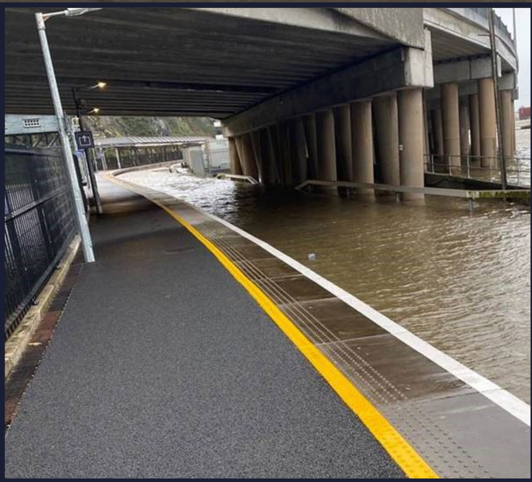

Waterford City Public Infrastructure Project
Flood Defences West

Appropriate Assessment - Volume 1
Natura Impact Statement | October 2021

Waterford City Public Infrastructure Project

Flood Defences West

Natura Impact Statement

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1. INTRODUCTION

1.1 Background

Roughan & O'Donovan (ROD) has been appointed by Waterford City and County Council (WCCC) to produce an Appropriate Assessment (AA) Screening Report in respect of proposed Waterford City Public Infrastructure Project, Flood Defences West ("the proposed development"). The AA Screening Report aimed to determine whether or not the proposed development, either individually or in combination with other plans or projects, was likely to have a significant effect on areas designated as being of European importance for nature conservation ("European sites"), thereby enabling WCCC, as the competent authority at that stage, to comply with its obligations under Article 6(3) of Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora ("the Habitats Directive").

The AA Screening Report in respect of the proposed development was prepared by ROD on behalf of WCCC and in accordance with the requirements of the Habitats Directive and the Planning and Development Act, 2000 (as amended) ("the Planning and Development Act"). ROD, as the author of the AA Screening Report, considered that the proposed development, either individually or in combination with other plans or projects, had the potential to significantly affect the Lower River Suir SAC and the River Barrow and River Nore SAC, in view of their Conservation Objectives. Therefore, ROD recommended that WCCC should determine, in undertaking its AA Screening, that AA was required in respect of the proposed development.

In accordance with Section 177AE of the Planning and Development Act and following the determination by WCCC that AA was required in respect of the proposed development, the role of competent authority and responsibility for undertaking the AA was assumed by An Bord Pleanála. In order to assist An Bord Pleanála in carrying out its AA, WCCC is required to submit a Natura Impact Statement (NIS) in respect of the proposed development.

This document comprises the NIS in respect of the proposed development and has been prepared by ROD on behalf of WCCC. It contains an examination, analysis and evaluation of the likely impacts from the proposed development, both individually and in combination with other plans and projects, in view of best scientific knowledge and the Conservation Objectives of the European sites concerned. It also prescribes appropriate mitigation to ensure that the proposed development will not adversely affect the integrity of those sites. Finally, it provides complete, precise and definitive findings which are capable of removing all reasonable scientific doubt as to the absence of adverse effects on the integrity of the European sites concerned.

1.2 Legislative Context

The Habitats Directive and Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds ("the Birds Directive") list habitats and species which are, in a European context, important for conservation and in need of protection. This protection is afforded in part through the designation of sites which support significant examples of habitats or populations of species ("European sites"). Sites designated for birds are termed "Special Protection Areas" (SPAs) and sites designated for natural habitat types or other species are termed "Special Areas of Conservation" (SACs). The complete network of European sites is referred to as "Natura 2000".

In order to ensure the protection of European sites in the context of land use planning and development, Article 6(3) of the Habitats Directive provides for the assessment of the implications of plans and projects for European sites, as follows:

> "*Any plan or project not directly connected with or necessary to the management of the site* [or sites] *but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives. In the light of the conclusions of the assessment of the implications for the site* [...]*, 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* [...]."

