting should be minimised in potential foraging and commuting areas, and the times during which the lighting is on should be limited to provide some dark periods. Lights should be positioned to avoid sensitive areas and restricted so that there are dark areas. The timing of lights should be restricted to avoid bat activity (i.e. from dusk until dawn).

Operational Phase Lighting

The following specifications have been recommended for the lighting to be installed:

- 4000k colour temperature
- 0% ULR
- Full cut off visor

5.2.2 Trees to be Retained

Where possible, mature trees and treelines that are located immediately adjacent to planned work areas or are not directly impacted should be avoided and retained intact. Overall impacts on these sites should be reduced through modified design and sensitivity during works. Retained trees should be protected from root damage by machinery by an exclusion zone of at least c. 7 metres or equivalent to canopy height. Such protected trees should be fenced off by adequate temporary fencing prior to other works commencing.

5.2.3 Removal of Trees

Should any mature broadleaved tree(s) be scheduled for removal as part of the proposed development plans, it should be surveyed for bat presence by a suitably experienced specialist immediately prior to felling. If bats are found, an application for a derogation licence should be made to the National Parks and Wildlife Service to allow its legal removal. Such trees should ideally be felled in the period late August to late October, or early November, in order to avoid disturbance of any roosting bats as per National Roads Authority (NRA) guidelines and also to avoid the bird breeding seasons. Tree felling should be completed by mid-November at the latest as bats roosting in trees are vulnerable to disturbance during their hibernation period (November - April). If trees are to be removed outside of these periods extra care should be taken prior to felling to ensure no protected species are present. Trees with ivy-cover, once felled, should be left intact onsite for 24 hours prior to disposal to allow any bats beneath foliage to escape overnight.

5.2.4 Boundary Vegetation

Linear features such as treelines and hedgerows serve as commuting corridors for bats (and other wildlife). The onsite boundary vegetation especially that bordering the Barrow River should be retained and/or replaced once construction ends. Native species should be chosen in all landscaping schemes. Planting schemes should attempt to link in with existing wildlife corridors (hedgerows and treelines) to provide continuity of wildlife corridors.

5.3 Residual Impact

The construction phase of the proposed Graiguenamanagh Flood Relief Scheme may displace certain bat species through disruption of commuting routes however, this is expected to be temporary. If the recommended mitigation measures outlined above to safeguard bats are implemented, preserving the present nature of the site and river

corridor, the residual impact of the development on bats is expected to be negligible and all bat species recorded in the area should persist.

Section 6: SURVEY CONCLUSION

In general (according to Lundy *et al,* 2011), the landscape in which the proposed project is situated is of high suitability for Common Pipistrelle, Soprano Pipistrelle, Leisler's bat and Daubenton's bat.

A total of No. 4 species of bat were recorded commuting and foraging within the survey area. The following bat species were recorded during this bat survey: Common Pipistrelles, Soprano Pipistrelles, Leisler's bats, and Daubenton's bat. This represents No. 4 of the No. 9 resident bat species known to Ireland.

The most abundant species was Common Pipistrelle, followed by Leisler's bat and Soprano Pipistrelle, this is a typical species assemblage for rural sites in Ireland. The remaining No. 1 bat species are less common but are associated with specific habitats. Bat activity was broadly distributed throughout the Site, with no obvious clustering of activity at any specific locations. Activity levels appeared to be slightly higher at some of the sampling points that were near linear habitat features (e.g. a road lined with treelines, or a partial hedgerow).

The ecological value of the Site can be categorised using the valuation system of the CIEEM Guidelines (2018). As the majority of the study area is used on a regular basis by common bat species, it is considered to be of *Local Ecological Value*. Nonetheless, it is noted that all bats and their roosts receive legal protection from destruction or disturbance under the *European Communities (Birds and Natural Habitats) Regulations 2011* (as amended).

The Overriding Purpose of the project is to provide flood defences in Graiguenamanagh Town to the standards of the EU Directive on the Assessment and Management of Flood Risk (Floods Directive 2007/60/EC) transposed into Irish Law as SI 122 of 2010. The proposed flood defences to include an allowance for freeboard (300mm for walls, 500mm for embankments) as per the OPW guidelines and to address Environmental, Social and Health and Safety concerns.

The Graiguenamanagh Flood Relief Scheme was assessed in relation to potential impact on local bat populations. Due to the fact that the majority of bat activity was recorded along linear features such as treelines and hedgerows within the study area, any works which involve loss of treelines and hedgerows will impact on local bat populations due to the removal of commuting routes and foraging habitat.

Therefore, in consideration of the conservation of local bat populations, the application of the proposed mitigation measures outlined above in **Section 5** aims to ensure the implementation of safeguards for bats. By preserving the current nature of the site and river corridor, it is anticipated that the impacts of the development on bats will be negligible, and all bat species recorded in the area should persist.

Section 7: BIBLIOGRAPHY

Abbott, I. M., Berthinessen, A., Stone, E., Booman, M., Melber, M. and Altringham, J. (2015) Bats and Roads, Chapter 5, pp/ 290-299. In: Handbook of Road Ecology. Editors: R. Van der Ree., D. J. Smidt and C. Grilo. Wiley Blackwell.

Abbott, I. M., Butler, F. And Harrison, S. (2012) When flyways meet highways – the relative permeability of different motorway crossing sites to functionality diverse bat species. Landscape and Urban Planning 106 (4): 293-302.

Altringham, J. And Kerth, G. (2016) Bats and Roads, Chapter 3. In: Bats in the Anthropocence: Conservation of Bats in a Changing World. Editors: C. C. Voigt and T. Kingston. Springer Open.

Altringham, J. D. (2013) British Bats. Collins New Naturalist Library, Volume 93. Harper Collins, London.

Aughney, T., Roche, N., & Langton, S (2018) The Irish Bat Monitoring Programme 2015-2017. *Irish Wildlife Manuals*, No. 103. National Parks and Wildlife Service, Department of Cultural heritage and the Gaeltacht, Ireland.

Barratt, E. M., Deauville, R., Burland, T. M., Bruford, M. W., Jones, G., Racey, P. A., & Wayne, R. K. (1997). DNA answers the call of pipistrelle bat species. *Nature* 387: 138 - 139.

Bat Conservation Ireland (2015) BATLAS 2020 Pilot Project 2015: Volunteer Survey Manual. Version 01. www.batconservationireland.org.

Bat Conservation Trust (2018) Bats and artificial lighting in the UK: bats and the built environment series. Guidance Note 08/2019. BCT, London.

BTHK (2018) Bat Roosts in Trees – A Guide to Identification and Assessment for Tree-Care and Ecology Professionals. Exeter: Pelagic Publishing.

CIEEM (2016) Guidelines for Ecological impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (2nd Edition). CIEEM, Winchester.

CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

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

Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) 1982.

Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979.

Dietz, C., Helversen, O. and Dietmar, N. (2011) Bats of Britain, Europe & Northweat Africa. A&C Black, London.

EC Directive on The Conservation of Natural habitats and of Wild Fauna and Flora (Habitats Directive) 1992.

Fossitt, J. A. (2000) A guide to habitats in Ireland. The Heritage Council.

Gunnell, K., Grant, G. and Williams, C (2012) Landscape and urban design for bats and biodiversity. The Bat Conservation Trust, London.

Hopkirk, A. and Russ, J. (2004) Pre-hibernal and hibernal activity and dispersal of Leisler's bat, *Nyctalus leisleri*, in Northern Ireland. Hopkirk & Russ Bat Ecology.

Hundt, L. (2012) Bat Surveys: Good Practice Guidelines (2nd Edition). The Bat Conservation Trust, London.

Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Lundy, M.G., Montgomery, I.W., Roche, N. & Aughney, T. (2011). *Landscape Conservation for Irish Bats & Species-Specific Roosting Characteristics* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Lysaght, L. and Marnell, F. (eds) (2016) Atlas of Mammals in Ireland 2010-2015, National Biodiversity Data Centre, Waterford.

Marnell, F., Kingston, N. & Looney, D. (2009) *Ireland Red List No. 3: Terrestrial Mammals*, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

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

Mathews, F., Roche, N., Aughney, T., Jones, N,m Day, J., Baker, J. and Langton, S. (2015) Barriers and benefits: implications of artificial night-lighting for the distribution of common bats in Britain and Ireland. *Philosphical Transactions of the Royal Society of London B* 370 (1667), doi: 10.1098/rstb.2014.0124.

McAney, K., O'Mahony, C., Kelleher, C., Taylor, A. & Biggane, S. (2013). *The Lesser Horseshoe Bat in Ireland: Surveys by The Vincent Wildlife Trust*. Belfast, Northern Ireland: Irish Naturalists' Journal.

National Roads Authority (2006) Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes.

Nelson, B., Cummins, S., Fay, L., Jeffrey, R., Kelly, S., Kingston, N., Lockhart, N., Marnell, F., Tierney, D. and Wyse Jackson, M. (2019) Checklists of protected and threatened species in Ireland. *Irish Wildlife Manual*s, No. 116. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Norberg U.M. and Rayner J.M.V. (1987). Ecological morphology and flight in bats (Mammalia; Chiroptera): wing adaptations, flight performance, foraging strategy and echolocation. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences.* 316: 335-427.

NPWS (2018) Conservation objectives supporting document – lesser horseshoe bat (Rhinolophus hipposideros) Version 1. Conservation Objectives Supporting Document Series. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Dublin, Ireland.

O'Sullivan, P. (1994). *Bats in Ireland.* Special supplement to the Irish Naturalists' Journal.

Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). *Irish Bats in the 21st Century.* Bat Conservation Ireland, Cavan, Ireland.

Roche, N., Langton, S. & Aughney, T. (2012). *Lesser Horseshoe Bat: Population, Trends and Threats 1986 to 2012* (Unpublished). Bat Conservation Ireland, Cavan, Ireland.

Russ, J. (2012) British Bat Calls: A guide to species identification. Pelagic Publishing, Exeter.

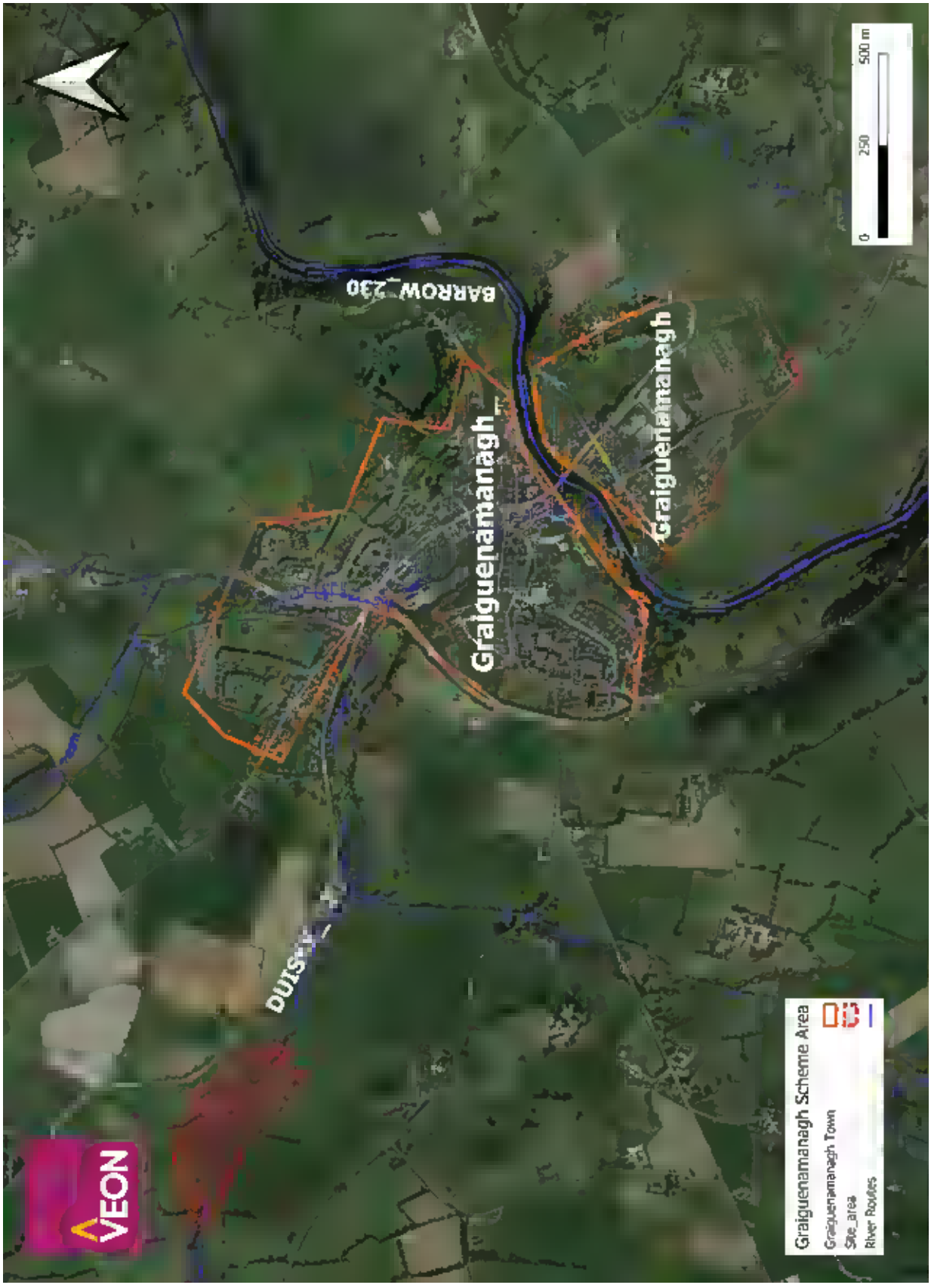
Rydell J. (2006). Bats and their insect prey at streetlights. In C. Rich and T. Longcore (eds.) Ecological Consequences of Artificial Night Lighting. 43-60.

Schofield, H. (2008). *The Lesser Horseshoe Bat Conservation Handbook*. Herefordshire, England: The Vincent Wildlife Trust.

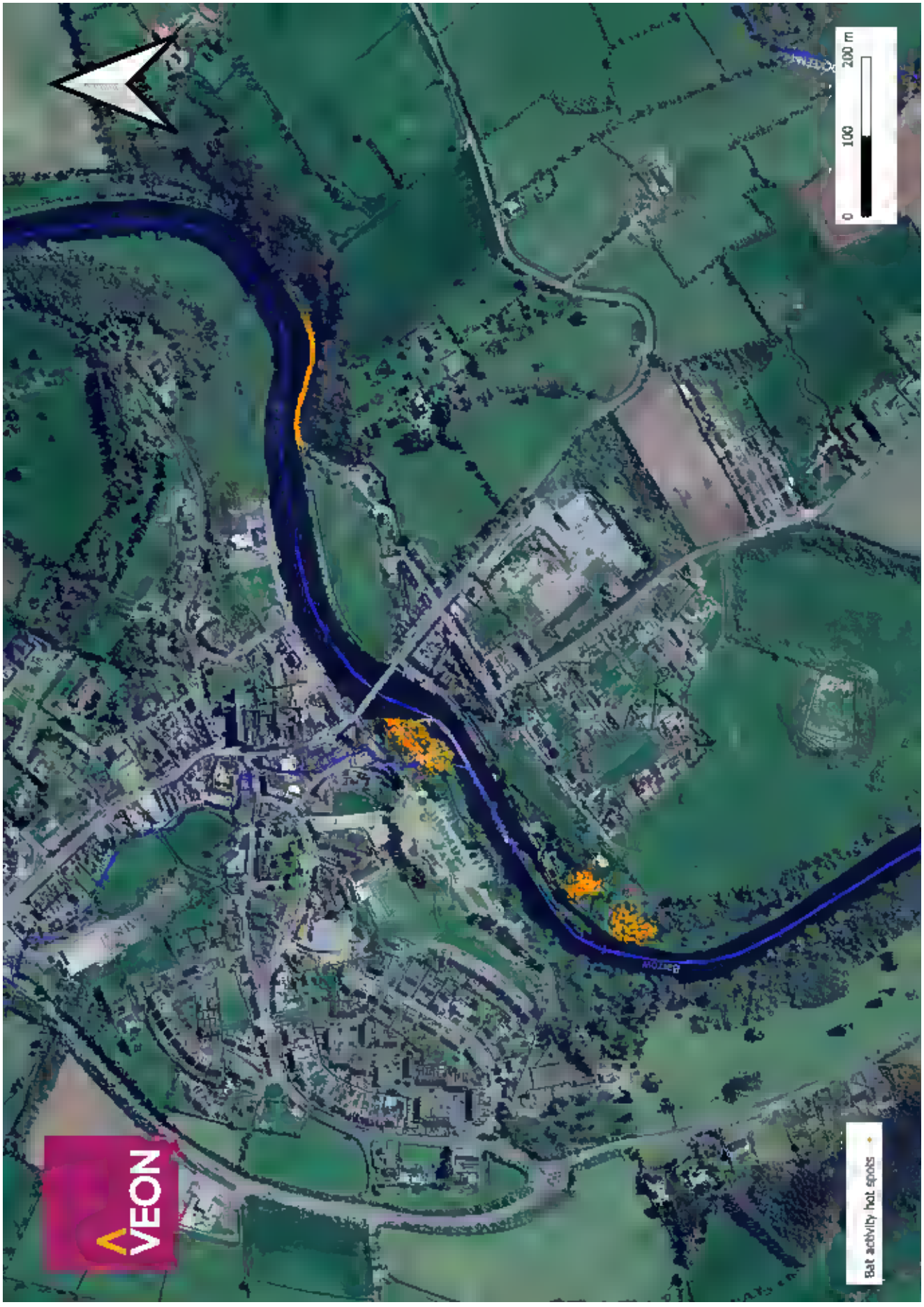
Wildlife Act 1976 and Wildlife [Amendment] Act 2000. Government of Ireland.

Section 8: APPENDICES

Appendix 1. MAPS & FIGURES



Survey areas in Graiguenamanagh



Hotspots of bat activity within and outside the survey areas

Area of bat hotspot activity near the River Barrow

Higher value foraging habitats – grassland and woodland with low levels of artificial lighting.

Main bridge in Graiguenamanagh (no Daubenton's roosts present)

Bat hotspot area – outside of proposed works boundaries

High levels of artificial lighting at night in the town

Appendix 2. BAT SPECIES PROFILES

Ireland has No. 9 known established bat species from two distinct families. Each is briefly described below. For a more comprehensive overview see Roche et al (2014). The conservation status of each species is derived from NPWS (2019).

Vespertilionidae:

Leisler's bat (*Nyctalus leisleri*)

This species is Ireland's largest bat, with a wingspan of up to 320mm; it is also the third most common bat, preferring to roost in buildings, although it is sometimes found in trees and bat boxes. It is the earliest bat to emerge in the evening, flying fast and high with occasional steep dives to ground level, feeding on moths, caddisflies and beetles. The echolocation calls are sometimes audible to the human ear being around 15 kHz at their lowest. The audible chatter from their roost on hot summer days is sometimes an aid to location. The conservation status of this species is Favourable.

Ireland's population is deemed of international importance and the paucity of knowledge of roosting sites, makes this species vulnerable. However, it is widespread across the island. The modelled Core Area for Leisler's bats is a relatively large area that covers much of the island of Ireland (52,820km^2). The Bat Conservation Ireland Irish Landscape Model indicated that the Leisler's bat habitat preference has been difficult to define in Ireland. Habitat modelling for Ireland shows an association with riparian habitats and woodlands (Roche *et al.,* 2014). The landscape model emphasised that this is a species that cannot be defined by habitats preference at a local scale compared to other Irish bat species but that it is a landscape species and has a habitat preference at a scale of 20.5km. In addition, of all Irish bat species, Leisler's bats have the most specific roosting requirements. It tends to select roosting habitat with areas of woodland and freshwater.

The principal concerns for Leisler's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats.
- Relative to the population estimates, the number of roost sites is poorly recorded.
- Tree felling, especially during autumn and winter months.
- Increasing urbanisation.

Common pipistrelle (*Pipistrellus pipistrellus*)

The common pipistrelle's echolocation calls peak at 45 kHz. The species forages along linear landscape features such as hedgerows and treelines as well as within woodland. This species is generally considered to be the most common bat species in Ireland. The species is widespread and is found in all provinces. The modelled Core Area for common pipistrelles is a large area that covers much of the island of Ireland (56,485km^2) which covers primarily the east and southeast of the area (Roche *et al.,* 2014). The Bat Conservation Ireland Irish Landscape Model indicates that the Common pipistrelle selects areas with broadleaf woodland, riparian habitats and low-density urbanization (<30%) (Roche *et al.,* 2014). The conservation status of this species is Favourable.

Principal concerns for Common pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosting requirements.
- This species has complex habitat requirements in the immediate vicinity of roosts. Therefore, careful site-specific planning for this species is required in order to ensure all elements are maintained.
- Renovation or demolition of derelict buildings.
- Tree felling .
- Increasing urbanisation (e.g. increase in lighting).

Soprano pipistrelle (*Pipistrellus pygmaeus*)

The soprano pipistrelle's echolocation calls peak at 55 kHz, which distinguishes it readily from the common pipistrelle on detector. The pipistrelles are the smallest and most often seen of our bats, flying at head height and taking small prey such as midges and small moths. Summer roost sites are usually in buildings but tree holes and heavy ivy are also used. Roost numbers can exceed 1,500 animals in mid-summer. The conservation status of this species is Favourable.

This species is generally considered to be the second most common bat species in Ireland. The species is widespread and is found in all provinces, with particular concentration along the western seaboard. The modelled Core Area for soprano pipistrelle is a large area that covers much of the island of Ireland (62,020km^2). The Bat Conservation Ireland Irish Landscape Model indicates that the soprano pipistrelle selects areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

Principal concerns for Soprano pipistrelles in Ireland that are relevant for this survey area are as follows:

- Lack of knowledge of roosts.
- Renovation or demolition of structures.
- Tree felling.
- Increasing urbanisation (e.g. increase in lighting).

Nathusius' pipistrelle (*Pipistrellus nathusii*)

Nathusius' pipistrelle is a recent addition to the Irish fauna and has mainly been recorded from the north-east of the island in Counties Antrim and Down (Richardson, 2000) and in Fermanagh, Longford and Cavan. It has also been recorded in Counties Cork and Kilkenny (Kelleher, 2005). However, the known resident population is enhanced in the autumn months by an influx of animals from Scandinavian countries. It is not known whether the Irish population migrates within or from Ireland to another country to overwinter, although there is evidence that Nathusius' pipistrelle bats migrate from Britain to overwinter on continental Europe. The Nathusius' pipistrelle often forages over water or along forest tracks. The conservation status of this species is Favourable.

Natterer's bat (*Myotis nattereri*)

There are three species included in the Myotis species family and their echolocation calls are very similar across these three species. One of the rarer Irish bat species, the Natterer's bat likes woodland, mature hedgerow and pasture habitats. The Natterer's bat has broad wings so it can fly with great manoeuvrability among trees and around hedgerows. It sometimes gleans insects or even spiders from foliage and may eat larger prey at a feeding perch. Its usual roost sites are in tree holes, old stone buildings such as churches and barns, and under bridges. This species has a fringe of stiff bristles along the trailing edge of its tail membrane, which may help to hold or trap its prey.

This species has a slow to medium flight, usually over trees but sometimes over water. It usually follows hedges and treelines to its feeding sites, consuming flies, moths, caddis-flies and spiders. The Natterer's bat is one of our least studied species and further work is required to establish its status in Ireland. The conservation status of this species is Favourable.

The modelled Core Area for Natterer's bats is a relatively large area that covers much of the island of Ireland (52,864km^2). The Bat Conservation Ireland Irish Landscape Model indicates that the Natterer's bat selects areas with broadleaf woodland, riparian habitats and areas with larger scale provision of mixed forest (Roche et al., 2014).

Brown long-eared bat (*Plecotus auritus*)

This species of bat is a 'gleaner', hunting amongst the foliage of trees and shrubs, and hovering briefly to pick a moth or spider off a leaf, which it then takes to a sheltered perch to consume. They often land on the ground to capture their prey. Using its nose to emit its echolocation, the long-eared bat 'whispers' its calls so that the insects, upon which it preys, cannot hear its approach (and hence, it needs oversize ears to hear the returning echoes). As this is a whispering species, it is extremely difficult to monitor in the field as it is seldom heard on a bat detector. Furthermore, keeping within the foliage, as it does, it is easily overlooked. It prefers to roost in old buildings. The conservation status of this species is Favourable.

This species is generally considered to be widespread across the island. The modelled Core Area for Brown long-eared bats is a relatively large area that covers much of the island of Ireland (52,820km^2) with preference suitable areas in the southern half of the island. The Bat Conservation Ireland Irish Landscape Model indicates that the Brown long-eared bat habitat preference is for areas with broadleaf woodland and riparian habitats on a small scale of 0.5km emphasising the importance of local landscape features for this species (Roche *et al.,* 2014).

Principal concerns for brown long-eared bats are poorly known in Ireland, but those that are relevant for this survey area are as follows:

- Selection of maternity sites is limited to specific habitats.
- Lack of knowledge of winter roosts.
- Loss of woodland, scrub and hedgerows.
- Tree surgery and felling.
- Increasing urbanisation.
- Light pollution.

Daubenton's bat (*Myotis daubentonii*)

This bat species prefers feeding close to the surface of smooth water, either over rivers, canals, ponds, lakes or reservoirs but it can also be found foraging in woodlands. Flying at 15 kilometres per hour, it gaffs insects with its over-sized feet as they emerge from the surface of the water - feeding on caddis flies, moths, mosquitoes, midges etc. It is often found roosting beneath bridges or in tunnels and also makes use of hollows in trees. The conservation status of this species is Favourable.

The modelled Core Area for Daubenton's bats is a relatively large area that covers much of the island of Ireland (41,285km^2) reflecting the distribution of sizeable river catchments. The Bat Conservation Ireland Landscape Model indicates that the Daubenton's bat habitat preference is for areas with broadleaf woodland, riparian habitats and low density urbanisation (Roche *et al.,* 2014).

Principal concerns for Daubenton's bats are poorly known in Ireland but those that are relevant for this survey area are as follows:

- Potential roost loss due to bridge works.
- Loss of woodland and forest clearance.
- Loss of woodland, scrub and hedgerows.
- Tree surgery and felling.
- Increasing urbanisation.
- Light pollution.

Whiskered bat (*Myotis mystacinus*)

This species, although widely distributed, has been rarely recorded in Ireland. It is often found in woodland, frequently near water. Flying high, near the canopy, it maintains a steady beat and sometimes glides as it hunts. It also gleans spiders from the foliage of trees. Whiskered bats prefer to roost in buildings, under slates, lead flashing or exposed beneath the ridge beam within attics. However, they also use cracks and holes in trees and sometimes bat boxes. The conservation status of this species is Favourable.

Rhinolophidae:

Lesser horseshoe bat (*Rhinolophus hipposideros*)

This species is the only representative of the Rhinolophidae or horseshoe bat family in Ireland. It differs from our other species in both habits and looks, having a unique nose leaf with which it projects its echolocation calls. It is also quite small and, at rest, wraps its wings around its body. Lesser horseshoe bats feed close to the ground, gleaning their prey from branches and stones. It often carries its prey to a perch to consume, leaving the remains beneath as an indication of its presence.

The echolocation call of this species is of constant frequency and, on a heterodyne bat detector, sounds like a melodious warble. The species is confined to six counties along the Atlantic seaboard: Mayo, Galway, Clare, Limerick, Kilkenny and Cork. The current Irish national population is estimated at 12,500 – 14,000 individuals. This species is listed on Annex II of the EC Habitats Directive and 41 Special Areas of Conservation have been designated in Ireland for its protection, of which 9 have also been selected for the Annex I habitat 'Caves not open to the public'. Where it occurs, it is often found roosting within farm buildings. In Ireland, the overall conservation status of lesser horseshoe bat is assessed as Favourable.

Lesser horseshoe bats forage on flying insects predominantly in deciduous woodland and riparian vegetation normally within a couple of kilometres of their roosts. The bats rely on linear landscape features (e.g. treelines, stonewalls and hedgerows) to navigate and commute from roosts to feeding sites and they are reluctant to fly out in the open.

Lesser horseshoe bats are sensitive to disturbance and normally do not occupy the same buildings as humans. Loss of roosting sites due to deterioration or renovation of old buildings, loss of commuting routes linking roosts to foraging sites and unsympathetic management of foraging sites are the major threats to this species.

Lesser horseshoe bats are very sensitive to light pollution and will avoid brightly lit areas. Artificial light at night at or near roosts may impact bats in a number of ways, for example, delaying emergence time after dusk, causing abandonment of roosts when exits are lit at night and/or reducing reproductive success.

Appendix E: Breeding Bird Survey Results

Original CFRAM Survey, 2021

Table E-0-1: Species Abundance (Breeding Survey), 2021

Species	Scientific Name	No. of Transects with +ve ID	Designation
Blackbird	*Turdus merula*	5	N/A
Chaffinch	*Fringilla coelebs*	5	N/A
Great tit	*Parus major*	4	N/A
Rook	*Corvus frugilegus*	4	N/A
Woodpigeon	*Columba palumbus*	4	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Blue tit	*Cyanistes caeruleus*	3	N/A
Robin	*Erythacus rubecula*	3	N/A
Song thrush	*Turdus philomelos*	3	N/A
Starling	*Sturnus vulgaris*	3	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Wren	*Troglodytes troglodytes*	3	N/A
Blackcap	*Sylvia atricapilla*	2	N/A
Chiffchaff	*Phylloscopus collybita*	2	N/A
Goldfinch	*Carduelis carduelis*	2	N/A
Great Spotted Woodpecker	*Dendrocopus major*	2	N/A
House Sparrow	*Passer domesticus*	2	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Long-tailed tit	*Aegithalus caudatus*	2	N/A
Magpie	*Pica pica*	2	N/A
Barn Swallow	*Hirundo rustica*	1	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Jackdaw	*Corvus monedula*	1	N/A
Mallard	*Anas platyrhinchos*	1	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Pheasant	*Phasianus colchicus*	1	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Raven	*Corvus corax*	1	N/A
Treecreeper	*Certhia familiaris*	1	N/A
Whitethroat	*Sylvia communis*	1	N/A
Willow warbler	*Phylloscopus trochilus*	1	N/A

Table E-0-2: Breeding Bird Survey (02/04/2021)

Transect ID	Date Start/End Time Weather	Species	Visual Distance bands				Aural records	
			0-25m	25-100m	>100m	In flight	+	-
A	02/04/21 08:50-09:17 Clear, dry, 10°C, calm	Blackbird				1	X	
		Willow warbler					X	
		Chaffinch					X	
		Rook				1	X	
		Song thrush	1				X	
		Starling	1				X	
		Robin	1				X	
		Wren	1					X
		Whitethroat	1					X
		Long-tailed tit	2					X
B	02/04/21 08:17-08:47 Clear, dry, 10°C, calm	Blue tit					X	
		Great tit					X	
		Magpie					X	
		Woodpigeon					X	
		Chaffinch					X	
		Chiffchaff					X	
		Wren	1				X	
		Mallard	2					X
		Rook	1			3	X	
		Blackcap	1				X	

		Great Spotted Woodpecker					X	
		Starling	2					X
		Barn Swallow	6					X
C	02/04/21 07:24-07:54 Clear, dry, 10°C, calm	Rook	20			6	X	
		Chiffchaff					X	
		Woodpigeon					X	
		Blackbird					X	
		Song thrush					X	
		Jackdaw					X	
		Blue tit					X	
		Great tit					X	
		Great Spotted Woodpecker					X	
		Pheasant					X	
D	02/04/21 10:08-10:30 Clear, dry, 10°C, calm	Woodpigeon					X	
		Song thrush					X	
		Blackbird					X	
		Chaffinch	1				X	
		Treecreeper	1					X
		Robin	1					X
E	02/04/21 11:00-11:20 Clear, dry, 10°C, calm	Starling					X	
		Blackbird	1				X	
		Blue tit					X	
		Chaffinch	1				X	
		House Sparrow	3				X	

		Great tit	1				X	
		Magpie					X	
		Raven	3					X
		Woodpigeon	1					X
		Goldfinch	2					X
F	02/04/21 11:50-12:10 Clear, dry, 10°C, calm	Long-tailed tit	1				X	
		Blackbird	1				X	
		Robin	1				X	
		Chaffinch					X	
		Great tit					X	
		House Sparrow	2				X	
		Goldfinch					X	
		Rook					X	
		Blackcap	1					X
		Wren	1					X

Notes:

1. 10x Barn Swallows recorded circling outside the Waterside Guesthouse along the northern quay. Outside transect.
2. Some Rooks recorded in flight in Transect C were carrying twigs for nest-building
3. 2x House Sparrows recorded in Transect E were building a nest (in Tree ID T37)
4. Lone Mute Swan recorded by main bridge. Outside transect.

The drumming sound attributed to the Great Spotted Woodpecker may be from a Carrion Crow. This information came from a verbal communication with a local passer-by during Transect B.

Sites deemed suitable for perching Kingfishers were recorded and are shown in Table E-2 and Figures E-1 and E-2 below. Suitable perches are generally narrow, stable structures that allow Kingfishers to perch above flowing water while searching for prey. In total, 18 Kingfisher perches were recorded.

Table E-0-3: Kingfisher Perches

ID	Coordinates (ITM)	Notes
KF1	671422, 643799	Alder branches
KF2/3	671362, 643720	Ash branches
KF4	670806, 643465	Pollarded tree – species unconfirmed (probably willow)
KF5	670605, 643229	Ash branches
KF6	670688, 643377	Overhanging willow
KF7	670785, 643871	Willow branches
KF8	670781, 643876	Alder branches
KF9	670755, 643920	Alder branches
KF10	670744, 643945	Ash and sycamore branches
KF11	670735, 643972	Sycamore branches
KF12	670735, 643972	Overhanging ivy
KF13	670596, 643965	Steel bar associated with concrete structure on mill race
KF14	670572, 644012	Fallen branch (blackthorn) spanning mill race
KF15	670267, 644235	Collection of dead stumps and branches spanning Duiske
KF16	670226, 644244	Alder branches
KF17	670126, 644179	Fallen branches with ivy spanning Duiske
KF18	669975, 644210	Sycamore branches

Figure E-1: Kingfisher Perches (KF1-KF14)

Figure E-2: Kingfisher Perches (KF15-KF18)

E.1 Survey 1 (9-11/08/2023)

E.1.1 Upstream Storage Area

Table E-0-4: Survey Conditions

Date	Start time	Finish time	Notes	
09/08/2023	06:00	09:00		
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%) (X)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 – drizzle (X)
Wind	1 - Calm		2 – Light (X)	3 – Breezy
Visibility	1- Good		2 – Moderate	4 – Poor

Table E-0-5: Birds recorded within and adjacent to the project footprint

Common name	Species name	No. counted	Designation
Barn Swallow	*Hirundo rustica*	~49	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List.
Buzzard	*Buteo buteo*	2	Protected under Section 22 of the Wildlife Acts
Coal Tit	*Periparus ater*	1	Protected under Section 22 of the Wildlife Acts
Common Black Bird	*Turdus merula*	1	Protected under Section 22 of the Wildlife Acts
Common Chiffchaff	*Phylloscopus collybita*	2	Protected under Section 22 of the Wildlife Acts
Common Redstart	*Phoenicurus phoenicurus*	1	Protected under Section 22 of the Wildlife Acts
Common Wood Pigeon	*Columba palumbus*	13	Protected Species: Wildlife Acts Protected Species: EU Birds Directive-Annex II; Annex III
Eurasian Magpie	*Pica pica*	3	Protected under Section 22 of the Wildlife Acts
European Robin	*Erithacus rubecula*	9	Protected under Section 22 of the Wildlife Acts
Gold Crest	*Regulus regulus*	3	Protected under Section 22 of the Wildlife Acts
Great Tit	*Parus major*	3	Protected under Section 22 of the Wildlife Acts
Hooded Crow	*Corvus cornix*	2	Protected under Section 22 of the Wildlife Acts
Long Tailed Tit	*Aegithalus caudatus*	2	Protected under Section 22 of the Wildlife Acts
Starling	*Sturnus vulgaris*	~20	Protected under Section 22 of the Wildlife Acts
Spotted Flycatcher	*Musciapa striata*	1	Protected under Section 22 of the Wildlife Acts
Tit Spp**	***	2	

Common name	Species name	No. counted	Designation
Barn Swallow	*Hirundo rustica*	~49	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List.
Wren	*Troglodytes troglodytes*	6	Protected under Section 22 of the Wildlife Acts

E.2 Survey 2 (28-29/03/2024)

E.2.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table E-0-6: Survey Conditions

Date	Start time	Finish time	Notes	
29/03/2024	11:30	3:30	Bright, good visibility, cold (6°C)	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table E-0-7: Birds recorded from Site A – 29/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	3	Perched within trees and hedgerow, and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	2	Perched within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Perched within trees	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	3	Within trees	Protected Species: Wildlife Acts
Great Spotted Woodpecker	*Dendrocopos major*	2	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Aural recording	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	1	Standing on riverbank	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	6	Within the river and rushes, and aural recordings (including ducklings)	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	10	In flight overhead, perched within trees, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	3	In flight and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
				EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Within trees and aural recording	Protected Species: Wildlife Acts

Table E-0-8: Birds recorded from Site B – 29/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	10	Perched within trees, hedgerow and riverbank, and aural recording	Protected Species: Wildlife Acts
Blue Tit	*Cyanistes caeruleus*	1	Perched within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	4	Perched within trees	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	1	Within trees and in flight between trees	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	2	Perched on low-lying branches, within river and on riverbank	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	2	In flight overhead	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	2	On the river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	10	In flight overhead and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	1	Perched within the trees	Protected Species: Wildlife Acts

Table E-0-9: Birds recorded from Site C – 29/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	4	Perched within trees and hedgerow, and aural recording	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	2	Perched within trees	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Aural recording	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	2	In flight and on riverbank	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	2	In flight overhead	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	10	In flight, within the trees, perched on buildings and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	9	In flight overhead and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
				EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	2	Aural recording	Protected Species: Wildlife Acts

Table E-0-10: Birds recorded from Site D – 29/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	Perched within trees and hedgerow, and aural recording	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	2	In flight overhead	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>30	In flight, within the trees, perched on buildings and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	2	Perched within the trees and foraging in grass	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	3	In flight overhead and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	2	Aural recording	Protected Species: Wildlife Acts

Table E-0-11: Birds recorded from Site E – 29/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	18	Perched within trees and hedgerow, foraging, bathing in river, and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	5	Perched within trees and foraging	Protected Species: Wildlife Acts
Collared Dove	*Streptopelia decaocto*	5	In flight overhead	Protected Species: Wildlife Acts
Eurasian Jackdaw	*Corvus monedula*	2	In flight overhead and within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Perched within trees	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	22	Within trees and in flight between trees	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	In flight overhead	Protected Species: Wildlife Acts
House Sparrow	*Passer domesticus*	7	Perched within trees and bathing in river	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
Mallard	*Anas platyrhynchos*	2	Within the river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	3	Perched on electricity wire/within trees, and aural recording	Protected Species: Wildlife Acts
Siskin	*Carduelis spinus*	14	Within trees, in flight between trees and aural recording	Protected Species: Wildlife Acts
Starling	*Sturnus vulgaris*	>15	Perched on electricity wire	Protected Species: Wildlife Acts

E.2.2 Upstream Storage Area

Table E-0-12: Survey Conditions.

Date	Start time	Finish time	Notes	
28/03/2024	9:00	10:55	Bright, good visibility, cold (6°C)	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table E-0-13: Birds recorded from Site A – 28/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	4	In flight, within trees	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	5	Within trees, feeding and aural recording	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	5	Perched within the trees and aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Perched within trees and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Perched within trees	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalos caudatus*	3	Perched within trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	4	In flight overhead, within trees, and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	4	Perched within the trees, foraging in grass, and aural recording	Protected Species: Wildlife Acts
Starling	*Sturnus vulgaris*	1	Perched on electricity wire	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Wood Pigeon	*Columba palumbus*	9	In flight overhead, within the trees and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
				EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	3	Perched within trees and aural recording	Protected Species: Wildlife Acts

Table E-0-14: Birds recorded from Site B – 28/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	3	Foraging in wooded area and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Perched within trees	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	In flight overhead	Protected Species: Wildlife Acts
Eurasian Treecreeper	*Certhia familiaris*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Perched within trees	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	2	Perched within trees	Protected Species: Wildlife Acts
Great Spotted Woodpecker	*Dendrocopos major*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Perched within trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	4	In flight overhead	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	1	Aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	5	In flight overhead and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

Table E-0-15: Birds recorded from Site C – 28/03/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	Aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Perched within trees and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Aural recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	2	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight overhead, within trees, and aural recording	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	3	Perched within trees and aural recording	Protected Species: Wildlife Acts

E.3 Survey 3 (22-23/05/2024)

E.3.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table E-0-16: Survey Conditions

Date	Start time	Finish time	Notes	
23/05/2024	9:25	13:00	Cloudy with occasional sunshine, strong breeze, chilly in shade (12°C)	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)	2 - (33-66%)	3 - (66-100%)	
Rain	1 - None	2 - Showers	3 - drizzle	
Wind	1 - Calm	2 - Light	3 – Breezy	
Visibility	1- Good	2 – Moderate	3 - Poor	

Table E-0-17: Birds recorded from Site A – 23/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	7	Foraging and aural recording	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	3	Aural recording	Protected Species: Wildlife Acts
Common Bullfinch	*Pyrrhula pyrrhula*	2	Perched in tree	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	Perched on fence	Protected Species: Wildlife Acts
Great Black-Backed Gull	*Larus marinus*	1	In flight overhead and catching fish in river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Goldcrest	*Regulus regulus*	1	Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Within tree	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	15	In flight over river – feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
Mallard	*Anas platyrhynchos*	7	Within the river including two ducklings	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	10	In flight, within trees, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	13	In flight overhead/over river, foraging in field, and aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	2	Aural recording	Protected Species: Wildlife Acts

Table E-0-18: Birds recorded from Site B – 23/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	8	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	13	Foraging on riverbank, within hedgerows, and aural recording	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Perched within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	4	Perched within trees	Protected Species: Wildlife Acts
Common Bullfinch	*Pyrrhula pyrrhula*	1	Foraging	Protected Species: Wildlife Acts
Eurasian Jackdaw	*Corvus monedula*	2	In flight overhead	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Within tall grass and trees	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Within trees	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	2	Foraging	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	4	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	4	Within and in flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	>20	In flight overhead, within the trees, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	2	In flight overhead, within the trees	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Aural Recording	Protected Species: Wildlife Acts

Table E-0-19: Birds recorded from Site C – 23/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	3	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	3	Foraging on riverbank and within vegetation	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	In vegetation along riverbank	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Perched within trees	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	2	Within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural Recording	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	15	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	2	Within river	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Pied Wagtail	*Motacilla alba subsp. yarrellii*	1	Foraging on riverbank	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	1	Aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	6	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Aural Recording	Protected Species: Wildlife Acts

Table E-0-20: Birds recorded from Site D – 23/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	15	In flight over river and field – feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	5	Within trees and aural Recording	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Perched within trees	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural Recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural recording	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	20	In flight over river and field – feeding and seen using nest beneath roof verge on boat club	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	5	Within the river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Pied Wagtail	*Motacilla alba subsp. yarrellii*	2	Perched on boat and in flight over river	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>15	In flight overhead, perched within trees and on buildings, and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	1	Perched within the trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	2	Aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

Table E-0-21: Birds recorded from Site E – 23/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	19	In flight overhead – feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	9	Foraging on path, within hedgerows and trees, including one juvenile within	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
			the hedgerow, and aural recording	
Blackcap	*Sylvia atricapilla*	1	Within trees	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	5	Within trees	Protected Species: Wildlife Acts
Eurasian Jackdaw	*Corvus monedula*	2	In flight overhead	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	2	In flight overhead	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	10	In flight between stone buildings and trees, and in flight – feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
House Sparrow	*Passer domesticus*	5	Within trees including three juveniles	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	4	In flight, within river and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	7	In flight overhead, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	5	Perched on telephone wire, within trees, in flight overhead, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	2	Aural Recording	Protected Species: Wildlife Acts

E.3.2 Upstream Storage Area

Table E-0-22: Survey Conditions.

Date	Start time	Finish time	Notes	
22/05/2024	12:05	13:30	Rain showers, overcast, visibility poor, and mild (14°C)	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy

Visibility	1- Good	2 – Moderate	3 - Poor

Table E-0-23: Birds recorded from Site A – 22/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	2	In flight overhead - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	2	Aural recording	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	5	In flight over head– feeding and on telephone wire	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Rook	*Corvus frugilegus*	15	In flight overhead, within trees and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight overhead and between trees, and aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Aural Recording	Protected Species: Wildlife Acts

Table E-0-24: Birds recorded from Site B – 22/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	In flight	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	2	In flight overhead and aural recording	Protected Species: Wildlife Acts
Eurasian Treecreeper	*Certhia familiaris*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Within trees and aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural Recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	1	Aural Recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	6	Aural Recording	Protected Species: Wildlife Acts

Table E-0-25: Birds recorded from Site C – 22/05/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	8	In flight overhead - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	6	Within tree and aural recording	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Perched within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Within trees and aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural recording	Protected Species: Wildlife Acts
Great Spotted Woodpecker	*Dendrocopos major*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	2	Within trees	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos*	1	Within trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

E.4 Survey 4 (26-27/06/2024)

E.4.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table E-0-26: Survey Conditions

Date	Start time	Finish time	Notes
26/06/2024	13:20	16:20	Cloudy with occasional sun, light breeze but warm (21°C)
Weather, highlight as appropriate			
Cloud cover	1 - (0-33%)	2 - (33-66%)	3 - (66-100%)
Rain	1 - None	2 - Showers	3 - drizzle
Wind	1 - Calm	2 - Light	3 – Breezy
Visibility	1- Good	2 – Moderate	3 - Poor

Table E-0-27: Birds recorded from Site A – 26/06/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	10	In flight - feeding	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	11	In flight and aural recording	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	1	Aural Recording	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural Recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Aural Recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Aural Recording	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	5	Perched within trees and in flight between trees	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	1	Standing on weir	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	3	In flight – feeding and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Long-tailed Tit	*Aegithalos caudatus*	10	Perched within trees and in flight between trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	1	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	9	In flight overhead, and aural Recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

Table E-0-28: Birds recorded from Site B – 26/06/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	>15	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	10	Within trees, in flight, and aural recording	Protected Species: Wildlife Acts
Blackcap	*Sylvia atricapilla*	1	Within trees	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Perched within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	2	Perched within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	3	In flight and standing on weir	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	4	In flight overhead and perched on buildings	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	2	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	14	Standing on weir and within the river (Juveniles)	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III

Common name	Species name	No. counted	Description of bird activity	Designation
Rook	*Corvus frugilegus*	2	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	2	In flight	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Table E-0-29: Birds recorded from Site C – 26/06/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	1	In flight over river – feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackcap	*Sylvia atricapilla*	1	Aural recording	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	2	In flight overhead and aural recording	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	2	In flight between trees	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	1	Aural recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	4	In flight overhead, perched within the trees, and aural recording	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	1	In flight over river - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	1	In river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	7	In flight and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	3	Aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Table E-0-30: Birds recorded from Site D – 26/06/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	>10	In flight - feeding	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackcap	*Sylvia atricapilla*	1	Aural Recording	Protected Species: Wildlife Acts
Chiffchaff	*Phylloscopus collybita*	1	Aural recording	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	1	In flight overhead	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Eurasian Magpie	*Pica pica*	1	Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Aural recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	13	In flight overhead and perched on rowing club	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	>20	In flight – feeding and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	3	On the river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	6	In flight and aural recording	Protected Species: Wildlife Acts
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

Table E-0-31: Birds recorded from Site E – 26/06/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Barn Swallow	*Hirundo rustica*	10	In flight overhead	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Blackbird	*Turdus merula*	2	In flight and within vegetation	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	5	Perched within trees, foraging, and aural recording (Juveniles)	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	>30	Foraging on grass and within trees	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Common Swift	*Apus apus*	6	In flight overhead	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Eurasian Collared Dove	*Streptopelia decaocto*	2	In flight and perched on telephone wire	Protected Species: Wildlife Acts
Eurasian Jackdaw	*Corvus monedula*	1	In flight overhead	Protected Species: Wildlife Acts
European Goldfinch	*Carduelis carduelis*	6	In flight, perched within the trees and on telephone wire, and aural recording (Juveniles)	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Perched within trees	Protected Species: Wildlife Acts
Great Tit	*Parus major*	5	Within vegetation and foraging (Juveniles)	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	In flight	Protected Species: Wildlife Acts
House Martin	*Delichon urbicum*	>20	In flight overhead and entering abandoned building	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
House Sparrow	*Passer domesticus*	7	Within vegetation and foraging	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				Birds of Conservation Concern: Amber List
Rook	*Corvus frugilegus*	6	In flight and aural recording	Protected Species: Wildlife Acts
Siskin	*Carduelis spinus*	1	Within trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	6	Within trees, in flight, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Appendix F: Breeding Bird Survey Photographs (2024)

Figure F-1: Male Chaffinch spotted in Graiguenamanagh Town – 29/03/2024

Figure F-2: House Martin nest seen at the top of the verge soffit on Graiguenamanagh-Tinnahinch Rowing Club. Birds seen exiting and entering - 23/05/2024.