The requirements arising out of Article 6(3) are transposed into Irish law by Part 5 of the Habitats Regulations and Part XAB of the Planning and Development Act, and the assessment is referred to as "Appropriate Assessment" (AA).

The determination of whether or not a plan or project meets the two thresholds for requiring AA is referred to as "Stage 1" or "AA Screening". The first threshold is reached if the plan or project is not directly connected with or necessary to the management of one or more European sites. In its ruling in *Waddenzee*[1], the Court of Justice of the European Union (CJEU) interpreted the second threshold as being reached where "*it cannot be excluded, on the basis of objective information, that* [the plan or project] *will have a significant effect on that site*". Thus, in applying the Precautionary Principle, the CJEU interpreted the word "likely" to mean that, as long as it cannot be demonstrated that an effect will not occur, that effect is considered "likely". A likely effect is considered to be "significant" only if it interrupts or causes a delay in achieving the Conservation Objectives of the site concerned.[2]

Prior to approval of a plan or project which is the subject of AA (also referred to as "Stage 2"), it is necessary to "*ascertain*" that the plan or project will not "*adversely affect the integrity of the site*". In its guidance document (EC, 2001), the European Commission stated that "*the integrity of a site involves its ecological functions*" and that "*the decision as to whether it is adversely affected should focus on and be limited to the site's conservation objectives*". Regarding the word "ascertain", the CJEU, also in *Waddenzee*, interpreted this as meaning "*where no reasonable scientific doubt remains as to the absence of such effects*". Therefore, the legal test at Stage 2 is satisfied (and the plan or project may be authorised) when it can be demonstrated beyond reasonable scientific doubt that the plan or project will not interrupt or cause delays in the achievement of the Conservation Objectives of the site or sites concerned. AA is informed by a "Natura Impact Report" (NIR) in the case of plans or a "Natura Impact Statement" (NIS) in the case of projects.

The CJEU has made a relevant judgment on what information should be contained within documents supporting AA[3] (in the NIR or NIS):

> "[The AA] *cannot have lacunae and must contain complete, precise and definitive findings and conclusions capable of removing all reasonable scientific doubt as to the effects of the works proposed on the protected site concerned.*"

[1] Landelijke Vereniging tot Behoud van de Waddenzee, Nederlandse vereniging tot Bescherming van Vogels *v*. Staatssecretaris van Landbouw, Naturbeheer en Visserij (Waddenzee) [2004] C-127/02 ECR I-7405.

[2] Conservation Objectives are referred to, but not defined, in the Habitats Directive. In Ireland, Conservation Objectives are set for Qualifying Interests (the birds, habitats or other species for which a given European site is selected) and represent the overall target that must be met for that Qualifying Interest to reach or maintain favourable conservation condition in that site and contribute to its favourable conservation status nationally.

[3] Sweetman *v*. An Bord Pleanála [2013] Case C-258/11.

The Irish High Court has also provided clarity on how competent authorities should undertake valid and lawful AA[4], directing that the AA:

> "*Must identify, in the light of the best scientific knowledge in the field, all aspects of the development project which can, by itself or in combination with other plans or projects, affect the European site in the light of its conservation objectives. This clearly requires both examination and analysis.*"
>
> "*Must contain complete, precise and definitive findings and conclusions and may not have lacunae or gaps. The requirement for precise and definitive findings and conclusions appears to require examination, analysis, evaluation and decisions. Further, the reference to findings and conclusions in a scientific context requires both findings following analysis and conclusions following an evaluation of each in the light of the best scientific knowledge in the field.*"
>
> "*May only include a determination that the proposed development will not* adversely *affect the integrity of any relevant European site where, upon the basis of complete, precise and definitive findings and conclusions made, the consenting authority decides that no reasonable scientific doubt remains as to the absence of the identified potential effects.*"

In accordance with Article 6(3) of the Habitats Directive, the responsibility to screen for and carry out AA lies solely with the "competent national authorities", i.e. those with responsibility for granting or refusing consent for plans and projects. In that respect, an AA Screening Report, NIR or NIS (if not prepared by the competent authority) does not in itself constitute a valid AA Screening or AA; it merely provides the competent authority with the information that it needs in order to screen for and carry out its AA. In Ireland, the competent authority for a given plan or project is the relevant planning authority, e.g. the local authority or An Bord Pleanála.