Figure F-3: House Martin nest seen at the top of the verge soffit on Graiguenamanagh-Tinnahinch Rowing Club. Birds seen exiting and entering - 23/05/2024.

Appendix G: Wintering Bird Survey Results

Original CFRAM Survey, 2021

Table G-0-1: Species Abundance (Wintering Survey), 2021

Species	Scientific Name	No. of Transects with +ve ID	Designation
Rook	*Corvus frugilegus*	5	N/A
Blackbird	*Turdus merula*	4	N/A
Chaffinch	*Fringilla coelebs*	4	N/A
House Sparrow	*Passer domesticus*	4	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Blue tit	*Cyanistes caeruleus*	3	N/A
Great tit	*Parus major*	3	N/A
Coal tit	*Periparus ater*	2	N/A
Collared Dove	*Streptopelia decaocto*	2	N/A
Jackdaw	*Corvus monedula*	2	N/A
Magpie	*Pica pica*	2	N/A
Mallard	*Anas platyrhinchos*	2	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III
Pied wagtail	*Motacilla alba yarrellii*	2	N/A
Wren	*Troglodytes troglodytes*	2	N/A
Buzzard	*Buteo buteo*	1	N/A
Cormorant	*Phalacrocorax carbo*	1	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Great Spotted Woodpecker	*Dendrocopus major*	1	N/A
Greenfinch	*Carduelis chloris*	1	N/A
Mute swan	*Cygnus olor*	1	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Robin	*Erythacus rubecula*	1	N/A
Song thrush	*Turdus philomelos*	1	N/A
Woodpigeon	*Columba palumbus*	1	Protected Species: Wildlife Acts EU Birds Directive - Annex II, Annex III

Table G-0-2: Wintering Survey (16-18/02/2021)

Transect ID	Date Start/End Time Weather	Species	Visual Distance bands				Aural records	
			0-25m	25-100m	>100m	In flight	+	-
A	16/02/21 09:30-09:52 Overcast, dry, 8°C, calm	Cormorant		1				X
		Great tit					X	
		Rook					X	
		Coal tit					X	
		Magpie					X	
		Wren					X	
		Robin					X	
		Blue tit					X	
		Mallard	2					X
		Buzzard		1				X
B	17/02/21 08:05-08:26 Light rain from 09:05 to end, 6°C, windy	Rook		6		4	X	
		Chaffinch					X	
		Collared Dove					X	
		Robin	1					X
		Blackbird	1					X
		Pied wagtail	1					X
C	16/02/21 08:30-08:50 Overcast, dry, 8°C, calm	Robin					X	
		Rook	1	6		7	X	
		Magpie					X	
		Chaffinch					X	
		Song thrush					X	

		Great Spotted Woodpecker					X	
		House Sparrow					X	
		Wren	1					X
		Mallard	4					X
D	17/02/21 08:40-09:53 Overcast, dry, 6°C, windy	Jackdaw	1				X	
		Chaffinch					X	
		Blue tit					X	
		Rook	2			3	X	
		Robin					X	
		Great tit				1	X	
		Greenfinch					X	
		Collared dove		1			X	
		Blackbird	4					X
E	17/02/21 10:12-10:32 Overcast, dry, 6°C, windy	House sparrow	10				X	
		Jackdaw	2	6			X	
		Blackbird					X	
		Great tit					X	
		Pied wagtail	6					X
		Mute swan	1					X
F	18/02/21 09:09-09:29 Clear, dry, 7°C, calm	Chaffinch					X	
		Blue tit					X	
		House Sparrow					X	
		Coal tit					X	
		Woodpigeon	1				X	
		Blackbird	1					X

		House Sparrow	3					X
		Rook	1					X

Notes:

3x house sparrows recorded near old forge (Between transect D and E)

G.1 Survey 1 (19-20/12/2023)

G.1.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table G-0-3: Survey Conditions

Date	Start time	Finish time	Notes	
20/12/2023	09:00	12:40	Temperature: 9°C	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table G-0-4: Birds recorded from Site A – 20/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	Within the trees and In flight	Protected Species: Wildlife Acts
Common Kingfisher	*Alcedo atthis*	1	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex I Birds of Conservation Concern - Amber List
Eurasian Magpie	*Pica pica*	1	Within trees and Aural Recording	Protected Species: Wildlife Acts
Eurasian Siskin	*Carduelis spinus*	1	Visual and Aural Recording	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	33	In flight and perched within tree	Protected Species: Wildlife Acts
Great Black-Backed Gull	*Larus marinus*	1	In flight overhead	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Great Cormorant	*Phalacrocorax carbo*	3	In flight over the river and within the river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Greenfinch	*Chloris chloris*	9	Perched in tree and In flight	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	Aural Recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	Perched on tree	Protected Species: Wildlife Acts
Redwing	*Turdus iliacus*	1	In flight	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	10	In flight overhead and Aural Recording	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Thrush Sp*	*Turdidae sp.*	1	Perched in Tree	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	6	In flight overhead and Aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

Table G-0-5: Birds recorded from Site B – 20/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	11	Within trees, foraging and In flight	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Perched within tree	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	3	In flight	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	2	Within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Perched within tree	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	3	Standing within river and In flight over river	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	1	Foraging in grass	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	5	In river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	>20	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	9	In flight	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Within tree	Protected Species: Wildlife Acts

Table G-0-6: Birds recorded from Site C – 20/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	In flight	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	In tree and Aural Recording	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Goldcrest	*Regulus regulus*	1	Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Perched in tree	Protected Species: Wildlife Acts
Gull Sp*	*Laridae sp.*	1	Aural Recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>45	In flight overhead and Aural Recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	6	In flight and Aural Recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

Table G-0-7: Birds recorded from Site D – 20/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Common Starling	*Sturnus vulgaris*	1	Aural Recordings	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Hooded Crow	*Corvus cornix*	3	In flight and Foraging on riverbank	Protected Species: Wildlife Acts
Gull Sp*	*Laridae sp.*	1	In flight overhead	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	In flight over river	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	1	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Pied Wagtail	*Motacilla alba subsp. Yarrellii*	1	Perched within tree	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>100	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	4	In flight and Aural Recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Within tree	Protected Species: Wildlife Acts

Table G-0-8: Birds recorded from Site E – 20/12/202.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	8	Within the trees, foraging, and In flight	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Chaffinch	*Fringilla coelebs*	11	Within the trees	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	1	Aural Recordings	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Dunnock	*Prunella modularis*	1	Foraging	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	5	Within the trees and In flight	Protected Species: Wildlife Acts
European Goldfinch	*Carduelis carduelis*	14	Within the trees and Foraging	Protected Species: Wildlife Acts
European Greenfinch	*Carduelis chloris*	1	Within the trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Perched in tree and Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	6	Perched in tree and Foraging	Protected Species: Wildlife Acts
House Sparrow	*Passer domesticus*	6	Within the trees	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Mallard	*Anas platyrhynchos*	2	In river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Pied Wagtail	*Motacilla alba subsp. yarrellii*	1	Foraging	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	10	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight, foraging, and within the trees	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

G.1.1 Upstream Storage Area

Table G-0-9: Survey Conditions.

Date	Start time	Finish time	Notes	
19/12/2023	10:00	12:10	Temperature: 6°C	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table G-0-10: Birds recorded from Site A – 19/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	3	Within the trees and Aural Recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	3	Perched within tree	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Within the trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	5	In flight overhead	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	In flight	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>20	In flight overhead	Protected Species: Wildlife Acts
Thrush Sp*	*Turdidae sp**	4	Within the tree and In flight	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	3	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	6	Within trees and Aural Recording	Protected Species: Wildlife Acts

Table G-0-11: Birds recorded from Site B – 19/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	In flight	Protected Species: Wildlife Acts
Coal Tit	*Periparus ater*	2	Visual and Aural Recordings	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	1	In flight	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	In flight	Protected Species: Wildlife Acts
Eurasian Treecreeper	*Certhia familiaris*	1	Within tree	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Aural Recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural Recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	Aural Recording	Protected Species: Wildlife Acts
Pied Wagtail	*Motacilla alba subsp. yarrellii*	1	In flight	Protected Species: Wildlife Acts
Redwing	*Turdus iliacus*	1	In trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	9	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	2	In flight overhead and Aural Recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III

Common name	Species name	No. counted	Description of bird activity	Designation
				Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	3	Perched within tree	Protected Species: Wildlife Acts

Table G-0-12: Birds recorded from Site C – 19/12/2023.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	Aural Recording	Protected Species: Wildlife Acts
Coal Tit	*Periparus ater*	1	Within the trees	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	1	In flight	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	In flight	Protected Species: Wildlife Acts
Gull Sp*	*Laridae sp.*	1	In flight overhead	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	2	In flight overhead and Aural Recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	8	Within the trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>30	In flight overhead	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	1	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	2	In the rushes, within the trees and Aural Recording	Protected Species: Wildlife Acts

G.2 Survey 2 (16-17/01/2024)

G.2.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table G-0-13: Survey Conditions

Date	Start time	Finish time	Notes
17/01/2024	09:20	12:50	Temperature: -2°C Poor visibility with cold fog in some locations, sun appeared in the latter half of the survey

Weather, highlight as appropriate			
Cloud cover	1 - (0-33%)	2 - (33-66%)	3 - (66-100%)
Rain	1 - None	2 - Showers	3 - drizzle

Wind	1 - Calm	2 - Light	3 – Breezy
Visibility	1- Good	2 – Moderate	3 - Poor

Table G-0-14: Birds recorded from Site A – 17/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	4	Within the trees and foraging	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	3	Perched within trees and on telephone pole	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Perched within tree	Protected Species: Wildlife Acts
Common Bullfinch	*Pyrrhula pyrrhula*	1	Perched in tree	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	2	On building; flying in and out of air vent	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
European Goldfinch	*Carduelis carduelis*	7	In flight and perched within the trees	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Within the tree and aural recording	Protected Species: Wildlife Acts
Great Cormorant	*Phalacrocorax carbo*	1	In flight over the river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Great Tit	*Parus major*	1	Foraging on grass	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	2	In flight over river, standing within the river and aural recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	8	Foraging on grass and within the trees	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	6	Within the river, standing on the weir	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Pipit sp*	*Anthus sp**	1	Perched on wall	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	>20	In flight overhead, within the trees, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	1	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	4	Foraging on grass, within trees and aural recording	Protected Species: Wildlife Acts

Table G-0-15: Birds recorded from Site B – 17/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	16	In flight, within the trees and foraging	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	1	Perched within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	2	Perched within tree	Protected Species: Wildlife Acts
Dunnock	*Prunella modularis*	1	Foraging on riverbank	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	1	Perched on telephone wire	Protected Species: Wildlife Acts
European Goldfinch	*Carduelis carduelis*	1	Foraging on riverbank	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Within the trees, foraging, and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Foraging	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	1	In flight over river and aural recording	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	1	Standing on riverbank and aural recording	Protected Species: Wildlife Acts
Kingfisher	*Alcedo atthis*	1	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex I Birds of Conservation Concern - Amber List
Mallard	*Anas platyrhynchos*	2	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	>10	In flight overhead, within the trees, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	1	Aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Foraging in wooded area	Protected Species: Wildlife Acts

Table G-0-16: Birds recorded from Site C – 17/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	In flight	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	2	Perched within trees	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Chaffinch	*Fringilla coelebs*	2	Perched within trees	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	>10	Foraging on grass	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Great Cormorant	*Phalacrocorax carbo*	1	In flight over the river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Great Tit	*Parus major*	1	Within tree	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	1	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	>40	In flight overhead, within the trees, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	4	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Foraging on riverbank	Protected Species: Wildlife Acts

Table G-0-17: Birds recorded from Site D – 17/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	In flight over river	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	>15	Foraging on grass and within trees	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Duck sp*	*Anatidae sp.*	1	Aural recording	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	4	In flight overhead/ over the river, and within trees	Protected Species: Wildlife Acts
European Goldfinch	*Carduelis carduelis*	2	In flight and perched within the trees	Protected Species: Wildlife Acts
Great Cormorant	*Phalacrocorax carbo*	2	In flight over the river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Kingfisher	*Alcedo atthis*	1	In flight over river	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				EU Birds Directive: Annex I Birds of Conservation Concern - Amber List
Mallard	*Anas platyrhynchos*	2	In flight over river	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	>40	In flight overhead, within the trees, perched on buildings, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	4	In flight over river/ overhead, within trees, and aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	3	Within trees and aural recording	Protected Species: Wildlife Acts

Table G-0-18: Birds recorded from Site E – 17/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	5	In flight, within trees, foraging, and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	>20	Perched within trees and foraging	Protected Species: Wildlife Acts
Common Starling	*Sturnus vulgaris*	4	Perched within trees and aural recordings	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Common Bullfinch	*Pyrrhula pyrrhula*	4	Perched within trees	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	2	In flight and within trees	Protected Species: Wildlife Acts
European Goldfinch	*Carduelis carduelis*	>25	Perched within trees and in flight	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Within the trees, foraging, and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	4	Within the trees and aural recording	Protected Species: Wildlife Acts
European Greenfinch	*Carduelis chloris*	1	Within tree	Protected Species: Wildlife Acts
House Sparrow	*Passer domesticus*	3	Within the trees and on wall	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List
Meadow Pipit	*Anthus pratensis*	1	Within tree	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Rook	*Corvus frugilegus*	4	In flight overhead, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	3	Within trees, in flight and aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

G.2.2 Upstream Storage Area

Table G-0-19: Survey Conditions

Date	Start time	Finish time	Notes	
16/01/2024	09:20	12:50	Temperature: -1°C Clear skies, good visibility, and very cold	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table G-0-20: Birds recorded from Site A – 16/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	6	Within trees, in flight between trees and aural recording	Protected Species: Wildlife Acts
Blue tit	*Cyanistes caeruleus*	8	Perched within trees	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Within the trees	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	2	Within trees and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	7	In flight between trees,	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	7	Within trees and in flight overhead	Protected Species: Wildlife Acts
Thrush Sp*	*Turdidae sp.*	1	Within trees and in flight	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	1	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
Wren	*Troglodytes troglodytes*	1	Within trees and aural recording	Protected Species: Wildlife Acts

Table G-0-21: Birds recorded from Site B– 16/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	3	In flight, within trees, and aural recording	Protected Species: Wildlife Acts
Coal Tit	*Periparus ater*	2	Within trees and aural recordings	Protected Species: Wildlife Acts
Common Pheasant	*Phasianus colchicus*	1	Foraging on woodland floor	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Foraging, within trees, and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	9	In flight between trees, within the trees	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	Aural recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	5	In flight overhead and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight within the woodland, and aural recording	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List

Table G-0-22: Birds recorded from Site C– 16/01/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	In flight, and aural recording	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	1	Perched on tree and in flight	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	2	Within the trees	Protected Species: Wildlife Acts
Redwing	*Turdus iliacus*	1	Within the trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	2	In flight overhead and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	>6	In flight overhead	Protected Species: Wildlife Acts EU Birds Directive: Annex II, Annex III Birds of Conservation Concern: Amber List
Wren	*Troglodytes troglodytes*	1	Within trees	Protected Species: Wildlife Acts

G.3 Survey 3 (22-23/02/2024)

G.3.1 Graiguenamanagh-Tinnahinch Towns (top up survey)

Table G-0-23: Survey Conditions

Date	Start time	Finish time	Notes	
23/02/2024	9:10	12:20	Temperature: 3°C Cloudy skies, moderate visibility, light winds and cold	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table G-0-24: Birds recorded from Site A – 23/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	Within trees	Protected Species: Wildlife Acts
Cormorant	*Phalacrocorax carbo*	2	In flight over river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Dunnock	*Prunella modularis*	1	Aural recording	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	1	Within trees, and in flight	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	2	Aural recording	Protected Species: Wildlife Acts
Grey Heron	*Ardea cinerea*	1	Perched high in tree and in flight over river	Protected Species: Wildlife Acts
Grey Wagtail	*Motacilla cinerea*	1	In flight over river	Protected Species: Wildlife Acts
Great Tit	*Parus major*	2	Within trees and aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural recording	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	9	Within trees and in flight between trees	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	Within trees, and aural recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	12	In flight overhead, perched within trees and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos* subsp. *clarkei*	2	Perched within trees and in flight	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	6	In flight overhead, within trees, and aural recording	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
				Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Table G-0-25: Birds recorded from Site B – 23/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	11	Within trees, foraging, and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	3	Within trees, and aural recording	Protected Species: Wildlife Acts
Cormorant	*Phalacrocorax carbo*	2	In flight over river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Eurasian Blue Tit	*Cyanistes caeruleus*	1	Within trees	Protected Species: Wildlife Acts
Eurasian Collared Dove	*Streptopelia decaocto*	2	In flight and perched within tree	Protected Species: Wildlife Acts
Eurasian Jackdaw	*Corvus monedula*	2	In flight between trees	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	8	Within trees, and aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	4	In flight overhead, foraging, perched within trees, and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Within trees, and aural recording	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	8	Within the river, standing on the riverbank, and in flight over river	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	17	In flight overhead, perched within trees and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	14	In flight overhead and between trees, within trees, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Table G-0-26: Birds recorded from Site C – 23/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Common Buzzard	*Buteo buteo*	1	In flight overhead	Protected Species: Wildlife Acts
Cormorant	*Phalacrocorax carbo*	2	In flight over river	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List
Eurasian Magpie	*Pica pica*	1	In flight overhead	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	4	Aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Within trees and aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	4	Within trees and aural recording	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	3	Within trees, foraging on riverbank, and aural recording	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	4	Within the river	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	20	In flight overhead, perched within trees and on buildings, and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos* subsp. *clarkei*	1	Perched within trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	5	Within trees, in flight, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Within trees	Protected Species: Wildlife Acts

Table G-0-27: Birds recorded from Site D – 23/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	Within the scrub	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	2	Aural recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	2	Within the trees	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Gull Sp*	*Laridae sp.*	2	In flight overhead	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	Perched on top of boat	Protected Species: Wildlife Acts
Mallard	*Anas platyrhynchos*	8	Within the river, standing on the riverbank, and in flight over river	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Rook	*Corvus frugilegus*	10	Perched within trees/on top of buildings, in flight, and aural recording	Protected Species: Wildlife Acts
Tit Sp*	*Paridae sp.*	3	Within trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	4	Perched within trees/on top of buildings, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Aural recording	Protected Species: Wildlife Acts

Table G-0-28: Birds recorded from Site E – 23/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	4	Perched within trees	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	5	Within trees and foraging on grass	Protected Species: Wildlife Acts
Coal Tit	*Periparus ater*	1	Perched within trees	Protected Species: Wildlife Acts
Dunnock	*Prunella modularis*	4	Perched within trees	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	1	Within trees	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	3	Perched within low-lying branches, foraging, and aural recording	Protected Species: Wildlife Acts
Goldfinch	*Carduelis carduelis*	14	Within trees and in flight between trees	Protected Species: Wildlife Acts
Great Tit	*Parus major*	1	Perched within trees	Protected Species: Wildlife Acts
Hooded Crow	*Corvus cornix*	1	In flight overhead	Protected Species: Wildlife Acts
House Sparrow	*Passer domesticus*	5	In flight	Protected Species: Wildlife Acts Birds of Conservation Concern - Amber List

Common name	Species name	No. counted	Description of bird activity	Designation
Kingfisher	*Alcedo atthis*	1	In flight over the river and perched upon bridge railing	Protected Species: Wildlife Acts EU Birds Directive: Annex I Birds of Conservation Concern - Amber List
Mallard	*Anas platyrhynchos*	6	In flight overhead and within the river	Protected Species: Wildlife Acts EU Birds Directive: Annex II and Annex III
Rook	*Corvus frugilegus*	3	In flight overhead and aural recording	Protected Species: Wildlife Acts
Song Thrush	*Turdus philomelos* subsp. *clarkei*	1	Perched within trees	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	7	In flight overhead, perched within trees, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Yellow-hammer	*Emberiza citrinella*	1	Perched within trees	Protected Species: Wildlife Acts Birds of Conservation Concern: Red List

G.3.2 Upstream Storage Area

Table G-0-29: Survey Conditions

Date	Start time	Finish time	Notes	
22/02/2024	10:05	11:55	Temperature: 4°C Cloudy skies, poor to moderate visibility, light winds and cold	
Weather, highlight as appropriate				
Cloud cover	1 - (0-33%)		2 - (33-66%)	3 - (66-100%)
Rain	1 - None		2 - Showers	3 - drizzle
Wind	1 - Calm		2 - Light	3 – Breezy
Visibility	1- Good		2 – Moderate	3 - Poor

Table G-0-30: Birds recorded from Site A – 22/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	6	Perched within/flying between trees, foraging, and aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Perched within trees	Protected Species: Wildlife Acts

Common name	Species name	No. counted	Description of bird activity	Designation
Common Bullfinch	*Pyrrhula pyrrhula*	1	Perched within trees	Protected Species: Wildlife Acts
Dunnock	*Prunella modularis*	1	Perched within trees	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	6	Within trees, in flight, and aural recording	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Perched within trees	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	Perched within trees and aural recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	4	Within trees, in flight overhead, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	12	In flight overhead and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	2	Perched within the trees, and aural recording	Protected Species: Wildlife Acts

Table G-0-31: Birds recorded from Site B– 22/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	2	Aural recording	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	1	In flight overhead	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	Aural recording	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Eurasian Treecreeper	*Certhia familiaris*	1	Aural recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	1	Aural recording	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	10	In flight overhead, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	5	In flight overhead and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III

Table G-0-32: Birds recorded from Site C– 22/02/2024.

Common name	Species name	No. counted	Description of bird activity	Designation
Blackbird	*Turdus merula*	1	Aural recording	Protected Species: Wildlife Acts
Chaffinch	*Fringilla coelebs*	1	Aural recording	Protected Species: Wildlife Acts
Common Buzzard	*Buteo buteo*	3	In flight overhead and perched on top of tree	Protected Species: Wildlife Acts
Dunnock	*Prunella modularis*	1	Perched on telephone wire	Protected Species: Wildlife Acts
Eurasian Blue Tit	*Cyanistes caeruleus*	2	Within/in flight between trees	Protected Species: Wildlife Acts
Eurasian Magpie	*Pica pica*	1	In flight overhead	Protected Species: Wildlife Acts
European Robin	*Erithacus rubecula*	1	Aural Recording	Protected Species: Wildlife Acts
Goldcrest	*Regulus regulus*	1	Aural recording	Protected Species: Wildlife Acts
Great Tit	*Parus major*	5	Within/in flight between trees and aural recording	Protected Species: Wildlife Acts
Long-tailed Tit	*Aegithalus caudatus*	5	Perched within trees	Protected Species: Wildlife Acts
Rook	*Corvus frugilegus*	12	In flight overhead, and aural recording	Protected Species: Wildlife Acts
Wood Pigeon	*Columba palumbus*	2	In flight overhead, and aural recording	Protected Species: Wildlife Acts Birds of Conservation Concern: Amber List EU Birds Directive: Annex II, Annex III
Wren	*Troglodytes troglodytes*	1	Perched within the trees	Protected Species: Wildlife Acts

Appendix H: Wintering Bird Survey Photographs (2023/2024)

Figure H-1: Grey Heron since on the bank of the River Barrow in Graiguenamanagh – Tinnahinch - 17/01/2024.

Figure H-2: Blue Tit seen climbing wall and entering the corrugated steel cladding in Graiguenamanagh – Tinnahinch - 17/01/2024.

Figure H-3: Goldfinch observed in Graiguenamanagh – Tinnahinch - 17/01/2024.

Figure H-4: Bullfinch observed in Graiguenamanagh – Tinnahinch - 17/01/2024.

Appendix I: Mammal Survey Photographs (2023/2024)

Figure 0-1. Mammal Tunnel

Figure 0-2. Mammal footprints in mammal tunnel

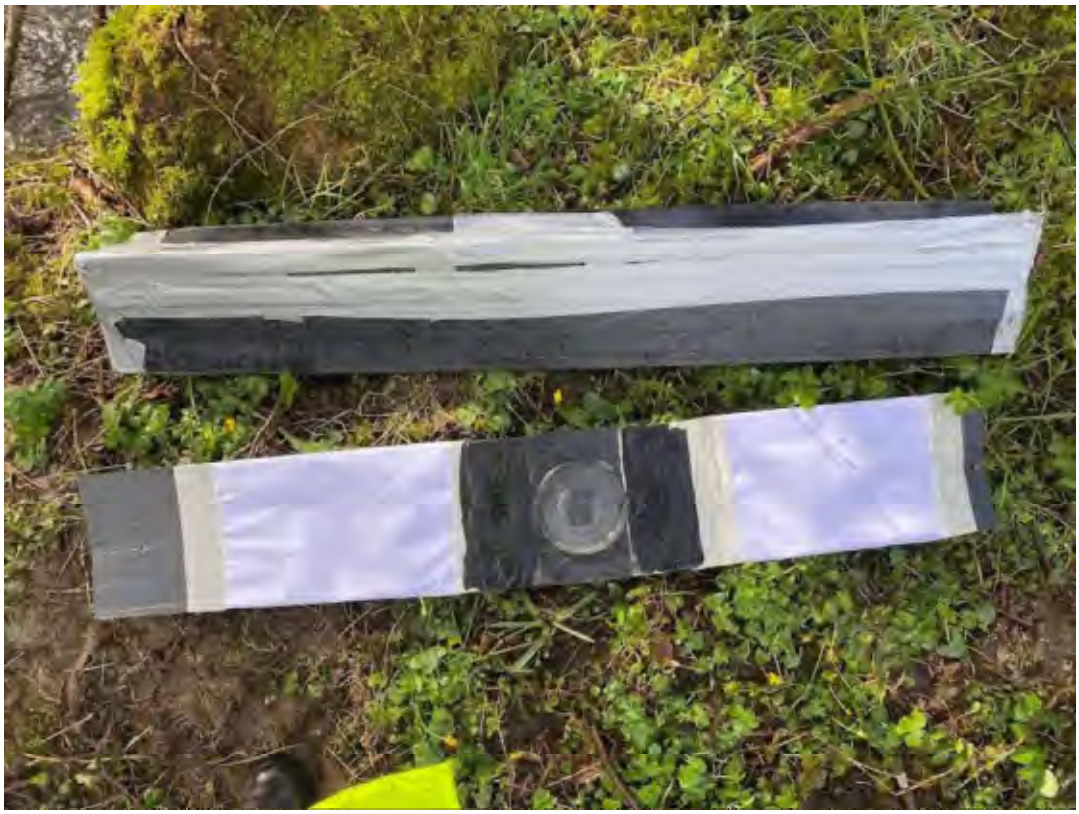


Figure 0-3. Mammal Tunnel

Figure 0-4. Mammal faeces

Figure 0-5. Mammal faeces

Figure 0-6. Mammal bone remains

Figure 0-7. Mammal Trail with potential den

Figure 0-8. Potential mammal burrowing

Figure 0-9. Mammal food remains – 28/03/2024

Figure 0-10. Potential Badger footprints - 28/03/2024

Appendix J: Q-Value Survey (Original CFRAM Survey) (AQUAFACT, 2021)

Graiguenamanagh
Q-value

Produced by

AQUAFACT International Services Ltd

For

BYRNE LOOBY

February 2021

AQUAFACT INTERNATIONAL SERVICES Ltd.,
12 KILKERRIN PARK,
GALWAY.
www.aquafact.ie

info@aquafact.ie

tel +353 (0) 91 756812

Report Approval Sheet

Client	BYRNE LOOBY
Report Title	Graiguenamanagh Q-value
Job Number	JN1595
Report Status	Draft
Issue Date	16th February 2021

Rev	Status	Issue Date	Document File Name	Author (s)	Approved by:
1	Draft	10.2.2021	JN1595 Graiguenamanagh Q-value	Kevin Mc Caffrey	Brendan O'Connor
2	Draft	11.2.2021	JN1595 Graiguenamanagh Q-value	Kevin Mc Caffrey	Brendan O'Connor
3	Draft	16.2.2021	JN1595 Graiguenamanagh Q-value	Kevin Mc Caffrey	Brendan O'Connor

AQUAFACT

Table of Contents

List of Figures

List of Tables

Appendices

1. Introduction

AQUAFACT was contracted by BYRNE LOOBY to carry out a Q-value assessment of the Barrow and Duiske Rivers in Graiguenamanagh Co. Kilkenny as part of an assessment of a proposed flood defence scheme. The sampling was carried out on the 8th of February 2021.

2. Methodology

2.1. Kick sampling

Five kick samples were taken (see Figure 2.1 and Table 2.1). Stream morphology at each station can be seen in Table 2.2. The two-minute kick and one minute stone wash sampling method was employed to collect samples of macroinvertebrates for analysis. This involved placing a standard hand net of pore size 500µm in the river, facing upstream and disturbing the river bed in front of the net mouth. The surveyor, Mr. Kevin McCaffrey, then moved in a diagonal direction upstream to ensure that different micro-habitats were included in the sample. The kick method dislodges macroinvertebrates from the substrates and submerged plant material. This was continued for approximately two minutes and followed by one minute of stone washing. The resulting sample was transferred from the net to a plastic bucket and fixed using a 70% ethanol solution (Toner *et al*., 2005).

The samples were then transported to the AQUAFACT laboratories where the macroinvertebrates were removed and identified using stereoscopic microscopes and the appropriate keys by Mr. McCaffrey who is a qualified freshwater taxonomist. The resulting species list was then used to assign a Biotic Index value (Q-Value) to the sampled streams.

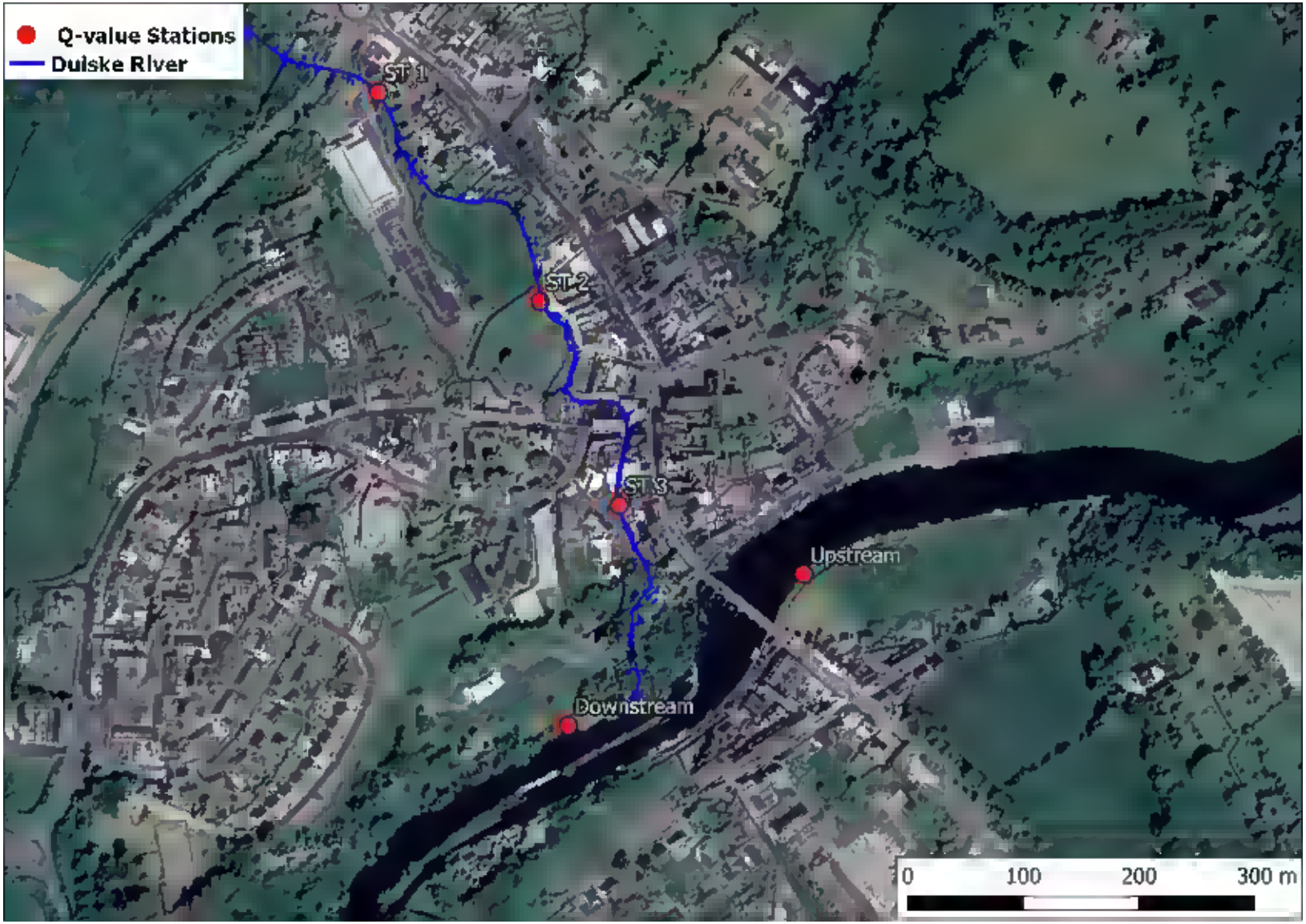


Figure 2.1: Graiguenamanagh Q-value station Locations.

Figure 2.2: Q-value Station 1.

Figure 2.3: Q-value Station 2.

Figure 2.4: Q-value Station 3.

Figure 2.5: Looking towards upstream station above the bridge.

Figure 2.6: Looking across to downstream station at flooded green area.

Table 2.1: Q-value station coordinates for Graiguenamanagh.

Station	Longitude	Latitude
ST 1	-6.95895	52.54344
ST 2	-6.95689	52.54182
ST 3	-6.95589	52.54024
Upstream	-6.95353	52.53971
Downstream	-6.95653	52.53854

Table 2.2: Stream Morphology.

Station	Width (m)	Depth (cm)	Substrate	Flow
ST 1	2.8	49	Cobbles	Flood
ST 2	3.4	44	Cobbles	Flood
ST 3	5.2	36	Cobbles	Flood
Upstream	63	>120	Mud	Flood
Downstream	56	>120	Mud	Flood

2.2. The Biological River Classification System (Q-Scheme)

The Biological River Quality Classification System (Q-Scheme) has been in use in Ireland since 1971. It has undergone a number of modifications since then and has been included in the Local Government (Water Pollution) Act, 1977 (Water Quality Standards for Phosphorus) Regulations, 1998. It is routinely employed by the EPA. For the purpose of this assessment benthic invertebrates have been divided into five indicator groups according to tolerance of pollution, particularly organic pollution.

In order to determine the biological quality of the river, the Q-scheme index is used whereby the analyst assigns a Biotic Index value (Q-Value) based on macroinvertebrate results. The Biotic Index is a quality measurement for freshwater bodies that range from Q1 – Q5 with Q1 being of poorest quality and Q5 being pristine/unpolluted (see Table 2.3).

Table 2.3: Biotic Index scoring system for the Q-Scheme (Toner *et al*., 2005).

Biotic Index	Quality Status	Quality Class
Q5, 4-5, 4	Unpolluted	Class A
Q3-4,	Slightly Polluted	Class B
Q3, 2-3	Moderately Polluted	Class C
Q2, 1-2, 1	Seriously Polluted	Class D

3. Results

All species recorded are included in Appendix 1. Stations 1 to 3 were taken from the Duiske River. Station 1 located to the north of the town recorded a Q-value of 4, which was the highest of any of the stations. Stations 2 and 3 both recorded an intermediate Q3-4. Two stations were sampled in the River Barrow, one upstream of the weir and one downstream. Both locations recorded a Q-value of 3 (Table 3.1). All species recorded where typical of the habitats sampled. Species composition recorded at station 2 and 3 is as expected for a slightly polluted status with only a few sensitive species present and in low numbers.

Table 3.1: Biological sampling results.

Location	Q-value
ST 1	Q4
ST 2	Q3-4
ST 3	Q3-4
Upstream	Q3
Downstream	Q3

4. Discussion

The Duiske River received a quality status of unpolluted as it entered Graiguenamanagh. Stations 2 and 3 located further downstream in the town were classified as slightly polluted. Although Stations 2 and 3 received a lower Q-value than station 1 they both recorded more sensitive species. Station 2 recorded three pollution sensitive species and Station 3 two sensitive species, while Station 1 only recorded one such species. However, Stations 2 and 3 also contained a higher abundance and diversity of pollution tolerant species.

Both of the stations located within the Barrow River were classified as moderately polluted. However, due to the depth of the river and it being in flood, these stations could not be sufficiently sampled for health and safety reasons. The upstream station was sampled from the river bank while the only location that could be sampled downstream was on a flooded grassy bank. As such, many of the habitats within the river could not be sampled and so sensitive species are likely to have been missed.

One minnow was recorded in the upstream sample, while three minnows and two sticklebacks were recorded at the downstream sample.

5. References

P. Toner, J. Bowman, K. Clabby, J. Lucey, M. McGarrigle, C. Concannon, C. Clenaghan, P. Cunningham, J. Delaney, S. O'Boyle, M. MacCárthaigh, M. Craig and R. Quinn (2005) Water Quality in Ireland 2001-2003: Appendix 1. Published by the Environmental Protection Agency, Ireland.

Appendix 1

Species List

Order/Family	Genus/ Species	Common Name	Station 1	Station 2	Station 3	Upstream of bridge	Downstream of bridge
Heptageniidae	*Ecdynurus sp.*			2			
Heptageniidae	*Rhitrogena sp.*		6	7	2		
Ephemerellidae				1	1		
Caenidae	*Caenis sp.*					2	
Nemouridae				2	2		
Leuctridae	*Leuctra sp.*		1		2		
Gammaridae			2	2	6	6	6
Coleptera				2	3		
Hydropsychidae			4	5	16		
Polycentropodidae					3		2
Sericostomatidae			2	12	2		
Baetidae	*Baetis rhodani*	Blue Winged Olive	26	85	49	3	2
chironomidae					1	3	12
Limnephilidae				2	2	3	9
Goeridae					1		
Simuliidae			3	6	2		
Rhyacophilidae				1	1		
Philopotamidae				1			

Order/Family	Genus/ Species	Common Name	Station 1	Station 2	Station 3	Upstream of bridge	Downstream of bridge
Glossosomatidae			3	46	11		
Asellidae	*Assellus aquaticus*	Waterlouse		1	2	2	2
Pediciidae	*Dicranota sp.*		2	2			
Planorbidae	*Ancylus sp.*			1	1		
Lymnaeidae							5
Cyprinidae	*Phoxinus phoxinus*	Minnow				1	3
Gasterosteidae	*Gasterosteus aculeatus*	Three-Spined Stickleback					2
	Total		**48**	**173**	**102**	**20**	**43**
	Species Richness		**9**	**17**	**18**	**7**	**9**

Appendix K: Aquatic Surveys Report (Upstream Storage Area) (APEM, 2023)

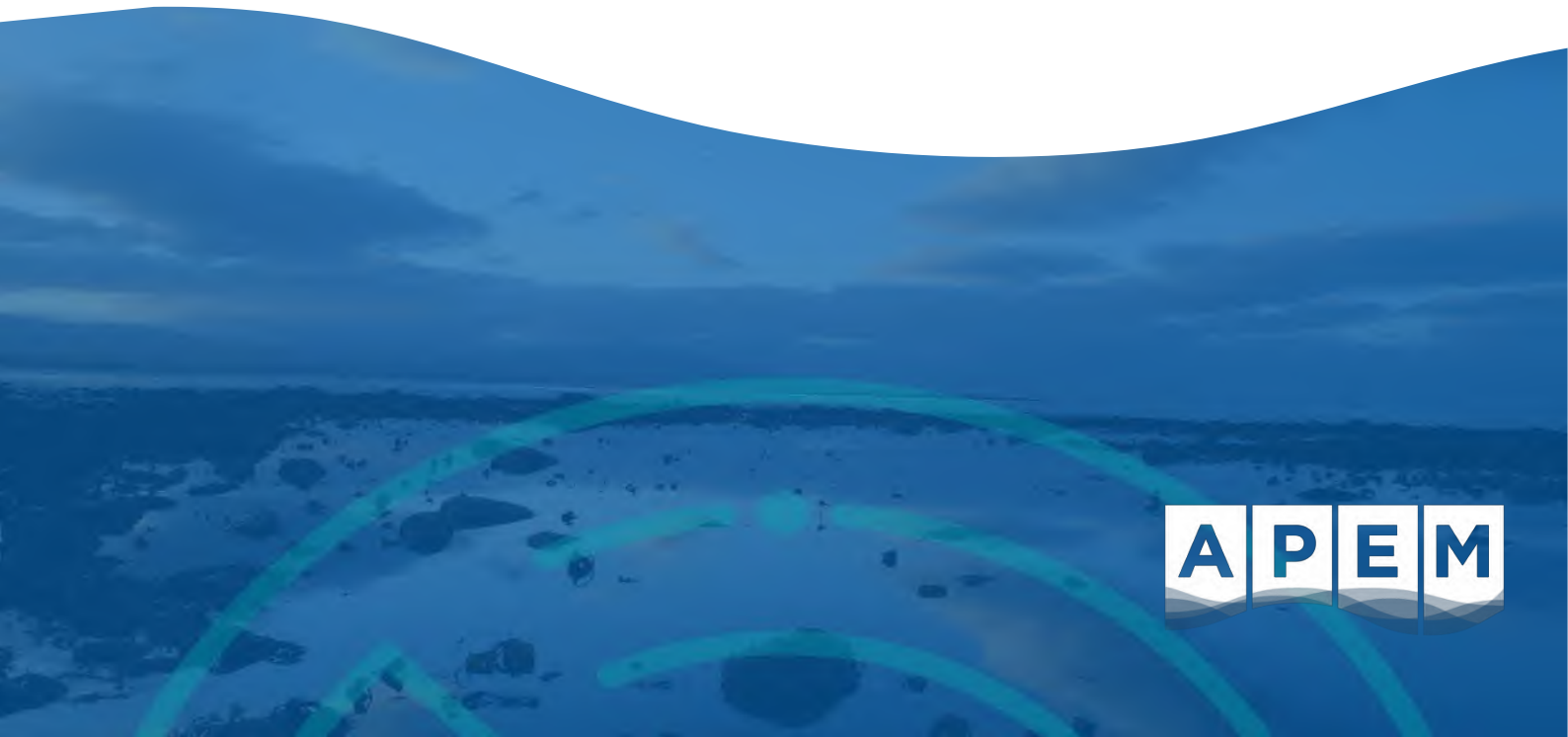
ByrneLooby

Griaguenamanagh-Tinnahinch Flood Relief Scheme

Aquatic Ecology Surveys Report

P00012428

October 2023



Client:	ByrneLooby
Address:	Building 2100, Cork Airport Business Park, Kinsale Road, Cork, T12 KV8R
Reference no:	P00012428
Date of issue:	25 October 2023

Project Director:	**Eliot Taylor**
Project Manager:	Gráinne Keogh
Project Author:	Gráinne Keogh and Adon McFarlane

APEM Ireland[1]

NSC-Campus

Mahon

Cork

T12 XY2N

Tel: 021 2339580

Registered in Ireland No. 493496

[1] APEM Ireland is a trading name of Woodrow Sustainable Solutions Ltd, based at Upper Offices, Ballisodare Centre, Station Road, Ballisodare, Co Sligo, F91 PE04, Ireland

Document Control

Document Properties	
Organisation	APEM Ireland
Project Name	Graiguenamanagh – Tinnahinch Flood Relief Scheme
Report Title	Aquatic Ecology Surveys Report
Author(s)	Gráinne Keogh, Adon McFarlane
Draft version/final	V2 Final
Document reference	P12428 GT Flood Relief Scheme Report Final

Revision and Amendment Register					
Version	**Date**	**Section(s)**	**Page(s)**	**Summary of Changes**	**Approved by**
1	04/10/2023	All	All	Draft for client review	ET
2	23/10/2023	7, Figure 7	20, 25	Additional text and figure following client review	MD

TABLE OF CONTENTS

Document references

List of Figures

List of Tables

List of Plates

1. Introduction

1.1. Background

APEM Ireland was commissioned by ByrneLooby to carry out aquatic surveys and prepare an aquatic ecology baseline report in support of the planning application for the flood storage area proposed on the Duiske River as part of the Graiguenamanagh and Tinnahinch Flood Relief Scheme. This follows a desk study baseline report carried out by APEM Ireland early in 2023 (APEM 2023).

1.2. Site Description

The proposed development site ("the Site") is located at Graiguenamanagh, Co. Kilkenny and is centred at Irish Transverse Mercator (ITM) 669328 644387 (Figure 1). The Site covers a ca. 750 m stretch of the lower reaches of the Duiske River that lies within the River Barrow and River Nore SAC. The Site is located in an agricultural setting, surrounded by grazing farmland.

The Duiske River is formed by the confluence of several smaller streams around Graiguenamanagh. It drains approximately 24 km^2 and discharges into the River Barrow immediately downstream of Graiguenamanagh Bridge, Co. Kilkenny on the upstream side of a major weir. It is classified by the EPA as suffering agricultural and urban run-off pressures, as well as from hydromorphological issues. Despite this, the EPA's own Q value sampling, conducted upstream in 2020, gave this river a High Ecological Quality status under the Water Framework Directive (WFD).

1.3. Brief Description of the Proposed Development

The following project description was provided by ByrneLooby for the proposed raised defences and Duiske River storage area.

The Proposed Scheme consists of a series of raised defences (flood walls and embankments) along the River Duiske and River Barrow. It further includes upstream storage of flood waters (upstream on the River Duiske) to facilitate a reduced extent of flood walls downstream in the built-up area of Graiguenamanagh, particularly in the complex areas of Turf Market where there are significant buildability and archaeological constraints. The flood storage area is to be located within agricultural lands of the Barrow Valley, approximately 1.5km upstream of the River Barrow and River Duiske confluence. Flood waters will be held back by headwall and flow control structure, which will enable a controlled release of waters through the River Duiske during a flood event.'

1.4. retaining embankmentPurpose of this Report

The purpose of this report is to describe the results of a series of baseline, aquatic ecology surveys conducted at the proposed works sites, which will inform the planning application.

1.5. Aquatic Ecology Survey Site Selection

A desk study was conducted to inform as to the kind of surveys that were necessary and as to the locations of such surveys. It was determined that to be able to effectively assess water quality under baseline conditions at the Site, three sites needed to be sampled for macroinvertebrates and water chemical analysis. Two locations were also selected for survey for white-clawed crayfish. Fish habitat surveys were undertaken across the Site (Figure 2 – Figure 6)

1.6. Evidence of Technical Competence and Experience

Summaries of the qualifications and experience of the personnel involved in the work, and their role in delivering it, are outlined below. Gráinne Keogh and Adon McFarlane carried out the field surveys. Gráinne Keogh and Adon McFarlane prepared this report and it was technically reviewed by Michael Dobson and Eliot Taylor.

Gráinne Keogh is a Senior Ecologist at APEM Ireland and holds an MSc in Marine Biology and a BSc in Ecology and Environmental Biology. Gráinne has carried out field and lab work across marine, terrestrial, and freshwater environments; these include habitat surveys and mapping, species identification, freshwater pearl mussel surveys, electrofishing surveys and chemical and biological water quality analysis including SSRS and Q Value assessments. She has previously worked on the Climate Change Mitigation Research Project in Inland Fisheries Ireland and she has also spent time at sea on research vessels conducting fisheries surveys with the Marine Institute. Grainne has a robust understanding of the impact assessment processes, and Irish and EU wildlife legislation and has written a number of Appropriate Assessments, Natura Impact Statements and Ecological Impact Assessments to support planning applications.

Dr Adon McFarlane is a freshwater biologist, specialising in protected species. He is an experienced field scientist, with extensive skills in the fields of freshwater habitat assessment; freshwater pearl mussel survey; white-clawed crayfish survey, macroinvertebrate survey, fish habitat assessment and electrofishing survey. He has built up skills in the collection of data both in the field and laboratory, analysis of data using statistical software programs such as R, BORIS, RAVEN and Minitab, creation of distribution maps using GIS. Adon has very strong technical skills in both freshwater and marine laboratory and fieldwork instrumentation and equipment usage. Adon has worked on a number of ecological reports, including Appropriate Assessments, Ecological Impact Assessments (EcIA), Preliminary Ecological Appraisal Reports (PEAR) and Invasive Species Reports.

Dr Michael Dobson FLS MCIEEM is a freshwater biologist with over 35 years' experience. He spent 20 years as a research scientist, specialising in ecology and management of rivers and freshwater wetlands throughout Europe and East Africa, along with developing biotic indices for river quality assessment in Central America. He was Director of the Freshwater Biological Association for six years before joining APEM in 2013, working initially in the limnology and water quality team before setting up its dedicated invasive species team in 2019 and moving to APEM Ireland in 2022. Mike has written many peer- reviewed papers in ecology and biogeography, along with two undergraduate textbooks for Oxford University Press (both in their second editions) and seven identification guides to freshwater invertebrates of Britain and Ireland. He has extensive experience of survey design, data analysis and reporting, including publication and verbal reporting for non-technical audiences. He has written and reviewed Habitats Directive assessments in both Ireland and the UK.

Dr Eliot Taylor CSci CEnv CWEM is a highly experienced freshwater environmental, ecological and technical specialist with +30 years' experience, including of numerous short and long-term assignments in over 15 western, eastern and southern African countries. He has extensive experience of work in integrated water resources management; catchment management; climate change adaptation; ecological and environmental impact assessment; environmental flow assessment; freshwater invasive species control; use of freshwater macroinvertebrate communities to determine water quality and sedimentation issues, as well as their conservation value. Eliot has undertaken assessment and understanding of wetlands and other freshwater aquatic ecosystems and freshwater and planning and management of wetland protected sites (Ramsar, SAC, SPA, National Parks etc). He is experienced in the provision of technical advice to clients, development and implementation of plans and reports, managing and facilitating workshops, as well as community and broader stakeholder consultation and participation. He has advised on the development / implementation of

water related policy, plans and assessments in liaison with development partners, private sector clients and a range of governments. Since September 2020, Eliot has been APEM Ireland's Divisional Director, based in Cork.

2. Field survey locations

2.1. Water quality and macroinvertebrate surveys

All survey sites are located on the Duiske River, three locations were chosen for surveys. Firstly, upstream of the proposed retaining embankment and within the area potentially to be flooded, secondly, around the location of the embankment construction itself, and thirdly, downstream of the proposed retaining embankment (Table 2-1, Figure 2). The exact retaining embankment location is not yet confirmed (Jackelyn Wren, *pers. comm.*) so the survey location was chosen to be representative of the area within which it will be placed.

Table 2-1 Location of water quality and macroinvertebrate survey sites

Site number	Description	Location
1	Downstream of works area; c. 155 m downstream of probable retaining embankment location	ITM 669480 , 644329
2	Within area of works	ITM 669319 , 644396
3	Upstream of works area; c. 475 m upstream of probable retaining embankment location	ITM 668895 , 644567

2.2. Fish habitat surveys

Fish habitat surveys were carried out along the entire river stretch within the Site (Figure 3 – Figure 6). This stretch ran from ca. 677 m upstream of the area of proposed works, through the area of proposed works (ca. 42 m) to a point ca. 327 m downstream of the area of proposed works. In covering this area, all channels within the proposed area of flooding, within the proposed area of works and the area that will be immediately downstream of the works, were all surveyed.

2.3. White-clawed crayfish surveys

Two survey locations were chosen to determine the presence/absence of white-clawed crayfish (WCC - *Austropotamobius pallipes*) on the Duiske River; these were one upstream of the location of works, and one at the location of the works.

3. Water Samples

3.1. Methods

Water quality assessment took place at three sites on 10th August 2023 (Plate 1-Plate 3). Field measurements were taken *in situ*, using a multimeter probe, and water samples were additionally collected for laboratory analysis. Each sample was collected in a pre-sterilised sampling bottle, pre-rinsed with river water. Water samples were taken from just below the surface, ensuring that the riverbed was not disturbed. Once sample bottles were filled, they were transported to an INAS accredited laboratory for analysis within the recommended holding time for the selected water quality parameters.

3.2. Results

The physiochemical data collected *in situ* in August 2023 is shown in Table 3-1. Readings were similar across all three sites and showed a general absence of negative water quality impacts, with high oxygen saturation and moderate conductivity levels.

Table 3-1. Summary of physicochemical readings recorded in situ in August 2023

Parameter	Unit of Measurement	Site 1 – Downstream of works area	Site 2 – within area of works	Site 3 – upstream of works area
Time of reading	HH:MM	07:50	08:45	09:50
Temperature	°C	14.8	14.7	14.7
Dissolved Oxygen	% Saturation	95.3	94.3	96
Dissolved Oxygen	mg/l	9.66	9.54	9.54
pH	-	7.57	7.56	7.55
Conductivity	µS/cm	182.6	180.8	168.40

Laboratory results for water quality parameters are shown in Table 3-2. BOD and ammonia, both indicators of organic pollution, were low across all sites. Suspended solids were also comparably low at all sites.

Nutrient concentrations were also low and, apart from a slight increase in orthophosphate at Site 2, similar across all sites. Other parameters also showed similarity across all sites.

3.1. Conclusions

The results show no adverse water quality impacts and little difference between the samples taken upstream, within, and downstream of the Site.

3.2. Limitations

A key limitation is the number of water quality readings available. Water quality can be variable, and will change under different flow and runoff conditions, so a single sample or set of readings can only give a snapshot indication of conditions at the point in time at which they are taken.

Table 3-2. Summary of laboratory water quality parameters from samples collected in August 2023

Parameter	Unit of Measurement	Site 1 - Downstream of works area	Site 2 - within area of works	Site 3 - upstream of works area
Biochemical Oxygen Demand (BOD)	mg/l	<1	<1	<1
Chemical Oxygen Demand (COD)	mg/l	<10	<10	<10
Suspended Solids	mg/l	2	<2	<2
Total Nitrogen as N	mg/l	2.44	2.39	2.37
TON as N	mg/l	2.64	2.64	2.63
Nitrate as NO_3	mg/l	12.4	11.7	11.7
Nitrite as NO_2	mg/l	<0.017	<0017	<0.017
Ammonia as N	mg/l	0.029	0.025	0.027
Total Phosphorus as P	mg/l	<0.05	<0.05	<0.05
Orthophosphate as PO_4-P	mg/l	0.012	0.043	0.020
TPH (>C5 - C44) by GC-FID	ug/l	<20	28*	35*
Alkalinity, total by titration	mg/l $CaCO_3$	52	48	48
Iron, total	ug/l	115	103	106
Iron, dissolved	ug/l	22	23	20
Copper, dissolved	ug/l	<1	<1	<1
Arsenic, dissolved	ug/l	1	1	1
Zinc, dissolved	ug/l	8	5	7
Dissolved Organic Carbon (DOC)	mg/l	2.75	2.32	1.93

*Unknown pattern: indicates the presence of naturally forming hydrocarbons in the sample that cannot be attributed with a known 'fingerprint' such as diesel or kerosene.

4. Macroinvertebrate Survey

4.1. Methods

Kick-sampling was carried out at the three sites on 9th August 2023 (Plate 1-Plate 3) according to the standard methodology used by the EPA (Toner *et al.,* 2005). A two-minute macroinvertebrate kick sample was conducted at each site using a standard, 1 mm mesh size, long-handled net, principally from the faster flowing riffle habitats, but glides, margins and pools were included according to their proportional presence. A further one-minute hand search was carried out to locate macroinvertebrates that attached themselves to solid structures, such as the underside of the cobbles. Each sample was preserved on site with >90% Isopropanol solution and returned to the laboratory for further analysis. Specimens were identified, under a binocular microscope, to family level in the laboratory using the standard range of identification keys published by the Freshwater Biological Association, AIDGAP and others, and their relative abundance was recorded.

An EPA Q-value classification was assigned to each site. The Q-values were assigned based on the presence and relative abundance of sensitive groups and the consideration of additional qualifying criteria, as described by Toner *et al.* (2005) and outlined in more detail in Appendix C.

4.2. Results

Results from the macroinvertebrate survey are provided in Table 4-1 and a full taxa list is provided in Appendix C. Each of the sites would be classed as Q3 based on the data gathered, equivalent to Moderate WFD status. Each site was dominated by Group C (tolerant) taxa, with a small number of Group B (less sensitive) taxa. All sites had a similar invertebrate composition, although overall abundance and taxon richness was lower in Site 2 than the other sites. Two Group A (sensitive) taxa were recorded, but only as single individuals and thus, as per the methodology, not included in the Q-value calculation.

Table 4-1. Summary of Q values assigned, and total number of taxa observed at each site in August 2023

Parameter		Site 1 - Downstream of works area	Site 2 – within area of works	Site 3 - upstream of works area
Q Value Classification		Q3	Q3	Q3
Number of Taxa	Group A (sensitive)	-	*	*
	Group B (less sensitive)	3	1	3
	Group C (tolerant)	11	9	10
	Group D (very tolerant)	-	-	-
	Group E (most tolerant)	-	-	-
	Total+	19	13	21

*Present, but only as single individuals, so not included in the classification

+Other taxa were present and counted in the total number of taxa but either had only one individual and were, therefore, discounted from Q value classification, or were not a taxon considered in the classification system

4.3. Conclusions

The Q-value assessment for the Duiske River, based on the data collected in August 2023, suggests Moderate WFD status, in contrast to the most recent EPA assessment in which High WFD status was assigned, but it was consistent across the three sites.

4.4. Limitations

The dataset is from a single sampling event and while it will integrate environmental conditions over the several months coved by the life cycles of the taxa recorded, it cannot give an indication of interannual variation. Where possible, therefore, it is always advisable to take repeat samples in different seasons in multiple years.

5. Fish and Habitat Surveys

5.1. Methods

5.1.1. Fish species present

Presence of fish species within the area to be affected was determined from pre-existing data and designations. Habitat walkover surveys were conducted in order to identify suitable habitat for the key fish species and their associated important life stages . Electrofishing was not conducted, as it has several disadvantages, including the fact that it is a one-off survey, and consequently species or individuals may be missed due to seasonal and shorter-term temporal changes in distribution. Existing datasets, which have the advantage of being collected at multiple times, show what has previously been recorded at the sites and habitat walkover surveys then identify suitable habitat for the key species and life stages of importance.

Baseline fisheries data was obtained from previous electrofishing surveys conducted upstream and downstream of the proposed works area on the Duiske River. These surveys were conducted by Inland Fisheries Ireland (IFI) for the Water Framework Directive fish ecological status 2008-2021 project. The newly published dataset river layer shows river fish status and fish distribution from surveys carried out from 2008 to 2021, as well as the species recorded and the dates the surveys were conducted[2]. Aquafact Ltd also conducted electrofishing surveys on the Duiske River in 2021 ca. 1.4 km downstream of the proposed works area.

IFI were contacted regarding the need for electrofishing in the area and have stated that we can assume all fish QIs of the River Barrow and River Nore SAC are present within the works area. This confirmed our original decision and recommendation to the client, not to undertake electrofishing and so minimise disturbance to any SAC QI populations.

5.1.2. Fish habitat survey

Walkover habitat surveys were conducted on 09 August 2023. Weather conditions were dry with 6/8 okta cloud cover, Beaufort 0 wind[3], air temperature 19°C. The river flow at this time was considered low and, therefore, allowed for good visibility during habitat surveys. Each survey mapped habitats suitable for salmonids and lamprey. An outline of the requirements for each survey is detailed in Appendix D.

The methodology applied to the habitat survey follows that of Hendry & Cragg-Hine (1997). This field mapping technique involves hand drawing features, onto a high-resolution map (OS 1 km tiles), at a scale of 1:10,000 using a field tablet. The riverbank was walked, noting habitat features in the river channel and drawing these directly onto the map, with the boundaries of the different habitat classifications being drawn to represent their actual position within the river, and with annotations as required. Prominent features, such as log jams, macrophyte beds, weirs and bridges, were noted and their locations confirmed using handheld GPS unit. This approach allows exact representation of areas of individual habitat types encountered and, in doing so, a mosaic of the different habitat types can be drawn along the whole section of the river. Definitions of habitat types included in the survey are

[2] Water Framework Directive Fish Ecological Status 2008-2021 | Water Framework Directive Fish Ecological Status 2008-2021 | Inland Fisheries Ireland Data Hub (arcgis.com)

[3] https://www.met.ie/forecasts/marine-inland-lakes/beaufort-scale

outlined in Appendix D. The drawings of the habitat types along the section of the river were subsequently digitised using QField and QGIS.

5.1. Results and Discussion

5.1.1. Fish species present

Electrofishing surveys were conducted ca. 550m upstream of the proposed work site on 20 July 2015 and 09 July 2020 and ca. 1.5 km downstream of the proposed work site on 09 July 2020 by IFI, and ca. 1.4 km downstream of the proposed work site by Aquafact Ltd on 10 February 2021. These surveys identified the presence of salmon (*Salmo salar*), brown trout (*Salmo trutta*), European eel (*Anguilla anguilla*) and lamprey spp. The Duiske River has also been identified as a potentially important nursery ground for Atlantic salmon by Delanty *et al.* (2017) and for lamprey (King, 2006).

Although no observations of Twaite Shad *Alosa fallax* [1103] have been recorded within the Duiske River, as the proposed site is within the River Barrow and River Nore SAC (002162) it needs to also be assumed that this QI fish species is present and should be considered for mitigation.

Table 2-1 below identifies the fish species actually recorded both above and below the proposed works area during electrofishing surveys.

Table 2-1. Fish species recorded by IFI and Aquafact on River Duiske with potential to reside within works area

Fish Species	2015 IFI Survey (Upstream of proposed works)	2020 IFI Survey (Upstream of proposed works)	2020 IFI Survey (Downstream of proposed works)	2021 Aquafact Survey (Downstream of proposed works)
Salmon, *Salmo salar*	X	X	X	X
Brown Trout, *Salmo trutta*	X	X	X	X
European eel, *Anguilla anguilla*		X	X	X
Lamprey species	X			X

5.1.2. Fish Habitat Surveys

The fish habitat survey covered a length of ca. 1,045 m of the Duiske River. Digitised maps of the walkover habitat survey are presented in (Figure 3 – Figure 6). Using these maps, the habitat was assessed for suitability based on the species listed as qualifying interests in the SAC, and on those species recorded previously at the site.

The section surveyed was characterised mainly as riffle, mixed juvenile, pool and glide habitats. The substrate was composed mainly of gravels, cobbles and boulders, with areas of fine silts and sand (Plate 7-Plate 11). The average width of the section surveyed was 5 m ranging between ca. 3 – 7m with fast to moderate flow. Instream macrophytes included *Apium nodiflorum*, *Mentha aquatica* and *Nasturtium officinale*. Areas suitable for lamprey ammocoetes were observed throughout the survey stretch, characterised by areas of stable fine sediment or sand which is greater than 15 cm deep with a low water velocity and the presence of organic detritus (Plate 4 -Plate 6). Undercut banks and tunnelled vegetation causing shading from deciduous tree canopy are present along the watercourse.

Himalayan Balsam, *Impatiens glandulifera,* is present on both banks along the entire stretch of the surveyed river, with dense areas being observed (Figure 7), including at the area of proposed works (Plate 19-Plate 20). Areas of suboptimal silted spawning habitat for salmonids were observed downstream, as well as at areas of the channel impacted by poaching from livestock (Plate 15-Plate 16, Plate 23).

5.2. Conclusions

Overall, the Duiske River provides a good mix of aquatic habitats, favoured by a range of fish and invertebrate species. Salmonid and mixed juvenile habitat was prevalent with adult salmonid passageway (fast moving glides and runs) and resting and holding areas (glides, and pools) being found along the reach. Abundant salmonid parr were observed throughout the survey area with large aggregations being observed in pool habitats.

It can, therefore, be safely assumed that all the species recorded in recent surveys are present throughout and that, likewise, those species listed as QIs in the SAC designation, namely the three species of lamprey, can be assumed to be present at the site on the basis of the survey.

5.3. Limitations

The use of historical fish survey data and the SAC designation, combined with the detailed walkover and fish habitat survey, reduces the limitations in determining species present.

6. White-clawed crayfish Survey

6.1. Methods

Prior to conducting field surveys for white-clawed crayfish (WCC - *Austropotamobius pallipes*), a check for previous records in the catchment was carried out.

Licences for WCC surveys were secured from National Parks and Wildlife Service (NPWS) prior to commencement of the survey (Licence No. C225/2023).

Two surveys were conducted on 09 August 2023 to determine the presence/absence of WCC on the Duiske River upstream of, and at, the area of works and according to the standard methodology used by Peay (2003) and Gammell *et al.* (2021). The river sections surveyed are shown in Figure 2. On arrival, channel conditions were assessed, and a 100 m stretch of suitable river was chosen for survey within the 500m survey stretch. Hand-searching of 50 potential refuges within 5 patches was carried out at each chosen 100 m stretch. Potential refuges were defined as any suitable substrata (e.g., boulder, cobble, woody debris) that would be resistant to high flows and capable of providing cover for WCC. Refuges were searched facing upstream to minimise the disturbance of softer substrata. Where possible, refuges were replaced after searching. Habitat features for each patch were also recorded.

In addition to hand-searching, a string of four trappy funnel baited crayfish traps (Plate 17 - Plate 18) were laid out on 09 August 2023 and left overnight, these within an area of suitable habitat that included abundant refuges and vegetation. Traps were spaced approximately 4 m apart and laid parallel to the riverbank in approximately 0.5 m of water. Each end of the rope was secured to the bank in order to prevent the baited traps from being moved. Each trap was baited with approximately 40 g of raw fish (mackerel). Traps were left overnight and checked early the following morning on 10 August 2023.

6.2. Results

WCC have been recorded throughout the Barrow catchment (Department of Culture, Heritage and the Gaeltacht, 2019). Crayfish plague, caused by the water mould *Aphanomyces astaci,* is present in the river (Update on Crayfish Plague in Ireland | Fish Health Unit).

No crayfish were found during surveys and the traps laid overnight were empty when retrieved. However extensive areas of suitable habitat were found throughout the site in the form of large cobble and boulders, undercut banks and woody debris within the glide/run sections, as well as along river margins with overhanging vegetation (Plate 12 - Plate 14). It is possible, therefore, that crayfish plague is now found within the Duiske River, accounting for the absence of the species in the reaches surveyed.

6.3. Conclusions

The absence of any records of WCC, or of other evidence, such as partial remains from predation, and despite an intensive search in a reach with suitable habitat, suggests the absence of this species from the Site. This may be due to upstream movement in recent years of crayfish plague, previously confirmed within the River Barrow.

6.4. Limitations

A survey of this type, based on a single site visit and short river reach, always has the risk of missing presence of the species elsewhere in the area to be affected. However the complete absence of

records, including from the baited traps, which will attract this mobile species, would suggest either genuine absence or the presence of very low numbers existing in small, localised populations. Notwithstanding the probable absence of WCC, its listing as an QI feature for the SAC means that consideration of this species is required irrespective, particularly with regard to habitat restoration following the works.

7. General conclusion

The baseline aquatic ecology surveys conducted revealed similar conditions along the reach surveyed. Water quality readings suggested an absence of pollution at the time of the survey, and the presence of large numbers of salmonids observed during fish habitat surveys would support this. The apparent low quality shown by the macroinvertebrate samples (Q-value 3, equivalent to Moderate WFD status) is, therefore, interesting in this regard.

Fish habitat surveys identified that the channel of the Duiske River surveyed provides a good mix of aquatic habitats, favoured by a range of fish and invertebrate species. Salmonid and mixed juvenile habitat was prevalent with adult salmonid passageway and resting and holding areas being found along the reach. There are therefore species present, or that can be assumed to be present at, upstream and downstream of the proposed works that need to be considered in the design of any mitigation; these include lamprey and salmon.

While WCC is apparently now absent, there is good habitat, and the river is a site for potential reintroduction in due course. No evidence of WCC was found at the proposed site during hand search and trapping surveys. However, the sensitivity and conservation importance of this species, its listing as a QI feature for the SAC, and its presence within the system prior to the outbreak of crayfish plague, means that consideration of this species is required irrespective of whether it is recorded. A preliminary recommendation therefore is to consider habitat restoration for WCC following the works as extensive areas of suitable habitat were found throughout the site.

Himalayan Balsam is present on both sides of the river within the riparian zone along the entire stretch of the surveyed area, with dense areas being observed, including within the area of proposed works. It is recommended that this invasive species is removed by an approved contractor following best practice prior to works and prior to the formation of seed pods which may cause the species to spread further within the site.

Possible mitigation to prevent a reduction in water quality and damage to the river channel habitats following the works may include improved fencing along the riverbank and riparian zone, along with provision of drinking troughs, in order to prevent the poaching from livestock which was evident at a number of locations along the channel surveyed.

References

APEM (2023). *Graiguenamanagh – Tinnahinch Flood Relief Scheme Desk Study Baseline Report*. ByrneLooby, APEM Scientific report P00010978. March 2023.

Aquafact (2021) *Electrofishing survey of The Duiske River, Graiguenamanagh, Co. Kilkenny.* Unpublished report for ByrneLooby.

Delanty, K., Kelly, F.L., McLoone, P., Matson, R., O' Briain, R., Gordon, P., Cierpal, D., Connor, L., Corcoran, W., Coyne, J., Feeney, R., Morrissey, E. (2017) *Fish Stock Assessment of the River Barrow Catchment 2015*. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Department of Culture, Heritage and the Gaeltacht (2019). *Crayfish Plague Status, August 2019*. https://invasives.ie/app/uploads/2021/09/Crayfish-plague-map-20190820.pdf.

Feeley, H.B., Bradley, C., Free, G., Kennedy, B., Little, R., McDonnell, N., Plant, C., Trodd, W., Wynne, C., and O'Boyle, S. (2020). A national macroinvertebrate dataset collected for the biomonitoring of Ireland's river network, 2007–2018. *Scientific Data* 7, 280.

Gammell, M., McFarlane, A., Brady, D., O'Brien, J., Mirimin, L., Graham, C., Lally, H., Minto, C. and O'Connor, I. (2021). *White-clawed Crayfish* Austropotamobius pallip*es survey in designated SACs in 2017. Irish Wildlife Manuals, No. 131.* National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland.

Harvey, J.P. and Cowx, I.G. (2003). *Monitoring the River, Brook and Sea Lamprey,* Lampetra fluviatilis*, L. planeri and* Petromyzon marinus*.* Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Heggenes, J. 1990. Habitat utilization and preferences in juvenile Atlantic salmon (*Salmo salar*) in streams. *Regulated Rivers: Research & Management* 5(4), pp.341-354.

Hendry, K. and Cragg-Hine, D. (1997). *Restoration of riverine salmon habitats.* Fisheries Technical Manual, 4.

JNCC (2015). *Common Standards Monitoring Guidance for Freshwater Fauna (2015).* Joint Nature Conservation Committee. ISSN 1743-8160.

King, J. (2006) The status and distribution of lamprey in the River Barrow SAC. Irish Wildlife Manuals No. 21. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Maitland P.S. (2003). *Ecology of the River, Brook and Sea Lamprey.* Conserving Natura 2000 Rivers Ecology Series No. 5. English Nature, Peterborough, 54pp.

Peay, S. (2003). *Monitoring the white-clawed crayfish* Austropotamobius pallipes*.* Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.

Toner, P., Bowman, J., Clabby, K., Lucey, J., McGarrigle, M., Concannon, C., Clenaghan, C., Cunningham, P., Delaney, J., O'Boyle, S., MacCarthaigh, M., Craig, M. and Quinn, R. (2005). *Water Quality in Ireland: 2001– 2003.* Environmental Protection Agency, Johnstown Castle Estate, Wexford, Ireland.

Appendix A: Figures

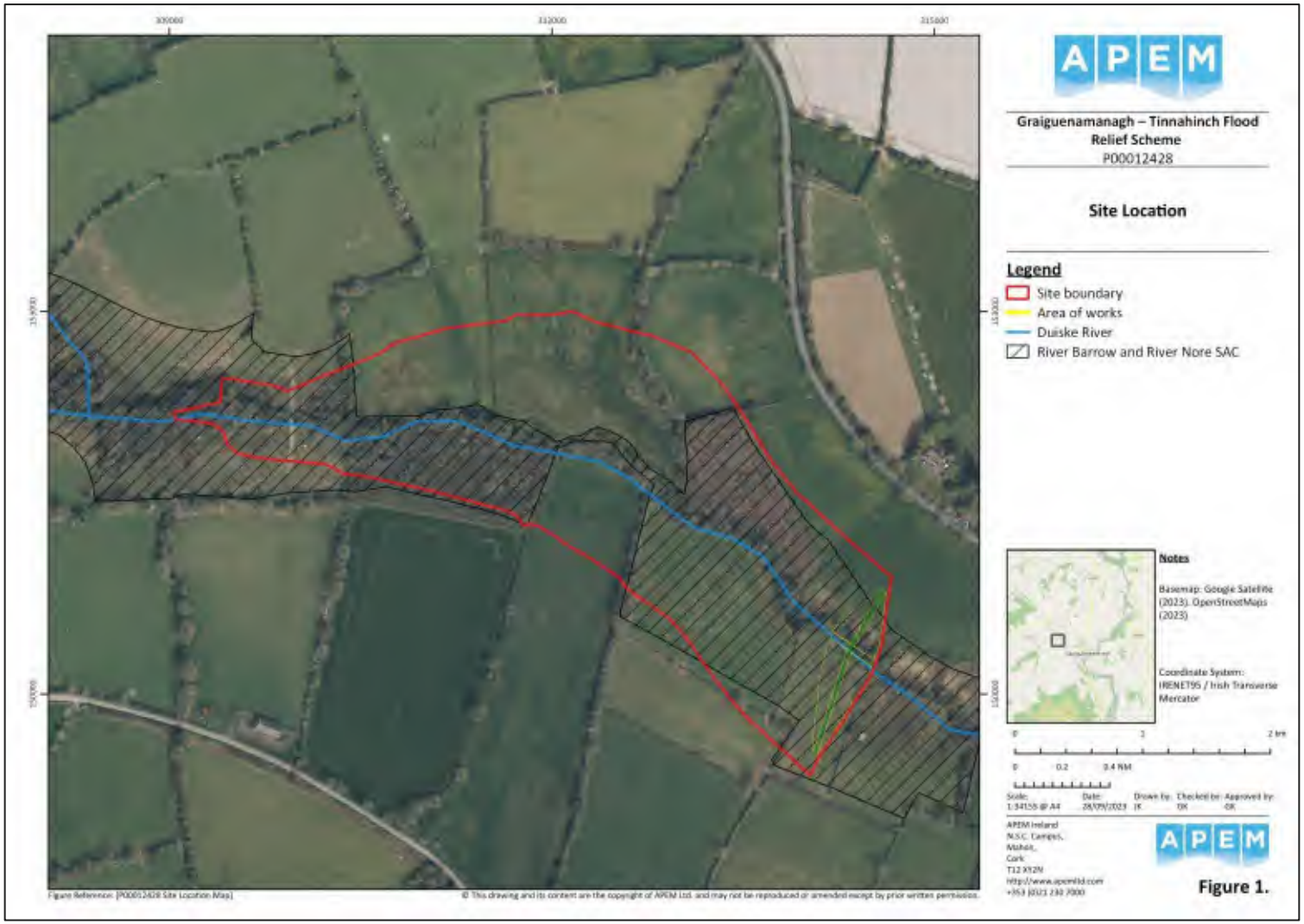


Figure 1 Site location at Graiguenamanagh

Figure 2 Survey locations at Graiguenamanagh

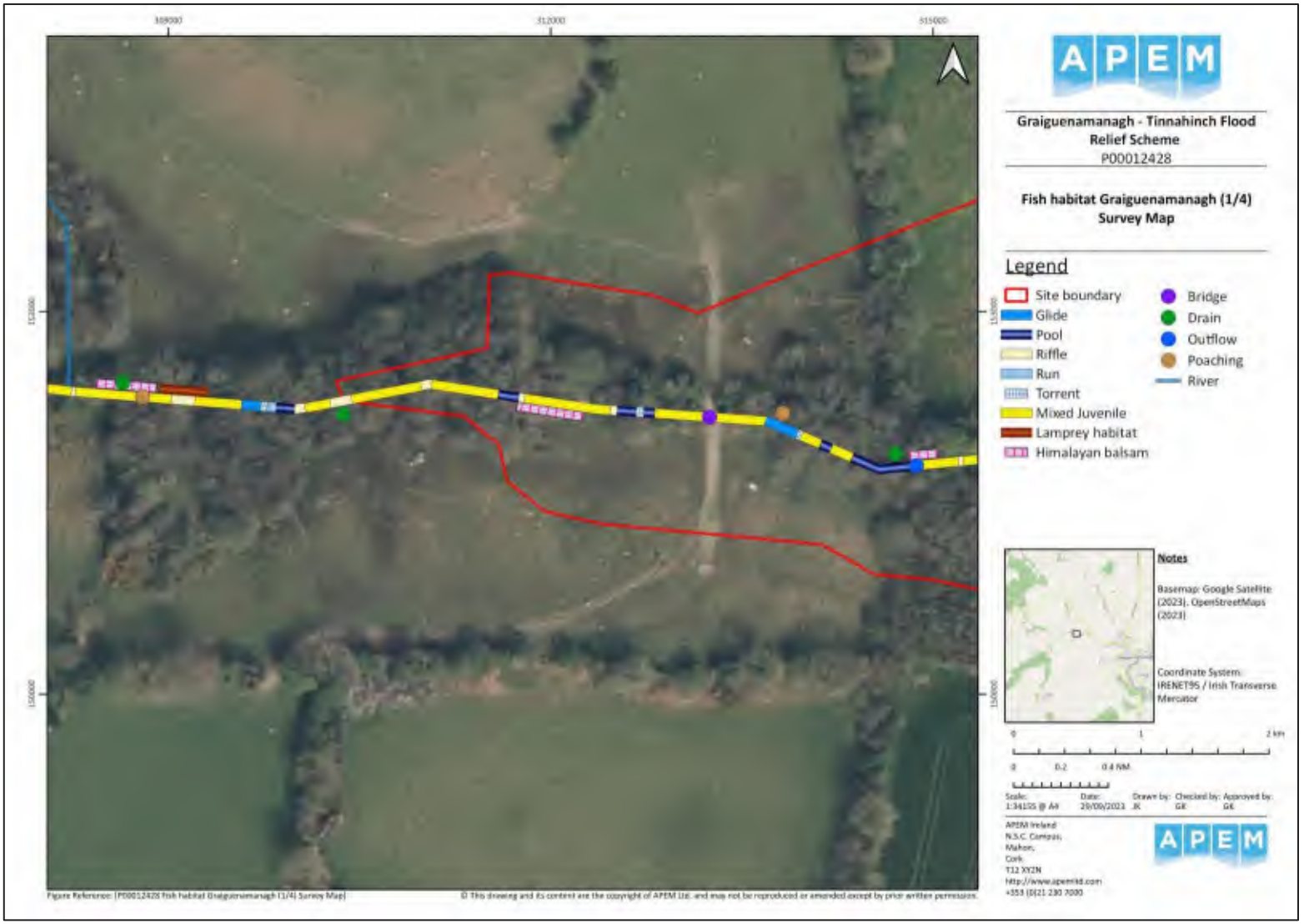


Figure 3 Fish habitats present at Graiguenamanagh 1/4

Figure 4 Fish habitats present at Graiguenamanagh 2/4

Figure 5 Fish habitats present at Graiguenamanagh 3/4

Figure 6 Fish habitats present at Graiguenamanagh 4/4

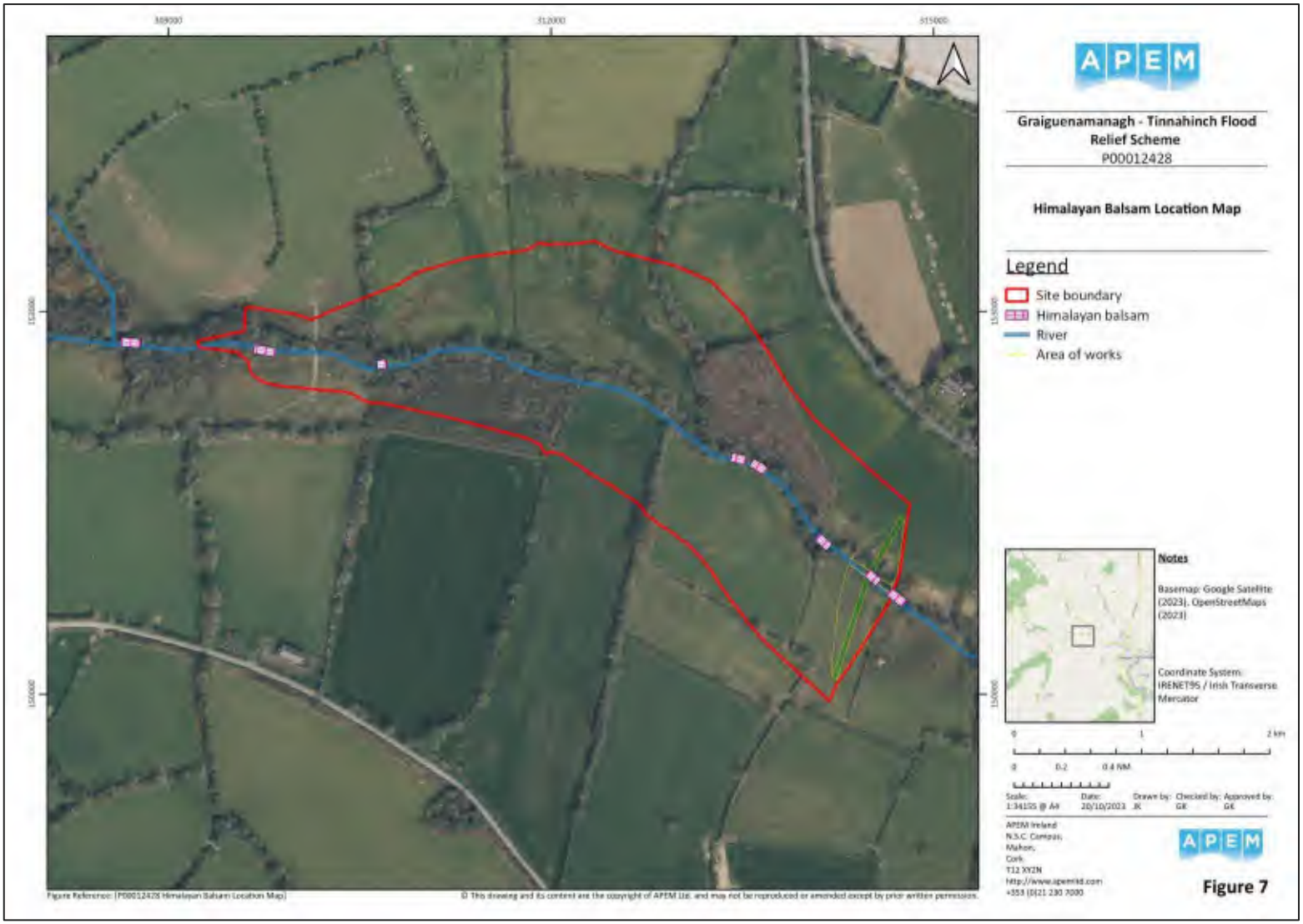


Figure 7 Dense stands of Himalayan Balsam present within and nearby the Site at Graiguenamanagh

Appendix B: Plates

Plate 1 Kick sample and water quality Site 1

Plate 2 Kick sample and water quality Site 2

Plate 3 Kick sample and water quality Site 3

Plate 4 Suitable lamprey habitat - 1

Plate 5 Suitable lamprey habitat - 2

Plate 6 Suitable lamprey habitat - 3

Plate 7 Suitable mixed juvenile salmonid habitat - 1

Plate 8 Suitable mixed juvenile salmonid habitat - 2

Plate 9 Suitable mixed juvenile salmonid habitat - 3

Plate 10 Suitable mixed juvenile salmonid habitat -4

Plate 11 Suitable mixed juvenile salmonid habitat - 5

Plate 12 Suitable mixed juvenile salmonid habitat with abundant crayfish refuges present

Plate 13 Suitable crayfish habitat - 1

Plate 14 Suitable crayfish habitat - 2

Plate 15 Potential spawning habitat - 1

Plate 16 Potential spawning habitat - 2

Plate 17 Crayfish traps in situ - 1

Plate 18 Crayfish traps in situ - 2

Plate 19 Himalayan balsam along the riverbank - 1

Plate 20 Himalayan balsam along the riverbank - 2

Plate 21 Land drain outflow - 1

Plate 22 Land drain outflow -2

Plate 23 Livestock access point with poaching

Appendix C: Description of Q Value Assessment and Taxa List

1 Q-Value Assessment

The EPA Q-value classification is assigned based on the assessment of a macroinvertebrate sample, which involves recording the taxa present at a suitable and attainable taxonomic resolution (under field conditions) and their categorical relative abundance determined using approximate counts (as described in Feeley *et al*., 2020). From this, the number of taxa present and categorical relative abundance of sensitive (Group A), less sensitive (Group B), tolerant (Group C), very tolerant (Group D) and most tolerant (Group E) taxa to organic pollution is examined. Additional Qualifying Criteria are also considered, consisting of recording the abundance of *Cladophora* spp, macrophytes, and slime growths / sewage fungus, as well as dissolved oxygen percent saturation and the level of substratum siltation. Then, based on the combination of number and relative abundance of the sensitive or tolerant groups present, a Q-value is assigned. Details on the assignment of the scores can be found in Toner *et al*., (2005).

In Ireland, macroinvertebrates are the main Biological Quality Element (BQE) determining the ecological status in rivers (required by the Water Framework Directive; WFD), based on the Q-value. The WFD requires BQE scores to be expressed as an Ecological Quality Ratio (EQR) to standardize and provide a common scale of ecological quality across participatory Member States using differing national methods. Intercalibration of the Q-value with the EQR and the corresponding ecological status are described in Table 0-1.

Table 0-1. EPA water quality status summary

Comparing the Q-value, ecological quality ratio (EQR), corresponding Water Framework Directive (WFD) status and pollution gradient resulting from anthropogenic pressures (Feeley et al., 2020).

Q value Score	EQR	Pollution Gradient	WFD Ecological Status
Q5	1.0	Unpolluted	High
Q4-5	0.9	Unpolluted	High
Q4	0.8	Unpolluted	Good
Q3-4	0.7	Slightly Polluted	Moderate
Q3	0.6	Moderately Polluted	Poor
Q2-3	0.5	Moderately Polluted	Poor
Q2	0.4	Seriously Polluted	Bad
Q1-2	0.3	Seriously Polluted	Bad
Q1	0.2	Seriously Polluted	Bad

2 Macroinvertebrate taxa and abundance recorded

Table 0-2. List of taxa and abundance recorded at each site during August sampling

Taxa	Group	Site 1	Site 2	Site 3
Ecdyonurus sp.	A		1	1
Rhithrogena sp.	A			1
Leuctra sp.	B	19		16
Agapetus sp.	B		2	
Glossosoma sp.	B			1
Goeridae	B			
Sericostomatidae	B	7		5
Limnephilidae	B	5	1	2
Baetis rhodanii	C		6	13
Serratella ignita	C	17	13	16
Hydropsyche sp.	C	10		6
Chimarra marginata	C	1		
Wormaldia sp.	C	6		
Philopotamus montanus	C	31		
Rhyacophila sp.	C	4	2	1
Elmidae	C	74	61	117
Chironomidae	C	19	4	55
Simuliidae	C	17	20	32
Pediciidae	C	8	19	14
Gammarus sp.	C	6	4	19
Ancylus fluviatilis	C			1
Lymnaeidae	C	1		
Ceratopogonidae		1	1	
Dixa sp.				1
Naididae		2		3
Lumbriculidae		3		2
Lumbricidae		1	9	2
Total number of individuals		232	143	308
Total number of taxa		19	13	20
Total number of Q value taxa		15	11	16

Appendix D: Fish habitat surveys

1. Salmonid habitat assessment

The principal instream physical habitat variables that determine suitability for juvenile salmonids are water depth, water velocity, streambed substratum and cover (Heggenes 1990). The habitat types and their descriptions are outlined in Table 0-1 and were recorded, where present, during the survey.

Table 0-1. Habitat classification system for salmonids

Habitat type	Description
Spawning Gravel	Ideally stable but not compacted, with a mean grain size 25 mm or less for trout, but up to 80 mm for salmon. 'Fines' (< 2 mm grain size) to be less than 20% by weight.
Fry (0+) habitat	Shallow, < 20 cm deep, fast flowing (> 30 cm/s), with surface turbulence and a gravel and cobble substrate
Parr (>1+) habitat	20 - 30 cm deep, fast flowing (>30 cm/s), surface turbulent, with gravel / cobble / boulder substrate.
Riffles	Shallow (< 30 cm deep), fast-flowing (> 50 cm/s), surface turbulent, gravel / cobble / boulder substrate.
Glides	= or > 30 cm deep, moderate velocity in range 10-30 cm/sec, surface smooth and unbroken, relatively even substrate of cobbles with finer material
Pools	= or > 40 cm deep, slow flowing (< 10 cm/s), surface unbroken, substrate with a high proportion of sand and silt.
Run	= or > 40 cm deep, moderate flow (>10 – 100 cm/s), broken surface. Often the interface between pool, glide and other habitats
Mixed Juvenile	10 - 30 cm deep, fast flowing (>30 cm/s), surface turbulent, with gravel /cobble / boulder substrate.

In addition to the habitats listed in Table 0-1, other features within the study site are noted including:

- The existence of physical barriers to fish migration which are graded 1-3 (G1 being impassable at Q90 flow conditions and G3 passable under Q90 flow conditions).
- Areas of excessive erosion which could cause siltation of spawning habitat- e.g., areas where cattle enter the river.
- Anthropogenic alterations to the channel which could affect fish migration.
- Areas which could cause difficulties for migrating or spawning individuals during periods of low water levels (e.g., shallow areas near weirs, spawning gravels etc.).
- Locations where branches cross the entire channel giving rise to tunnel vegetation.

2. Lamprey habitat assessment

The guidance published in JNCC (2015) was applied to lamprey habitat assessments. Our approach followed Natura 2000 guidance for the monitoring of river, brook and sea lamprey (*Lampetra fluviatilis, Lampetra planeri* and *Petromyzon marinus*; Harvey and Cowx 2003) and included assessment of habitats using visual mapping of substrates suitable for adult and Juvenile lamprey (Maitland 2003). The habitats suitable for lamprey spawning and larval lamprey (ammocoetes) are outlined in Table 0-2 and were recorded, where present, during the survey.

Table 0-2. Definitions of ecologically functional habitat types for lamprey
(based on Maitland 2003; Harvey & Cowx 2003)

Species / Life stage	Habitat Description
Lampetra spp. spawning	Areas of small stones and gravel in shallow flowing water
Petromyzon marinus spawning	Flowing water amid larger gravel/cobble
Lampetra spp. ammocoetes	Stable fine sediment or sand > 15 cm deep, low water velocity and the presence of organic detritus
Petromyson marinus ammocoetes	Non-marginal (open channel) sites of >1.5 m depth featuring fine sand and silt accumulations; lower velocity areas of pools and glide habitat

Appendix L: Q-Value Survey Photographs (2024)

Figure L.1: Kick Sample equipment and set up for examining invertebrates – 27/06/2024.

Figure L.2: ST1 Group A invertebrates – 27/06/2024.

Figure L.3: ST1 Group B invertebrates – 27/06/2024.

Figure L.4: ST1 Group C invertebrates – 27/06/2024.

Figure L.5: ST1 Group D invertebrates – 27/06/2024.

Figure L.6: ST1 Group E invertebrates – 27/06/2024.

Figure L.7: ST2 Group A invertebrates – 27/06/2024.

Figure L.8: ST2 Group B invertebrates – 27/06/2024.

Figure L.9: ST2 Group C invertebrates – 27/06/2024.

Figure L.10: ST2 Group D invertebrates – 27/06/2024.

Figure L.11: ST2 Group E invertebrates – 27/06/2024.

Figure L.12: ST3 Group A invertebrates – 27/06/2024.

Figure L.13: ST3 Group B invertebrates – 27/06/2024.

Figure L.15: ST3 Group D invertebrates – 27/06/2024.

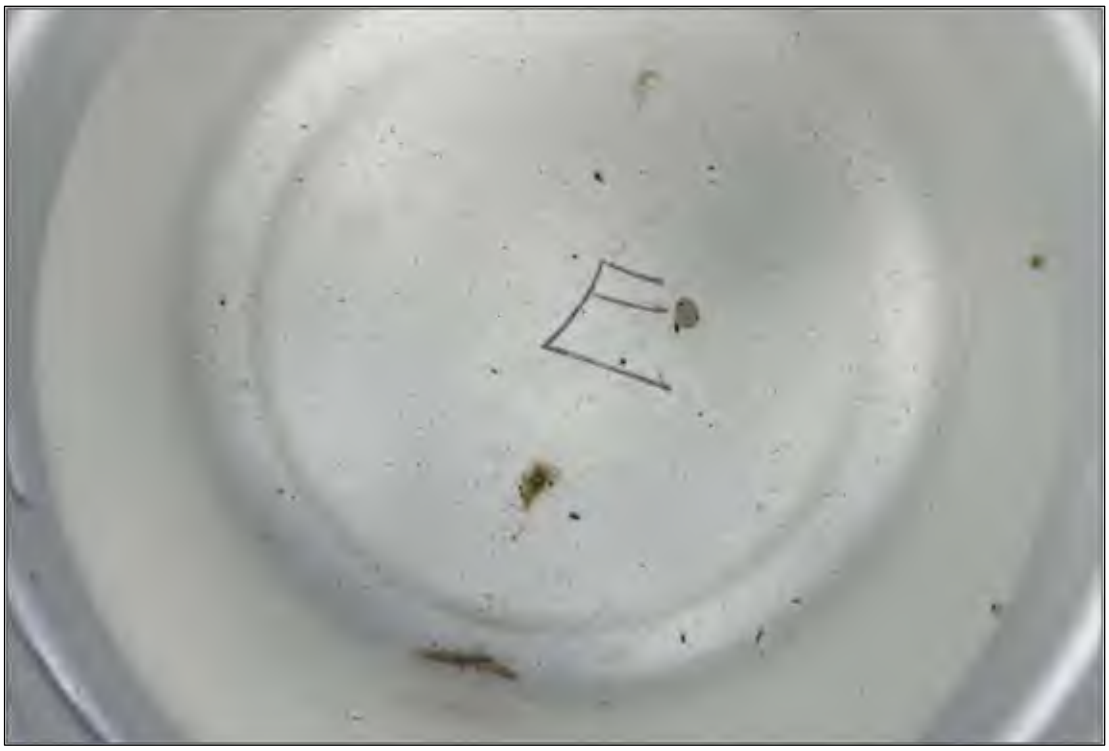


Figure L.16: ST3 Group E invertebrates – 27/06/2024.

Figure L.17: ST4 Group A invertebrates – 27/06/2024.

Figure L.18: ST4 Group B invertebrates – 27/06/2024.

Figure L.19: ST4 Group C invertebrates – 27/06/2024.

Appendix M: Electrofishing Survey Report (Original CFRAM Survey) (AQUAFACT, 2021)

Electrofishing survey of
The Duiske River, Graiguenamanagh,
Co. Kilkenny

Produced by

AQUAFACT International Services Ltd

On behalf of

Byrne Looby

February 2021

AQUAFACT International Services Ltd.,
12 Kilkerrin Park,
Galway.
www.aquafact.ie
info@aquafact.ie
Tel: +353 (0) 91 756812

Table of Contents

Introduction

This survey was conducted by Ross Macklin on behalf of Aquafact International on the 10th of February 2021 as part of the Graiguenamanagh-Tinnahinch flood relief scheme commissioned by Kilkenny County Council along with Carlow County Council and the Office of Public Works to alleviate the risk of flooding to the communities of Graiguenamanagh-Tinnahinch.

This purpose of this survey is to assess the condition of fish stocks within the Duiske River and the results would help to aid in the design of the flood relief scheme.

AQUAFACT International Services Ltd obtained authorisation under Section 14 of the Fisheries (Consolidation) Act, 1959 as substituted by Section 4 of the Fisheries (Amendment) Act, 1962 to undertake electrical fishing surveys at locations along the Duiske River, Co. Kilkenny, to provide baseline data to inform environmental impact assessment ahead of a planned flood relief scheme for the town of Graiguenamanagh.

Survey Sites

The Duiske River is formed by the confluence of several smaller streams around Graiguenamanagh. It drains approximately 24km^2 and discharges into the River Barrow immediately downstream of Graiguenamanagh Bridge, Co. Kilkenny on the upstream side of a major weir.

Underlying geology consists of mainly slate and schist. Land use of the surrounding area is dominated by pasture with some forestry plantations in the upper part of the catchment. As the river passes through Graiguenamanagh Town, artificial retaining walls alter the course of the river. The mid to lower reaches of the Duiske River forms part of the Barrow SAC (002162).

Three survey sites were chosen as shown below in figure 1. D1 on the Graiguenamanagh Stream (IE_SE_14D040200). D2 and D3 are located on the Duiske River (IE_SE_14D01_0150) within Graiguenamanagh Town.

Previous surveys have identified the majority of sites surveyed on the Duiske as being of Good Ecological Status in regards to Fish under the EU Water Frameworks Directive (Delanty *et al*., 2017).

Previously, species such as Atlantic salmon, brown trout, European eel and lamprey sp. have been encountered within the Duiske River. It has also been identified as a potentially important nursery ground for Atlantic salmon (*Salmo salar*) by Delanty *et al.* (2017) and for Lamprey by King (2006).

According to the EPA's Report on River Water Quality in Co. Kilkenny 2013, the Q values of the Duiske River were Q3-4 and the water chemistry was satisfactory other than slightly

elevated nitrate levels. Pressures on the river were identified as urban dumping of household rubbish within Graiguenamanagh which was observed during their most recent survey in 2011.

Figure 1: Map showing the three electrofishing locations on the Duiske River and the Graiguenamanagh Stream.

Site D1

The Graiguenamanagh Stream at site D1 was a moderate energy lowland depositing channel (FW2). The channel had 1m high banks, was 1m to 1.5m wide and had water depths between 0.15m and 0.3m. The stream had been historically straightened west of the Borris Road (R705) and the stream was culverted underground from the R705 crossing to the Duiske River confluence downstream. The bed was comprised of scattered boulders and cobbles but was dominated by sand and silt with lesser quantities of gravels. The harder substrata were heavily bedded and siltation levels were moderate overall. The macrophyte composition was dominated by *Apium nodiflorum* and *Oenanthe aquatica* that made up 40% by surface area of the streambed combined. *Cladophora glomerata* green filamentous algae covered 10% of the bed. The riparian areas comprised open wet (rushy) semi improved grassland.

Site D1 - Graiguenamanagh Stream	Conductivity (µS/cm)	317	
Date: 10th February 2021	Temperature °C	5.7	
River conditions: Base flow and clear	Elapsed Time	600s	
	Fishing Time	450s	
Elevation: 37m	GPS us end (dd)	52.54755206	-6.958477104
	GPS ds start (dd)	52.54687845	-6.958537284
	Site Dimensions and Area	90m*1.5m	135m^2

Site D2

Site D2 was a lowland depositing watercourse (FW2) that had a 4-5m water width and an average depth of 0.4m. The river deepened locally to 0.6m in pool habitat. The profile comprised 20% pool, 50% riffle and 30% glide and representative of a good quality semi-natural salmonid river. Exposed beds of built-up cobble, gravel and boulder supported frequent emergent *Oenanthe crocata* that further adding to flow diversity. The Duiske River also had more well developed riparian areas than downstream supporting mature alder and willow with dense bramble scrub in the understories. The channel was not heavily impounded by retaining walls as with downstream and had a lower gradient that resulted in a more stable bed greatly benefiting spawning viability. The riverbed supported boulders locally but was dominated by cobbles with well sorted coarse, medium and fine gravels that were unbedded with light siltation. Beds of sand and silt with a high organic fraction were present in the depositing margins adjoining pool habitat. The river supported locally frequent *Ranunculus* sp. (30% cover) which is an extremely important plant for juvenile salmonid populations.

Site D2 - Duiske (Well Lane footbridge)	Conductivity (µS/cm)	236	
Date: 10th February 2021	Temperature °C	6.4	
River conditions: Base flow and clear	Elapsed Time	600s	
	Fishing Time	380s	
Elevation: 16m	GPS us end (dd)	52.54212717	-6.956910104
	GPS ds start (dd)	52.54158303	-6.956362787
	Site Dimensions and Area	70m*4m	280m^2

Site D3

Site D3 was an upland eroding river (FW1) channel in the lower reaches of the Duiske River, *i.e.* a section of steepened gradient. The river had a 3-4m water width and an average depth of 0.3-0.5m with very swift flows. The river depth deepened locally to 0.6m in pool habitat, *i.e*. artificial weir and meander that were the most significant holding habitat areas within the survey reach. The river profile comprised of 10% pool, 60% fast glide and 30% riffle. The river was held between concreted retaining walls, 2.5-3m high in a realigned section of channel located upstream of the road bridge. Overall, the channel was heavily modified at site D1 but retained good semi-natural characteristics in terms of flow diversity. The channel supported localised exposed beds of built-up cobble, gravel and boulder that supported frequent emergent *Oenanthe crocata*. It also supported abundant *Ranunculus* sp. (40% cover) which greatly improved the nursery value of the Duiske River. The instream boulder and concreted weir and walls supported the riverine moss species *Cinclidotus fontinaloides* and *Brachythecium rivulare.* The riparian zone comprised built land (BL3) on both banks.

Site D3 - Duiske, Graignamanagh Town centre	Conductivity (µS/cm)	236	
Date: 10th February 2021	Temperature °C	6.4	
River conditions: Base flow and clear	Elapsed Time	600s	
	Fishing Time	320s	
Elevation: 20m	GPS us end (dd)	52.5401302	-6.955719109
	GPS ds start (dd)	52.53956131	-6.95542303
	Site Dimensions and Area	50m*4m	200m^2

Materials and Methods

Surveying took place on the 10th of February 2021 across three sites, D1 on the Graiguenamanagh Stream, D2 and D3 on the Duiske River.

Electrofishing was carried out using battery powered backpack electrofishing equipment (Smith-Root Lr-24) which was deployed at 240v / 40Hz / 18% duty cycle pulse DC settings across all survey locations.

At each site, electrofishing was carried out over an elapsed time period totalling 10 minutes (600 seconds). Actual fishing time during this period was provided by a 'fishing on' timer mechanism on the LR-24.

For salmonid species and European eel, electro-fishing was carried out in an upstream direction for a 10-minute CPUE, an increasingly common standard approach for wadable streams (Matson *et al.,* 2018).

Electrofishing for lamprey ammocoetes was conducted as per Harvey & Cowx, (2003) by targeting areas of sand/silt, where encountered by using a low frequency (20-30Hz). This was used in combination with the burst of pulses direct current setting to optimize lamprey ammocoete capture without physical damage. This was carried out after completion of the 10-minute CPUE salmonid and eel electrofishing.

Results

Five species were encountered during the survey, namely, brook lamprey (*Lampetra planeri)*, Atlantic salmon (*Salmo salar*), brown trout (*Salmo trutta)*, European Eel (*Anguilla anguilla)* and stone loach (*Barbatula barbatula*).

Atlantic Salmon were present at the two sites on the Duiske River but were absent at site D1 on the Graiguenamanagh Stream. Brown Trout were present at all of the survey locations. Brook lamprey were present at two of the three sites being absent at the most downstream site D3. Eels were present at both sites on the Duiske River but were absent at site D1 on the Graiguenamanagh Stream. A single Stone Loach was found on the most downstream survey site D3.

Table 1: Results showing the number and minimum density of each species captured at each of the three sites.

Site Number	0+ brown trout		1++ brown trout		0+ salmon		1++ salmon		European eel		Brook lamprey	
	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2	No.	No./m^2
D1	0		3	0.022							3	0.022
D2	11	0.039	9	0.032	8	0.029	7	0.025	3	0.011	35	0.125
D3	8	0.04	3	0.015	14	0.07	7	0.035	2	0.01		

Length Distribution

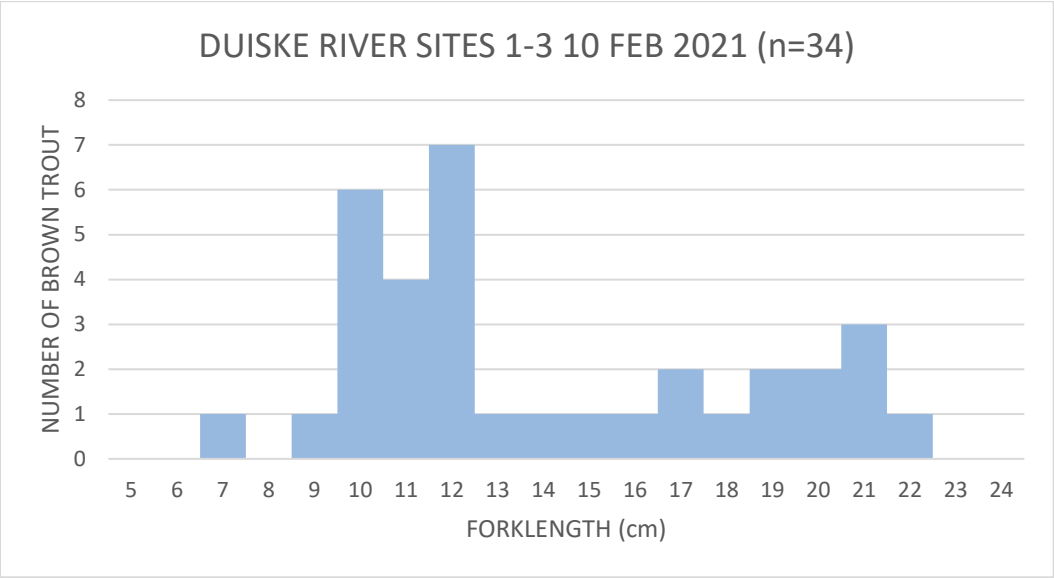


Figure 2: 1 Length frequency distribution of brown trout recorded during the February 2021 three site survey on the Duiske River (fish less than 13cm long are considered 0+).

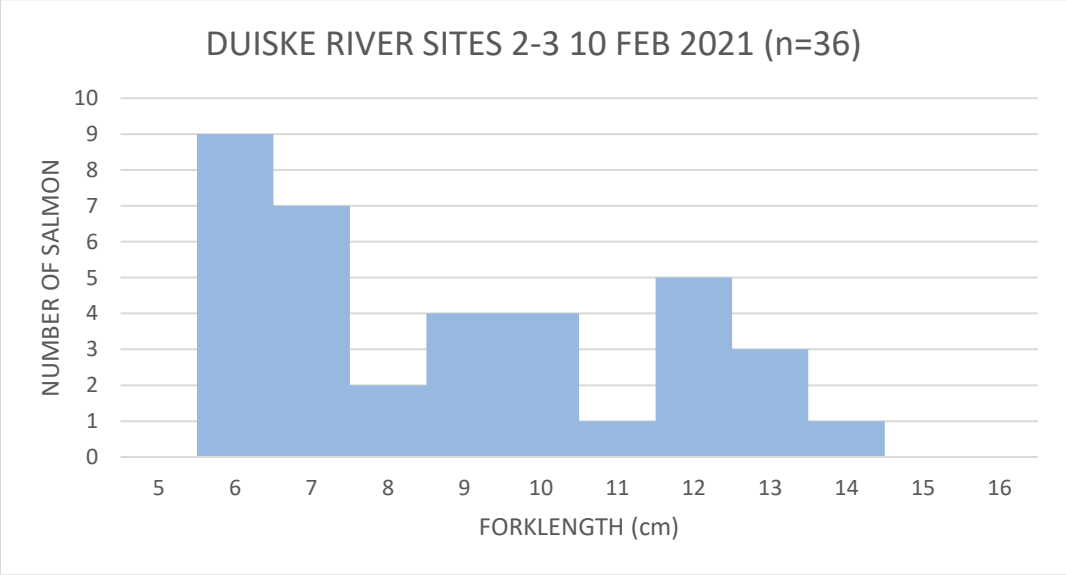


Figure 3: Length frequency distribution of Atlantic salmon recorded during the February 2021 three site survey on the Duiske River (fish less than 10cm long are considered 0+).

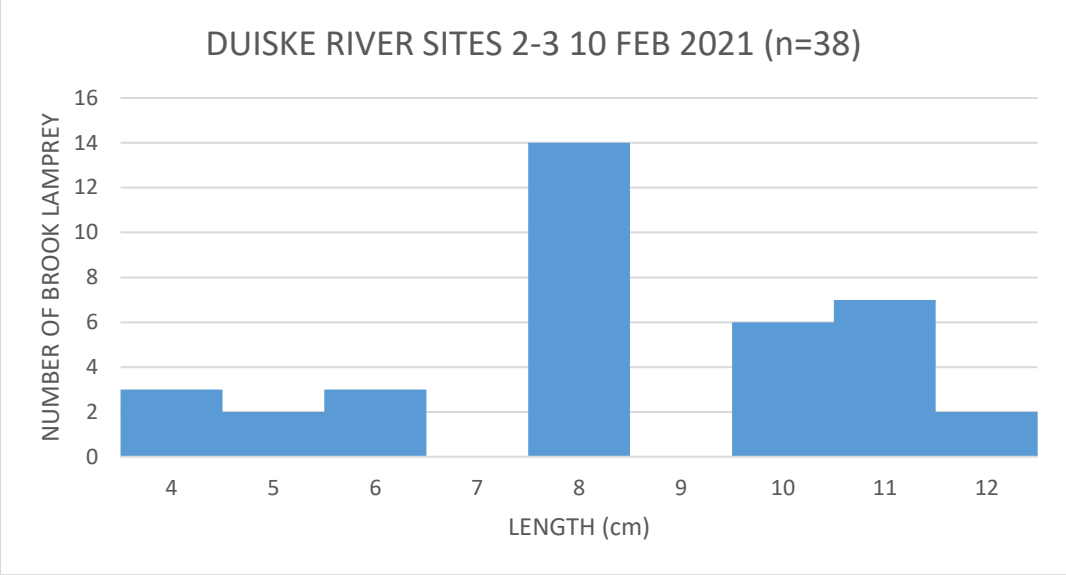


Figure 4: Length distribution of Brook Lamprey across all survey sites.

Brown trout lengths ranged from 7.6-22.4cm, with fish less than 13cm considered to be in the 0+ age group (n=19) and larger fish were considered to be in the 1++ age group (n=15).

Atlantic salmon lengths ranged from 6.3-14.5cm, with fish less than 10cm in length considered to be part of the 0+ age group (n=22) and larger fish were considered to be in the 1++ age group (n=14)

Brook lamprey lengths ranged from 4.6-12.1cm. Brook Lamprey cannot be easily aged from length distributions and therefore no ages were assessed.

Discussion

The Graiguenamanagh Stream, site D1, was a poor to moderate quality spawning channel due to the compacted bed and very limited clean gravels. The nursery value appeared good with riffle and glide sequences and macrophyte cover. However, the fisheries survey results did not reflect this given an absence of juvenile trout. This was considered consequential of the poor spawning habitat rather than the river profile attributes. The channel had very localised pool and deeper glide habitat that supported a small adult trout population. The poor downstream connectivity with the Duiske due to extensive culverting and smaller size of the channel likely accounted for the absence of both European eel and Atlantic salmon that were present downstream (sites D2 & D3). The stream supported moderate quality brook lamprey habitat with localised sand/ silt beds on meanders near glide and pool. The ammocoete densities recorded in these patches of habitat were low indicating that while small local populations were present, the habitat was sub-optimal overall. Never the less, lamprey habitat is often fragmented and isolated in small stream habitats and the presence of any local populations can be considered of high conservation value.

Threats to the site are the historical artificial straightening of the river and a risk of siltation.

In terms of fisheries value, the Duiske River was considered a very good quality salmonid nursery given its larger size and semi-natural profile*, i.e.* mixed glide, riffle and pool sequences. The Atlantic salmon densities also indicate it of very high importance in the Barrow catchment as an Atlantic salmon nursery.

Salmonid spawning habitat at site D2 was considered overall very good given the presence of well sorted coarse, medium and fine gravels amongst cobble. Holding habitat was also good due to the presence of deeper glide and pool. The combination of very good nursery and spawning habitat was reflected in the very good numbers of juvenile salmonids, including mixed cohorts of Atlantic salmon parr. Eel habitat was moderate overall due to downstream impediments to eel passage (*i.e.* weir) with small numbers captured. Lamprey ammocoete habitat was excellent locally with silt and sand beds in pool and glide slack areas supporting healthy populations. The sediment was light and uncompacted with good organic content and indicating very high suitability for ammocoetes. Very good ammocoete habitat was recorded adjoining both bridge abutments at the Well Lane footbridge.

Salmonid spawning habitat at site D3 was considered moderate but improved to good locally given pockets of coarse, medium and fine gravels in pool tailings. Holding habitat was limited overall due to a paucity of deeper pools which was reflected in the lower number of adult salmonids recorded. The combination of good nursery habitat and moderate-good spawning was reflected in the good numbers of juvenile salmonids, including mixed cohorts of Atlantic salmon. Eel habitat was moderate overall due to more limited pools, bedded substrata (due to high flows) and impediments to fish passage (i.e. weir). Lamprey ammocoete habitat was not recorded present due to the high energy of the lower Duiske River and the absence of any significant accumulations of suitable ammocoete burial habitat. Very good lamprey ammocoete habitat is known to be present outside of the survey reach downstream near the Duiske confluence with the River Barrow (pers. obs.).

A small weir 0.5m high located downstream of a small bridge (52.54008488 W, -6.95567596 N) was identified as a potential threat to eel passage in the river.

The results of the February 2021 surveys would be expected to result in fewer fish being captured compared to a similar survey carried out in, say, June – September 2021. By the time February 2020 comes around, there would be fewer and larger 0+ / 1+ salmonids in the stream because juvenile salmonids require larger territories as they grow and consequently occur at a lower density that might have pertained during June – September 2020.

Also, the river flow conditions for sites studied in February 2021 meant that the wetted area equalled the bank to bank stream dimensions whereas for surveys carried out during the summer months the wetted area might be expected to be significantly less than bank to bank stream dimensions resulting is lower wetted area estimates and correspondingly higher minimum density estimates for fish.

References

Delanty, K., Kelly, F.L., McLoone, P., Matson, R., O' Briain, R., Gordon, P., Cierpal, D., Connor, L., Corcoran, W., Coyne, J., Feeney, R., Morrissey, E. (2017). Fish Stock Assessment of the River Barrow Catchment 2015.
Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

King, J. (2006) The status and distribution of lamprey in the River Barrow SAC.
Irish Wildlife Manuals No. 21. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Harvey, J. & Cowx, I. (2003) Monitoring the River, Brook and Sea *Lamprey, Lampetra fluviatilis, L. planeri* and *Petromyzon marinus*. Conserving Natura 2000 Rivers Monitoring Series No. 5, English Nature, Peterborough.

Matson, R. Delanty, K., Shephard, S. Coghlan, B. and Kelly, F. (2018) Moving from multiple pass depletion to single pass timed electrofishing for fish community assessment in wadeable streams, Fisheries Research, Volume 198. Inland Fisheries Ireland, 3044 Lake Drive, CityWest Business Campus, Dublin D24 Y265, Ireland.

Appendix N: White-Clawed Crayfish Survey Report (Original CFRAM Survey) (Triturus Environmental Ltd., 2021)

Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (*Austropotamobius pallipes*) survey

Prepared by Triturus Environmental Ltd. for ByrneLooby

June 2021

Please cite as:

Triturus (2021). Graiguenamanagh-Tinnahinch Flood Relief Scheme white-clawed crayfish (*Austropotamobius pallipes*) survey. Report prepared by Triturus Environmental Ltd. for ByrneLooby. June 2021.

Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. was contracted by ByrneLooby to undertake a baseline white-clawed crayfish (*Austropotamobius pallipes*) survey of the watercourses in the footprint of the proposed Graiguenamanagh-Tinnahinch Flood Relief Scheme (FRS) located near Graiguenamanagh, Co. Kilkenny (**Figure 2.1, Table 2.1**).

The OPW, working in partnership with Kilkenny County Council (KCC), Country Carlow Council (CCC) and other Local Authorities, commissioned and have completed the South Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study. The South Eastern CFRAM study area included Graiguenamanagh-Tinnahinch as an Area for Further Assessment (AFA) and concluded that a flood relief scheme would be viable and effective for the community. The viable scheme (currently under review) is comprised mainly of construction of hard defences and associated works through the urban area of Graiguenamanagh along the banks of both the River Duiske and River Barrow.

A viable scheme option for Graiguenamanagh-Tinnahinch was identified in the CFRAM level of assessment and the preferred measures outlined in the CFRAM comprise:

- Building hard defences, with at risk properties protected by a series of embankments and walls, sheet piled where necessary and set back where possible from, the river channel.
- Hard defences that would protect properties from the 1% AEP fluvial event and with an estimated average height of 1.56 m and total length of 1.31 km.

In light of the above, a white-clawed crayfish (*Austropotamobius pallipes*) survey was undertaken in April 2021 to establish the presence/absence of white-clawed crayfish in the vicinity of the proposed flood relief scheme footprint. This would identify the most important areas in the vicinity of the scheme for the species to inform design considerations to minimise negative effects on local populations. The scheme footprint was located within the River Barrow catchment (Barrow_SC_0130 sub-catchment) and encompassed the River Barrow and two tributaries (Duiske River and Graiguenamanagh River), in addition to a small historical mill race channel linking the Tinnapark Stream and lower Duiske River.

In the vicinity of the proposed FRS, the River Barrow (EPA code: 14B01) and tributary Duiske River (14D04) were located within the River Barrow and River Nore SAC (site code: 002162). Whilst not located within this European site, the Graiguenamanagh Stream (14G42), a tributary of the Duiske River, shared downstream hydrological connectivity with the River Barrow and River Nore SAC.

1.2 Conservation status of white-clawed crayfish in Ireland

The white-clawed crayfish (*Austropotamobius pallipes*) has been listed as endangered since 2010 on the IUCN Red List (Füreder *et al.*, 2010). Given increased pressure on the species' survival, it is listed under Appendix III of the Bern Convention (82/72/EEC) and Annexes II and V of the European Communities (Birds and Natural Habitats) Regulations 2011-2015 (S.I. No. 477/2011).

In Ireland, it is also protected nationally under the Wildlife Act, 1976 and the Wildlife (Amendment) 2000. The European Union (Invasive Alien Species) (Freshwater Crayfish) Regulations 2018 (SI 354/2018) affords further protection to native white-clawed crayfish by prohibiting the introduction and spread of (five no.) invasive 'Union concern' crayfish species listed under EU Regulation 1143/2014.

The current overall conservation status for white-clawed crayfish in Ireland is 'bad', with a deteriorating trend (NPWS, 2019), largely as a result of widespread crayfish plague (*Aphanomyces astaci*) outbreaks in several catchments since 2017.

1.3 Status of white-clawed crayfish in the Barrow catchment (desktop review)

White-clawed crayfish require hard, mineral rich waters flowing over (high calcium) calcareous substrates (Holdich, 2003). Consequentially, crayfish distribution follows many of Ireland's carboniferous limestone belts and occurs throughout the limestone-rich Irish midlands, including in the River Barrow (Lucey & McGarrigle, 1987; Demers *et al.*, 2005). White- clawed crayfish are listed as a qualifying interest for the River Barrow and River Nore SAC identifying the importance of the large river catchment for the species (NPWS, 2011). Populations of crayfish along the main River Barrow channel were, until recently, agreed as being particularly healthy and the species had a widespread distribution in the catchment. Historically, the species was present from the upper reaches and tributaries (Co. Laois) to the lower reaches at the Bahana Weir, St. Mullins. On the main channel of the River Barrow the species tends to favour areas downstream of weirs (pers. obs.) and under bridge aprons where large cobble and boulder is present. White-clawed crayfish also had healthy distributions in the smaller tributaries with improved river profile where well oxygenated water with abundant boulder and cobble substrata exist.

However, large-scale outbreaks of the water oomycete crayfish plague (*Aphanomyces astaci*) resulted in mass mortalities along the River Barrow main channel, from Carlow to Graiguenamanagh, in 2017 (NBDC data). Additional smaller-scale outbreaks were recorded from the upper Barrow catchment, upstream of previous outbreaks, in 2018 and again in 2019 (NPWS, 2019). Crayfish plague is highly infectious (water-borne spores) and usually leads to 100% mortality in a given white-clawed crayfish population within several weeks of infection (Holdich, 2003; Edgerton *et al.*, 2004). These outbreaks have significantly impacted crayfish populations within the River Barrow and the wider catchment (see Discussion for more details).

2. Methodology

2.1 White-clawed crayfish surveys

White-clawed crayfish (*Austropotamobius pallipes*) surveys were undertaken at a total of *n*=14 survey sites under a National Parks and Wildlife (NPWS) open licence (no. C145/2021), as prescribed by Sections 9, 23 and 34 of the Wildlife Act (1976-2018), to capture and release crayfish to their site of capture, under condition No. 6 of the licence.

2.1.1 Crayfish trapping

Twelve 51 x 20cm, 19mm mesh polypropylene Trappy crayfish traps (ballasted with extra rock to prevent excessive movement) were positioned in the vicinity of *n*=5 proposed instream works areas on the Duiske River and River Barrow (**Figure 2.1**). Traps were fished in pairs and were placed in suitable marginal areas overnight and retrieved the following morning. Traps were disinfected with Virkon between sites to minimise transfer of pathogens. All traps were baited with 100g of cat food to attract crayfish to the traps.

2.1.2 Hand-searching, sweep-netting & snorkelling

To expand survey area coverage, hand-searching of instream refugia (including sweep netting) was undertaken at a total of *n*=9 sites on the Duiske River and mill race channel, Graiguenamanagh River and the River Barrow (**Figure 2.1**). Surveys followed the methodology of Reynolds *et al.* (2010) and Peay (2003). A minimum of *n*=25 potential refugia (boulders, macrophyte beds, large woody debris, tree root systems *etc*.) were searched at each site. Additionally, instream snorkelling facilitated hand-searching of deeper areas of river channel (where applicable). An appraisal of white-clawed crayfish habitat at each site and in the wider survey area was also carried out based on physical channel attributes. Furthermore, an appraisal of crayfish distribution and habitat was completed whilst undertaking SCUBA dive surveys for the accompanying freshwater pearl mussel survey (Triturus, 2021) of the River Barrow within the survey area.

2.1.3 Riparian walkover survey (mustelid spraint)

Further to traditional survey methods, it was important to undertake a riparian walkover survey to examine any spraint from mustelids (*i.e*. otters & mink) which may contain crayfish remains. Given that mustelids hunt large areas of river, they can detect cryptic prey present at low densities, which are often not easily attainable via conventional survey methodologies. Whilst not quantitative, riparian walkover/spraint surveys are useful for clarifying the presence of absence of crayfish at a particular site.

Table 2.1 Location of *n*=14 white-clawed crayfish survey sites in the vicinity of Graiguenamanagh, Co. Kilkenny.

Site	Watercourse	Methodology	Location	ITM x	ITM y
D1	Duiske River	Hand-searching/ sweep netting	Tinnapark River confluence	669803	644173
D2	Duiske River	Hand-searching/ sweep netting	R705 road bridge	670580	644089
D3	Duiske River	Hand-searching/ sweep netting	Well Lane footbridge	670754	643912
D4	Duiske River	Hand-searching/ sweep netting	u/s Old Dock Bridge	670840	643629
G1	Graiguenamanagh River	Hand-searching/ sweep netting	u/s R705 culvert	670632	644454
M1	Mill Race channel	Hand-searching/ sweep netting	R705 road bridge	670532	644037
M2	Mill Race channel	Hand-searching/ sweep netting	Well Lane footbridge	670694	643840
B1	River Barrow	Hand-searching/ sweep netting	d/s Graiguenamanagh Weir	670801	643518
B2	River Barrow	Hand-searching/ sweep netting	Lower Tinnahinch Weir	670983	642623
T1	Duiske River	Trapping	Graiguenamanagh/Duiske River confluence	670597	644089
T2	Duiske River	Trapping	d/s Turfmarket Weir	670839	643696
T3	River Barrow	Trapping	Diving board	671125	643765
T4	River Barrow	Trapping	Graiguenamanagh Bridge	670952	643614
T5	River Barrow	Trapping	Graiguenamanagh Weir navigation	670698	643428

2.2 eDNA analysis

To further validate the site surveys and to detect potentially cryptically-low populations of white-clawed crayfish within the study area, *n*=3 water samples from sites on the Duiske River and River Barrow were analysed for *Austropotamobius pallipes* environmental DNA (eDNA) in April 2021. Sampling points were strategically chosen on the Duiske River (upstream of Tinnapark River confluence and downstream of Turfmarket Weir) and River Barrow (Lower Tinnahinch Weir) to maximise habitat coverage and eDNA detection within the wider survey area (**Figure 2.1**).

In accordance with best practice, composite (500ml) water samples were collected from each sampling point, maximising the geographic spread within each site (20 x 25ml samples at each site) and thus increasing the chance of detecting the target species' DNA. Each composite sample was filtered on site using a sterile proprietary eDNA sampling kit. Fixed samples were sent to the laboratory for analysis on the same day as collection. A total of *n*=12 qPCR replicates were analysed for each site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at or upstream of the sampling point. Please refer to **Appendix B** for

full eDNA laboratory analysis methodology.

2.3 Biosecurity

A strict biosecurity protocol following the Check-Clean-Dry approach was employed during the survey. Equipment and PPE used was disinfected with Virkon® between survey sites to prevent the transfer of pathogens and/or invasive species between survey areas. Particular cognisance was given to preventing the introduction or spread of crayfish plague (*Aphanomyces astaci*) given the known presence of the pathogen in the River Barrow in the vicinity of the flood relief scheme. As per best practice, surveys were undertaken at sites in a downstream order (*i.e.* uppermost site surveyed first *etc*.) to prevent the upstream mobilisation of invasive propagules and pathogens. The survey team has aquatic biosecurity training from the University of Leeds.

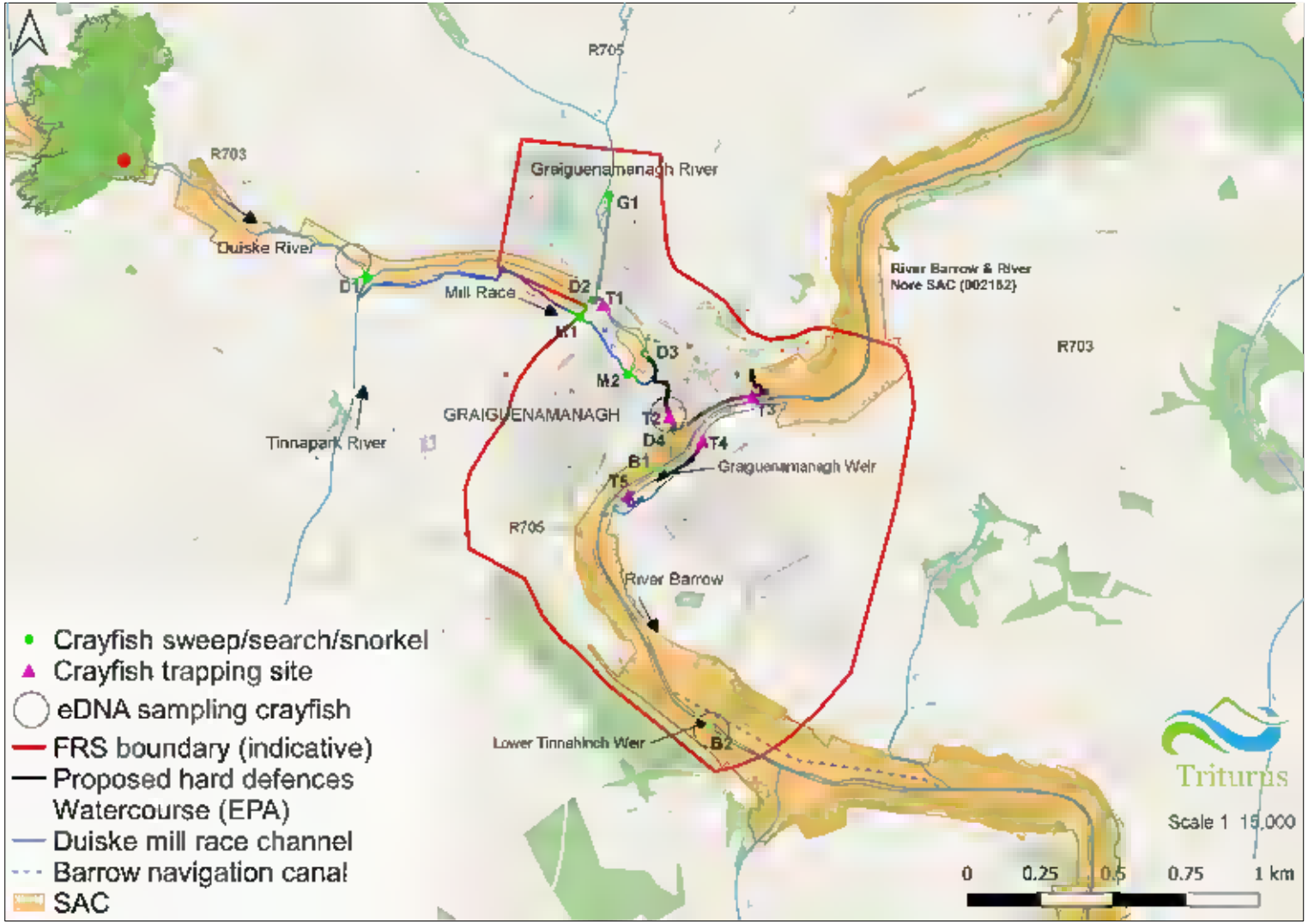


Figure 2.1 Overview of the white-clawed crayfish survey sites in the vicinity of Graiguenamanagh and Tinnahinch, Co. Kilkenny, April 2021.

3. Results

White-clawed crayfish surveys were undertaken on Thursday 29th and Friday 30th April 2021 via trapping (*n*=5 sites), hand-searching/sweep netting (including snorkelling) (*n*=9 sites) and the examination of otter spraints for crayfish remains. No white-clawed crayfish were recorded. Furthermore, eDNA analysis of n=*3* water samples failed to identify any white-clawed crayfish eDNA within the wider survey area.

The results of the surveys are presented below in terms of the number of crayfish recorded and overall crayfish suitability as well as general observations on the ecology of each survey site. The survey sites are summarised per site below and in more detail in **Appendix A**. Scientific names are provided at first mention only.

3.1 Site descriptions & crayfish habitat

3.1.1 Site D1 – Duiske River (Tinnapark River confluence)

Site D1 was located on the Duiske River at the Tinnapark River confluence, upstream of the proposed flood relief scheme boundary. Here, the Duiske River was a largely natural, high-energy upland eroding watercourse (FW1; Fossitt, 2000). The narrow channel averaged 2-2.5m wide and 0.1-0.3m deep in a habitat dominated by fast glide and riffle with only localised pool (0.7m max.). Given high flow rates, the site featured partially bedded (locally heavily bedded) substrata. Despite frequent boulder, these were bedded with silt which precluded crayfish access to potential refugia. Cover of filamentous algae was moderate. The river was bordered by narrow but mature riparian treelines supporting alder (*Alnus glutinosa*), willow (*Salix* sp.) and ash (*Fraxinus excelsior*) with scrubby understories. Shading was moderate and this resulted in low instream growth, with macrophytes limited to marginal hemlock water dropwort (*Oenanthe crocata*). The aquatic moss *Platyhypnidium riparoides* was common on instream boulder with *Hygroamblystegium* sp. occasional. The red alga *Lemanea* sp., characteristic of high-energy watercourses, was also occasional.

No white-clawed crayfish were recorded via sweep-netting or hand-searching of *n*=25 instream refugia (*i.e.* boulder and large woody debris). Although some tree root systems provided some potential habitat, refugia were typically not accessible to crayfish (bedded/compacted) and the banks were not suitable for crayfish burrowing. The high energy nature of the site was sub-optimal for the species. Superior crayfish habitat was present further downstream.

Plate 3.1 Site D1 on the Duiske River at the Tinnapark River confluence.

3.1.2 Site D2 – Duiske River (R705 road bridge)

Site D2 on the Duiske River was located downstream of the R705 road bridge at the confluence with the Graiguenamanagh River (**Figure 2.1**). The river averaged 2.5-3m in width and 0.1-0.3m in depth. The high-energy watercourse (FW1) was dominated by boulder and cobble with patches of gravel/coarse sand. Fast glide dominated with only localised shallow pool present. Given the high flow rates, compaction was relatively high and siltation was low overall. In contrast to upstream areas (highly natural), the river at this site had been historically modified with evident bank modifications (boulder/basket revetments) and ornamental planting. Storm drains were present upstream (at bridge and in Graiguenamanagh River), with high filamentous algae cover (*Vaucheria* sp. & *Cladophora* sp.). indicating enrichment. Flocculent deposits of decaying organic matter and silt (*i.e*. 'floc'[1]) were present locally in more depositional areas. Instream macrophytes were not present given high flows and compacted substrata. *Lemanea* sp. and *Platyhypnidium riparoides* were common on instream boulder with *Hygroamblystegium* sp. occasional.

No white-clawed crayfish were recorded via sweep-netting or hand-searching of *n*=25 instream refugia (*i.e.* boulder and cobble). Given high flow rates, refugia were typically not accessible to crayfish (bedded/compacted) and the banks were not suitable for crayfish burrowing. The high energy nature of the site was sub-optimal for the species. Superior crayfish habitat was present further downstream.

[1] Floc is defined as an aggregation of (mostly dead) organic material, mainly from algae and diatoms, but also with potential origins from decaying macrophytes and associated decomposers (bacteria and fungi). The floc can form a layer at the surface of the substrate, or infiltrate the substrate, generally where there is insufficient flow to keep the material in suspension (Moorkens & Killeen, 2020)

Plate 3.2 The modified Duiske River downstream of the R705 road bridge

3.1.3 Site D3 – Duiske River (Well Lane footbridge)

Site D3 on the Duiske River was located at the Well Lane footbridge (**Figure 2.1**). The river averaged 2.5-3m in width and 0.1-0.3m in depth. The upland eroding watercourse (FW1) was slower-flowing than upstream sites but still characterised by swift, shallow glide with occasional riffles and only localised pool (1m max.). The riverbed featured more in the way of mixed gravels and coarse sand, though the predominant substrata was still cobble with frequent boulder. He substrata were moderately compacted but still accessible to crayfish. Some limited sand/silt accumulations were present in the vicinity of the bridge. Natural scouring has resulted in the western bank being substantially undercut (underneath an adjoining hedgerow/scrub). The site was bordered by scattered treelines of alder and scrub dominated by bramble (*Rubus fruticosus* agg.). Water crowfoot (*Ranunculus* sp.) was frequent downstream of the bridge with hemlock water dropwort (margins only) and *Platyhypnidium riparoides* common. Filamentous algal cover was relatively low but present (*Cladophor*a sp.).

Despite some good suitability, no white-clawed crayfish were recorded via sweep-netting or hand-searching of *n*=25 instream refugia (*i.e.* boulders, cobbles, macrophyte beds and undercut banks). The crayfish habitat was much improved over upstream sites given the presence of instream macrophyte beds and undercut banks (featuring tree root systems). However, though less compacted compared with upstream areas, the boulder and cobble substrata were still partially bedded. Nonetheless, many were accessible to crayfish but none were recorded. Otter spraint recorded underneath the footbridge did not contain any crayfish remains.

Plate 3.3 The Duiske River facing upstream of the Well Lane footbridge.

3.1.4 Site D4 – Duiske River (Old Dock Bridge)

Site D4 was located at Old Dock Bridge on the lower reaches of the Duiske River, approx. 90m upstream of the River Barrow confluence (**Figure 2.1**). The upland eroding watercourse (FW1) had been historically modified and straightened locally, with retaining walls on both banks. Good recovery was evident. The channel was 3-3.5m wide and 0.2-0.5m deep, with fast-flowing glide predominating. Small pools to 1m were associated with upstream meanders. The substrata were dominated by boulder and cobble with small patches of interstitial gravel/coarse sand. Siltation was low given the high flow rates. Enrichment was evident with abundant filamentous algal cover on substrata (*Cladophora* sp. & *Vaucheria* sp.) as well as high amounts of floc. These substrata were bedded/compacted given the high flow rates of the river (as observed upstream). Instream macrophytes were limited to occasional hemlock water dropwort with a relatively high coverage of bryophytes such as *Platyhypnidium riparoides*.

Despite some moderate suitability, no white-clawed crayfish were recorded via sweep-netting or hand-searching of *n*=25 instream refugia (*i.e.* boulders, cobbles). Boulder refugia, whilst frequent, were invariably inaccessible to crayfish given high compaction/bedding of the substrata. Some refugia such as tree roots and flood walls were present but no crayfish were recorded. Otter spraint recorded at the site did not contain any crayfish remains.

Plate 3.4 Site D4 on the lower reaches of the Duiske River (facing downstream towards bridge).

3.1.5 Site G1 - Graiguenamanagh River (upstream R705 culvert)

Site G1 was located on the upper reaches of the Graiguenamanagh River, upstream of an extensive culvert to the Duiske River (**Figure 2.1**). The river represented a small, swift-flowing lowland depositing watercourse (FW2) with a semi-natural profile featuring frequent meanders with riffle, glide and pool sequences. The channel width varied between 1.5-2m with low banks (0.5m bank height). The river was shallow and averaged 0.1-0.2m deep with very occasional pools to 0.3-0.7m max. The bed comprised of mixed large cobble, coarse, medium and fine gravels and sand with frequent silt. The substrata were compacted with moderate siltation that increased in depositing pool areas. Boulder was also present but localised. The exposed hard substrata on the channel margins supported frequent hemlock water dropwort with occasional fool's watercress (*Apium nodiflorum*), lesser water parsnip (*Berula erecta*) and water mint (*Mentha aquatica*). The riparian zone was dominated by open pasture with abundant soft rush (*Juncus effusus*), gorse (*Ulex europaeus*) and scattered alder (*Alnus glutinosa*).

The upper Graiguenamanagh River supported some moderate to good quality crayfish habitat given the presence of large cobble and marginal macrophyte beds. However evident compaction and sedimentation reduced the viability of the habitat for crayfish. None were recorded during the survey. Approximately 50 refugia were searched which included sweeps of macrophytes and large cobble. Further examination with the bathyscope did not reveal any evidence of the species. The notable absence of salmonids (which would typically be expected in such a site) indicated a potential pollution event that may have impacted the small river historically.

Plate 3.5 Representative image of site G1 on the upper Graiguenamanagh River.

3.1.6 Site M1 – Mill Race channel (R705 road bridge)

Located at the R705 road bridge (adjacent to Aldi Graiguenamanagh), the Mill Race channel was a small, 1.5-2m wide, swift-flowing lowland depositing watercourse (FW2). The Mill Race at site M1 was a 1m-wide artificial channel (mature) that averaged 0.1m deep with low (0.5m) bankfull heights. The substrata comprised bedded mixed fine, medium and coarse gravels with small cobble. No large boulders or cobble were present. Siltation was moderate to high locally given the more depositional nature of the habitat. Accumulations of soft sediment were present along the channel margins. Enrichment was also evident with filamentous algae present (10% cover). Instream macrophytes were limited to frequent encroaching hemlock water dropwort with the moss *Chiloscyphus polyanthos* also frequent. The riparian zone was dominated by hedgerows/scrub of hawthorn (*Crataegus monoygna*), bramble and scattered mature trees which provided moderate levels of shading. Amenity grassland (GA2) bordered the channel to the north.

No crayfish were recorded from site M1 via sweep netting or hand-searching. The small, shallow channel provided poor suitability for crayfish given the paucity of suitable refugia and bedded substrata. The banks were also largely unsuitable for burrowing. However, suitability improved slightly further downstream where deeper glide became more prominent.

Plate 3.6 The Duiske Mill Race channel downstream of the R705 road crossing (adjacent to Aldi).

3.1.7 Site M2 – Mill Race channel (Well Lane footbridge)

Located at the Well Lane footbridge crossing, site M2 on the Mill Race channel featured more depositional habitat compared with upstream. Slow-flowing glide of 0.1-0.25m was present with the substrata dominated by silt and localised superficial (silted) gravels. Larger cobble and boulder were rare and bedded in silt where present. In terms of instream macrophytes, water crowfoot was frequent in riffle area downstream of the footbridge, with frequent fool's watercress (*Apium nodiflorum*) and hemlock water dropwort along channel margins. The moss *Chiloscyphus polyanthos* was occasional instream. The riparian zone was dominated by bramble and hawthorn hedgerow on the south with rank grassy areas to the north.

No crayfish were recorded from site M2 via sweep netting or hand-searching. Although the crayfish habitat was improved compared with upstream site M1 (*e.g.* presence of macrophyte beds *etc*.), the shallow channel at site M2 provided poor suitability for crayfish given the paucity of suitable refugia and bedded substrata. The banks were also largely unsuitable for burrowing. The shallow nature of the site and likely low seasonal flows also reduced the overall value for crayfish.

Plate 3.7 The Duiske Mill Race channel upstream of the Well Lane footbridge.

3.1.8 Site B1 - River Barrow (Graiguenamanagh Weir)

Site B1 on the River Barrow was located downstream of Graiguenamanagh Weir (Figure 2.1). The river averaged 20-25m wide with 1-1.5m deep fast glide, grading to deeper, slower-flowing glide (>2.5m) downstream. The bed in the vicinity of the weir was dominated by cobble and coarse gravel with occasional boulder with larger areas of coarse sand with marginal silt downstream of weir pool. Larger substrata, although frequent, were typically compacted and bedded given the high flow rates. Filamentous algal cover was excessively high (>50%), indicating significant enrichment. The weir face featured many crevices and cracks suitable as crayfish refugia and, downstream of the weir pool area, soft steep marginal slopes along the western shore provided some suitability for crayfish burrowing. Growth of instream macrophytes was sparse but arrowhead (*Sagittaria sagittifolia*), clubrush (*Schoenoplectus lacustris*) and very occasional yellow water lily (*Nuphar lutea*) were present. Bryophyte cover was low given abundant filamentous algae and floc.

Despite some high suitability, no crayfish were recorded via hand-searching, sweep-netting or snorkelling at site B1. Approximately 50 refugia were searched which included sweeps of macrophytes, boulder/large cobble, banks suitable for burrowing and the weir structure – areas which historically supported white-clawed crayfish at this site (pers. obs.).

Plate 3.8 Hand-searching and sweep netting for crayfish below Graiguenamanagh Weir.

3.1.9 Site B2 - River Barrow (Lower Tinnahinch Weir)

Site B2 on the River Barrow was located at Lower Tinnahinch Weir (Figure 2.1). Upstream of the weir featured 100% deep (2-3m), slow-flowing glide habitat 30-40m wide with frequent large substrata and instream macrophyte beds. Downstream of the weir was turbulent in nature with abundant large boulders in addition to frequent cobble and coarser gravels in a water death of <1m. The high flow rates here resulted in a moderately compacted bed but low siltation. Filamentous algal cover was high at the time of survey (30% cover). The weir face featured many crevices and cracks suitable as crayfish refugia and, downstream of the weir pool area, soft steep marginal slopes along the northern bank provided some suitability for crayfish burrowing. Large woody debris was also present which provided some high value as crayfish refugia. Growth of instream macrophytes was sparse downstream of the weir but arrowhead, clubrush, hemlock water dropwort and yellow water lily were present. Bryophyte cover was high downstream of the weir on larger instream substrata. The site was bordered by mature treelines and mixed broad-leaved woodland.

Despite some high suitability (and historical presence), no crayfish were recorded via sweep netting, hand-searching or snorkelling at site B2. Furthermore, eDNA sampling did not identify the presence of crayfish at or upstream of this location – see section 3.2 below. Lower Tinnahinch Weir offered abundant suitable refugia for crayfish by way of large boulders, cobble, macrophyte beds, large woody debris and weir sill crevices but the examination of approx. 60 refugia did not reveal any crayfish. Furthermore, otter spraint recorded on the top of the weir structure did not contain any visible crayfish remains.

Plate 3.9 eDNA sampling for white-clawed crayfish and crayfish plague at Lower Tinnahinch Weir, April 2021.

3.1.10 Site T1 – Duiske River (downstream Aldi access bridge)

Trapping site T1 was located on the Duiske River immediately downstream of the Aldi access bridge, approx. 30m downstream from the Graiguenamanagh River confluence (**Figure 2.1**). The swift-flowing river averaged 2.5-3m wide and 0.5-1.5m deep downstream of the access bridge. The substrata were dominated by boulder and cobble with localised patches of mixed gravels and coarse sand. Given high flow rates, the substrata were moderately compacted, with some siltation in pool slacks. Riparian shading (from mature treelines and scrub) was high and instream macrophyte growth was absent. However, aquatic bryophyte coverage was high.

The site was chosen for overnight trapping due to the presence of a 1.5m-deep, tree-lined pool with abundant crayfish refugia by way of tree root systems, undercut banks and large boulders. However, despite high physical suitability, no crayfish were recorded via trapping.

Plate 3.10 Trapping for white-clawed crayfish at site T1 on the Duiske River.

3.1.11 Site T2 – Duiske River (Turfmarket Weir)

Site T2 was located downstream of Turfmarket Weir on the lower reaches of the Duiske River (**Figure 2.1**). The upland eroding watercourse (FW1) had been historically modified and straightened locally, with retaining walls on both banks in addition to a small weir (0.3m fall). The channel was 3m wide and 0.2-0.5m deep, with fast-flowing glide predominating. Small pools to 0.7-1m were associated with the small weir and downstream meanders. The substrata were dominated by boulder and cobble with small patches of interstitial gravel/coarse sand. Siltation was low given the high flow rates. Enrichment was evident with abundant filamentous algal cover on substrata. These were also bedded given high flow rates of the river (as observed upstream).

Despite some good suitability in terms of crayfish refugia (macrophytes, boulders, large cobbles, weir face crevices, retaining wall base crevices *etc*.), no crayfish were recorded via trapping.

Plate 3.11 Trapping the small weir pool at Turfmarket Weir on the lower reaches of the Duiske River.

3.1.12 Site T3 – River Barrow (diving board)

Site T3 was located on the River Barrow upstream of Graiguenamanagh Bridge, adjacent to the diving board at Graiguenamanagh Rowing Club (**Figure 2.1**). The river upstream of Graiguenamanagh Bridge was 40-50m-wide canalised channel (FW2) with depths varying from 1.5-2.5m. The river was bound by a retaining wall along the west (town) bank, with historical modifications present on the east. The river at this location was depositional in nature and featured 100% deep slow-flowing glide. The substrata were dominated by silt with localised areas of sand and bedded cobbles and gravels, particularly associated with the marginal slopes of the channel. Abundant filamentous algae was present on the substrata (very high cover).

Despite some good suitability, no crayfish were recorded via trapping. Furthermore, SCUBA diving undertaken in April 2021 as part of the accompanying freshwater pearl mussel survey for the scheme in this section of river did not identify any white-clawed crayfish. Whilst impacted by both siltation and high filamentous algae/floc cover (**Plate 3.13**), refugia accessible and suitable for crayfish were abundant, such as large boulders, retaining wall crevices and instream debris.

Plate 3.12 Setting baited crayfish traps on the River Barrow at site T3.

Plate 3.13 Potential crayfish refugia adjacent to site T3 (heavily silted with high filamentous algae and floc cover).

3.1.13 Site T4 – River Barrow (Graiguenamanagh Bridge)

Site T4 was located on the River Barrow immediately downstream of Graiguenamanagh Bridge, along the east bank of the river (**Figure 2.1**). The river upstream of the weir, at the bridge, was a 60-70m-wide canalised channel (FW2) with depths varying from 1.5-2m. The river was bound by retaining walls on both banks. Swift-flowing glide predominated with localised pool areas. The substrata alternated between plains of coarse sand and silt with boulder zones in the centre channel. Abundant boulders were present under the bridge arches. Abundant filamentous algae and floc was present on the substrata (very high cover). Macrophyte growth near the trapping site was absent with only localised bryophyte growth (mostly covered by algae).

Despite some good suitability, no crayfish were recorded via trapping. Furthermore, SCUBA diving undertaken in April 2021 as part of the accompanying freshwater pearl mussel survey for the scheme in this section of river did not identify any white-clawed crayfish. Whilst impacted by both siltation and high filamentous algae/floc cover (Plate 3.15), refugia accessible and suitable for crayfish were abundant, such as large boulders, retaining wall crevices and instream debris.

Plate 3.14 Set crayfish traps on the River Barrow at Graiguenamanagh Bridge (east bank).

Plate 3.15 Boulder zone in the vicinity of Graiguenamanagh Bridge with very high cover of filamentous algae and floc.

3.1.14 Site T5 – River Barrow (Upper Tinnahinch Lock)

Site T5 was located upstream of the Lock gates at Tinnahinch Lock (Upper) adjacent to Graiguenamanagh Weir on the River Barrow (**Figure 2.1**). The channel was of variable width (5-12m) as it was situated in a macrophyte rich bay upstream of the canal lock gates (**Plate 3.16**). The depth ranged between 1.3m and 2.5m and the water had a very slight flow only. The substrata were dominated by silt although localised boulder and cobble were present. The bed supported submerged arrowhead, yellow water lily, spiked water milfoil and common clubrush. The area had some suitability for crayfish that could utilise the quay walls, adjoining boulder substrata and or macrophyte beds. However, none were recorded during trapping and snorkelling of the area.

Plate 3.16 Trapping area upstream of Tinnahinch Lock (Upper).

3.2 eDNA analysis

Composite water samples collected from the Duiske River upstream of Tinnapark River confluence (C0285), Turfmarket Weir (C0282) and Lower Tinnahinch Weir (C0280) all returned a negative result for white-clawed crayfish eDNA (0 positive of 12 qPCR replicates, respectively) (**Figure 3.1** & **Appendix B**). In conjunction with traditional survey results (provided above), these results were considered as evidence of the species' absence from the watercourses in the vicinity of Graiguenamanagh.

Positive results for crayfish plague eDNA were returned in the River Barrow sample collected at Lower Tinnahinch Weir (C0280) (4 of 12 qPCR replicates) and the lower Duiske River sample (C0282) (12 of 12 QPCR replicates) (**Figure 3.2** & **Appendix B**). The water sample collected from the upper Duiske River, upstream of the Tinnapark River confluence (C0285) tested negative for crayfish plague (0 of 12 qPCR replicates).

Table 3.1 Survey results for the *n*=14 white-clawed crayfish survey sites in the vicinity of Graiguenamanagh and Tinnahinch, Co. Carlow, April 2021.

Site	Watercourse	Methodology	Location	Crayfish recorded
D1	Duiske River	Hand-searching/ sweep netting	Tinnapark River confluence	No
D2	Duiske River	Hand-searching/ sweep netting	R705 road bridge	No
D3	Duiske River	Hand-searching/ sweep netting	Well Lane footbridge	No
D4	Duiske River	Hand-searching/ sweep netting	u/s Old Dock Bridge	No
G1	Graiguenamanagh River	Hand-searching/ sweep netting	u/s R705 culvert	No
M1	Mill Race channel	Hand-searching/ sweep netting	R705 road bridge	No
M2	Mill Race channel	Hand-searching/ sweep netting	Well Lane footbridge	No
B1	River Barrow	Hand-searching/ sweep netting	d/s Graiguenamanagh Weir	No
B2	River Barrow	Hand-searching/ sweep netting	Lower Tinnahinch Weir	No
T1	Duiske River	Trapping	Graiguenamanagh/Duiske River confluence	No
T2	Duiske River	Trapping	d/s Turfmarket Weir	No
T3	River Barrow	Trapping	Diving board	No
T4	River Barrow	Trapping	Graiguenamanagh Bridge	No
T5	River Barrow	Trapping	River Barrow (near Tinnahinch Lock Upper)	No

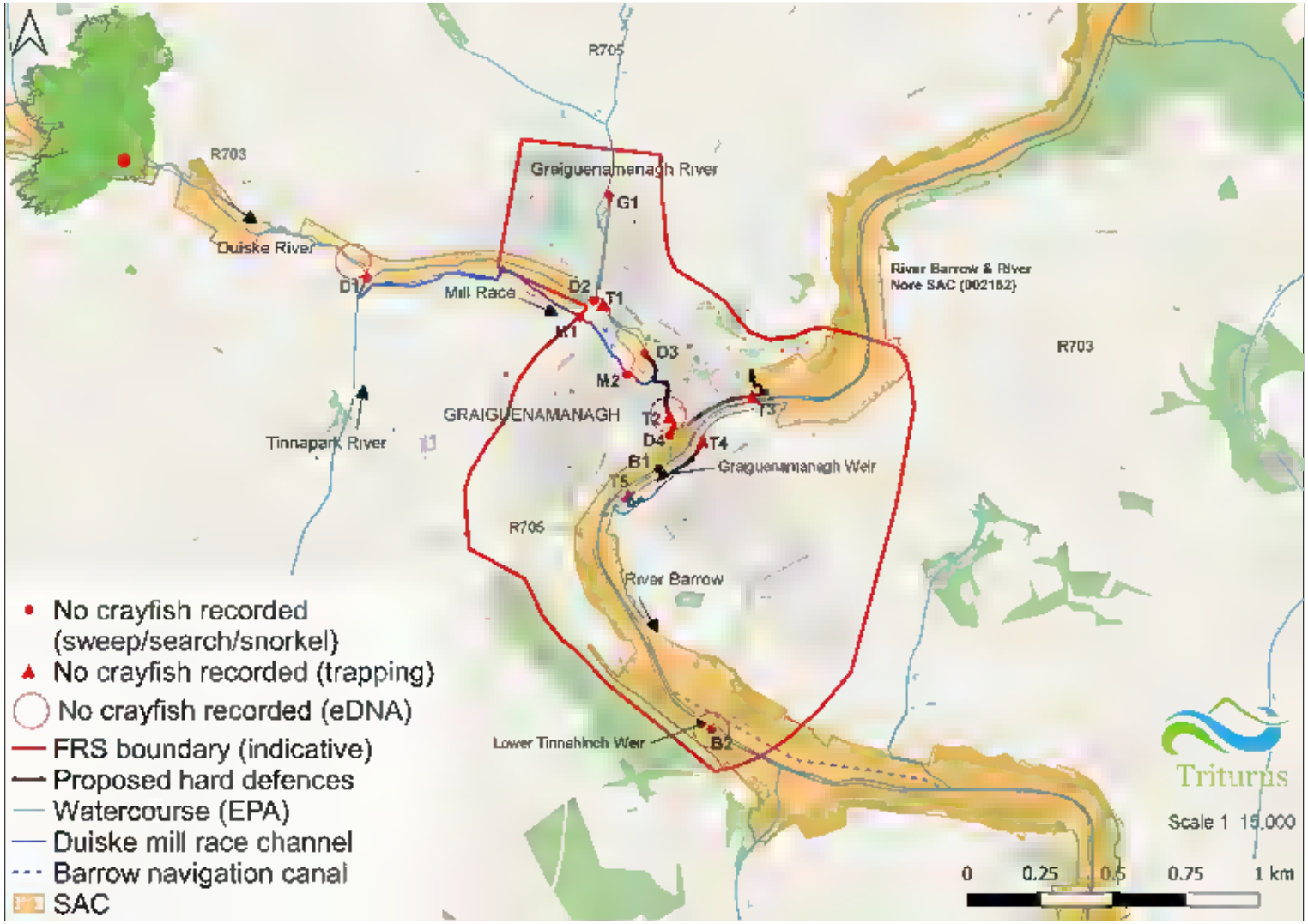


Figure 3.1 Results summary of white-clawed crayfish hand-searching, sweep-netting, snorkelling and trapping surveys, April 2021.

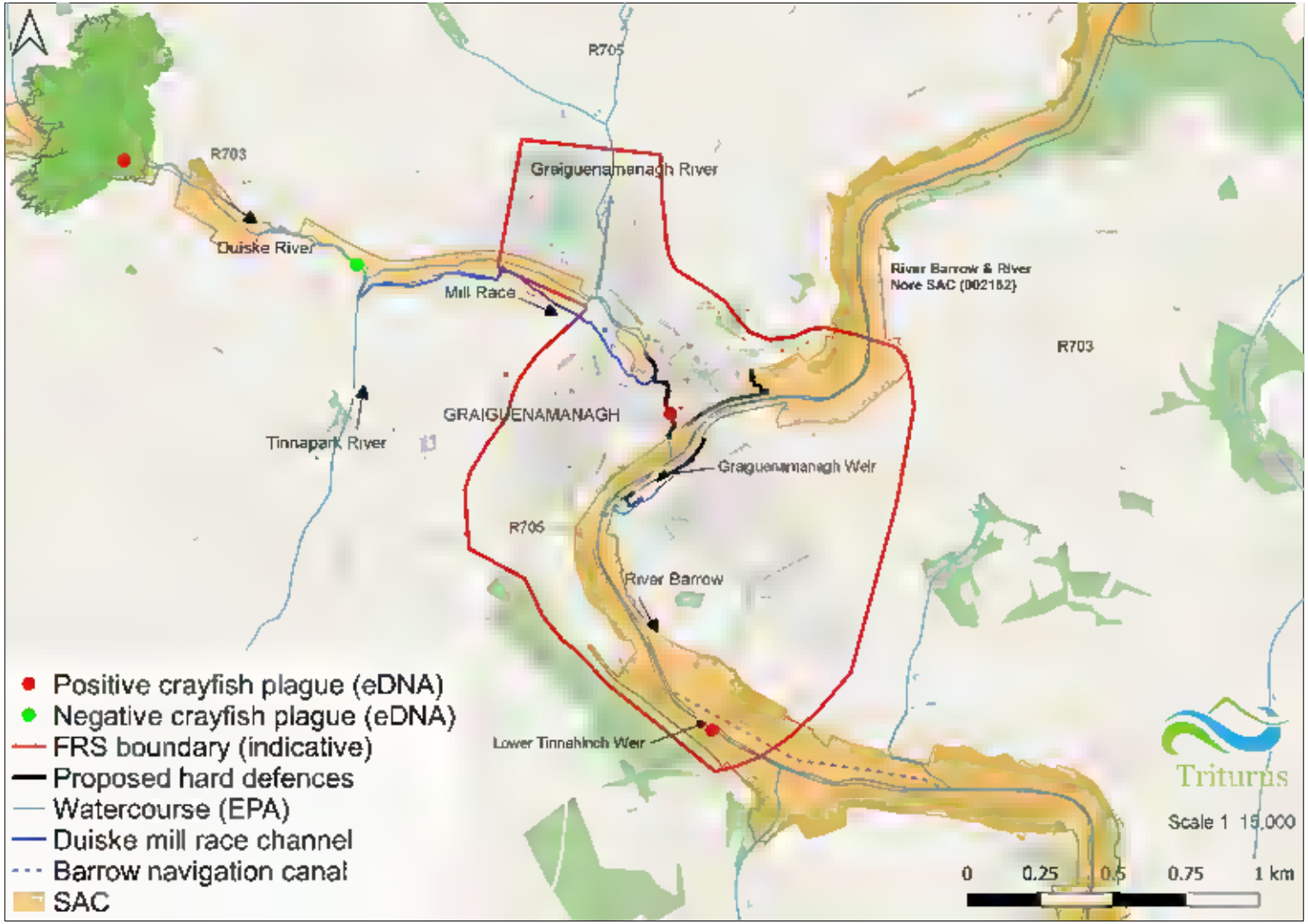


Figure 3.2 Results summary of crayfish plague (*Aphanomyces astaci*) eDNA sampling, April 2021.

4. Discussion

4.1 Absence of white-clawed crayfish

Despite some good suitability and known historical distribution, trapping and traditional surveys (hand-searching, sweep-netting, snorkelling) undertaken at a total of *n*=14 sites on the Duiske River and mill race, Graiguenamanagh River and River Barrow in April 2021 failed to record any white-clawed crayfish. Visual inspection of otter spraints on the Duiske River and River Barrow did not reveal any crayfish remains. SCUBA diving of the main Barrow channel undertaken for the accompanying freshwater pearl mussel survey for the Graiguenamanagh-Tinnahinch FRS (Triturus, 2021) also failed to identify any white-clawed crayfish. These survey findings were further validated by eDNA sampling, which failed to detect any white-clawed crayfish eDNA in the survey area.

Although no historical records were available for the Duiske River, white-clawed crayfish were present until relatively recently in the River Barrow at Graiguenamanagh (2017; Marine Institute data). In line with recent data, our results, regrettably, suggest an extirpation of the species from their known historical range within the River Barrow channel in the vicinity of Graiguenamanagh. Outbreaks of the pathogenic oomycete (water mould) crayfish plague (*Aphanomyces astaci*) were recorded along the River Barrow main channel, from Carlow to Graiguenamanagh, in 2017 (see NBDC data) with characteristic large-scale mortalities recorded from Leighlinbridge downstream to Graiguenamanagh (NPWS, 2017). Additional, smaller-scale outbreaks were recorded from the upper Barrow catchment, upstream of previous outbreaks, in both 2018 and 2019 (NPWS, 2019). Environmental DNA sampling for white-clawed crayfish as part of the National Crayfish Plague Surveillance Program 2018-2019 identified the species presence in the upper River Barrow catchment only (Swords, 2020). Consequently, the conservation status of this Annex II conservation objective species in the River Barrow (part of the River Barrow & River Nore SAC) appears seriously jeopardised.

4.2 Presence of crayfish plague

Whilst our findings regarding the absence of white-clawed crayfish in the vicinity of Graiguenamanagh and Tinnahinch may be expected in light of the above, the presence of crayfish plague eDNA in both the River Barrow (Lower Tinnahinch Weir) and lower Duiske River (Turfmarket Weir) samples was surprising (**Figure 3.2**). Crayfish plague is highly infectious (water-borne spores) and usually leads to 100% mortality in a given white-clawed crayfish population within several weeks of infection (Holdich, 2003; Edgerton *et al.*, 2004). Generally, *Aphanomyces astaci* is considered an obligate crayfish parasite not capable of surviving for a long period outside a crayfish host (Strand *et al.*, 2011; Söderhall & Cerenius, 1999). Exceptions to this theory are typically explained through other mechanisms such as latent infections or reintroductions of the pathogen (Oidtmann, 2012). However, the detection of crayfish plague eDNA in the Duiske River and River Barrow despite the absence of crayfish, suggests the potential for another host species or an artefact of eDNA degradation.

It has long been proposed that the host range of *A. astaci* may include not only crayfish but freshwater decapods in general (*i.e.* higher crustaceans including crabs, crayfish and shrimps) (Unestam & Nylund, 1972; Strand *et al.*, 2011). Indeed, recent experiments demonstrated that freshwater crabs (including the Chinese mitten crab, *Eriocheir sinensis*) can be infected by and spread crayfish plague (Svoboda *et al.*, 2014.). The possibility that some other crustaceans may become accidental hosts of the crayfish plague pathogen, for example when stressed, cannot be rejected (Svoboda *et al.*, 2016). Clearly, more research into other possible host species is required in both an Irish and global context.

Alternatively, though considered unlikely given the strength of our crayfish plague eDNA signatures (**Appendix B**), false positives may have resulted from historic eDNA, which can still be present in sediments after the extinction or emigration of the target species (Turner *et al.*, 2015). However, given downstream transport of eDNA, remnant eDNA detection is more likely to occur in lotic waterbodies rather than riverine systems, particularly one with high flow rates such as the Duiske River (crayfish plague in 12 of 12 qPCR replicates). Both inhibition and different target-eDNA size distributions might also explain differences in detection of white-clawed crayfish (absent) and crayfish plague (present) in our riverine samples. A fundamental distinction between the two species is that *A. astaci* depends, for its proliferation, on the frequent and abundant release of encapsulated spores (~8 µm in diameter). It seems likely that these spores, which are designed for transport along large distances, will show lower sensitivity to degradation than white-clawed crayfish DNA (Troth *et al.*, 2021). Though white-clawed crayfish appear extirpated from the survey area, this characteristic may explain our eDNA results from the Duiske River and River Barrow.

An additional explanation for our results is that white-clawed crayfish currently infected by crayfish plague were present at cryptically-low densities in both the Duiske River and River Barrow, although this defies not only our extensive current survey findings but those of national monitoring programs also.

Given the apparent absence of crayfish hosts, crayfish plague (and its eDNA) may have been recently introduced to the survey area by a multitude of vectors including the surfaces of crustaceans, fish, water birds and mammals such as otter (Svoboda *et al.*, 2016, 2020). Nevertheless, the likelihood of *A. astaci* transmission by such vectors from an area hosting both white-clawed crayfish and crayfish plague (*e.g.* upper Barrow catchment) to the Graiguenamanagh study area seems highly unlikely given the large distances involved (>70km). Given the known distribution of crayfish plague in the main River Barrow channel since 2017, transmission of by mobile species such as otters may explain the presence of *A. astaci* in the lower Duiske River (at Turfmarket Weir).

5. References

Demers, A., Lucey, J., McGarrigle, M. L., & Reynolds, J. D. (2005). The distribution of the white-clawed crayfish, *Austropotamobius pallipes*, in Ireland. In Biology and Environment: Proceedings of the Royal Irish Academy (pp. 65-69). Royal Irish Academy.

Edgerton, B. F., Henttonen, P., Jussila, J., Mannonen, A. R. I., Paasonen, P., Taugbøl, T. & Souty-Grosset, C. (2004). Understanding the causes of disease in European freshwater crayfish. Conservation Biology, 18(6), 1466-1474.

Fossitt, J. (2000) A Guide to Habitats in Ireland. The Heritage Council, Ireland.

Füreder, L., Gherardi, F., Holdich, D., Reynolds, J., Sibley, P. & Souty-Grosset, C. (2010). *Austropotamobius pallipes*. The IUCN Red List of Threatened Species 2010: e.T2430A9438817

Gallagher, M. B., Dick, J. T. A., & Elwood, R. W. (2006). Riverine habitat requirements of the white-clawed crayfish, *Austropotamobius pallipes*. In Biology and Environment: Proceedings of the Royal Irish Academy (pp. 1-8). Royal Irish Academy.

Holdich, D.M. (2003). Crayfish in Europe–an overview of taxonomy, legislation, distribution, and crayfish plague outbreaks. Management & Conservation of Crayfish. Nottingham: Environment Agency, 15-34.

Lucey, J., & McGarrigle, M. L. (1987). The distribution of the crayfish *Austropotamobius pallipes* (Lereboullet) in Ireland.

Moorkens, E.A. & Killeen, I.J. (2020). Monitoring Populations of the Freshwater Pearl Mussel, *Margaritifera margaritifera*, Stage 3 and Stage 4 Survey. Irish Wildlife Manuals, No. 122. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

NPWS (2011). Conservation Objectives: River Barrow and River Nore SAC 002162. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2017). Crayfish plague outbreaks update October 2017. Information note issued by National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht and Marine Institute. Available at: https://www.biodiversityireland.ie/wordpress/wp-content/uploads/CRAYFISH-PLAGUE-OUTBREAKS-UPDATE-27-OCTOBER-2017-final.pdf

NPWS (2019). Crayfish plague outbreaks update August 2019. Information note issued by National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht and Marine Institute. Available at: https://www.biodiversityireland.ie/wordpress/wp-content/uploads/CRAYFISH-PLAGUE-NPWS-UPDATE-Number-5_August-2019.pdf

NPWS (2019). 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. 84.

O'Connor, W., Hayes G., O'Keeffe, C. and Lynn, D. (2009). Monitoring of white-clawed crayfish *Austropotamobius pallipes* in Irish lakes. Irish Wildlife Manuals, No 37. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin

Oidtmann B. (2012). Crayfish plague (*Aphanomyces astaci*). Chapter 2.2.1. In: Manual of Diagnostic Tests for Aquatic Animals 2012, pp. 101–118. Office international des epizooties, Paris.

Oidtmann B., Heitz E., Rogers D. & Hoffmann R.W. (2002). Transmission of crayfish plague. Diseases of Aquatic Organisms 52, 159–167.

Peay, S. (2003). Monitoring the white-clawed crayfish *Austropotamobius pallipes*. Conserving Natura 2000 Rivers Monitoring Series No. 1, English Nature, Peterborough.

Reynolds, J. D. (1988). Crayfish extinctions and crayfish plague in central Ireland. Biological Conservation, 45, 279–285.

Reynolds, J.D., Lynn, D., O' Keeffe, C., Lucey, J., Clabbey, K., McGarrigle, M. & King, J. (2010). Conservation assessment and current status of protected white-clawed crayfish, *Austropotamobius pallipes* (Lereboullet), in Ireland. Freshwater Crayfish 17: 123-127.

Söderhäll, K., & Cerenius, L. (1999). The crayfish plague fungus: History and recent advances. Freshwater Crayfish, 12, 11–35.

Strand, D. A., Holst-Jensen, A., Viljugrein, H., Edvardsen, B., Klaveness, D., Jussila, J., & Vrålstad, T. (2011). Detection and quantification of the crayfish plague agent in natural waters: direct monitoring approach for aquatic environments. Diseases of aquatic organisms, 95(1), 9-17.

Svoboda, J., Fischer, D., Kozubíková-Balcarová, E., Šťástková, A., Brůčková, M., Kouba, A., & Petrusek, A. (2020). Experimental evaluation of the potential for crayfish plague transmission through the digestive system of warm-blooded predators. Journal of fish diseases, 43(1), 129-138.

Svoboda, J., Mrugała, A., Kozubíková-Balcarová, E., & Petrusek, A. (2016). Hosts and transmission of the crayfish plague pathogen *Aphanomyces astaci*: a review. Journal of Fish Diseases, 40(1), 127–140.

Svoboda, J., Strand, D. A., Vrålstad, T., Grandjean, F., Edsman, L., Kozák, P. & Petrusek, A. (2014). The crayfish plague pathogen can infect freshwater-inhabiting crabs. Freshwater Biology, 59(5), 918-929.

Swords, F. (2020). Environmental DNA (eDNA) Surveillance of Crayfish Plague and White-clawed crayfish, an Irish National Monitoring Program. Annual Workshop of the National Reference Laboratories for Crustacean Diseases. Kgs. Lyngby, Denmark November 5th 2020.

Triturus (2021). Graiguenamanagh Tinnahinch Flood Relief Scheme freshwater pearl mussel (*Margaritifera margaritifera*) survey. Report prepared by Triturus Environmental Ltd. for ByrneLooby. June 2021.

Troth, C. R., Burian, A., Mauvisseau, Q., Bulling, M., Nightingale, J., Mauvisseau, C., & Sweet, M. J. (2020). Development and application of eDNA-based tools for the conservation of white-clawed crayfish. Science of The Total Environment, 748, 141394.

Turner, C. R., Uy, K. L., & Everhart, R. C. (2015). Fish environmental DNA is more concentrated in aquatic sediments than surface water. Biological Conservation, 183, 93-102.

Unestam, T., & Nylund, J. E. (1972). Blood reactions in vitro in crayfish against a fungal parasite, *Aphanomyces astaci*. Journal of Invertebrate Pathology, 19(1), 94-106.

6. Appendix A – survey site characteristics

Table A1 Summary characteristics of each white-clawed crayfish survey site in the vicinity of the proposed Graiguenamanagh-Tinnahinch FRS, April 2021.

Site	Watercourse	River profile	Substrata	Crayfish habitat	Macrophytes & bryophytes (DAFOR)	Crayfish recorded	Crayfish plague recorded	Methodology
D1	Duiske River (u/s Tinnapark River confluence)	Upland eroding watercourse (FW1), average 2-2.5m wide and 0.1-0.3m deep, fast glide and riffle with localised pool (0.7m max.), high flow rates	Boulder & cobble dominated with localised beds of mixed gravels; moderate siltation; moderate filamentous algae cover, moderate compaction	Moderate quality Frequent boulder refugia but partially-bedded; tree root systems and undercut banks present	*Oenanthe crocata* (O), *Lemanea* sp. (O), *Platyhypnidium riparoides* (F),	No	**No**	Sweep-netting, hand-searching, eDNA
D2	Duiske River (R705 road bridge)	Upland eroding watercourse (FW1), average 3-4m wide & 0.2-0.5m deep, fast glide dominated, bank modifications near R705 crossing, high flow rates	Boulder & cobble dominated with localised beds of mixed gravels and sand; low siltation, high filamentous algae cover, high compaction	Moderate quality Boulder/cobble refugia compacted and poorly accessible, some refugia in retaining wall bases	*Oenanthe crocata* (O), *Lemanea* sp. (O), *Platyhypnidium riparoides* (F), *Hygroamblystegium* sp. (O)	No	n/a	Sweep-netting, hand-searching
D3	Duiske River (Well Lane footbridge)	Upland eroding watercourse (FW1), average 2.5-2m wide and 0.1-0.3m deep, swift glide with localised pool, retaining wall along east bank	Cobble with frequent boulder & mixed gravels/sand with some deposition areas of silt, low filamentous algae cover, moderate compaction	Good quality Frequent boulder/cobble refugia but partially-bedded; tree root systems, macrophyte beds and undercut banks present, some refugia in retaining wall bases	*Ranunculus* subsp. *Batrachion* agg. (F), *Oenanthe crocata* (O), *Platyhypnidium riparoides* (F), *Hygroamblystegium* sp. (O)	No	n/a	Sweep-netting, hand-searching
D4	Duiske River (Old Dock Bridge)	Upland eroding watercourse (FW1), average 3-3.5 wide and 0.2-0.5m deep, swift glide with localised pool, historically straightened with retaining wall along both banks but good	Boulder and cobble with small patches of interstitial gravel/coarse sand, moderate compaction, abundant filamentous algae and floc	Good quality Frequent boulder refugia but accessibility reduced due to partial-bedding & high filamentous algae; undercut banks present, some refugia in retaining wall bases	*Oenanthe crocata* (O), *Platyhypnidium riparoides* (F)	No	n/a	Sweep-netting, hand-searching

Site	Watercourse	River profile	Substrata	Crayfish habitat	Macrophytes & bryophytes (DAFOR)	Crayfish recorded	Crayfish plague recorded	Methodology
		instream recovery, high flow rates						
G1	Graiguenamanagh River (u/s R705 culvert)	Lowland depositing watercourse (FW2), average 1.5-2m wide and 0.1-0.2m deep, riffle-pool-glide sequences, natural channel u/s culvert, swift-flowing glide	Mixed large cobble, coarse, medium and fine gravels and sand with frequent silt; moderate siltation and high compaction	Moderate quality Boulder & large cobble rare but present; undercut banks, macrophyte beds and tree root systems present	*Oenanthe crocata* (F), *Apium nodiflorum* (O), *Berula erecta* (O), *Mentha aquatica* (O)	No	n/a	Sweep-netting, hand-searching
M1	Mill Race channel (R705 road bridge)	Lowland depositing watercourse (FW2), average 1.5-2m wide and 0.1-0.2m deep, swift flowing riffle and glide with lack of pool	Bedded mixed fine, medium and coarse gravels with small cobble & silt accumulations; no large boulders or cobble present; moderate siltation, high filamentous algae cover	Low-moderate quality Potential refugia rare, banks not suitable for burrowing	*Oenanthe crocata* (O), *Chiloscyphus polyanthos* (O)	No	n/a	Sweep-netting, hand-searching
M2	Mill Race channel (Well Lane footbridge)	Lowland depositing watercourse (FW2), average 1.5-2m wide and 0.1-0.2m deep, slow-flowing glide and riffle	Silt and localised superficial (silted) gravels; larger cobble and boulder were rare and bedded in silt where present	Low-moderate quality Potential refugia rare, banks not suitable for burrowing	*Ranunculus* subsp. *Batrachion* agg. (F), *Apium nodiflorum* (O), *Oenanthe crocata* (O), *Chiloscyphus polyanthos* (O)	No	n/a	Sweep-netting, hand-searching
B1	River Barrow (d/s Graiguenamanagh Weir)	Lowland depositing watercourse (FW2), average 20-25m wide and 1-1.5m deep, fast flowing glide below weir grading to deep pool downstream	Cobble and coarse gravel with occasional boulder with larger areas of coarse sand; moderate compaction; very high filamentous algae cover	Good quality Boulder/cobble refugia frequent but very high cover of filamentous algae; plentiful refugia along weir face	*Sagittaria sagittifolia* (O), *Schoenoplectus lacustris* (O), *Nuphar lutea* (O)	No	n/a	Sweep-netting, hand-searching, snorkelling

Site	Watercourse	River profile	Substrata	Crayfish habitat	Macrophytes & bryophytes (DAFOR)	Crayfish recorded	Crayfish plague recorded	Methodology
B2	River Barrow (Lower Tinnahinch Weir)	Lowland depositing watercourse (FW2), average 30-40m wide and 1-1.5m deep, fast flowing glide below weir grading to deep pool downstream	Abundant large boulders in addition to frequent cobble and coarser gravels; moderate compaction	High quality Abundant boulder refugia, plentiful refugia along weir face	*Sagittaria sagittifolia* (O), *Schoenoplectus lacustris* (O), *Nuphar lutea* (O), *Oenanthe crocata* (O)	No	**Yes; eDNA recorded (4 of 12 qPCR replicates)**	Sweep-netting, hand-searching, snorkelling, eDNA
T1	Duiske River (Aldi access bridge)	Upland eroding watercourse (FW1), 0.5-3m wide and 0.5-1.5m deep, swift glide with deep pool, historical bank modifications	Boulder and cobble with localised patches of mixed gravels and coarse sand	Good quality Abundant boulder refugia, undercut banks, and tree root systems present	*Platyhypnidium riparoides* (F)	No	n/a	Trapping
T2	Duiske River (Turfmarket Weir)	Upland eroding watercourse (FW1), 3m wide and 0.2-0.5m deep, fast-flowing glide with localised pool, retaining walls both banks	Boulder and cobble with small patches of interstitial gravel/coarse sand; abundant filamentous algae	Good quality Frequent boulder/cobble refugia with macrophyte and retaining wall base refugia also present	*Ranunculus* subsp. *Batrachion* agg. (O), *Oenanthe crocata* (O), *Platyhypnidium riparoides* (F)	No	**Yes; eDNA recorded (12 of 12 qPCR replicates)**	Trapping. eDNA
T3	River Barrow (diving board)	Lowland depositing watercourse (FW2), 40-50m wide and 1.5-2.5m deep, 100% slow-flowing glide, retaining wall (quay) along west bank	Silt with localised areas of sand and bedded cobbles and gravels; abundant filamentous algae and floc	Moderate quality Frequent boulder/cobble and macrophyte refugia in addition to retaining wall crevices	*Nuphar lutea (O), Sagittaria sagittifolia* (O)	No	n/a	Trapping
T4	River Barrow (Graiguenamanagh Bridge)	Lowland depositing watercourse (FW2), 60-70m wide and 1.5-2m deep, swift--flowing glide, retaining wall on both banks	Boulder and cobble along south bank with high cover of filamentous algae and floc	Good quality Abundant instream refugia (boulder/cobble, retaining wall crevices, macrophytes *etc*.)	*Sagittaria sagittifolia* (O)	No	n/a	Trapping

Site	Watercourse	River profile	Substrata	Crayfish habitat	Macrophytes & bryophytes (DAFOR)	Crayfish recorded	Crayfish plague recorded	Methodology
T5	River Barrow (u/s Upper Tinnahinch Lock)	Artificial channel (FW3), 5-12m variable width, 1.3-2.5m deep, slow-flowing glide & pool, retaining wall along both banks (*i.e.* lock structure adjacent to weir)	Silt with occasional boulder and cobble; high cover of filamentous algae	Moderate quality Locally frequent instream refugia (boulder/cobble, retaining wall crevices, macrophyte beds)	*Sagittaria sagittifolia* (A), *Myriophyllum spicatum* (F), *Nuphar lutea* (O), *Schoenoplectus lacustris* (O)	No	n/a	Trapping

7. Appendix B – eDNA analysis lab report

Triturus

SureScreen Scientifics

Foho No: E9978b
Report No: 1
Purchase Order: MY01_21
Client: Triturus Environmental Limited
Contact: Ross Macklin

TECHNICAL REPORT

ANALYSIS OF ENVIRONMENTAL DNA SAMPLES FOR THE DETECTION OF CRAYFISH SPECIES AND CRAYFISH PLAGUE

SUMMARY

All organisms continuously release small amounts of environmental DNA (eDNA) into their habitat. By collecting and analysing this eDNA from water samples from lakes, ponds or rivers we can detect the presence or absence of crayfish species including: the white-clawed crayfish (Austropotamobius pallipes), signal crayfish (*Pacifastacus leniusculus*), the marbled crayfish (*Procambarus virginalis*) and the crayfish plague (*Aphanomyces astaci*).

RESULTS

Date sample received at Laboratory: 18/05/2021
Date Reported: 18/06/2021
Matters Affecting Results: None

Lab Sample ID.	Site Name	O/S Reference	Species	Result	SIC	DC	IC	Positive Replicates
C0280	Tinnahinch Weir		*White-Clawed Crayfish*	Negative	Pass	Pass	Pass	0
			Crayfish Plague	Positive	Pass	Pass	Pass	4
C0282	Duiske Lower		*White-Clawed Crayfish*	Negative	Pass	Pass	Pass	0
			Crayfish Plague	Positive	Pass	Pass	Pass	12
C0285	Duiske Upper		*White-Clawed Crayfish*	Negative	Pass	Pass	Pass	0
			Crayfish Plague	Negative	Pass	Pass	Pass	0

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Ltd, Morley Retreat, Church Lane, Morley, Derbyshire, DE7 6DE
UK Tel: +44 (0)1332 292093 Email: scientifics@surescreen.com
Company Registration No. 08950940

SureScreen Scientifics

Reported by: Chris Troth **Approved by:** Jennifer Higginbottom

METHODOLOGY

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: white-clawed crayfish, signal crayfish and crayfish plague, ensuring no DNA from any other species present in the water is amplified.

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. These methods have been extensively tested since 2015 in a number of different environments, habitats, conditions and ecological situations in order to successfully enable the full application of eDNA for the detection of crayfish species and the crayfish plague.

RESULTS INTERPRETATION

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]
Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.
Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. In accordance with Natural England protocol, even a score of 1/12 is declared positive. 0/12 indicates negative species presence
Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.
Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Ltd, Morley Retreat, Church Lane, Morley, Derbyshire, DE7 6DB
UK Tel. +44 (0)1332 292003 Email: scientifics@surescreen.com
Company Registration No. 03950940

Triturus Environmental Ltd.

42 Norwood Court,

Rochestown,

Co. Cork,

T12 ECF3.

Appendix O: Freshwater Pearl Mussel Survey Report (Original CFRAM Survey) (Triturus Environmental Ltd., 2021)

Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (*Margaritifera margaritifera*) survey

Prepared by Triturus Environmental Ltd. for ByrneLooby

June 2021

Please cite as:

Triturus (2021). Graiguenamanagh-Tinnahinch Flood Relief Scheme freshwater pearl mussel (*Margaritifera margaritifera*) survey. Report prepared by Triturus Environmental Ltd. for ByrneLooby. June 2021.

Table of contents

1. Introduction

1.1 Background

Triturus Environmental Ltd. was contracted by ByrneLooby to undertake a baseline freshwater pearl mussel (*Margaritifera margaritifera*) survey of the watercourses in the footprint of the proposed Graiguenamanagh-Tinnahinch Flood Relief Scheme (GTFRS) located near Graiguenamanagh, Co. Carlow (**Figure 2.1, Table 2.1**).

The OPW, working in partnership with Kilkenny County Council (KCC), Country Carlow Council (CCC) and other Local Authorities, commissioned and have completed the South Eastern Catchment Flood Risk Assessment and Management (CFRAM) Study. The South Eastern CFRAM study area included Graiguenamanagh-Tinnahinch as an Area for Further Assessment (AFA) and concluded that a flood relief scheme would be viable and effective for the community. The viable scheme (currently under review) is comprised mainly of construction of hard defences and associated works through the urban area of Graiguenamanagh along the banks of both the River Duiske and River Barrow.

A viable scheme option for Graiguenamanagh-Tinnahinch was identified in the CFRAM level of assessment and the preferred measures outlined in the CFRAM comprise:

- Building hard defences, with at risk properties protected by a series of embankments and walls, sheet piled where necessary and set back where possible from, the river channel.
- Hard defences that would protect properties from the 1% AEP fluvial event and with an estimated average height of 1.56 m and total length of 1.31 km.

In light of the above, a Stage 1 pearl mussel survey was undertaken in April 2021 to establish the presence/absence of freshwater pearl mussel in the vicinity of the proposed flood relief scheme footprint, thus informing impact assessment and mitigation for the works. The scheme footprint was located within the River Barrow catchment (Barrow_SC_0130 sub-catchment) and encompassed the River Barrow and two tributaries (Duiske River and Graiguenamanagh River), in addition to a small historical mill race channel linking the Tinnapark Stream and lower Duiske River. The survey area did not overlap with any *Margaritifera* sensitive areas.

In the vicinity of the proposed GTFRS, the River Barrow (EPA code: 14B01) and tributary Duiske River (14D04) were located within the River Barrow and River Nore SAC (site code: 002162). Whilst not located within this European site, the Graiguenamanagh Stream (14G42), a tributary of the Duiske River, shared downstream hydrological connectivity with the River Barrow and River Nore SAC.

1.2 Conservation status of freshwater pearl mussel in Ireland

The freshwater pearl mussel (*Margaritifera margaritifera*) is listed on the IUCN Invertebrate Red Data List as an 'endangered species' (Moorkens *et al*., 2018) according to the most recent status classification. It is also protected under the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). Pearl mussel are protected by law in Ireland under the

Wildlife Acts 1976 to 2018 (S.I. 112, 1990) and the species is listed on Annex II and Annex V of the EU Habitats Directive (92/43/EEC).

Three Article 17 reports have been prepared for pearl mussel (to report on national status as part of the requirements of the Habitats Directive) with the overall conservation status being considered as 'Bad' on all three occasions (NPWS, 2008, 2013, 2019). During 2009, The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations S.I. No. 296/2009 were created to establish environmental quality objectives for SAC pearl mussel populations, including the preparation of sub-basin management plans. These regulations set out conservation targets for pearl mussel, as shown in **Table 1.1** below.

Table 1.1 Targets for sustainable pearl mussel population structure under the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009

Criterion	Target to pass	Notes
Numbers of live adults	No recent decline	Based on comparative results from the most recent surveys
Numbers of dead shells	<1% of population and scattered distribution	1% considered to be indicative of natural losses
Mussels shell length ≤65mm	At least 20% of populations ≤65mm in length	Field survey of 0.5 x 0.5 m quadrats must be carried out in suitable habitat areas for juveniles
Mussels shell length ≤30mm	At least 5% of populations ≤30mm in length	Field survey of 0.5 x 0.5m quadrats must be carried out in suitable habitat areas for juveniles

1.3 Status of freshwater pearl mussel in the Barrow catchment (desktop review)

Freshwater pearl mussel are listed as a qualifying interest for the River Barrow and River Nore SAC (NPWS, 2011). However, extant populations are only known from three tributaries. These are the Mountain River[1], Ballymurphy River (Ballyroughan River) (Moorkens, 1992, 2008, 2009a, 2009b; Ross, 2006; DEHLG, 2010a, 2010b, 2010c) (*i.e.* not the main River Barrow channel) and Aughavaud River (DEHLG, 2010c).

The nearest populations to Graiguenamanagh and Tinnahinch are in the Mountain and Ballymurphy Rivers located ≥4km upstream (see **Figure 1.1**). Although a live specimen was recorded in the River Barrow in 1991, c. 5km upstream of Graiguenamanagh near Ballynagrane Lock (Sweeny, 2011), the freshwater pearl mussel would appear to be extinct in the main channel of the River Barrow (Lucey, 1998). Whilst 2008 surveys failed to identify any live mussels in the Aughavaud River (DEHLG, 2010c), which adjoins the River Barrow near St. Mullin's, Co. Carlow (**Figure 1.1**), recent NPWS data (2018) indicates low numbers of pearl mussels within this sub-

[1] Status of freshwater pearl mussel in the Aughnabrisky River (Mountain River tributary) is now uncertain

catchment. There is no means of connectivity with this population and the study area given the river confluence with the River Barrow is located >7km downstream.

The status of the freshwater pearl mussel (*Margaritifera margaritifera*) as a qualifying Annex II species for the River Barrow and River Nore SAC is currently under review (NPWS, 2020). Numerous significant pressures to pearl mussel populations have been identified, including erosion, diffuse nutrient enrichment, diffuse siltation, riparian zone impacts and field drainage, as well as surface water quality impacts (DEHLG, 2010a, 2010b, 2010c). Pearl mussel numbers have declined significantly in the Mountain River and Ballymurphy River sub-catchments, with the remaining low-density populations (<1000 and <300 individuals, respectively) composed entirely of aged adults with no evidence of recruitment for a considerable time (DEHLG, 2010a, 2010b). In both the Mountain River and Ballymurphy River, the greatest risk to pearl mussel persistence is exceptionally high siltation and both populations are in rapid decline (DEHLG, 2010a, 2010b).

There were no contemporary or historical records for freshwater pearl mussel available for the Duiske River, Graiguenamanagh River or River Barrow in the vicinity of Graiguenamanagh or Tinnahinch.

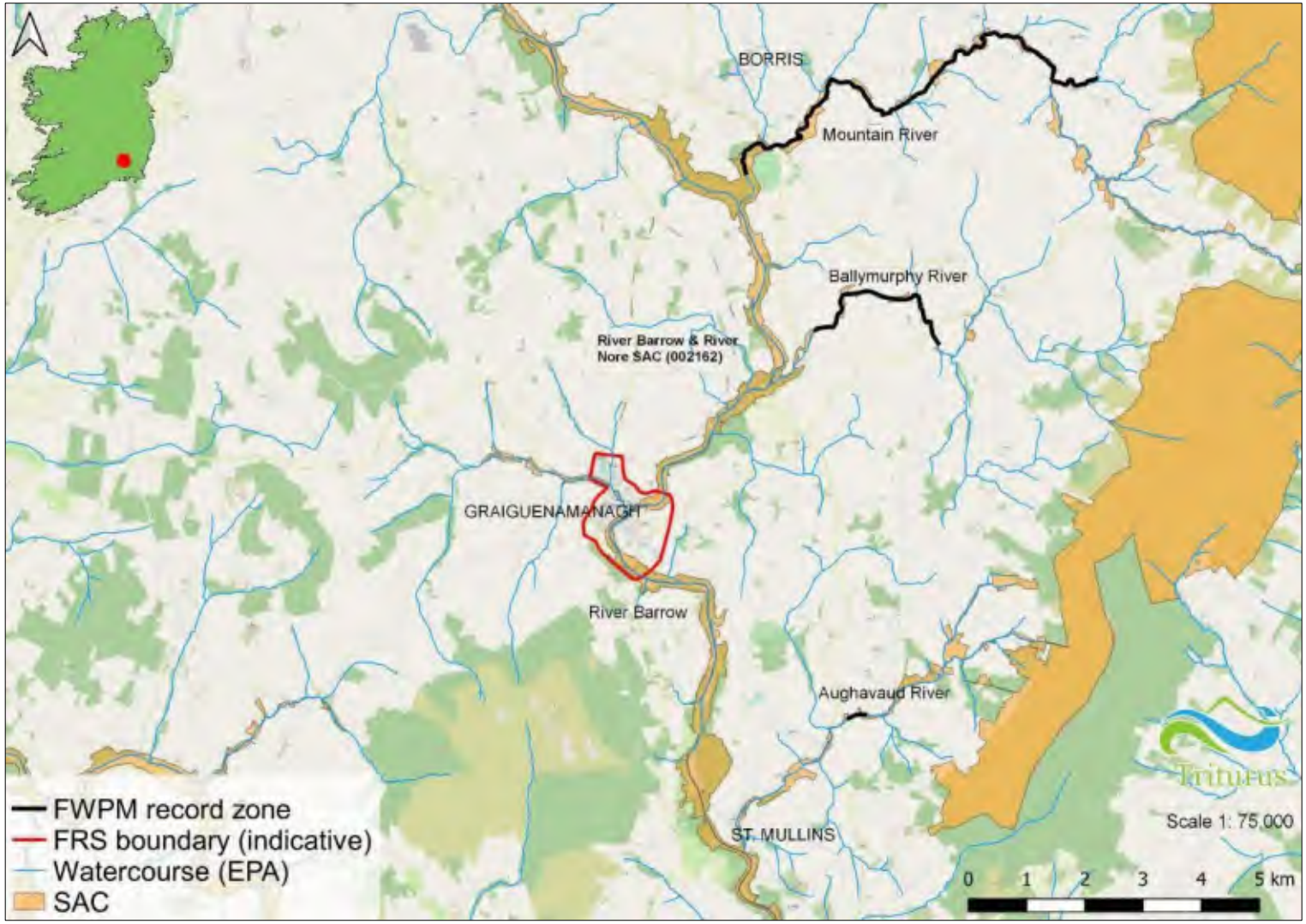


Figure 1.1 Extent of the freshwater pearl mussel records in the River Barrow catchment (adapted from DEHLG 2010a, 2010b and 2010c).

2. Methodology

2.1 Freshwater pearl mussel surveys

The pearl mussel surveys were carried out on Thursday 29th and Friday 30th April 2021 in bright weather, with good underwater visibility and under base flow conditions. This helped to maximise visibility of pearl mussel against dark substrata and also helped increase chances of detection when mussels are filtering in brighter conditions. The visual pearl mussel survey (stage 1 and stage 2) was carried out under Section 23 & 34 of the Wildlife Acts 1976 to 2018 (licence number C136/2021) issued by the National Parks and Wildlife Service (NPWS) on the 12th April 2021. The survey methodology used was in accordance with the Stage 1 and 2 guidelines given by the NPWS in the Irish Wildlife Manual No. 12 (Anon., 2004) (guidelines currently being updated but unpublished at the time of survey). The surveys were also cognisant of the latest European-wide guidance for freshwater pearl mussel survey methodology (*e.g.* CEN, 2017; Boon *et al*., 2019).

Stage 1 presence-absence surveys were undertaken in *n*=5 discreet survey sections (A to E) along a total of c.4km of channel on the Duiske River, Graiguenamanagh River and River Barrow (**Table 2.1, Figure 2.1**). Surveys incorporated a combination of bathyscope surveying, snorkelling and SCUBA diving techniques, dependant on local water depths and flow regimes. To maximise detection rates and efficiency, two operators worked in tandem, with one surveyor in-stream and one bank manager to collate data. As per best practice, surveys within each survey section began downstream and worked upstream at each site to avoid silt and debris blocking the view of pearl mussels and to avoid damage to pearl mussels by trampling (*i.e.* because of better visibility). Notes were also taken on the aquatic habitat conditions and suitability for freshwater pearl mussels at each site, based on the criteria of Moorkens & Killeen (2020), Skinner *et al*. (2003) and Hastie *et al.* (2000).

Table 1 Location of *n*=5 freshwater pearl mussel Stage 1 and 2 survey sections in the vicinity of Graiguenamanagh, Co. Kilkenny.

Section	Watercourse	EPA code	Approx. length (km)	Start point (ITM)	End point (ITM)
A	Duiske River	14D04	0.55	670074, 633212	670596, 644092
B	Duiske River	14D04	0.65	670596, 644092	670840, 643547
C	Graiguenamanagh River	14G42	0.6	670621, 644699	670596, 644092
D	River Barrow	14B01	0.9	671521, 643966	670850, 643537
E	River Barrow	14B01	1.3	670850, 643537	671156, 642529

2.2 eDNA analysis

To further validate the site surveys and to detect potentially cryptically-low populations of freshwater pearl mussel within the study area, water samples from sites on the Duiske River and River Barrow were analysed for *Margaritifera margaritifera* environmental DNA (eDNA) in April 2021. The Turfmarket Weir (Duiske) and Tinnahinch Weir (Barrow) sampling points were strategically chosen to maximise habitat coverage within the study area (**Figure 2.1**).

In accordance with best practice, composite (500ml) water samples were collected from each sampling point, maximising the geographic spread within each site (20 x 25ml samples at each site) and thus increasing the chance of detecting the target species' DNA. Each composite sample was filtered on site using a sterile proprietary eDNA sampling kit. Fixed samples were sent to the laboratory for analysis on the same day as collection. A total of *n*=12 qPCR replicates were analysed for each site. Given the high sensitivity of eDNA analysis, a single positive qPCR replicate is considered as proof of the species' presence (termed qPCR No Threshold, or qPCR NT). Whilst an eDNA approach is not currently quantitative, the detection of the target species' DNA indicates the presence of the species at or upstream of the sampling point. Please refer to **Appendix B** for full eDNA laboratory analysis methodology.

2.3 Biosecurity

A strict biosecurity protocol following the Check-Clean-Dry approach was employed during the survey. Equipment and PPE used was disinfected with Virkon® between survey sites to prevent the transfer of pathogens and/or invasive species between survey areas. Particular cognisance was given to preventing the introduction or spread of crayfish plague (*Aphanomyces astaci*) given the known presence of the pathogen in the River Barrow in the vicinity of the flood relief scheme. As per best practice, surveys were undertaken at sites in a downstream order (*i.e.* uppermost site surveyed first *etc*.) to prevent the upstream mobilisation of invasive propagules and pathogens.

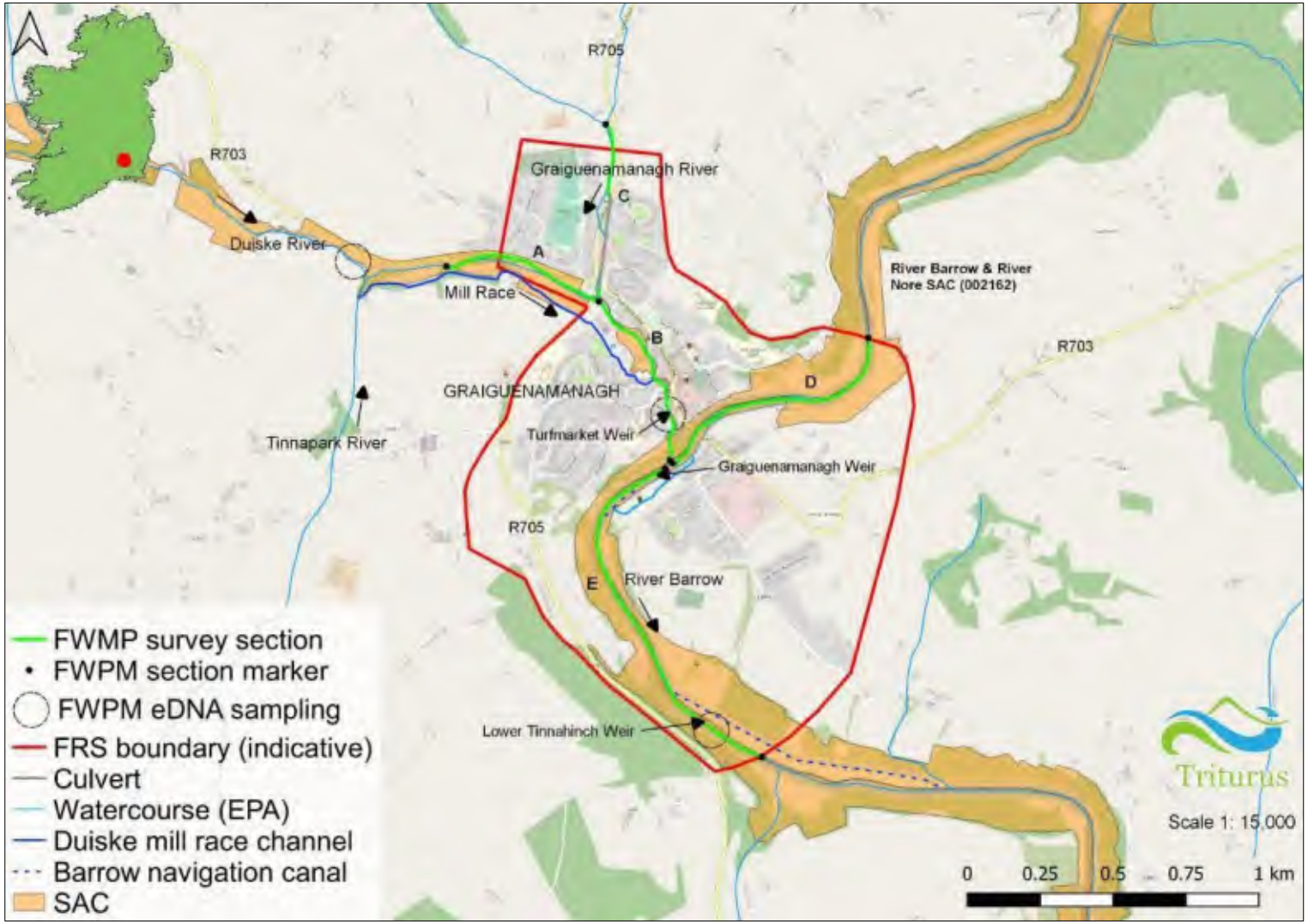


Figure 2.1 Overview of the freshwater pearl mussel survey sections in the vicinity of Graiguenamanagh and Tinnahinch, Co. Kilkenny, April 2021.

3. Results

Freshwater pearl mussel surveys were undertaken on Thursday 29th and Friday 30th April 2021. The results of the surveys are presented below in terms of the number of mussels recorded (live or dead), number of shells and overall pearl mussel suitability as well as general observations on the ecology of each site. The survey sites are summarised per survey section below (A to E) and in more detail in **Appendix A**. Scientific names are provided at first mention only.

3.1 Site descriptions & pearl mussel habitat

3.1.1 Section A – Duiske River (upper)

Section A was located upstream of the Graiguenamanagh River confluence (Aldi access road bridge). Here, the Dusike River was a largely natural, high-energy upland eroding watercourse (FW1; Fossitt, 2000). The river had not been modified, apart from in the vicinity of the R705 road bridge and Aldi bridge where a concrete bridge apron was present (buried under gravels) alongside retaining walls. Several storm drains entered the channel in vicinity of the R705 road bridge (i.e. point sources). The shallow-U shaped channel averaged 3-4m in width and 0.2-0.5m in depth, with locally deeper pool to 0.75m. Riffle and fast glide dominated the survey section but pools were frequent also, with the channel occasionally cascading over larger boulder. The substrata of the high-energy river (prone to spate) were dominated by cobble and boulder with high fractions of mixed gravels and coarse sand in interstitial spaces. Although largely free from siltation (on and within the substrata), the bed was highly compacted due to high flow rates. Some calcification of the substrata was also evident, locally. Flocculent deposits of decaying organic matter and silt (*i.e.* 'floc'[2]) were present locally in more depositional areas (this increased significantly downstream). *Vaucheria* sp. (common) and *Cladophora* sp. algae (less common) were present on instream substrata, indicating enrichment. The river channel meandered through a narrow but mature riparian zone supporting scattered sycamore (*Acer psuedoplatanus*), ash (*Fraxinus excelsior*), alder (*Alnus glutinosa*), hawthorn (*Crataegus monoygna*) and elder (*Sambucus nigra*) with scrubby understories. The channel was bordered by improved agricultural grassland and rough pasture (GA1). Shading was frequently high but not excessive. Macrophytes were rare and limited to occasional hemlock water dropwort (*Oenanthe crocata*) on exposed and marginal gravel deposits. The red algae *Lemanea* sp., characteristic of high-energy watercourses, was common. The aquatic moss *Platyhypnidium riparoides* was common on instream boulder with *Hygroamblystegium* sp. occasional.

No live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling in survey section A (**Figure 3.1**). The upper Duiske survey reaches were of high salmonid value in terms of nursery and spawning habitat (both Atlantic salmon and brown trout). However, whilst the substrata were clean, un-silted and stable, these were invariably highly compacted given high flow rates, thus presenting conditions inimical to mussel footing. Significant enrichment was also

[2] floc is defined as an aggregation of (mostly dead) organic material, mainly from algae and diatoms, but also with potential origins from decaying macrophytes and associated decomposers (bacteria and fungi). The floc can form a layer at the surface of the substrate, or infiltrate the substrate, generally where there is insufficient flow to keep the material in suspension (Moorkens & Killeen, 2020)

noted with often high filamentous algal cover instream. As such, there was no suitability for freshwater pearl mussel.

Plate 3.1 The natural Duiske River channel in the uppermost survey reaches of section A.

Plate 3.2 *Vaucheria* sp. algae was common on instream boulders, indicating enrichment.

Plate 3.3 Underwater image showing compacted bed with growth of red algae (*Lemanea* sp.) and filamentous algae (*Cladophora* sp.).

Plate 3.4 Bathyscope survey of the Duiske River upstream of the R705 road bridge.

Plate 3.5 The modified Duiske River downstream of the R705 road bridge.

3.1.2 Section B – Duiske River (lower)

Located downstream of the Graiguenamanagh River confluence (**Figure 2.1**), the lower reaches of the Dusike River in section B were semi-natural (FW1 with some FW2 characteristics in lowermost reaches). However, the high energy (spate-like) river had been historically modified and straightened through Graiguenamanagh town and residential areas with retaining walls often present on both banks (invariably >2-2.5m high). The river channel averaged 3-4m wide with depths of 0.2-0.4m, with occasionally deeper pool to 0.8m. Fast shallow glide and riffle dominated the section with only occasional pool (*e.g.* on meanders). Despite modification, good instream recovery was present although enrichment was evident with abundant filamentous algal cover on substrata (mostly *Cladophora* sp.). Coverage of floc was also high (up to >50%) in areas of lower flow. Substrata cover often exceeded 30-40%. The substrata were dominated by boulder and cobble with patches of gravel/coarse sand. Given the high flow rates, compaction was relatively high and siltation was low overall (as per upstream section A). However, some sediment accumulations (sand/silt) were present in the lowermost reaches near the Barrow confluence and on some meanders. Instream macrophyte cover was greater than upstream section A, with *Ranunculus* sp. vegetation dominating (often >20% cover). The aquatic bryophyte *Platyhypnidium riparioides* was often common on instream boulder and cobble.

No live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling in survey section B (**Figure 3.1**). The lower Duiske was of high salmonid value in terms of nursery and spawning habitat (both Atlantic salmon and brown trout). However, whilst the substrata of the lower Duiske channel were clean, un-silted and stable, these were often highly compacted given high flow rates, thus presenting conditions inimical to mussel footing. Significant enrichment was also noted with often high filamentous algal cover instream in addition to locally abundant *Ranunculus* vegetation. As such, there was no suitability for freshwater pearl mussel.

Plate 3.6 The historically modified Duiske River at the Graiguenamanagh River confluence (near Aldi).

Plate 3.7 The Duiske River immediately downstream of the Well Lane footbridge.

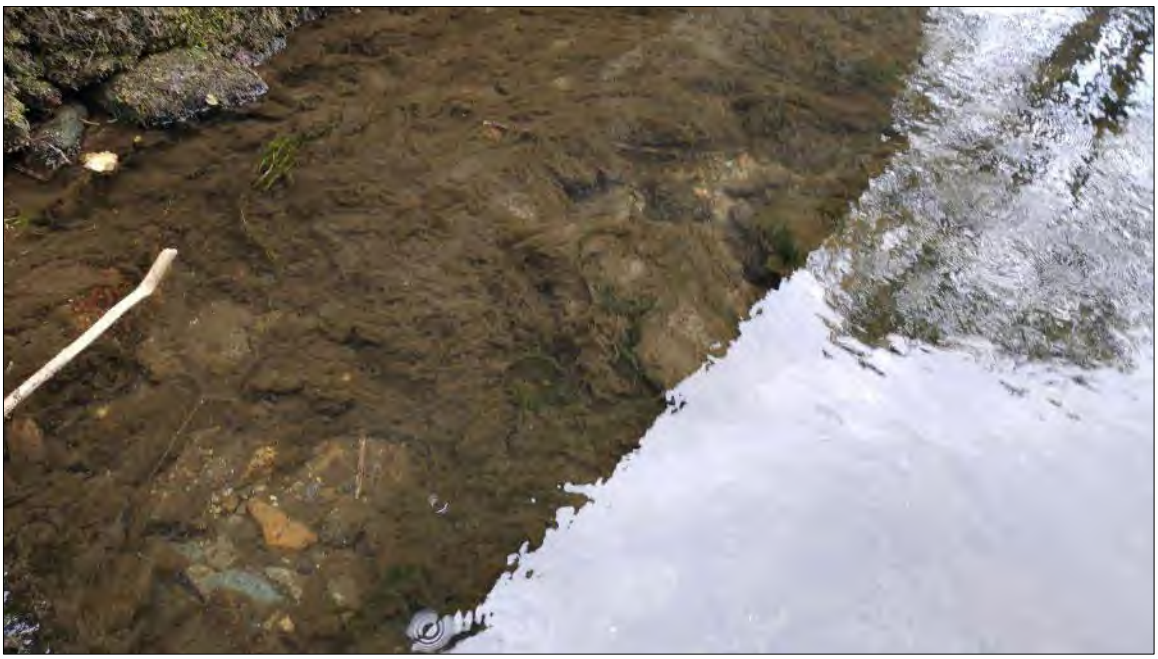


Plate 3.8 High cover of filamentous algae and floc in the Duiske River downstream of the Turfmarket Weir, April 2021.

Plate 3.9 The modified Duiske River at Mill Road Bridge (facing downstream).

Plate 3.10 The modified Duiske River at Old Dock Road Bridge (facing upstream).

Plate 3.11 The Duiske River at the Barrow confluence showing clean gravel substrata with marginal soft sediment accumulations.

3.1.3 Section C - Graiguenamanagh River

Survey section C encompassed the Graiguenamanagh River from the West Killeen Stream confluence to the Duiske River confluence (**Figure 2.1**). The river was culverted underground over a steep gradient for much of the survey reach (i.e. 0.35km). The upper reaches, upstream of the R705 road culvert, represented a small, swift-flowing lowland depositing watercourse (FW2) with a semi-natural profile featuring frequent meanders with riffle, glide and pool sequences. The channel width varied between 1.5-2m with low banks (0.5m bank height). The river was shallow and averaged 0.1-0.2m deep with very occasional pools to 0.3-0.7m max. The bed comprised of mixed large cobble, coarse, medium and fine gravels and sand with frequent silt. The substrata were compacted with moderate siltation that increased in depositing pool areas. Boulder was also present but localised. The exposed hard substrata on the channel margins supported frequent hemlock water dropwort with occasional fool's watercress (*Apium nodiflorum*), lesser water parsnip (*Berula erecta*) and water mint (*Mentha aquatica*). The riparian zone was dominated by open pasture with abundant soft rush (*Juncus effusus*), gorse (*Ulex europaeus*) and scattered alder (*Alnus glutinosa*).

The lower reaches of the Graiguenamanagh River represented an upland eroding watercourse (FW1) flowing over a moderate gradient, with frequent cascades over large instream boulder. The river emanated from a large pipe culvert under the Harristown Roundabout (R705) and adjoined the Duiske River approx. 30m downstream. This short section had been historically straightened but not deepened, with retaining walls along both banks (gabion baskets on north, retaining wall on south bank). The channel averaged 1.5m wide with depths highly variable from 0.1-0.5m. Fast glide predominated in between frequent plunge pools (0.6m max). Riffle was present near the Duiske confluence. The substrata were partially bedded given relatively high flow rates, with boulder and cobble dominating. However, medium-fine gravels and sand were frequent interstitially. Flocculent silt deposits were present in pool/margins slacks (rare). Riparian shading was high from retaining walls and scrub vegetation (bramble and ornamental garden plants). No macrophytes were present instream although *Hygroamblystegium* sp. moss was common. *Vaucheria* sp. algae was also common, indicating significant enrichment. The site was of moderate value for salmonids in the lowermost reaches, although the extensive pipe culvert effectively blocked upstream fish passage.

No live or dead freshwater pearl mussels were recorded via bathyscope survey or snorkelling in survey section C (**Figure 3.1**). Neither the upper or lower survey reaches of the Graiguenamanagh River had any suitability for freshwater pearl mussel. Upstream of the R705 culvert, the small size of the channel, bed compaction, enrichment pressures and moderate siltation (derived largely from sheep poaching and adjoining agricultural land use) precluded the presence of pearl mussels. Furthermore, the river did not support a salmonid population upstream of the culvert (2021 Triturus electro-fishing data) and also suffered from low flows, seasonally. The lower survey reaches, downstream of the Harristown Roundabout culvert, were also unsuitable for pearl mussel given evident enrichment, historical modifications, bed compaction and the small nature of the channel.

Plate 3.12 Representative image of the upper survey reaches of the Graiguenamanagh River.

Plate 3.13 Bathyscope survey on the upper reaches of the Graiguenamanagh River.

Plate 3.14 Unsuitable substrata for pearl mussel in the upper survey reaches of the Graiguenamanagh River (silted, partially-bedded gravels and cobble).

Plate 3.15 The Graiguenamanagh River (right) at the Duiske River confluence.

3.1.4 Section D - River Barrow (upstream Graiguenamanagh Weir)

Located upstream of Graiguenamanagh Weir, the River Barrow in survey section D was a large 40-50m wide canalised channel with depths varying from 1.5-2.5m. The river was bound by a retaining wall along the west (town) bank, with historical modifications present on the east. The river at this location was depositional in nature and featured 100% deep slow-flowing glide. The substrata were dominated by silt with localised areas of sand and bedded cobbles and gravels, particularly associated with the marginal slopes of the channel. Downstream of bridge (upstream of the weir), the substrata alternated between plains of coarse sand and silt with boulder zones in the centre channel. Abundant boulders were present under the bridge arches, which often supported freshwater sponges (see **Plate 3.23**). Sand and silt dominated immediately upstream of the weir structure. Abundant filamentous algae was present on the substrata (very high cover). Macrophytes were limited to heterophyllous yellow water lily (*Nuphar lutea*) (submerged more so than emergent) with occasional patches of submerged clubrush (*Schoenoplectus lacustris*) and water mint in marginal areas. Perfoliate pondweed (*Potamogeton perfoliatus*) was occasional with rare spiked water milfoil (*Myriophyllum spicatum*). The channel was lined with reed canary grass (*Phalaris arundinacea*), marsh marigold (*Caltha palustris*), iris (*Iris pseudacorus*), arrowhead (*Sagittaria sagittifolia*), water mint, hemlock water dropwort and scattered invasive Himalayan balsam (*Impatiens glandulifera*).

No live or dead freshwater pearl mussels were recorded via bathyscope or SCUBA diving surveys in survey section D (**Figure 3.1**). The River Barrow upstream of Graiguenamanagh Weir had no suitability for freshwater pearl mussel. However, the deep glide habitat upstream of the bridge did support duck mussel (*Anodonta anatina*), at an average density of 1 per $10m^2$ (**Plate 3.19, 3.20**). The majority of these were located at the base of the quay wall slope (45° angle). This slope had metal debris, cobble and boulder with patches of coarse sand and silt. Duck mussels were present in coarse sand and silt at base of slope, with most mussels recorded covered in silt and evidently choking. A number of dead duck mussels (some recently deceased) were also recorded in a small, heavily-silted off-shoot channel along Old Dock Road (**Plate 3.21**).

Plate 3.16 The River Barrow upstream of Graiguenamanagh Bridge (100% deep depositional glide habitat).

Plate 3.17 SCUBA dive survey of the River Barrow upstream of Graiguenamanagh Bridge, April 2021.

Plate 3.18 Underwater image of the heavily silted substrata present in survey section D (upstream of Graiguenamanagh Bridge).

Plate 3.19 Example of duck mussel (*Anodonta anatina*) recorded in soft sediment upstream of Graiguenamanagh Bridge.

Plate 3.20 Example of duck mussel (*Anodonta anatina*) recorded from survey section D.

Plate 3.21 Dead duck mussel (*Anodonta anatina*) and shells recorded from the small off-shoot channel along Old Dock Road.

Plate 3.22 Underwater image showing macrophyte growth and heavy coverage of filamentous algae and floc in survey section D (conditions inimical to freshwater pearl mussel).

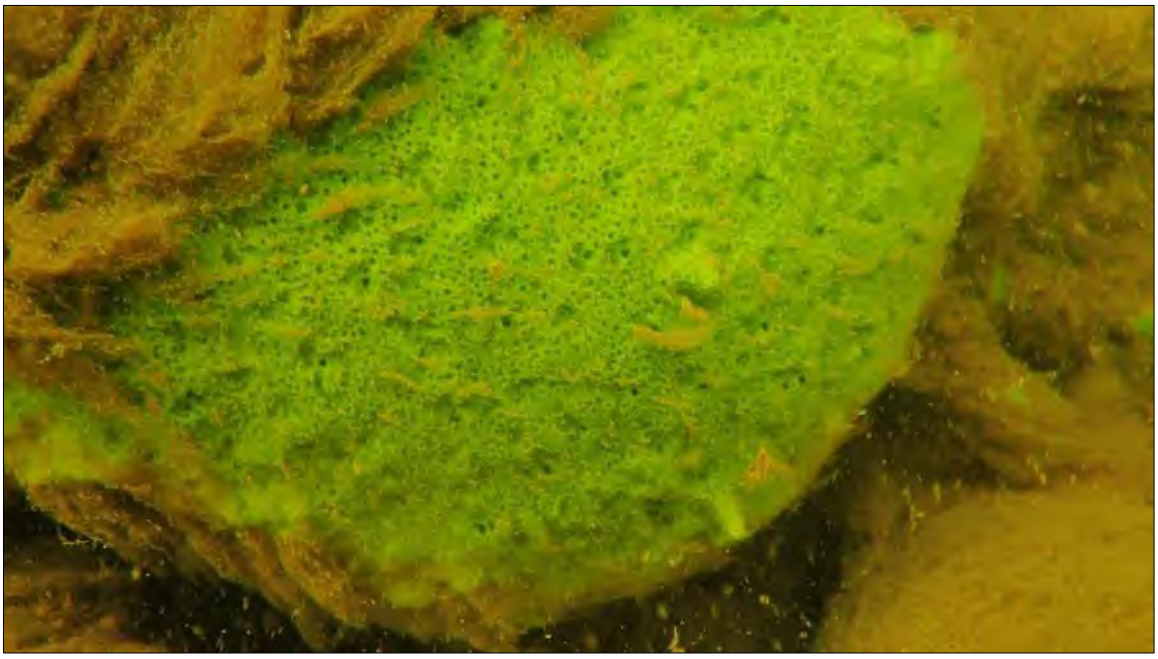


Plate 3.23 Freshwater sponge growing on submerged boulder in the vicinity of Graiguenamanagh Bridge (high coverage of filamentous algae and floc evident).

Plate 3.24 The River Barrow downstream of Graiguenamanagh Bridge and upstream of Graiguenamanagh Weir.

3.1.5 Section E - River Barrow (Graiguenamanagh Weir to Lower Tinnahinch Weir)

Located downstream of Graiguenamanagh Weir, survey section E was dominated by riffle and shallow deep glide grading into deeper glide and pool downstream. The river averaged 1-1.5m deep adjoining the weir but deepened significantly to >3m *c*.100m downstream. From Graiguenamanagh Lock to Tinnahinch Weir, the river was exclusively deep glide and pool. The bed was dominated by cobble and coarse gravel with occasional boulder. Outside of shallower areas associated with the weir, these were heavily silted with relatively high levels of compaction and partial bedding. Excessive filamentous algae was present throughout the survey section, particularly in vicinity of the weir (**Plate 3.26**). Macrophytes were rare but arrowhead, clubrush and localised yellow water lily were present. Scattered, mature treelines of willow (*Salix* spp.), ash and occasional sycamore bordered the river.

No live or dead freshwater pearl mussels were recorded via bathyscope or SCUBA diving surveys in survey section E (**Figure 3.1**). The River Barrow downstream of Graiguenamanagh Weir had no suitability for freshwater pearl mussel given evident enrichment, abundant filamentous algae, high levels of siltation and bedding/compaction of substrata. Very low densities of duck mussel (<1 per $10m^2$) were recorded in the vicinity of the weir, predominantly in localised beds of coarse sand with low densities also recorded in the deeper pool habitat between Graiguenamanagh Weir and Lower Tinnahinch Weir.

Plate 3.25 Graiguenamanagh Weir facing downstream from the weir sill.

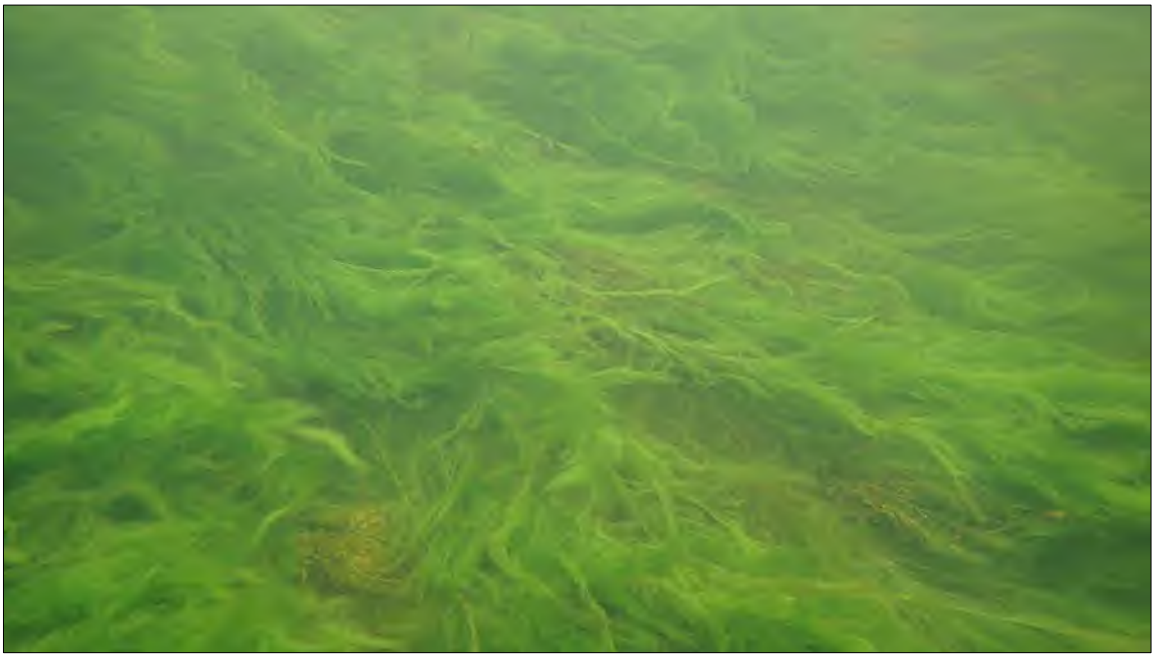


Plate 3.26 Extreme cover of filamentous algae (*Cladophora* sp.) on compacted cobbles immediately downstream of Graiguenamanagh Weir.

Plate 3.27 Downstream of Graiguenamanagh Weir at Duiske River confluence (right foreground).

Plate 3.28 Sampling for *Margaritifera margaritifera* eDNA at Lower Tinnahinch Weir, April 2021.

3.2 eDNA analysis

Composite water samples collected from the Duiske River upstream of Tinnapark River confluence (C0282) and Turfmarket Weir (C0285) returned a negative result for freshwater pearl mussel eDNA (0 positive of 12 qPCR replicates, respectively) (**Appendix B**). These results were considered as evidence of the species' absence from the Duiske River and its tributaries (*i.e.* Graiguenamanagh and Tinnapark Rivers).

However, a positive result for freshwater pearl mussel eDNA was returned in the River Barrow sample collected at Lower Tinnahinch Weir (C0280) (1 of 12 qPCR replicates) (**Figure 3.1** & **Appendix B**). Although eDNA was present at low concentrations, this result indicated the presence of freshwater pearl mussel an undefined distance upstream of Lower Tinnahinch Weir (see Discussion).

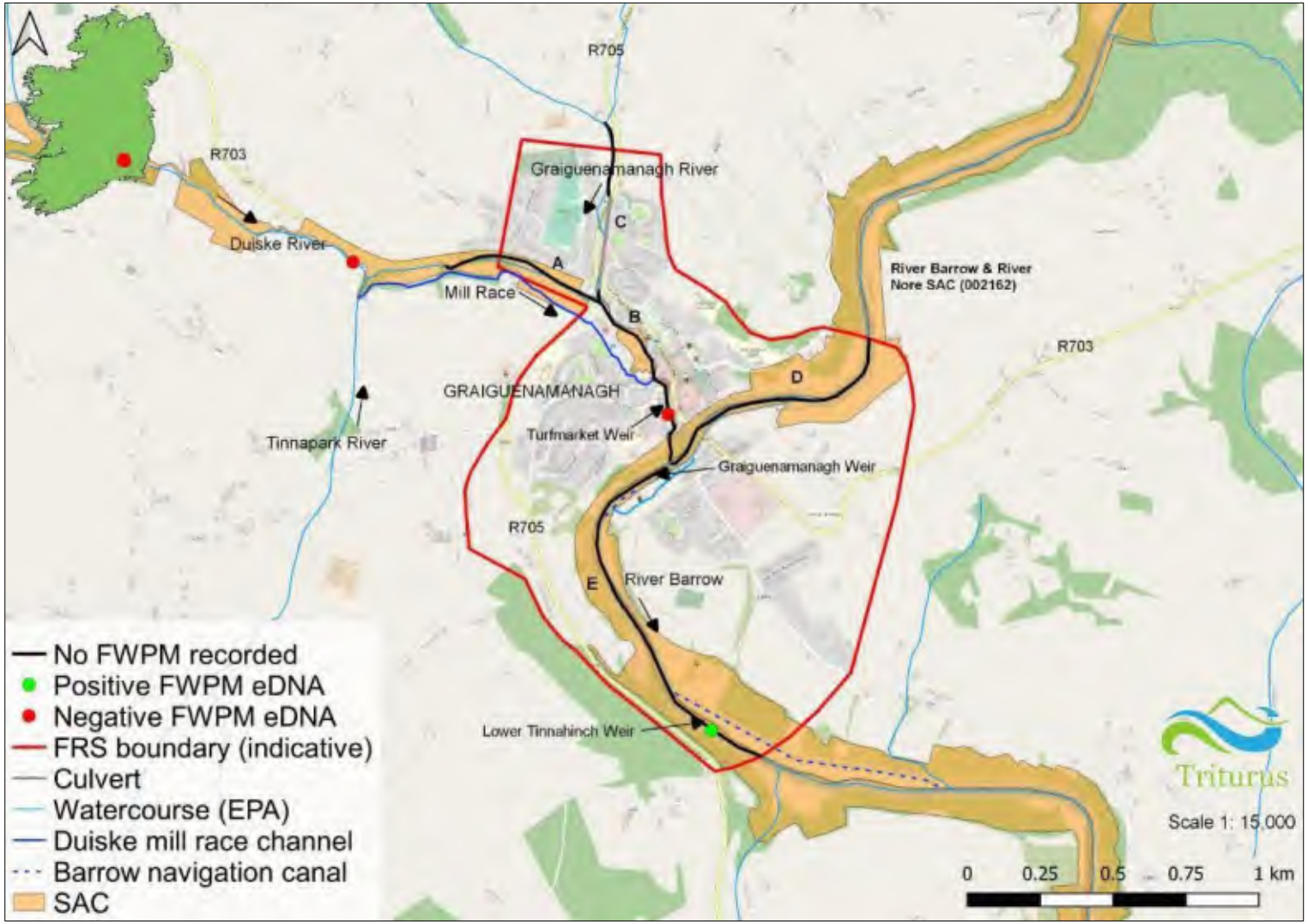


Figure 3.1 Results of freshwater pearl mussel surveys and eDNA analysis, April 2021.

4. Discussion

4.1 Freshwater pearl mussel detection via eDNA

Stage 1 freshwater pearl mussel surveys undertaken in the vicinity of Graiguenamanagh in April 2021 failed to identify freshwater pearl mussels (live or dead) through a combination bathyscope, snorkelling and SCUBA dive surveys. However, *Margaritifera margaritifera* eDNA was detected in the River Barrow water sample, collected at Lower Tinnahinch Weir (1 positive qPCR replicate out of 12; **Appendix B**). Although eDNA via qPCR is not fully quantitative in respect that it can only confirm the presence of a species, the laboratory result supports a low concentration of freshwater pearl mussel DNA within the Barrow channel in the vicinity of Graiguenamanagh. Due to various significant pressures (*e.g.* eutrophication, siltation), the River Barrow retains no suitability for a recruiting freshwater pearl mussel population (see section 4.2) and the species is generally accepted as being extinct within the main Barrow channel (Lucey, 1998; however, see below). Extant populations within the Barrow catchment are confined to the Mountain River, Ballymurphy River (Ballyroughan River) and Aughavaud River sub-catchments (Moorkens, 1992, 2008, 2009a, 2009b; Ross, 2006; DEHLG, 2010a, 2010b, 2010c).

The high sensitivity of eDNA analysis likely enabled a detection of these upstream freshwater pearl mussel populations from the Lower Tinnahinch Weir water sample. Although highly variable, downstream transport of eDNA in riverine environments is known to extend to >100km (Pont *et al*., 2018), with reported detectable distances for freshwater bivalves ranging from as little as 25m to 12km (*e.g*. Preece *et al*., 2020; Lor *et al*., 2020; Stoekle *et al*., 2015; Deiner & Altermatt, 2014). Although studies are lacking, the greatest reported distance at which freshwater pearl mussel eDNA has been detected from a known downstream population is 1.7km (Wacker *et al*., 2019a). In light of this, it is unclear whether our analysis detected pearl mussel eDNA from the upstream Mountain River or Ballymurphy River populations. The Mountain River and Ballymurphy River populations are located c. 7km and 5km upstream of Graiguenamanagh, respectively (see **Figure 1.1**). Alternatively, the detected eDNA may have originated from pearl mussel washed into the main Barrow channel from the Mountain River. Fluvial mussel migration from the Mountain River to the main Barrow channel has been noted previously in the River Barrow catchment (in 1991, Sweeny, 2011). Recent NPWS data (2018) indicate low numbers of pearl mussels within the main Barrow channel downstream of the Mountain River and Little Ballyine River confluences, respectively. These are likely individuals originating in the Mountain River. The closest live pearl mussel record for the River Barrow record is located approx. 6.1km upstream of Graiguenamanagh (Ballyine River confluence). It is possible that our analysis detected eDNA emanating from this location or from an overlooked site of fluvially-migrated mussels from a Barrow tributary.

The use of fresh pearl mussel shells as a source of viable posthumous genetic material has been demonstrated (Geist *et al.,* 2008), although the detectability of such via eDNA sampling is yet to be confirmed for freshwater bivalves. Thus, the exact source of our positive eDNA result remains unclear. Irrespectively, Stage 1 surveys confirmed the absence of freshwater pearl mussels from the Graiguenamanagh survey area (*i.e.* present some undefined upstream only).

4.2 Freshwater pearl mussel habitat

The absence of freshwater pearl mussel from the Graiguenamanagh survey area was unsurprising given habitat characteristics inimical to the species. For example, the River Barrow channel (survey sections D and E) featured high levels of siltation and high coverage of filamentous algae, indicative of significant eutrophication. Siltation of interstitial spaces in the substrata reduces oxygen exchange required by juvenile mussels and is the critical factor determining successful *Margaritifera* recruitment (Hyvärinen *et al*., 2021; Moorkens & Killeen, 2014; Geist & Auerswald, 2007). Siltation (invariably associated with eutrophication) also impacts the filter feeding ability of adult mussels (Goldsmith *et al.,* 2021; Moorkens, 1999) and can lead to mortality via smothering in extreme cases.

Furthermore, the Barrow at Graiguenamanagh Bridge (station RS14B013500) achieved Q3-4 (moderate status) water quality in 2020, a decline from Q4 in 2016 (EPA data). The species typically requires water quality corresponding to high ecological status (*i.e.* ≥Q4-5) (Moorkens, 2000), as set out under the Freshwater Pearl Mussel Regulations S.I. No. 296 (2009). Thus, there is no suitability for *Margaritifera margaritifera* in the River Barrow in the vicinity of Graiguenamanagh.

While the Duiske River had some greater suitability to support freshwater pearl mussel, none were recorded via traditional surreys of eDNA analysis. This high-energy watercourse typically featured a compacted bed dominated by boulder and cobble, with little opportunity for adult mussel footing. Although beds of finer gravels and coarse sand were present locally (in upper survey reaches, upstream of R705), these were typically not accompanied by larger substrata and were not suitable for juvenile mussel burial. Siltation (surface cover & substrata infiltration) and cover of floc increased from low in the upper survey reaches to moderate and locally heavy in the lower reaches of the river. Additionally, there was evident agricultural and urban enrichment resulting in moderate to high filamentous algal cover (often 5-10% cover, increasing moving downstream). Despite the presence of high quality water (Q4-5) in the Duiske upstream of Graiguenamanagh in 2020 (station RS14D040100, EPA data), the issues outlined above would preclude the presence of pearl mussel from the river.

The Graiguenamanagh River (Duiske tributary) provided no suitability for freshwater pearl mussel given high bed compaction, enrichment pressures and moderate siltation (derived largely from sheep poaching and adjoining agricultural land use). Furthermore, the small river did not support a salmonid population upstream of the extensive R705 culvert (2021 Triturus electro-fishing data) and also suffered from low flows, seasonally. The lower survey reaches, downstream of the culvert, were also unsuitable for pearl mussel given evident enrichment, historical modifications and bed compaction.

4.3 Duck mussel (*Anodonta anatina*) in River Barrow channel

Filtering mussels were present in the River Barrow upstream and downstream of Graiguenamanagh Weir and were identified as duck mussel (*Anodonta anatina*). These were present at low densities (≤1 per $10m^2$) but there were many dead shells. Whilst *Anodonta* sp. are

somewhat tolerant of organic enrichment (Lucey, 1995), it was considered that the observed eutrophication of the River Barrow (high filamentous algal cover) in addition to siltation was negatively impacting the habitat. Duck mussel are classed as a 'vulnerable' species in Ireland (Byrne *et al*., 2009). In light of this and the restricted distribution within the Barrow catchment (refer to NBDC data), the Graiguenamanagh populations can, therefore, be considered of high conservation value. In contrast to freshwater pearl mussel which require salmonids as obligate intermediate hosts to complete their life cycle (Taeubert & Geist, 2017; Wacker *et al*., 2019b), *Anodonta* sp. glochidia may develop in a wide range of fish species, including brown trout as well as cyprinids (Huber & Geist, 2020; Dias *et al*., 2020; Chowdhury *et al*., 2018). Duck mussels demonstrate a relatively high plasticity and tolerance to different abiotic conditions and can thus be found from fast-flowing streams to lentic habitats (Zieritz & Aldridge, 2011). Whilst sympatry with *Margaritifera* has been noted (Lopes-Lima *et al*., 2016), life history and water quality tolerance discrepancies mean that freshwater pearl mussel and duck mussel are not typically found in coexistence.

5. References

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

Boon, P.J., Cooksley, S.L., Geist, J., Killeen, I.J., Moorkens, E.A., & Sime, I. (2019). Developing a standard approach for monitoring freshwater pearl mussel (*Margaritifera margaritifera*) populations in European rivers. Aquatic Conservation: Marine and Freshwater Ecosystems.

CEN (2017). Water quality - Guidance standard on monitoring freshwater pearl mussel (*Margaritifera margaritifera*) populations and their environment. In EN 16859. Brussels, Belgium: European Committee for Standardization.

Chowdhury, M. M. R., Salonen, J. K., Marjomäki, T. J., & Taskinen, J. (2018). Interaction between the endangered freshwater pearl mussel *Margaritifera margaritifera*, the duck mussel *Anodonta anatina* and the fish host (*Salmo*): acquired and cross-immunity. Hydrobiologia, 810(1), 273-281.

DEHLG (2010a). Second Draft Mountain Freshwater Pearl Mussel Sub-basin Management Plans (2009-2015). March 2010. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

DEHLG (2010b). Second Draft Ballymurphy Freshwater Pearl Mussel Sub-basin Management Plans (2009-2015). March 2010. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

DEHLG (2010c). Second Draft Aughavaud Freshwater Pearl Mussel Sub-basin Management Plans (2009-2015). March 2010. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Deiner, K., & Altermatt, F. (2014). Transport distance of invertebrate environmental DNA in a natural river. PLoS One, 9(2), e88786

Dias, A. R., Teixeira, A., Lopes-Lima, M., Varandas, S., & Sousa, R. (2020). From the lab to the river: determination of ecological hosts of *Anodonta anatina*. Aquatic Conservation: Marine and Freshwater Ecosystems, 30(5), 988-999.

Geist, J., & Auerswald, K. (2007). Physicochemical stream bed characteristics and recruitment of the freshwater pearl mussel (*Margaritifera margaritifera*). Freshwater Biology, 52(12), 2299–2316.

Geist, J., Wunderlich, H., & Kuehn, R. (2008). Use of mollusc shells for DNA-based molecular analyses. Journal of Molluscan Studies, 74(4), 337-343.

Goldsmith, A. M., Jaber, F. H., Ahmari, H., & Randklev, C. R. (2021). Clearing up cloudy waters: a review of sediment impacts to unionid freshwater mussels. Environmental Reviews, 29(1), 100-108.

Hastie L.C., Boon P.J. and Young M.R. (2000). Physical microhabitat requirements of freshwater pearl mussel *Margaritifera margaritifera* (L.). Hydrobiologia 429 59-71

Huber, V., & Geist, J. (2019). Host fish status of native and invasive species for the freshwater mussel *Anodonta anatina* (Linnaeus, 1758). Biological conservation, 230, 48-57.

Lor, Y., Schreier, T. M., Waller, D. L., & Merkes, C. M. (2020). Using environmental DNA (eDNA) to detect the endangered Spectaclecase Mussel (*Margaritifera monodonta*). Freshwater Science, 39(4), 837-847.

Lucey, J. (1995). The distribution of *Anodonta cygnea* (L.) and *Anodonta anatina* (L.) (Mollusca: Bivalvia) in southern Irish rivers and streams with records from other areas. The Irish Naturalists' Journal, 25(1), 1-8.

Lucey, J. (1998). The Barrow, the Nore and the Suir. In: C. Moriarty (ed.) Studies of Irish rivers and lakes. Essays on the occasion of the XXVII Congress of Societas Internationalis Limnologiae (SIL), 99-118 Marine Institute, Dublin.

Moorkens, E. A. (2000). Conservation management of the freshwater pearl mussel *Margaritifera margaritifera*. Part 2: Water quality requirements. Irish Wildlife Manuals, 9.

Moorkens, E. A., & Killeen, I. J. (2014). Assessing near-bed velocity in a recruiting population of the endangered freshwater pearl mussel (*Margaritifera margaritifera*) in Ireland. Aquatic Conservation: Marine and Freshwater Ecosystems, 24(6), 853-862.

Moorkens, E., Cordeiro, J., Seddon, M.B., von Proschwitz, T. & Woolnough, D. (2018). *Margaritifera margaritifera* (errata version published in 2018). The IUCN Red List of Threatened Species 2018: http://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T12799A508865.en.

Moorkens, E., Costello, M., & Speight, M. (1992). Status of the Freshwater Pearl Mussels *Margaritifera margaritifera* and *M. m. durrovensis* in the Nore, Barrow and Suir River Tributaries, South-East Ireland. *The Irish Naturalists' Journal, 24*(3), 127-131.

Moorkens, E.A. & Killeen, I.J. (2020). Monitoring Populations of the Freshwater Pearl Mussel, *Margaritifera margaritifera*, Stage 3 and Stage 4 Survey. Irish Wildlife Manuals, No. 122. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland.

Moorkens, E.A. & Killeen, I.J. (2020). Monitoring Populations of the Freshwater Pearl Mussel, *Margaritifera margaritifera*, Stage 3 and Stage 4 Survey. Irish Wildlife Manuals, No. 122. National Parks and Wildlife Service, Department of Culture, Heritage and the Gaeltacht, Ireland

Moorkens, E.A. (2008). NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Aughavaud River. Unpublished Report to the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Moorkens, E.A. (2009a). NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Mountain River. Unpublished Report to the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin

Moorkens, E.A. (2009b). NS II Freshwater Pearl Mussel Sub-basin Management Plans: Monitoring of the Freshwater Pearl Mussel in the Ballymurphy River. Unpublished Report to the National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

NPWS (2008). The Status of EU Protected Habitats and Species in Ireland. Unpublished report, National Parks and Wildlife Services, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. 81.

NPWS (2011). Conservation Objectives: River Barrow and River Nore SAC 002162. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

NPWS (2013). The Status of Protected EU Habitats and Species in Ireland. Overview Volume 1. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland. Editor: Deirdre Lynn. 81.

NPWS (2019). 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. 84.

NPWS (2020). Natura 2000 – Standard Data Form: River Barrow and River Nore SAC 002162. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Updated October 2020.

Pont, D., Rocle, M., Valentini, A., Civade, R., Jean, P., Maire, A., & Dejean, T. (2018). Environmental DNA reveals quantitative patterns of fish biodiversity in large rivers despite its downstream transportation. Scientific reports, 8(1), 1-13.

Preece, E. P., Bryan, M., Mapes, S. M., Wademan, C., & Dorazio, R. (2020). Monitoring for freshwater mussel presence in rivers using environmental DNA. Environmental DNA 3(3), 591-694

Ross, E. (2006). Initiation of a monitoring program for the freshwater pearl mussel, *Margaritifera margaritifera* (L.) in the Mountain River (Barrow). Unpublished report to National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.

Skinner, A, Young M. & Hastie, L. (2003). Ecology of the Freshwater Pearl Mussel. Conserving Natura 2000 Rivers Ecology Series No. 2 English Nature, Peterborough.

Stoeckle, B. C., Kuehn, R., & Geist, J. (2015). Environmental DNA as a monitoring tool for the endangered freshwater pearl mussel (*Margaritifera margaritifera* L.): a substitute for classical monitoring approaches? Aquatic Conservation: Marine and Freshwater Ecosystems, 26(6), 1120–1129.

Sweeney, P. (2011). Natura Impact Statement (Stage 2: Appropriate Assessment). Impacts of Powerstown Landfill, Co. Carlow on Special Area of Conservation 002162.

Taeubert, J. E., & Geist, J. (2017). The relationship between the freshwater pearl mussel (*Margaritifera margaritifera*) and its hosts. Biology Bulletin,44, 67–73.

Wacker, S., Fossøy, F., Larsen, B. M., Brandsegg, H., Sivertsgård, R., & Karlsson, S. (2019). Downstream transport and seasonal variation in freshwater pearl mussel (*Margaritifera margaritifera*) eDNA concentration. Environmental DNA, 1(1), 64-73.

Wacker, S., Larsen, B. M., Karlsson, S., & Hindar, K. (2019). Host specificity drives genetic structure in a freshwater mussel. *Scientific reports*, *9*(1), 1-7.

Zieritz, A., & Aldridge, D. C. (2011). Sexual, habitat-constrained and parasite-induced dimorphism in the shell of a freshwater mussel (*Anodonta anatina*, Unionidae). Journal of Morphology, 272(11), 1365-1375.

6. Appendix A – survey site characteristics

Table A1 Summary characteristics of each freshwater pearl mussel survey section in the vicinity of the proposed Graiguenamanagh-Tinnahinch FRS, April 2021

Section	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
A	Duiske River (upper)	Upland eroding watercourse (FW1), average 3-4m wide & 0.2-0.5m deep, fast glide dominated, largely natural channel with some modifications near R705 crossing, high flow rates, narrow but mature riparian zone with moderate to high shading, low macrophyte cover, moderate bryophyte cover	Improved agricultural grassland (GA1), treelines (WL2), scrub (WS1), mixed broad-leaved woodland (WD1)	Boulder & cobble dominated with localised beds of mixed gravels and sand	Low siltation and high compaction overall; low floc cover; filamentous algal cover often 5-10%; storm drains present near R705	*Oenanthe crocata* (O), *Lemanea* sp. (O), *Platyhypnidium riparoides* (F), *Hygroamblystegium* sp. (O)	No	Eutrophication, siltation
B	Duiske River (lower)	Upland eroding watercourse (FW1), average 3-4m wide & 0.2-0.4m deep, fast glide dominated, historically modified & locally straightened with frequent retaining walls, poorly intact riparian zones (urbanisation), moderate macrophyte cover (enrichment), moderate bryophyte cover	Buildings and artificial surfaces (BL3), amenity grassland (GA2), treelines (WL2), scattered trees and parkland (WD5)	Boulder & cobble dominated with localised beds of mixed gravels and sand	Low siltation and high compaction overall; high floc cover; abundant filamentous algal cover; storm drains present throughout	*Ranunculus* subsp. *Batrachion* agg. (F), *Oenanthe crocata* (R), *Platyhypnidium riparoides* (F), *Hygroamblystegium* sp. (R)	No	Eutrophication, siltation, water quality, channel modifications, hydromorphological impacts
C	Graiguenamanagh River	Upland eroding watercourse (FW1), average 1-1,5m wide & 0.1-0.3m deep, fast glide dominated, natural	Improved agricultural grassland (GA1), wet grassland (GS4), treelines	Small cobble & mixed gravels upstream of culvert with	Moderate siltation & compaction overall	*Oenanthe crocata* (O), *Apium nodiflorum* (O), *Berula erecta* (R), *Mentha aquatica* (R),	No	Eutrophication, siltation, water quality, channel modifications and hydromorphological

Section	Watercourse	River profile	Bordering land uses & riparian habitat	Substrata	Riverbed condition & siltation	Macrophytes & bryophytes (DAFOR)	FWPM recorded	Threats & pressures
		channel upstream of R705 culvert but heavily modified downstream (retaining walls, culvert), well-developed riparian zone only in upper reaches, moderate macrophyte cover (enrichment)	(WL2), scrub (WS1), buildings and artificial surfaces (BL3)	boulder & cobble downstream	(increasing downstream)	*Hygroamblystegium* sp. (R)		impacts (downstream of culvert)
D	River Barrow (upstream Graiguenamanagh Weir)	Lowland depositing watercourse (FW2), average 40-50m wide & 1.5-2.5m deep, 100% slow-flowing glide, historically modified (retaining walls/quays), poorly intact riparian zone (urbanisation), low to macrophyte cover (usually margins only)	Buildings and artificial surfaces (BL3), dry meadows and grassy verges (GS2), treelines (WL2), improved agricultural grassland (GA1)	Silt with localised areas of sand and bedded cobbles & gravels, occasional boulder	Heavy siltation, abundant filamentous algae and floc	*Nuphar lutea* (O), *Schoenoplectus lacustris* (O), *Potamogeton perfoliatus* (R), *Myriophyllum spicatum* (R), *Sagittaria sagittifolia* (O)	No	Eutrophication, siltation, water quality, channel modifications
E	River Barrow (downstream Graiguenamanagh Weir)	Lowland depositing watercourse (FW2), average 20-35 wide & 1-3m deep, dominated by slow flowing glide & pool (faster near weir), historically modified near town (weir), well-developed riparian zone downstream of town, low macrophyte cover (usually margins only)	Buildings and artificial surfaces (BL3), amenity grassland (GA2), treelines (WL2), scattered trees and parkland (WD5)	Silt with localised areas of cobble & occasional boulder (cobble & gravels dominated near weir)	Heavy siltation, abundant filamentous algae and floc	*Nuphar lutea* (O), *Schoenoplectus lacustris* (O), *Potamogeton perfoliatus* (R), *Sagittaria sagittifolia* (O), *Mentha aquatica* (O)	Yes; eDNA recorded at Lower Tinnahinch Weir (see section 4.1)	Eutrophication, siltation, water quality, channel modifications

7. Appendix B – eDNA analysis lab report

SureScreen Scientifics

Folio No: E9978
Report No: 1
Purchase Order: -
Client: Triturus Environmental Ltd
Contact: Ross Macklin

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: 05/05/2021
Date results reported: 18/05/2021
Matters affecting result: None

TARGET SPECIES: Freshwater pearl mussel *(Margaritifera margaritifera)*

Lab ID	Site Name	OS Reference	SIC	QC	IC	Result	Positive Replicates
C0280	Tinnahinch Weir	-	Pass	Pass	Pass	Positive	1/12
C0282	Duiske Upper	-	Pass	Pass	Pass	Negative	0/12
C0285	Duiske Lower	-	Pass	Pass	Pass	Negative	0/12

If you have any questions regarding results, please contact us: ForensicEcology@surescreen.com

Reported by: Dr Chris Troth (BSc) Approved by: Dr Chris Troth (BSc)

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Division Ltd, Morley Retreat, Church Lane, Morley, Derbyshire, DE7 6DE, UK
Tel +44 (0)1332 292003 Email: scientifics@surescreen.com
Company Registration No. 08950940

SureScreen Scientifics

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 each of the 6 sub-sample tubes are first centrifuged and pooled together into a single sample which then undergoes DNA extraction. 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.

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Division Ltd, Morley Retreat, Church Lane, Morley, Derbyshire, DE7 6DE, UK
Tel +44 (0)1332 292003 Email scientifics@surescreen.com
Company Registration No. 08950940

SureScreen Scientifics

INTERPRETATION OF RESULTS

SIC: **Sample Integrity Check** [Pass/Fail]
When samples are received in the laboratory, they are inspected for any tube leakage, suitability of sample (not too much mud or weed etc.) and absence of any factors that could potentially lead to inconclusive results.

DC: **Degradation Check** [Pass/Fail]
Analysis of the spiked DNA marker to see if there has been degradation of the kit or sample, between the date it was made to the date of analysis. Degradation of the spiked DNA marker may indicate a risk of false negative results.

IC: **Inhibition Check** [Pass/Fail]
The presence of inhibitors within a sample are assessed using a DNA marker. If inhibition is detected, samples are purified and re-analysed. Inhibitors cannot always be removed, if the inhibition check fails, the sample should be re-collected.

Result: **Presence of eDNA** [Positive/Negative/Inconclusive]

Positive: DNA was identified within the sample, indicative of species presence within the sampling location at the time the sample was taken or within the recent past at the sampling location.

Positive Replicates: Number of positive qPCR replicates out of a series of 12. If one or more of these are found to be positive the pond is declared positive for species presence. It may be assumed that small fractions of positive analyses suggest low level presence, but this cannot currently be used for population studies. Even a score as low as 1/12 is declared positive. 0/12 indicates negative species presence.

Negative: eDNA was not detected or is below the threshold detection level and the test result should be considered as evidence of species absence, however, does not exclude the potential for species presence below the limit of detection.

Inconclusive: Controls indicate inhibition or degradation of the sample, resulting in the inability to provide conclusive evidence for species presence or absence.

Forensic Scientists and Consultant Engineers
SureScreen Scientifics Division Ltd, Morley Retreat, Church Lane Morley, Derbyshire DE7 6DE, UK
Tel: +44 (0)1332 292003 Email: scientifics@surescreen.com
Company Registration No. 08950940

Triturus Environmental Ltd.

42 Norwood Court,

Rochestown,

Co. Cork,

T12 ECF3.

Appendix P: Arboricultural Report (VEON, 2024)

ARBORICULTURAL REPORT

Location: -
Lands at Graiguenamanagh, Co. Kilkenny
& Tinnahinch, Co. Carlow

Prepared for: -
ByrneLooby Ltd.

Prepared by: -
Ethan Gannon 'Dip Arb L4 (ABC), ISA Cert Arb, Cert Hort L6 (QQI), TechArborA'

09th May 2025

Contents

1.0 Introduction

1.1 In support of the environmental assessments being undertaken by ByrneLooby for the proposed Graiguenamanagh/Tinnahinch Flood Relief Scheme; Veon Ltd has been instructed to provide the following information in accordance with BS 5837:2012 Trees in Relation to Design, Demolition and Construction – Recommendations.

1. Tree Survey
2. Arboricultural Impact Assessment
3. Arboricultural Method Statement
4. Tree Constraints and Removal/Retention Plan

1.2 The OPW, working in partnership with Local Authorities, have concluded that a flood relief scheme would be viable and effective for the Graiguenamanagh/Tinnahinch communities. The flood defence measures proposed are currently being reviewed through project-level assessment and optioneering.

2.0 Limitations of Survey

2.1 The tree survey was conducted from ground level only, without the use of decay detection equipment. All findings, observations and recommendations are based on the knowledge and experience of the surveyor. Information contained in this report covers only those items that were examined and reflects the condition of those items at the time of the inspection. Trees are dynamic living organisms, whose health and condition can be subject to rapid change, depending on multiple external and internal factors. The conclusions and recommendations contained in this report relate to the trees at the time of inspection and its validity will diminish over time. Trees should be routinely assessed, particularly after storms.

3.0 Site Inspection & Methodology

3.1 The areas were assessed between the 23rd and 25th of May 2023, the 19th of December 2023 and the 15th November 2024. Trees were visually assessed from ground level and the findings from this assessment are in the Tree Survey in Appendix 1, along with the supporting tree survey form key and images of the surveyed trees. The Arboricultural data presented in the Tree Survey has been recorded in line with BS 5837:2012. The tree survey was conducted by collecting and assessing the following information on all significant trees located on site and proximal to the site.

- Tree number
- Tree species both common and scientific
- Dimensions (height, trunk diameter, crown spread, crown clearance, Root Protection Area)
- Age class
- Physiological condition

- Structural condition
- Preliminary recommendations
- Estimated remaining contribution within their present environment
- Retention category grade
- Ecological significance

3.1 Aluminium tags have been stapled to the trees at a height of 1.5m for identification purposes. Trees that were inaccessible for tagging, and Tree Groups or Tree Lines growing as one coherent unit have been numbered numerically i.e. Tree No. 1, Tree Group No. 1, Tree Line No. 1, respectively.

3.2 The Tree Constraints and Removal/Retention Plan has been created using ArcGIS mapping, with the maps provided in Appendix 3. These maps illustrate the five surveyed areas, with detailed descriptions available in Section 4, "Summary of Findings". The maps show tree positions, tag numbers, trees for removal (in red), trees for retention (in green) and Root Protection Areas (RPA). The Root Protection Area (RPA) constraint for each tree has been shown as a 'Light Blue Circle' and all proposed development should be positioned outside of the RPA of retained trees. The RPA is the minimum area around individual trees to be protected from disturbance during construction works; RPA is usually expressed as a radius in meters measured from the centre of the tree's stem.

3.3 The tree retention category has been assessed and categorised according to their quality and value within the existing context (BS 5837:2012 sec 4.5), and not in conjunction with any proposed development plans. In making this assessment, particular consideration was given to:
-Arboricultural Value – including health, structural form, life expectancy, species and its physical contribution to or effects on other features located on site.
-**Landscape Value** – an assessment of a tree's locality, including its contributions to other features as well as to the overall site.
-**Cultural Value** – additional contributions made such as conservation, historical, commemorative value.

3.4 The trees have been divided into one of the following categories, in accordance with the BS 5837:2012 cascade chart illustrated in Table 4 (Appendix 1). The classification process begins by determining whether the tree falls within the (U) category (unretainable), if not, then the process will continue by assuming that all trees are considered according to the criteria for inclusion in the high category (A). Trees that do not meet these strict criteria will then be considered for inclusion in the moderate category (B), and failing this, they will be allocated a low category (C).

3.5 The Arboricultural Impact Assessment in Section 5 describes how construction activities can impact trees, and it details the specific impacts the proposed works will have on the existing tree population.

3.6 The Arboricultural Method Statement (AMS) in Section 6 outlines appropriate control measures to protect trees and hedgerows during construction. This includes site investigation, preparation, clearance, demolition and post-development. Construction will proceed according to the AMS to safeguard retained trees, tree groups and hedgerows on and adjacent to the site.

4.0 Summary of Findings

4.1 The survey was divided into five areas.

4.2 Area 1 is where the upstream storage area is proposed, north-west of the towns (see Figure 1). It is the largest of the areas and it consists of agricultural grass fields that slope down to form a valley with the River Duiske which meanders through its centre. Mature hedgerows comprised of species such as hawthorn *(Crataegus monogyna),* blackthorn *(Prunus spinosa),* elder *(Sambucus nigra),* goat willow *(Salix caprea),* holly *(Ilex aquifolium)* and spindle *(Euonymus europaeus)* make up the boundaries between these fields, and mature trees including ash *(Fraxinus excelsior),* oak *(Quercus robur),* horse chestnut *(Aesculus hippocastanum),* sycamore *(Acer pseudoplatanus)* and alder *(Alnus glutinosa)* make up the upper canopies of these hedgerows. All the ash trees display symptoms of ash dieback – causal agent *Hymenoscyphus fraxineus*. The oak trees in this area hold the highest merit, the majority of which have been given Category A grades. There are also two semi-mature forestry plantations in this area comprised of ash *(Fraxinus excelsior),* oak *(Quercus robur),* beech *(Fagus sylvatica)* and alder *(Alnus glutinosa).*

Figure 1: Area 1 outlined in orange.

4.3 Area 2 is a grass field bounded by walls and fences, with a single mature hawthorn *(Crataegus monogyna)* and sycamore *(Acer pseudoplatanus)* towards the back (north) of the field (see Figure 2).

4.4 Area 3 is the trees along the planned defences at the beginning of the River Duiske, east of the Hub (see Figure 2). There are two mature oak trees *(Quercus robur*), a group of mature Lawson cypress' *(Chamaecyparis lawsoniana),* and a mature large leaved lime *(Tilia platyphyllos)* all close the bridge. There is also group of early mature trees between the river and the recreation area, species present include alder *(Alnus glutinosa)*, beech *(Fagus sylvatica)*, white willow *(Salix alba)*, wild cherry *(Prunus avium)* and hazel *(Corylus avellana).*

4.5 Area 4 is the trees adjacent to the planned embankment and raised ground behind Tinnahinch Quay (see Figure 2). This area is mainly a private garden, with four, self-set trees - a semi mature and early mature ash *(Fraxinus excelsior),* a semi mature sycamore *(Acer pseudoplatanus)* and a mature goat willow *(Salix caprea).* There is also a mixed species, mature woodland on the higher ground to the west of this area, separated by a retaining wall, the trees that make up the outer canopy formation of this woodland, and overhang Area 4, include ash *(Fraxinus excelsior),* western red cedar *(Thuja pilcata)* and larch *(Larix decidua).*

4.6 Area 5 is the trees along the planned raised defence wall adjacent to Tinnahinch Castle and the quay (see Figure 2). Significant trees in this area include a mature horse chestnut *(Aesculus hippocastanum*) and a mature sycamore *(Acer pseudoplatanus),* both located on the adjoining property side of the wall that runs parallel to the public walkway and river. Outside of this, in the overgrown scrub area to the south of the river, there is a mature white willow *(Salix alba)* and a group of semi mature alder *(Alnus glutinosa)* and white willows *(Salix alba)*. To the east of this area, but still along the quay, there is a group of three, mature, moderate quality, Category B, Lawson cypress *(Chamaecyparis lawsoniana)* trees and a mature, moderate quality, Category B, birch *(Betula pendula)* growing in a small grass area adjoining residences.

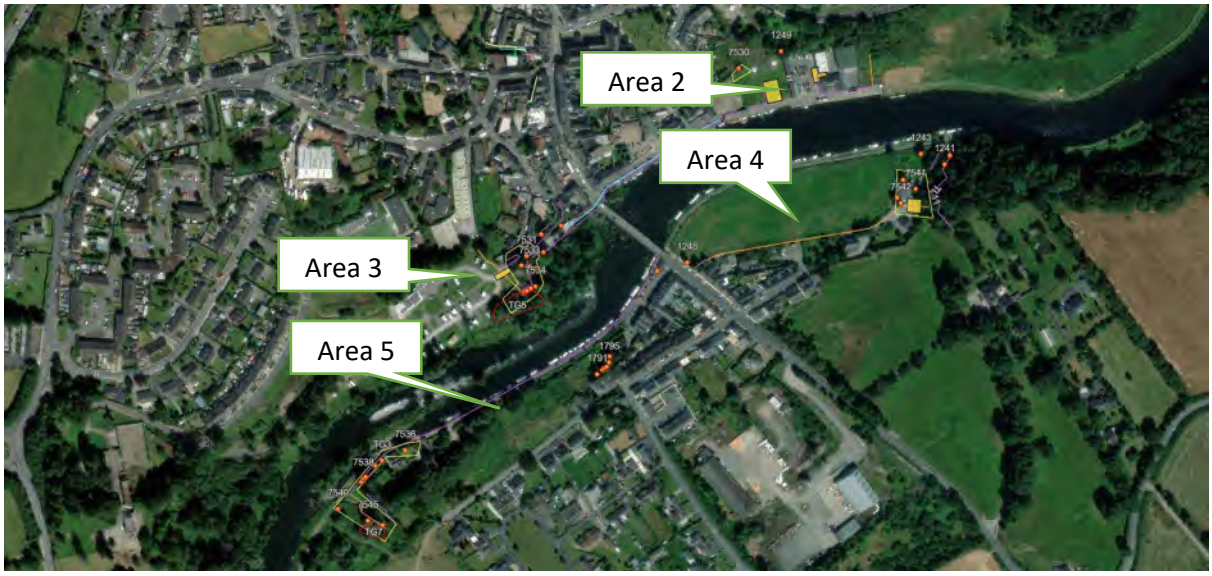


Figure 2: Overview of Town Areas Nos. 2-5 in their environs.

4.7 In total, 64 Trees were individually tagged, and 6 Trees, 8 Tree Groups, 15 Hedges, 2 Woodland Blocks and 13 Tree Lines were numbered numerically.

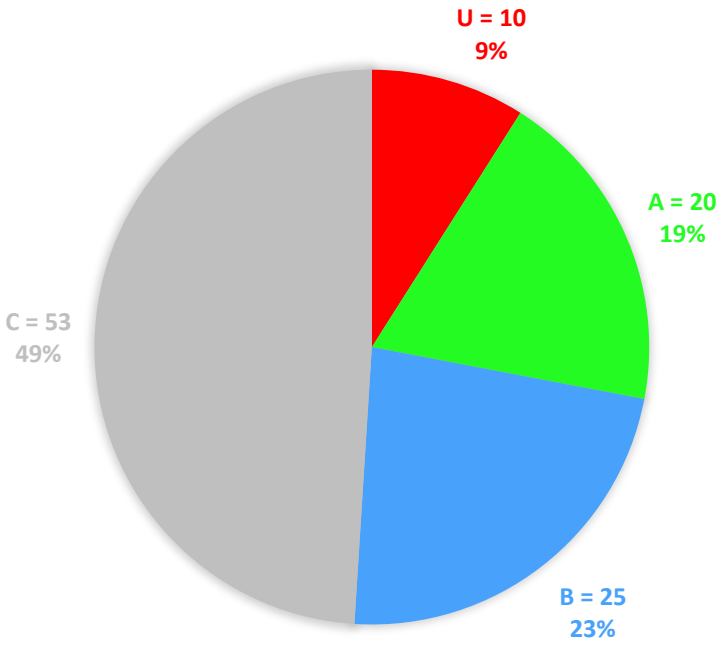


Figure 3: Category grade distribution of the surveyed trees (see Table 4 in Appendix 1 for category grade definitions). Note that tree groups, tree lines, woodland blocks and hedges have been assigned a single value in this figure - see Table 1 below for detailed breakdown of the category grade distribution.

Table 1: Category grade table of surveyed trees.

Category Grade	No. of Trees
Category U 8 Trees 2 Tree Lines	**Tree Nos.** 7519, 1253, 7526, T7, T4, 1241, 1242, 7537 **Tree Line Nos.** 11, 12
Category A 19 Trees 1 Tree Line	**Tree Nos.** 7503, 7504, 7505, 7506, 7508, 7509, 7510, 7515, 1251, 1252, 7524, 7527, T3, 7528, 7529, 7520, T2, 7531, 1243 **Tree Line No.** 6
Category B 21 Trees 1 Tree Line 3 Tree Groups	**Tree Nos.** 7507, 7512, 7513, 7518, 7523, 7521, T1, 1249, 7530, 7532, 7534, 7535, T5, 7543, 7536, 7538, 1791, 1792, 1793, 1794, 1796 **Tree Line No.** 9 **Tree Group Nos.** 1, 2, 5
Category C 22 Trees 15 Hedges 2 Woodland Blocks 9 Tree Lines 4 Tree Groups	**Tree Nos.** 7501, 7502, 7511, 7514, 7516, T6, 7525, 7522, 7533, 1244, 1245, 1246, 1247, 7541, 7542, 7544, 1248, 7539, 7540, 7545, 7546, 1795 **Hedge Nos.** 1A, 1B, 1C, 1D, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 **Woodland Block Nos.** 1, 2 **Tree Line Nos.** 1, 2, 3, 4, 5, 7, 8, 10, 13 **Tree Group Nos.** 3, 4, 6, 7517
Total = 70 Trees, 8 Tree Groups, 15 Hedges, 2 Woodland Blocks, 13 Tree Lines	

5.0 Arboricultural Impact Assessment

5.1 This proposed development will require the removal of the trees in Table 2. Note that Category U are poor-quality and therefore deemed unsuitable for retention.

Table 2: Tree removal table and their category grade.

Category Grade	No. of Trees
Category U 4 Trees 1 Tree Line	**Tree Nos.** 1253, 7519, 1797, T4 **Tree Line No.** 12
Category A 3 Trees	**Tree Nos.** 1251, 1252, 7531
Category B 7 Trees 1 Tree Group	**Tree Nos.** 7518, 7532, 7534, 7535, T5, 7543, 1796 **Tree Group No.** 2
Category C 9 Trees 1 Tree Group 4 Hedges 2 Tree Lines	**Tree Nos.** 7516, 7533, 1244, 1245, 1246, 1247, 1248, 7542, T6 **Tree Group No.** 7517 **Hedge Nos.** 1C, 1D, 11, 12 **Tree Line Nos.** 4, 5
Total = 23 Trees, 2 Tree Groups, 4 Hedges, 3 Tree Lines	

5.2 All the trees for retention will be proximal to the proposed construction works. It is therefore essential that tree protective fencing measures, as outlined in section 6.5 and Appendix 3, are adhered to protect trees from mechanical damage and impacts on the rhizosphere.

5.3 Services installation should utilise existing infrastructure and service routes to mitigate soil and root damage. All services must be routed outside retained trees Root Protection Area (RPA). No excavations or trenches are to be dug within a RPA as this can have massive impacts on tree health and stability. See section 6.11 and 6.12 for guidance on protecting trees from excavation and service installation.

5.4 New hard surfaces, such as paths, within a RPA must be avoided. Where this is not possible, No-Dig using cellular confinement systems will be used to raise ground levels and mitigate impacts on the rhizosphere. See section 6.10 for more details on working in a Construction Exclusion Zone (CEZ)

5.5 The overall impact the proposed development will have on the arboricultural assets is considered to be moderate to high. Tree loss compensation will therefore need to be negotiated between the developer and the local authorities involved in this flood relief scheme, to ensure compliance with their relative regulations.

6.0 Arboricultural Method Statement

6.1 This Arboricultural Method Statement provides information on how the trees will be protected throughout the construction phases. A copy of the Arboricultural Method Statement and Tree Constraints, Removal/Retention Plans will be retained in the site offices for reference. The protection of trees is divided into three stages:
Pre-Construction stage, Construction Works Stage, Post-Construction Stage.

6.2 Pre-Construction Works

6.2.1 The project arboriculturist will work with the design team to show how and where trees can be less impacted and how trees can have less impact on the proposal.

6.2.2 The design team will adjust the layout where practicable to reduce these impacts.

6.2.3 Any issues in relation to the trees on site will be discussed with the project arboriculturist and local authority prior to works being carried out.

6.3 Site Meetings

6.3.1 Prior to construction work, meetings will be necessary between the project arboriculturist, the development team and local authority, so that tree protection and trees for removal and retention can be agreed upon.

6.4 Tree Works

6.4.1 All tree works will be carried out prior to construction activity on site. The tree surgery contractor will be insured, qualified and have a method statement detailing how they will undertake the works required. The tree works will be in accordance with BS:3998 2010.

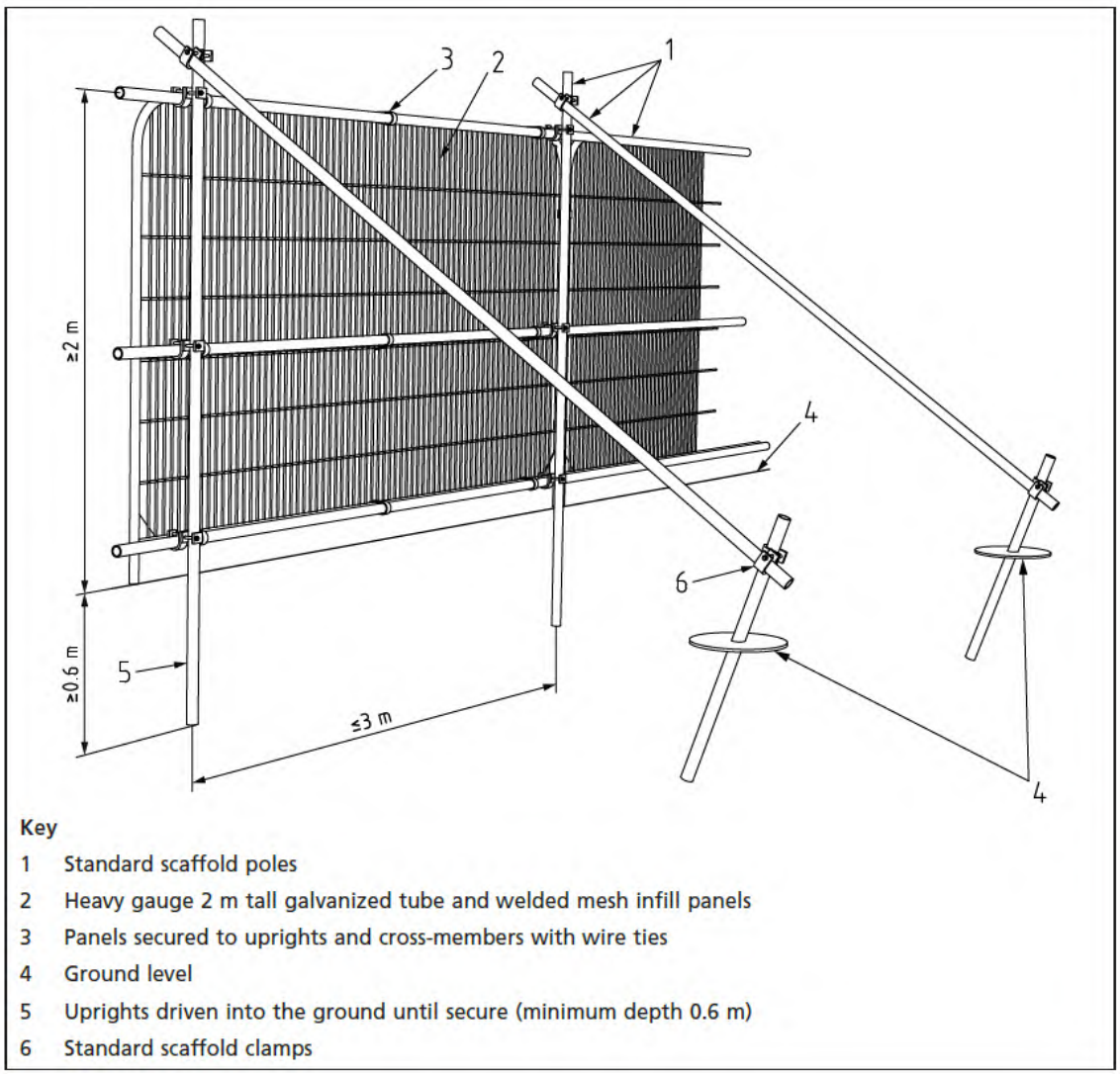
6.4.2 The removal of a tree will not cause damage to another tree or its surroundings. When stumps are to be removed or grinded using heavy machinery, any neighbouring tree's Root Protection Area (RPA) will be protected using ground guards or sheets of heavy-duty plywood butted together over a layer of compressible woodchip.

6.5 Tree Protective Fencing

6.5.1 When tree works are completed, the line of protective fencing will be erected outside of the Root Protection Area (RPA) – shown as a light blue on the Tree Constraints Plans and attached shapefiles. The area between the protective fencing and trees is the

Construction Exclusion Zone (CEZ), this zone is necessary to protect the tree, its RPA and areas for supplementary planting.

6.5.2 The fencing will be 2.3m high, with vertical and horizontal scaffold bars well braced together to resist impact. The verticals will be spaced out at a maximum interval of 3m and driven securely into the ground. Onto this, Heras fence panels will be securely fixed with scaffold clamps. In some instances, site hoarding can serve as tree protective fencing, but only upon approval by the project arboriculturist.



Key

1 Standard scaffold poles
2 Heavy gauge 2 m tall galvanized tube and welded mesh infill panels
3 Panels secured to uprights and cross-members with wire ties
4 Ground level
5 Uprights driven into the ground until secure (minimum depth 0.6 m)
6 Standard scaffold clamps

Figure 4: Tree Protective Fencing example using uprights driven into the ground.

6.5.3 All weather 'Keep Out' signs will be secured to the fences.

Figure 5: 'Keep Out' sign examples for tree protective fencing.

6.5.4 In some cases, stabiliser struts mounted on a block tray will be more practicable.

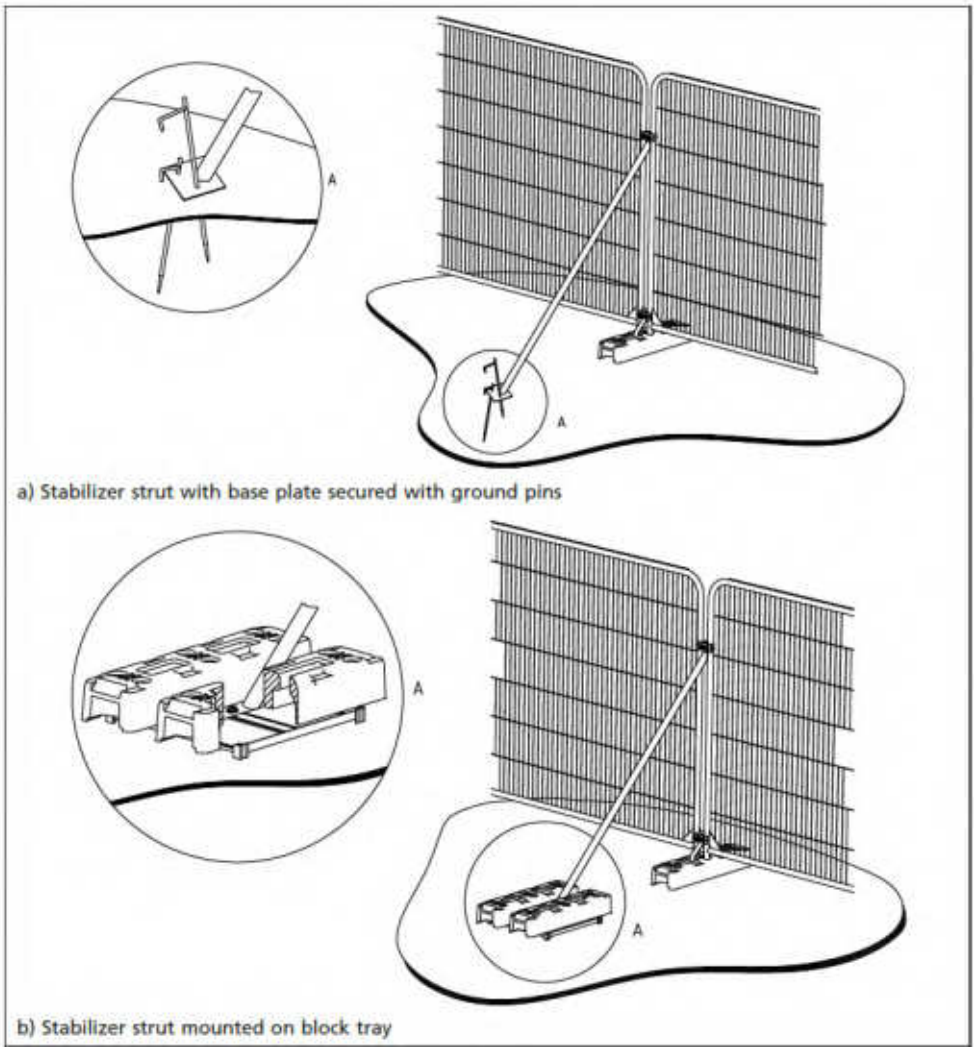


Figure 6: Tree Protective Fencing example using above ground stabilising units

6.5.5 Where space is limited for the installation of tree protective fencing, tree protective boxes (using timber frames and plywood) and ground protection will be used (see section 6.7 for ground protection details and 6.10 for working within a Construction Exclusion Zone).

6.6 Site access, storage of material, work yards and staff car parking

6.6.1 These areas will be a minimum of 10 metres away from trees and away from slopes.

6.6.2 Storage area will be clearly sign posted so that all personnel know where to store materials.

6.6.3 Materials will be stored in containers and/or on pallets with plastic coverings to prevent soil from getting compacted and/or contaminated.

6.7 Ground Protection

6.7.1 Where traffic is expected within in a Construction Exclusion Zone (CEZ), and it has been approved by the project arboriculturist, ground protection will be used to dissipate the vertical load and prevent soil contamination. The ground protection will be a three-dimensional cellular confinement system, such as 'Cell Web' (see step by step instructions for 'Cell Web' installation below).

Step 1

- Loose organic matter and woody vegetation will be removed carefully using hand tools.
- Undulating surfaces will be made using stone with no fines and it will not be compacted.

Step 2

- The non-woven, geotextile, fleece, separation filtration layer will be placed over the prepared ground surface, with dry joints overlapping by 300mm.

Step 3

- Constraints, such as treated timber or railway sleepers, will be placed along the edges to contain the fill material.

Step 4

- The cellular confinement system (Cell Web 150-200mm) will be placed over the geotextile layer and the cell walls will be pinned and anchored open for infilling.

Step 5

- The infill material, 20-40mm clean sharp stone, will be filled into the open cells of the Cell Web in a 'roll-out' fashion so that the machinery is driving on the filled Cell Web. The infill material will be compacted to the desired density.

Step 6

- The Cell Web will be slightly surcharged with 25mm of 40-20mm clean angular stone.

6.8 Construction Works Stage

6.8.1 Once works have commenced on site, the project arboriculturist will be informed of any planned works within the Construction Exclusion Zone, so that a suitable protection plan can be put in place.

6.8.2 The project arboriculturist will monitor the trees for any decline during the construction phase and make recommendations towards their health and safety as they arise.

6.9 Tree Protective Fencing

6.9.1 Throughout the construction phase, the tree protective fencing will remain in place, upright and rigid. It will be the main contractor's responsibility to check the fencing daily and have any faults immediately fixed.

6.9.2 Under no circumstances will the Construction Exclusion Zone (behind the Tree Protection Fencing) be used for the storage of equipment or materials.

6.10 Working within the Construction Exclusion Zone (CEZ)

6.10.1 The project arboriculturist will be consulted when works are to occur within the CEZ so that mitigation measures can be put in place e.g., ground guards or sheets of heavy-duty plywood butted together over a layer of compressible woodchip, or the use of three-dimensional cellular confinement systems (see section 6.7 for applying 3D cellular confinement systems).

6.10.2 Where tree protective fencing is to be temporarily taken down for works within the CEZ, it will be stored in a secure location outside of the CEZ, before being reinstated after the works.

6.10.3 Ground protection for temporary works within the CEZ will be applied from outside the CEZ working in the way ('roll-out' method) on a singular route, and from inside the CEZ working away from the tree when being removed, this will reduce the potential for soil compaction.

6.10.4 Temporary portable barriers will be positioned at the edge of the temporary ground protection area to prevent personnel from entering onto the unprotected soil.

6.10.5 All works will be carried out manually; no heavy machinery will be used within the CEZ.

6.10.6 Removal of structures and materials within a CEZ will be done manually using appropriate hand tools, such as a mattock, pneumatic breaker, shovel, wheelbarrow etc., if roots are encountered, the guidance in section 6.12.4 & 6.12.5 will be followed.

6.10.7 Where permanent surfaces are to be installed within a CEZ, No-Dig methods will be implemented, and finished surfaces will be porous to allow gas and water movement (see Figure 7).

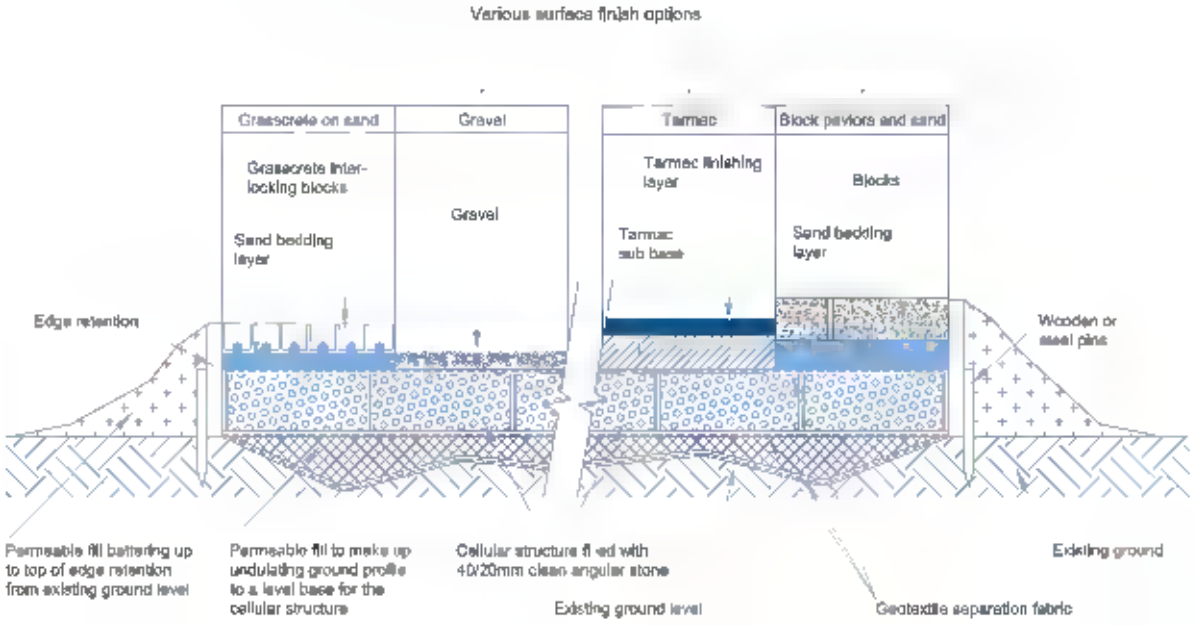


Figure 7: No-Dig, cellular confinement surface with examples of finishing options

6.11 Excavations

6.11.1 Excavations within a Root Protection Area (RPA) will be avoided where possible. Where this is not possible, it will be viewed on site by the development team, local authority and the project arboriculturist, so that any potential impacts can be assessed and mitigated.

6.11.2 Excavations for strip foundations in an RPA will be avoided, unless this is necessary to prevent flooding. Instead, specially engineered foundations such as piles or pads with above-ground beams will be used, localising excavation to just the pile or pad holes, allowing for water and gas exchange and avoiding roots first identified by site investigation.

6.11.3 Trial holes, using compressed air soil displacement (Air-Spade), or hand tools, will be made to a minimum depth of 600mm prior to installation, so that large roots (over 25mm diameter) are avoided.

6.11.4 Roots <25mm in diameter may be pruned back using sharp cutting tools, such as a secateurs or hand pruning saw, leaving as clean a wound as possible. Roots occurring in clumps or of 25mm diameter and over will only be severed following consultation with the project arboriculturist, as such roots might be essential to the tree's health and stability.

6.11.5 If roots are to be left exposed overnight or for longer, they will be covered with soil removed from the pit or with hessian sack (jute) to reduce frost damage or drying out; hessian sack will be kept moist in prolonged dry periods, and dry in freezing temperatures. Hessian sack will be removed before the area is backfilled.

6.11.6 Ground protection will be used when installing piles or pads within a RPA. e.g., ground guards or sheets of heavy-duty plywood butted together over a layer of compressible woodchip, or the use of three-dimensional cellular confinement systems (see section 6.7 for applying 3D cellular confinement systems). Gaps in the ground protection will be left for where the pile or pad is to be installed.

6.11.7 Where piling is to be installed near to trees, the smallest practicable pile diameter will be used, as this reduces the possibility of striking major tree roots and reduces the size of the rig required to sink the piles, which reduces the potential of soil compaction.

6.11.8 If the rig is expected to interfere with the tree's crown, then working space will be provided by facilitation pruning or temporarily tying back tree branches. Pruning or tying will be undertaken in accordance with a specification prepared by the project arboriculturist.

6.11.9 A sleeved bored pile or screw pile will be used to protect the soil and adjacent roots from the potentially toxic effects of uncured concrete.

6.12 Services

6.12.1 Services will be routed outside of the Root Protection Area (RPA) to avoid soil and root damage.

6.12.2 If routing underground services through the RPA is unavoidable, trenchless insertion methods will be implemented, with entry and retrieval pits outside of RPA (see trenchless examples in Table 3).

Table 3: Trenchless solutions for differing utility apparatus installation requirements

Method	Accuracy	Bore dia. [A]	Max. sub. [B] length	Applications	Not suitable for
	mm	mm	m		
Microtunnelling	<20	100 to 300	40	Gravity-fall pipes, deep apparatus, watercourse/ roadway undercrossings	Low-cost projects due to relative expense
Surface-launched directional drilling	≈100	25 to 1 200	150	Pressure pipes, cables including fibre optic	Gravity-fall pipes, e.g. drains and sewers [C]
Pipe ramming	≈150	150 to 2 000	70	Any large-bore pipes and ducts	Rocky and other heavily obstructed soils
Impact moling [D]	≈50 [E]	30 to 180 [F]	40	Gas, water and cable connections, e.g. from street to property	Any application that requires accuracy over distances in excess of 5 m

6.12.3 To avoid damage to roots when using trenchless insertion methods, the depth of the pit will be 750mm. Methods involving external lubrication of the equipment with materials other than water or vegetable oil (e.g. mineral oil, bentonite, etc.) will not be used when working within the RPA.

6.12.4 If the service route must pass through the RPA, it will be routed under the centre of the tree, where there are less roots.

6.12.5 If roots can be retained and protected, excavation using hand-held tools and pneumatic breakers may be acceptable for shallow service runs – feeding the services between and under roots and moving intact roots away from the working area where they are pliable. Root exposure and severance will follow the guidance in section 6.12.4 & 6.12.5.

6.12.6 Under no circumstances will heavy machinery be used to excavate open trenches within a RPA.

6.12.7 See National Joint Utilities Group (NJUG) Guidelines for the planning, installation and maintenance of utility apparatus in proximity to trees. Volume 4, Issue 2 London NJUG 2007 for more guidance.

6.13 Use of Cranes

6.13.1 If the use of cranes is expected to interfere with trees, then working space will be provided by facilitation pruning or temporarily tying back tree branches. Pruning or tying will be undertaken in accordance with a specification prepared by the project arboriculturist.

6.13.2 The smallest crane practicable will be used to prevent potential damage to trees and soil compaction. If there is a large crane on site, then it may be more prudent to move materials around trees from a far, as this will prevent soil compaction around trees.

6.13.3 To prevent damage to trees, a banksman will be used to direct the loads being lifted and there will be radio communication between the designated groundsmen and the crane operator.

6.14 Finished Ground Levels & Landscaping

6.14.1 The existing ground levels of the Root Protection Area (RPA) will be maintained and incorporated into the finished development. If the new ground level outside of the RPA is higher, then a retaining structure will be used to prevent water pooling around the tree.

6.14.2 No heavy machinery will be used within the RPA. Landscaping will be done manually and works within a RPA will follow the guidance in section 6.10.

6.14.3 Herbicide around retained trees will be avoided where possible, where this is not possible (such as when eradicating invasive species), direct, systemic applications will be applied to the target plant so that spray off is prevented; residual herbicides will not be used.

6.15 The following is a list of additional activities that are not allowed within a Construction Exclusion Zone or within the vicinity of the trees being retained:

6.15.1 Stockpiling of soil or rubble.

6.15.2 Washing of machinery.

6.15.3 Attaching notice boards, cables, or other services to any part of the tree.

6.15.4 Using neighbouring trees as anchor points.

6.15.5 Fires or burning of any kind.

6.15.6 Any action likely to cause waterlogging.

6.16 Post Construction Works

6.16.1 This development will not be considered complete until all retained trees have been re-examined by the project arboriculturist and he is satisfied that they can be safely integrated into the finished development.

Appendix 1
Tree Survey and Key

BS 5837 – Survey Form Key

Tag No: Tag stapled to tree for reference
Species: Both scientific and common name are provided
Stem diam: Stem diameter - diameter of the main stem in millimetres measured at 1.5m. This measurement forms the basis of the
Root Protection Area (RPA) calculation – that being the equivalent to a circle with a radius of 12 x the stem diameter
Crown spread: The radial spread of the crown from the centre of the tree, indicated at four cardinal points, **N**orth, **S**outh, **E**ast and **W**est.
C.Ht: The height of the first significant branch, measured in metres
C. Circa
A: Average
T: Tree, **TL:** Tree Line, **TB**: Tree Belt, **TG**: Tree Group, **H**: Hedge, **SB**: Shrub Border
LE: Life Expectancy of the tree in years
Age classes:
Young: In the first fifth of its life expectancy
Semi-Mature: In the second fifth of its life expectancy
Early-Mature: In the third fifth of its life expectancy
Mature: In the penultimate fifth of its life expectancy, reached maximum height
Over-Mature: In the final fifth of its life expectancy, in natural decline
Dead wood diameter sizes:
Small: <50mm
Medium: Between 50 – 100mm
Large: >100mm
Phys Cond: Physiological condition, an assessment of the tree's overall health –
Good: Good vitality e.g., healthy foliage or buds, crown density is consistent with that of the species
Fair: Low vitality e.g., sparseness of foliage or buds
Poor: Poor vitality e.g., dieback of foliage or shoot development, disease affecting growth.
Dead: The tree is dead
Struc Cond: Structural condition, noting any structural defects –
Good: No major structural defects observed (possibly some minor defects)
Fair: Minor defects present, such as bark wounds and isolated decay pockets, structure affected due to overcrowding and is dependent on group structure
Poor: Major structural defects present such as extensive dead wood, decay cavities affecting stability, splitting or cracking at unions
Preliminary Recommendations: Any initial work requirements in terms of sound arboricultural practice, irrespective of proposed works
Cat.: Category grade in terms of quality and value (Table 4)

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
WB1	**ash, alder, goat willow, birch, sycamore, hazel**	Semi-Mature	14	140	2	2	2	2	1	7	Fair	Fair	Dominant species is ash and oak with abundant alder present. Ash trees in decline from ash dieback with a lot already dead. Understory of hazel and goat willow. Forest is un-thinned.	It requires no works at present.	Distinct ecosystem	20+	C2	The northern periphery trees could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
TG1	**alder** *Alnus glutinosa*	Mature	17	300	4	4	2	2	2	8	Good	Good	A group of trees with a combined canopy formation. Cattle are grazing in this area.	Cordon off area from cattle to prevent soil being poached.	It forms part of the ecological corridor in this area.	20+	B2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
TL1	**ash, sycamore**	Mature	15	280	3	3	3	3	2	8	Poor	Fair	Line of mainly ash with some sycamore trees growing on the northern side of the river. The ash trees are in decline from ash dieback. They have combined	They require no works at present	They form part of the ecological corridor in this area.	10+	C3	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													group canopy formation.						
H2	**goat willow, hawthorn, gorse, spindle, dog-rose**	Mature	4	280	NA	NA	3	3	0	3	Fair	Fair	It extends north to south and makes up the boundary between two fields. It receives no maintenance. Reinforced by fence.	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain
TL2	**ash** *Fraxinus excelsior*	Mature	16	330	3	3	4	4	2	3	Poor	Poor	A line of ash trees making up the upper canopy of H2. They are all in decline from ash dieback.	They require no works at present. Retain for ecological value.	Bat roost potential as the trees die from ash dieback and cavities develop.	10+	C3	No impacts expected.	Retain
7501	**ash** *Fraxinus excelsior*	Mature	16	810	5	5	5	5	3	9.7	Poor	Fair	Large tree growing out of the hedgerow bank. Minor symptoms of ash die back. Ivy is in mid crown	It requires no works at present. Retain for ecological value.	Bat roost potential as the tree dies from ash dieback and cavities develop. Ivy could form nesting potential and is a food source for birds.	10+	C3	No impacts expected.	Retain
7502	**ash** *Fraxinus excelsior*	Mature	17	400	5	4	5	5	3	4.8	Poor	Poor	Growing out of H2. It is in decline from ash die back.	It requires no works at present. Retain for ecological value.	Bat roost potential as the tree dies from ash	<10	C3	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													Bark included junction at 2m.		dieback and cavities develop.				
7503	**oak** *Quercus robur*	Early Mature	15	640	2	5	6	3	2	7.7	Good	Fair	It is growing out of H2. It was originally twin stemmed from near base, but one limb has failed, leaving a large wound that is susceptible to decay. Ivy is in mid crown.	It requires no works at present.	Decay cavity has bat roost potential. Ivy could form nesting potential and is a food source for birds.	40+	A2	No impacts expected.	Retain
7504	**oak** *Quercus robur*	Early Mature	13	410	4	4	6	4	3	4.9	Good	Fair	It is growing out of H2. Bark wounds at 0.5 m on eastern side. Ivy is in mid crown.	It requires no works at present.	Bat roost potential at bark wound. Ivy could form nesting potential and is a food source for birds.	40+	A2	No impacts expected.	Retain
H1A	**goat willow, hawthorn, ash, sycamore, gorse, holly, dog-rose**	Mature	5	280	4	4	NA	NA	0	3	Fair	Fair	It extends east to west and makes up the boundary between a number of fields. Double sided hedge, growing on either side of the river, this section is on northern side. It	It requires no works at present.	Ecological corridor.	NA	C2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													receives no maintenance. Ash trees in decline from ash dieback.					extent is reached	
H1B	**goat willow, alder, hawthorn, ash, sycamore, gorse, holly, dog-rose**	Mature	5	280	4	4	NA	NA	3	3	Fair	Fair	It extends east to west and makes up the boundary between a number of fields. Double sided hedge, growing on either side of the river, this section is on southern side. It receives no maintenance. Ash trees in decline from ash dieback	It requires no works at present.	Ecological corridor.	NA	C2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached	Retain
H3	**hawthorn** *Crataegus monogyna*	Semi-Mature	2	180	1	NA	NA	1	0	3	Good	Fair	A relatively newly planted hedge extending east to west, making up the boundary between two fields.	It would benefit from trimming to improve hedge structure	Ecological corridor.	NA	C2	No impacts expected.	Retain
7505	**oak** *Quercus robur*	Early Mature	14	600	5	6	5	6	3	7.2	Fair	Fair	It is growing out of H1. Minor decay cavity at base on western side. Bark included junction at 1 m on northern side. Broken branch at	It requires no works at present.	Bat roost potential at broken branch.	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													2 m on western side.					extent is reached.	
7506	**oak** *Quercus robur*	Mature	18	940	#	7	10	12	3	11	Fair	Fair	It is growing out of H1. Broad spreading crown. Birds nest at 16 m on northern side. Limb failure at 12 m on northern side. Crown appears to be retrenching.	It requires no works at present.	Birds nest in crown. Bat roost potential at broken limb.	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
7507	**horse chestnut** *Aesculus hippocastanum*	Early Mature	12	600	4	4	4	3	2	7.2	Good	Good	It is growing out of H1A. It is multiple stemmed from base and shares a canopy with some of the taller trees in H1.	It requires no works at present.	Food source for wildlife	20+	B1	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
H4	**goat willow, hawthorn, blackthorn, sycamore, gorse, holly, dog-rose, yew, honeysuckle, oak, ash**	Mature	7	300	NA	NA	4	4	0	3	Fair	Fair	It extends north to south, and it makes up the boundary between two fields. There is a c.2m open wet drainage ditch on its eastern side. It receives no maintenance.	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
7508	**oak** *Quercus robur*	Mature	12	620	2	6	9	3	3	7.4	Fair	Fair	It makes up the outer canopy formation of WB2 and has an asymmetrical crown orientated to the west because of this.	It requires no works at present.	Food source for wildlife	40+	A2	No impacts expected.	Retain
7509	**oak** *Quercus robur*	Mature	16	630	4	7	6	5	3	7.6	Fair	Good	It makes up the outer canopy formation of WB2. Broken branch at 1 m on western side.	It requires no works at present.	Bat roost potential in broken branch at 1m.	40+	A2	No impacts expected.	Retain
7510	**oak** *Quercus robur*	Mature	16	660	7	7	7	5	3	7.9	Fair	Good	It makes up the outer canopy formation of WB2. Dead branches at 3 m on southern inside. 30% die back of foliage in its crown.	It requires no works at present.	Bat roost potential in dead branch at 3m.	40+	A2	No impacts expected.	Retain
7511	**ash** *Fraxinus excelsior*	Early Mature	13	290	3	3	3	3	5	3.5	Poor	Poor	It is growing out of H4 and is in advanced decline from ash dieback	It requires no works at present. Retain for ecological value.	Bat roost potential as the tree dies from ash dieback and cavities develop.	<10	C3	No impacts expected.	Retain
TL3	**ash** *Fraxinus excelsior*	Mature	16	400	5	5	4	4	2	2	Poor	Poor	Line of ash trees growing out of H4. They are all in decline from ash dieback, with	It requires no works at present. Retain for ecological value.	Bat roost potential as the trees die from ash dieback and	10+	C3	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													evidence of branch and limb failure already.		cavities develop.				
7512	**sycamore** *Acer pseudoplatanus*	Mature	14	500	5	4	5	5	3	6	Good	Good	It is growing out of H4, and it is twin stemmed from base with ivy extending into its mid crown.	It requires no works at present.	Ivy has value as a food source and nesting potential as it develops	20+	B1	No impacts expected.	Retain
7513	**oak** *Quercus robur*	Mature	13	620	5	4	4	6	3	7.4	Fair	Fair	It is growing out of H4, dieback is developing in the western side of its crown.	It requires no works at present.	Bat roost potential if dead wood continues to develop	20+	B1	No impacts expected.	Retain
7514	**ash** *Fraxinus excelsior*	Early Mature	13	200	2	3	4	1	3	2.4	Poor	Poor	It is growing out of H4, and is in decline from ash dieback	It requires no works at present. Retain for ecological value.	Bat roost potential as the tree dies from ash dieback and cavities develop.	<10	C3	No impacts expected.	Retain
7515	**oak** *Quercus robur*	Semi-Mature	8	300	4	4	4	4	3	3.6	Good	Good	It is growing out of H4, and it is has the potential to form part of the long-term tree cover in this area.	It requires no works at present.	Food source	40+	A1	No impacts expected.	Retain
H5	**goat willow, hawthorn, gorse, dog-rose**	Mature	7	280	4	4	NA	NA	0	3	Fair	Fair	It extends east to west and makes up the boundary between the woodland and two and two adjoining fields. There is a	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													c.0.5m open drainage ditch on its northern side						
WB2	**oak, beech, ash, willow, holly**	Semi-Mature	18	180	3	3	3	3	1	8	Fair	Fair	30-year-old thinned forest. Mostly oak and beech with ash and holly regrowth understory. Wet soil conditions with some windblow already. Mound drains full of water already.	If area is going to be used as flood relief. No more thinning should occur.	Distinct ecosystem	40+	C2	The southern periphery trees could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached	Retain
7516	**alder** *Alnus glutinosa*	Semi-Mature	9	390	4	3	3	4	1	0	Good	Good	Twin stemmed from near base	It requires no works at present.	Food source for wildlife	20+	C1	It will need to be removed to facilitate the water flow control structure.	Remove
TL5	**alder, ash**	Mature	11	200	4	4	4	4	2	0	Fair	Fair	Trees growing along riverbank with combined canopy formation. Ash trees in decline from ash dieback, some are dead already.	They require no works at present.	It forms part of the ecological corridor.	10+	C3	They will need to be removed to facilitate the flow control structure.	Remove
TG 7517	**alder** *Alnus glutinosa*	Early Mature	13	300	4	4	4	4	2	0	Good	Fair	A group of alder stems growing on	They require no works at present.	They form part of the	20+	C2	It will need to be removed to	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													the southern side of the river with a combined group canopy formation		ecological corridor along this hedgerow			facilitate the flow control structure.	
7518	**oak** *Quercus robur*	Semi-Mature	9	180	3	3	3	3	1	0	Good	Good	Located on the southern side of riverbank.	It requires no works at present.	Food source for wildlife.	40+	B1	It will need to be removed to facilitate the water flow control structure.	Remove
7519	**ash** *Fraxinus excelsior*	Early Mature	13	300	3	3	3	3	3	0	Poor	Poor	It advanced decline from ash dieback	It will need to be removed if this area comes into active use.	Bat roost potential as the tree dies from ash dieback and cavities develop.	<10	U	It will need to be removed to facilitate the water flow control structure.	Remove
TL4	**alder** *Alnus glutinosa*	Early-Mature	13	300	3	3	3	3	2	0	Fair	Fair	A line of alders growing on the northern side of the river. They have a combined group canopy formation.	They require no works at present.	It forms part of the ecological corridor.	20+	C2	It will need to be removed to facilitate the flow control structure.	Remove
H1C	**goat willow, hawthorn, holly, dog-rose**	Mature	5	280	4	4	NA	NA	0	0	Fair	Fair	It extends east to west and makes up the boundary between a number of fields. Double sided hedge, growing on either side of the river. It	It requires no works at present.	Ecological corridor.	NA	C2	It will need to be removed to facilitate the flow control structure.	Remove

Tree Survey																			
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													receives no maintenance.						
H1D	**goat willow, hawthorn, holly, dog-rose**	Mature	5	280	4	4	NA	NA	0	0	Fair	Fair	It extends east to west and makes up the boundary between a number of fields. Double sided hedge, growing on either side of the river. It receives no maintenance.	It requires no works at present.	Ecological corridor.	20+	C2	It will need to be removed to facilitate the flow control structure.	Remove
TL12	**ash** *Fraxinus excelsior*	Early-Mature	11	380	2	3	3	2	2	0	Poor	Fair	Line of trees in decline from ash dieback	Remove but leave 3m stumps for ecological value	Food source for wildlife	<10	U	It will need to be removed to facilitate the proposed works.	Remove
TL13	**alder** *Alnus glutinosa*	Early-Mature	15	430	4	4	4	4	2	0	Good	Good	Ivy on main stems. They form the upper canopy of the hedgerow	Ivy will require severing when it suppresses its crown	Food source for wildlife	20+	C2	May suffer root damage during construction	Retain
T6	**alder** *Alnus glutinosa*	Early Mature	14	420	2	4	4	3	2	0	Good	Good	Ivy in upper crown	Ivy will require severing when it suppresses its crown	Food source for wildlife	20+	C2	It will need to be removed to facilitate the proposed works.	Remove
H11	**dog-rose, hawthorn, bramble, blackthorn, gorse, holly**	Semi-Mature	3	100			1	1		0	Good	Fair	It extends north to south and makes up the boundary between two fields.	It requires no works at present.	Ecological corridor.	_	C2	It will need to be removed to facilitate the water storage structure	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
1251	**oak** *Quercus robur*	Early Mature	12	450	5	5	5	5	2	0	Good	Good	Growing out of H11. Symmetrical crown. Ivy in mid crown.	Ivy will require severing when it suppresses its crown	Food source for wildlife	40+	A1	It will need to be removed to facilitate the proposed works.	Remove
1252	**oak** *Quercus robur*	Early Mature	12	460	5	5	5	5	2	0	Good	Good	Growing out of H11. Symmetrical crown. Ivy in mid crown.	Ivy will require severing when it suppresses its crown	Food source for wildlife	40+	A1	It will need to be removed to facilitate the proposed works.	Remove
1253	**ash** *Fraxinus excelsior*	Early Mature	10	380	3	2	3	3	2	0	Poor	Poor	It is in advanced decline from ash dieback	Remove	Food source for wildlife	<10	U	It will need to be removed to facilitate the proposed works.	Remove
7523	**horse chestnut** *Aesculus hippocastanum*	Early Mature	13	400	5	5	5	5	1	4.8	Good	Fair	Located on the riverbank. Bark included junction from 1 m.	It requires no works at present.	Ivy has ecological value as a food source and nesting potential	40+	B1	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
7524	**oak** *Quercus robur*	Mature	14	500	4	4	4	3	1	6	Fair	Fair	It is growing up and out of the riverbank on the southern side.	It requires no works at present.	Lichen growth is present, and it has value as a food source	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
																		extent is reached.	
7525	**alder** *Alnus glutinosa*	Mature	16	350	3	3	3	3	3	4.2	Fair	Good	20% die back of foliage in crown, potentially Phytophthora disease. Ivy in upper crown.	It requires no works at present.	Ivy has value as a food source and for nesting	10+	C1	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
7526	**ash** *Fraxinus excelsior*	Mature	14	380	3	3	3	3	2	4.6	Poor	Poor	It is in advance decline from ash dieback	It will need to be removed if this area comes into active use.	Bat roost potential as dead wood develops due to ash dieback.	<10	U	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
7527	**oak** *Quercus robur*	Mature	14	800	5	6	5	6	3	9.6	Good	Fair	It is growing out of the hedgerow on the southern side of the river. There is some naturally suppressed dead wood in its crown.	It requires no works at present.	Bat roost potential at broken branch.	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
T3	**oak** *Quercus robur*	Mature	14	500	4	4	5	3	1	0	Fair	Fair	It is located on the southern side of the riverbank. There is a broken branch at 1 m on the southern side.	It requires no works at present.	Bat roost potential at broken branch.	40+	A2	No impacts expected.	Retain
7528	**oak** *Quercus robur*	Mature	15	500	4	4	3	5	1	0	Good	Fair	Oak within hedgerow along southern side of riverbank. It has a combined group canopy formation with the neighbouring tree line.	It requires no works at present.	Ivy has value as a food source and for bird nesting.	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain
7529	**oak** *Quercus robur*	Mature	18	610	6	5	4	5	4	0	Good	Good	Oak tree within hedgerow along southern side of riverbank. It has a combined group canopy formation with the neighbouring tree line. Ivy is in upper crown. Invasive Himalayan balsam around base and on opposite side of river	Remove invasive Himalayan balsam from this area.	Ivy has value as a food source and for nesting potential	40+	A2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
H6	**ash, dog-rose, hawthorn, bramble, blackthorn**	Semi-Mature	1	100	NA	NA	1	1	0	3	Good	Fair	It extends north to south and makes up the boundary between two fields. I suspect it was once a larger hedge that has been heavily cut back. It's growing out of raised bank	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain
7520	**oak** *Quercus robur*	Semi-Mature	9	360	4	4	4	5	2	4.3	Good	Good	Growing out of the hedgerow. Potential to form part of the long-term tree cover in this area.	It requires no works at present.	Food source for wildlife	40+	A1	No impacts expected.	Retain
H7	**honeysuckle, goat willow, gorse, hawthorn, dog-rose, elder**	Semi-Mature	1	280	1	1	NA	NA	0	3	Good	Good	It extends east to west and makes up the boundary between two fields. It is a well-structured hedge that receives regular trimming. There is a 0.5 metre drainage ditch on its northern side. It's growing out of a raised bank.	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain
7521	**goat willow** *Salix caprea*	Mature	9	580	5	5	5	5	1	7	Good	Fair	Twin stemmed from base. Bark included junction in one stem. Ivy is	It requires no works at present.	Ivy has value as a food source and for bird	20+	B1	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													extending into mid crown. Some broken branches in lower crown on southern side.		nesting. There will be bat roosting potential if the dead wood develops on the southern side of lower crown.				
7522	**ash** *Fraxinus excelsior*	Semi-Mature	8	200	3	3	3	3	2	2.4	Poor	Fair	It is growing out of the hedgerow. It has symptoms of ash die back.	It requires no works at present. Retain for ecological value.	Ivy has value as a food source and for bird nesting. Bat roost potential as the tree dies from ash dieback and cavities develop	<10	C3	No impacts expected.	Retain
H8	**goat willow, gorse, hawthorn, holly, elder, rowan, honeysuckle**	Mature	6	300	NA	NA	4	4	0	3	Fair	Fair	It extends north to south and makes up the boundary between two fields. It is growing out of a raised bank. C.1m deep, open, wet drainage ditch on its western side	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
TL6	**oak** *Quercus robur*	Mature	20	700	9	9	9	9	2	10	Good	Fair	Line of mature oaks with a combined group canopy formation. Some naturally suppressed dead wood in their lower crowns and Ivy is extending into their mid crowns.	It requires no works at present.	It forms part of the ecological corridor.	40+	A2	No impacts expected.	Retain
T1	**oak** *Quercus robur*	Mature	15	600	4	6	4	5	3	7.2	Poor	Poor	Large dead wood developing in its crown. Growing out of the hedgerow.	It requires no works at present.	Bat roost potential as dead wood continues to develop.	40+	B2	No impacts expected.	Retain
TL7	**alder, ash**	Early-Mature	14	350	4	4	3	3	2	7	Fair	Fair	Line of alder and ash trees making up the upper canopy of H1B. Ash trees are in decline from ash die back.	It requires no works at present.	It forms part of the ecological corridor.	10+	C2	It could suffer root asphyxiation if the 1% Annual Exceedance Probability baseline flood extent is reached	Retain
H9	**goat willow, hazel, rowan, hawthorn, holly, dog-rose, oak,**	Mature	5	280	NA	NA	3	3	0	3	Fair	Fair	It extends north to south and makes up the boundary between two fields. It's growing	It requires no works at present.	Ecological corridor.	NA	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
	elder, blackthorn												out of a raised hedgerow bank.						
T2	**oak** *Quercus robur*	Mature	15	650	6	6	7	6	2	7.8	Good	Good	Prominent tree. Ivy in upper crown.	It requires no works at present.	Ivy could form nesting potential and is a food source for birds.	40+	A2	No impacts expected.	Retain
1797	**ash** *Fraxinus excelsior*	Early Mature	12	680	6	4	5	5	2	0	Fair	Fair	Growing from the hedgerow. Minor symptoms of ash dieback. Overhangs the public road to the north.	Cut into the hedge and maintain as hedge bulking	Food source for wildlife.	<10	U	It requires removal to facilitate access gate and road	Remove
H12	**elder, dog-rose, bramble, hawthorn**	Mature	2		2	1					Fair	Fair	It extends east to west and forms the boundary between the public road (R703) to the north and the adjoining field to the south. Located next to T7. It is a small section of a long hedgerow	It requires no works at present.	Ecological corridor	10+	C2	This small section needs to be removed to facilitate access gate and road to the uphill water control structure	Remove
1249	**sycamore** *Acer pseudoplatanus*	Mature	17	900	6	4	7	4	2	11	Good	Good	Group of stems that may have suffered root damage during the installation of	Ivy will require severing when it suppresses its crown	Ivy in crown	40+	B2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													the footpath. Ivy is in mid crown.						
H10	***Cornus alba***	Early-Mature	2	180			1	1			Good	Good	Ornamental hedge extending north to south – makes up the boundary between the field and the car park	Continue to maintain through regular trimming	Ecological corridor	10+	C2	None expected	Retain
7530	**hawthorn** *Crataegus monogyna*	Mature	7	600	4	4	4	5	1	7.2	Fair	Fair	Located at the back of the field. Broad spreading crown.	It requires no works at present.	Ivy has value as a food source and for nesting potential	20+	B1	No impacts expected.	Retain
7531	**oak** *Quercus robur*	Mature	16	800	6	4	2	9	5	0	Fair	Fair	Large oak located next to the bridge. Limbs removed in past, leaving wounds that are susceptible to decay.	It requires no works at present.	Bat roost potential at pruning wounds	40+	A2	It will need to be removed to facilitate hard defences.	Remove
TG2	**Lawson cypress** *Chamaecyparis lawsoniana*	Mature	18	350	2	2	2	2	1	4	Fair	Fair	Group of 18 trees with combined canopy formation. Internal road on southern side. Ivy in mid crown.	They require no works at present.	It forms part of the ecological corridor.	20+	B2	It will need to be removed to facilitate the development.	Remove
7532	**oak** *Quercus robur*	Mature	17	1040	2	2	2	2	3	0	Fair	Fair	Its crown has been heavily reduced (topped) in the past, resulting in new small crown of re-	It requires no works at present.	Bat roost potential at pruning wounds	40+	B2	It will need to be removed to facilitate flood defences.	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													growth. Leaning 15 degrees from road towards river.						
7533	**alder** *Alnus glutinosa*	Semi-Mature	6	200	2	2	2	2	1	0	Good	Good	Small alder tree right on river bank. Twin stemmed.	It requires no works at present.	Food source for wildlife.	20+	C1	It will need to be removed to facilitate hard defences.	Remove
7534	**white willow** *Salix alba*	Mature	20	650	5	5	5	5	2	0	Fair	Fair	It is growing out of the riverbank, and there is ivy in its mid crown. Broken branch at 8 m on its western side.	It requires no works at present.	Bat roost potential at broken branch.	20+	B2	It will need to be removed to facilitate hard defences.	Remove
7535	**large leaved lime** *Tilia platyphyllos*	Mature	20	1000	6	6	6	7	0	0	Fair	Fair	Prominent tree. Hard surfacing is close to its base. Overhead utility wire passes through its mid crown. Ivy is in mid crown. Some tip die back evident.	Review annually for tip dieback development.	Ivy has value as a food source and for nesting potential	20+	B2	It will need to be removed to facilitate hard defences.	Remove
T4	**sycamore** *Acer pseudoplatanus*	Mature	15	300	3	3	3	3	3	3.6	Dead	Poor	Standing dead on river bank	Reduce to a height of 8 m and retain for ecological value	Bat roost potential as cavities develop.	<10	U	It will need to be removed to facilitate the proposed works.	Remove
T5	**sycamore** *Acer pseudoplatanus*	Mature	19	840	6	5	5	5	2	0	Good	Good	It is located on the riverbank and growing through the wall, causing	It requires no works at present.	Light ivy cover on main stem	40+	B2	It will need to be removed to facilitate the	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													structural damage to it					proposed works.	
TG5	**alder, beech, willow, wild cherry, hazel**	Early Mature	16	360	4	4	3	3	2	5	Good	Fair	Group of c.25 trees with a combined canopy formation. Growing in the open the grass area along the river.	It requires no works at present.	Ivy present will provide nesting potential and food source for wildlife, as will tree leaves.	20+	B2	Potential root damage, dependent on root distribution, in north-eastern corner where hard defences are proposed.	Retain
1244	**rowan** *Sorbus aucuparia*	Semi-Mature	11	200	1	1	1	1	2	0	Good	Fair	It is being suppressed by the neighbouring trees that also afford it shelter		Food source for wildlife	10+	C2	It will need to be removed to facilitate the proposed works.	Remove
1245	**beech** *Fagus sylvatica*	Semi-Mature	14	200	5	1	3	3	2	0	Good	Fair	Spindly tree with asymmetrical crown orientated to the north due to group growing environment that also affords it shelter		Food source for wildlife	10+	C2	It will need to be removed to facilitate the proposed works.	Remove
1246	**alder** *Alnus glutinosa*	Semi-Mature	13	200	2	1	1	1	2	0	Good	Fair	Spindly tree due to group growing environment that also affords it shelter		Food source for wildlife	10+	C2	It will need to be removed to facilitate the proposed works.	Remove
1247	**beech** *Fagus sylvatica*	Semi-Mature	14	240	5	1	3	3	3	0	Good	Fair	Spindly tree with asymmetrical crown orientated to the north due to group growing		Food source for wildlife	10+	C2	It will need to be removed to facilitate the proposed works.	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													environment that also affords it shelter						
7541	**ash** *Fraxinus excelsior*	Early Mature	13	250	2	3	3	3	5	4	Poor	Poor	In decline from ash dieback. Stonework previously done right to trunk. Small dead wood in upper crown.	It requires no works at present. Retain for ecological value.	Bat roost potential as the tree dies from ash dieback and cavities develop.	<10	C3	No impacts expected.	Retain
7542	**ash** *Fraxinus excelsior*	Early Mature	15	400	3	5	4	3	1	0	Fair	Fair	Ash tree with very little symptoms of ash dieback. Stonework previously done right to trunk on southern side.	It requires no works at present.	Bat roost potential as the tree dies from ash dieback and cavities develop.	10+	C1	It will need to be removed to facilitate the soft defences.	Remove
7543	**sycamore** *Acer pseudoplatanus*	Semi-Mature	11	250	4	5	5	5	1	0	Good	Fair	Located in field in open grass area. Twin stemmed from base	It requires no works at present.	Food source for wildlife.	40+	B1	It will need to be removed to facilitate the soft defences.	Remove
7544	**goat willow** *Salix caprea*	Mature	8	300	4	5	5	5	1	3.6	Good	Fair	Broad spreading crown with low crown formation down to ground	It requires no works at present.	Food source for wildlife.	20+	C1	It may suffer some soil compaction due to the proposed works proximal to it.	Retain
TL8	**ash, thuja, larch**	Mature	18	400	5	5	5	5	3	5	Fair	Fair	They make up the outer canopy formation of the woodland and are growing on raised ground separated	They require no works at present.	Distinct ecosystem.	10+	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													by a 1m stone retaining wall. Ash tree showing symptoms of ash dieback.						
1241	**ash** *Fraxinus excelsior*	Early Mature	16	700	5	4	2	5	4	8.4	Poor	Fair	It is in decline from ash dieback and it overhangs the garden building. Cavity at 2m on western side	Tree owner should consider removing or reducing size to reduce risk	Food source for wildlife	<10	U	No impacts expected.	Retain
1242	**ash** *Fraxinus excelsior*	Early Mature	14	700	4	2	2	4	3	8.4	Poor	Fair	It is in decline from ash dieback and it overhangs the garden building.	Tree owner should consider removing or reducing size to reduce risk	Food source for wildlife	<10	U	No impacts expected.	Retain
1243	**oak** *Quercus robur*	Early Mature	10	580	5	5	5	5	1	7	Good	Good	Prominent tree. Its crown overhangs the public path to the north and it has been cut back in the past to provide clearance over it	Continue to maintain clearance with path through regular pruning	Lichens	40+	A2	No impacts expected.	Retain
TL11	**ash** *Fraxinus excelsior*	Early-Mature	14	390	4	4	4	4	2	5	Poor	Fair	Line of trees in decline from ash dieback	Tree owner should consider removing or reducing size to reduce risk	Food source for wildlife	<10	U	No impacts expected.	Retain
1248	**ash** *Fraxinus excelsior*	Mature	10	900	3	3	3	3	0	0	Fair	Fair	Twin stemmed. It was topped in the past at 7 m with multiple stemmed, regrowth	Review annually for symptoms of ash dieback	Food source for wildlife	10+	C2	It will need to be removed to facilitate the proposed works.	Remove

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													occurring to produce a new, compact crown						
TG7	**cherry plum, whitebeam, Lawson cypress cv, privet**	Mature	8	400	4	3	3	3			Good	Good	It is a combination of hedge plants with a taller cherry plum that was allowed to grow tall above the height of the hedge and a white beam at the eastern end. They collectively form the boundary between the field and the adjoining property.	It requires no works at present.	Birds may nest in hedge plants	10+	C2	They may suffer some minor soil and root damage due to the proposed works in this area	Retain
7536	**horse chestnut** *Aesculus hippocastanum*	Mature	18	1040	7	6	6	7	2	12	Fair	Fair	Located on the adjoining property side of the boundary wall. Bleeding canker evident on trunk. Prominent tree	Review annually for bleeding canker development.	Food source for wildlife.	20+	B3	It may suffer root damage from hard defences installation	Retain
TG3	**yew, holly**	Semi-Mature	7	200	2	2	2	2	2	0	Good	Good	Ornamental trees growing on the adjoining property side of the boundary wall	It requires no works at present.	Bird nest potential in dense foliage.	20+	C1	It will need to be removed to facilitate hard defences.	Retain
7537	**sycamore** *Acer pseudoplatanus*	Mature	16	1200	4	5	3	5	3	0	Good	Poor	Growing on the adjoining property side of the boundary wall. It	The tree owner should consider reducing it to an 8m	Bat roost potential at pruning wound.	<10	No imp acts exp	Retain	The tree owner should consider

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													has been heavily reduced (topped) in the past due to brittle cinder fungus at base on southern side.	stump/snag for ecological value			ecte d.		reducing it to an 8m stump/snag for ecological value
7538	**sycamore** *Acer pseudoplatanus*	Mature	22	1200	6	8	4	8	3	0	Good	Fair	Large tree growing on the adjoining property side of the boundary wall. Broad, spreading crown	It requires no works at present.	Food source for wildlife.	20+	B2	No impacts expected.	Retain
7539	**horse chestnut** *Aesculus hippocastanum*	Mature	7	1200	4	2	5	2	3	0	Poor	Poor	It has been reduced to an 8m stump in the past	It requires no works at present.	Bat roost potential at pruning wound.	<10	C3	No impacts expected.	Retain
TG4	**Lawson cypress** *Chamaecyparis lawsoniana*	Semi-Mature	8	200	2	2	2	2	2	0	Good	Good	3 Lawson cypress trees growing on the adjoining property side of the boundary wall	It requires no works at present.	Bird nest potential in dense foliage.	20+	C1	No impacts expected.	Retain
7540	**hawthorn** *Crataegus monogyna*	Semi-Mature	4	200	2	2	2	2	0	2.4	Good	Good	Small hawthorn on edge of path.	It requires no works at present.	Food source for wildlife. Ivy has value as a food source and bird nesting.	40+	C1	No impacts expected.	Retain
7545	**white willow** *Salix alba*	Mature	16	600	6	8	5	6	1	0	Good	Fair	It is multiple stemmed from base with a broad spreading crown. Growing on the	It requires no works at present.	Food source for wildlife.	10+	C2	No impacts expected.	Retain

Tree Survey																			
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													western side of the river in the scrub area.						
7546	**alder** *Alnus glutinosa*	Early Mature	11	240	3	3	3	3	2	0	Good	Good	It forms part of a larger group in the scrub area to the west of the river	It requires no works at present.	Food source for wildlife.	20+	C1	No impacts expected.	Retain
TL9	**ash, copper beech, horse chestnut, sycamore**	Mature	20	500	5	5	5	5	1	10	Good	Good	Line of mature trees growing on the eastern side of the stream. They have a combined group canopy formation and a scrub area is developing between the tree line and the river. One of the ash trees is in advanced decline from ash dieback	They require no works at present.	Ecological corridor.	20+	B2	No impacts expected.	Retain
TL10	**Leyland cypress 'Castlewellan'** × *Cuprocyparis leylandii* 'Castlewellan'	Early-Mature	8	300	NA	4	4	NA	0	6	Fair	Fair	It extends east to west and its height has been reduced one its southern side.	It requires no works at present.	Ecological corridor.	20+	C2	No impacts expected.	Retain
TG6	**alder, white willow**	Semi-Mature	10	120	2	2	2	2	2	6	Good	Fair	A group of mainly alders with some white willow also present, growing up with a combined canopy	It requires no works at present.	Food source for wildlife.	20+	C2	No impacts expected.	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
													formation located in the scrub area to the west of the river.						
1791	**Lawson cypress** *Chamaecyparis lawsoniana* cv.	Early Mature	14	650	3	2	4	3	0	8	Good	Good	It is four stemmed from base due to natural layering and it forms part of a group with the neighbouring trees	No works presently	Low ecological value as coniferous	20+	B2	It may suffer minor root damage from hard defences installation	Retain
1792	**Lawson cypress** *Chamaecyparis lawsoniana* cv.	Early Mature	14	680	4	2	2	3	0	8	Good	Good	It is four stemmed from base due to natural layering and it forms part of a group with the neighbouring trees. Bark included junction at 2 m but it is less of a risk due to this area being of low use and it is sheltered by the neighbouring trees	No works presently	Low ecological value as coniferous	20+	B2	It may suffer minor root damage from hard defences installation	Retain
1793	***laburnum anagyroides***	Mature	10	480	4	2	2	1	0	7	Good	Fair	It is growing up through the two neighbouring Lawson cypress trees and it is sheltered by them	No works presently	Food source for wildlife	20+	B2	It may suffer minor root damage from hard defences installation	Retain
1794	**Lawson cypress**	Early Mature	14	680	3	2	4	1	0	8	Good	Good	It forms part of a group with the	No works presently	Low ecological	20+	B2	It may suffer minor root	Retain

Tree Survey																		
Tree No.	**Species**	**Age Class**	**Ht. m**	**Stem Diam mm**	**N m**	**S m**	**E m**	**W m**	**C. Ht m**	**RPA m**	**Phys Cond**	**Struc Cond**	**Comments**	**Management Recommendations**	**Ecological Value**	**LE years**	**Cat.**	**Impacts**	**Remove – Retain**
	Chamaecyparis lawsoniana cv.												neighbouring trees and it is sheltered by them		value as coniferous			damage from hard defences installation	
1795	**goat willow** *Salix caprea*	Mature	10	490	7	4	5	4	0	6	Good	Good	A group of stems growing centrally in this group of trees	No works presently	Food source for wildlife	10+	C2	It may suffer minor root damage from hard defences installation	Retain
1796	**birch** *Betula pendula*	Mature	16	820	7	7	5	5	2	0	Good	Good	Prominent tree with ivy in mid crown. Its crown overhangs the adjoining property. Witches broom infection observed. Branch failure at 7 m western side.	No works presently	Food source for wildlife	20+	B2	It will need to be removed to facilitate the proposed flood wall	Remove
1797	**Lawson cypress** *Chamaecyparis lawsoniana* cv.	Early Mature	14	650	3	2	4	3	0	8	Good	Good	It is four stemmed from base due to natural layering and it forms part of a group with the neighbouring trees	No works presently	Low ecological value as coniferous	20+	B2	It may suffer minor root damage from hard defences installation	Retain

Appendix 2
Tree Survey Images

Area 1

Image 1: Typical topography of Area 1 with the sloping fields divided by hedgerows and tree lines

Image 2: Tree Line No. 7 – mature oak trees growing out of Hedge No. 9

Image 3: Woodland Block No. 2 – semi mature trees that are poorly tapered due to competition for light

Image 4: Tree Line No. 2, growing out of Hedge No. 2 , with symptoms of ash dieback – as do most ash trees in this area

Image 5: Hedge No. 1B with Tree Line No. 5 in the upper canopy

Area 2

Image 6: Area 2 is mainly an open field with a single hawthorn – Tag No. 7530 – at the back

Image 7: Tag No. 7530

Area 3

Image 8: Tag No. 7535, a mature large-leaved lime

Image 9: Tag No. 7531, mature oak next to the bridge

Image 10: Tree Group No. 5 along the river, made up of alder, beech, willow, cherry and hazel

Image 11: Tree Group No. 2, Lawson cypress' next to the bridge

Image 12: Tag No. 7532, mature oak next to the bridge

Area 4

Image 13: Woodland just outside of Area 4

Image 14: Tag No. 7541 in decline from ash dieback

Area 5

Image 15: Tag No. 7537, mature sycamore with *Kretzschmaria deusta* fungus at base – see management recommendations in Tree Survey in Appendix 1.

Image 16: Tag No.7538, mature sycamore

Image 17: Tree Line No. 10, parallel to the side channel

Image 18: Tag Nos. 1791-1796 from right to left. Three mature Lawson cypress', a laburnum, a goat willow and a birch.

Appendix 3
Tree Protection and Removal Plans

Figure 8: Area 1 - Tree removal/retention and Root Protection Area constraints

Figure 9: Western section of Area 1

Figure 10: Northern section of Area 1

Figure 11: Southern section of Area 1

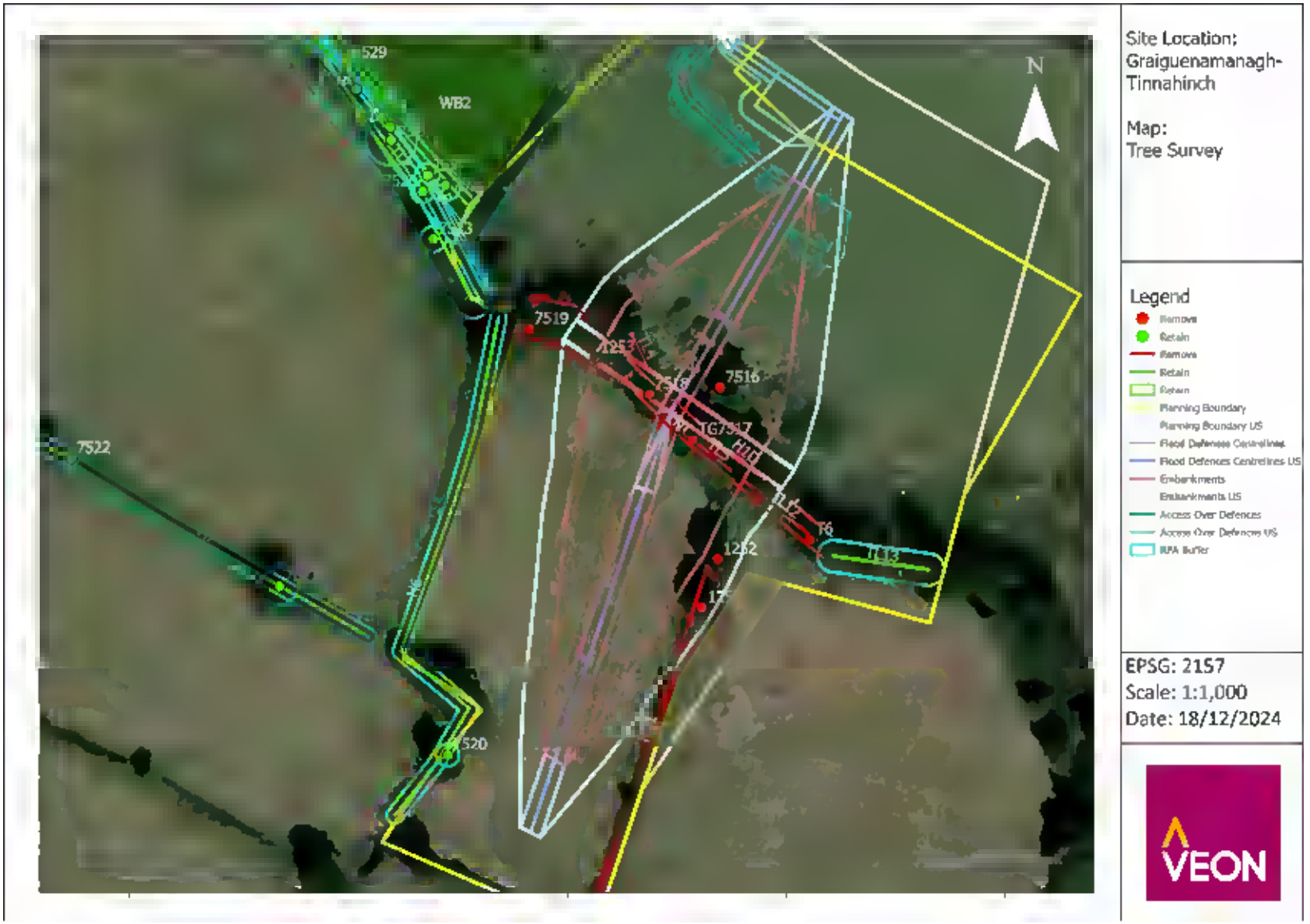


Figure 12: Eastern section of Area 1

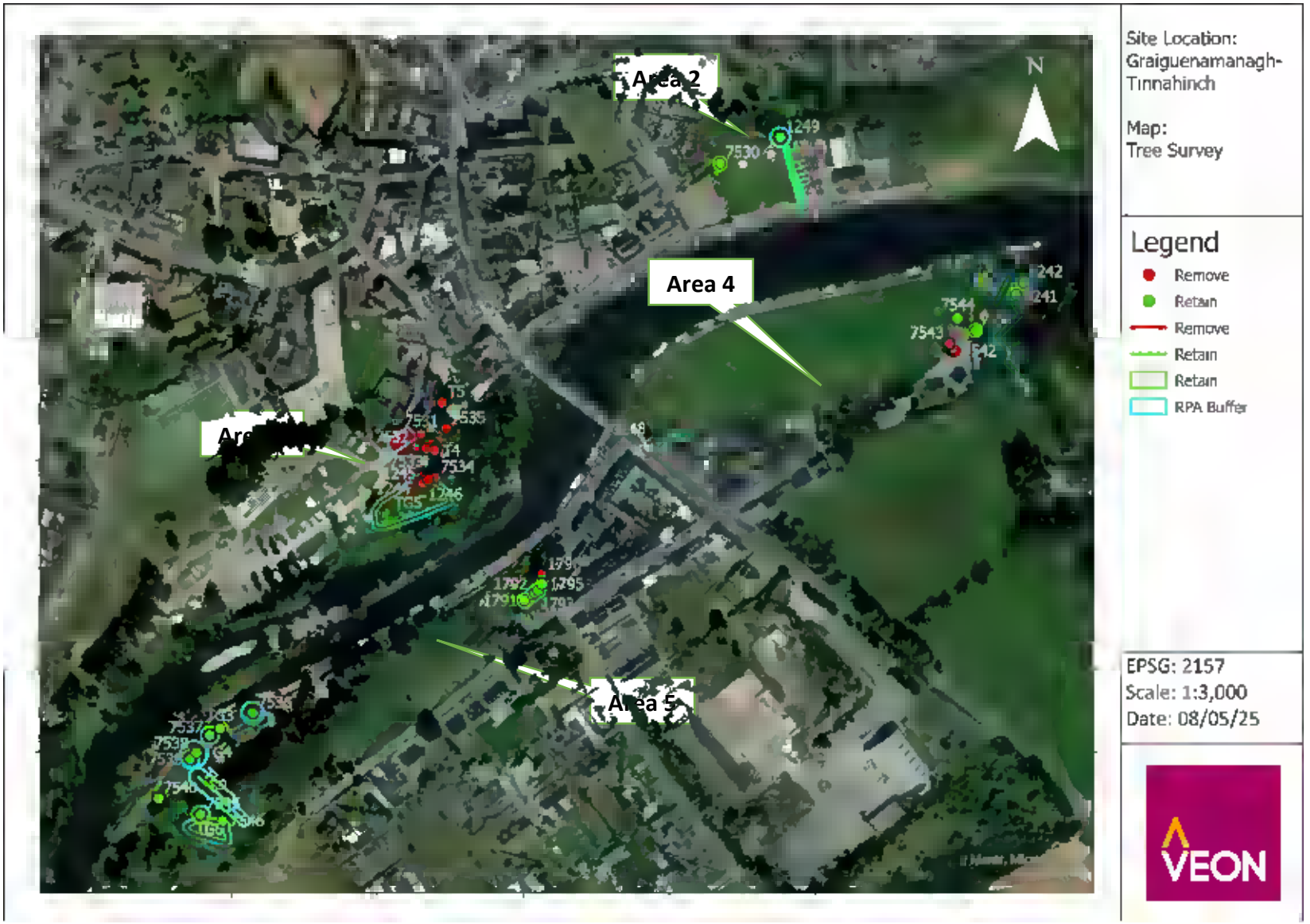


Figure 13: Area 2, 3, 4, 5 - Tree removal/retention and Root Protection Area constraints

Figure 14: Close up of Area 2

Figure 15: Close up of Area 3 – Note that the outline of TG5 is crown spread, not stems, so these trees can be retained

Figure 16: Close up of Area 4

Figure 17: Eastern section of Area 4 & western section of Area 5

Figure 18: Close up of Area 5