1.3 Methodology

On the basis of the objective information provided in the AA Screening Report and in view of the Conservation Objectives of the relevant European sites, WCCC, as the competent authority at that stage, determined that the proposed development, either individually or in combination with other plans and projects, was likely to have a significant effect on two European sites, namely the Lower River Suir SAC and the River Barrow and River Nore SAC.

In accordance with the requirements for AA, this NIS assesses the likely effects of the proposed development on the integrity of the European sites "screened in" at Stage 1. This assessment is undertaken in six steps, as follows:

1. Step 1 involves gathering all of the information and data that will be necessary for a full and proper assessment. These include, but are not limited to, the details of all phases of the plan or project, environmental data pertaining to the area in which the plan or project is located, e.g. rare or protected habitats and species or invasive species present or likely to be present, and the details of the European sites within the likely zone of impact.
2. Step 2 involves examination of the information gathered in the first step and detailed scientific analysis of the effects of the plan or project on the ecological structure and function of the receiving environment, focussing on European sites.

[4] Kelly *v*. An Bord Pleanála [2014] IEHC 422.

3. Step 3 evaluates the effects analysed in Step 2 against the Conservation Objectives of the relevant European site or sites, thereby determining whether or not they constitute adverse effects on site integrity.
4. Having established that the plan or project will adversely affect the integrity of one or more European sites, Step 4 involves the development of appropriate mitigation, including, where appropriate, monitoring and enforcement measures, to eliminate or minimise those effects such that they no longer constitute adverse effects on the integrity of the site(s) concerned, as well as consideration of the significance of any residual (post-mitigation) effects.
5. Step 5 involved the assessment of the significance of any residual effects arising from the proposed development in combination with other plans or projects.
6. Step 6 involves the final determination of whether or not the plan or project will adversely affect the integrity of one or more European sites. Notwithstanding the final recommendation made in the NIS, the responsibility for completing this step lies solely with the competent authority.

The following guidance documents informed the assessment methodology:

- EC (2001) *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*. Environment Directorate-General of the European Commission.
- EC (2018) *Managing Natura 2000 sites: The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC*. European Commission, Brussels.
- DEHLG (2010) *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities*. Department of the Environment, Heritage and Local Government, Dublin.
- NPWS (2010) *Appropriate Assessment under Article 6 of the Habitats Directive: Guidance for Planning Authorities*. Circular Letter NPWS 1/10 & PSSP 2/10. Department of the Environment, Heritage and Local Government, Dublin.

1.4 Ecological Assessment

In order to fully inform this NIS, it was necessary to establish the baseline ecological conditions in the receiving environment, particularly with regard to European sites. This was achieved by undertaking desktop studies, carrying out field surveys and engaging in consultations with the relevant consultees, including the National Parks & Wildlife Service (NPWS) and Inland Fisheries Ireland (IFI). The process of establishing this baseline is outlined in the subsequent subsections.

Desk Studies

During the preparation of the AA Screening Report and NIS, the statutory consultee, the NPWS, provided data on designations of sites, habitats and species (including birds) of conservation interest. This included reports pursuant to Article 17 of the Habitats Directive[5] (NPWS, 2019a-c) and the Site Synopses, Natura 2000 Standard Data Forms and Conservation Objectives (including supporting documents) for the relevant European sites. A review of the literature relating to aquatic species of conservation concern likely to be present in the River Suir Estuary was undertaken and included a number of local studies. This included a review of records from IFI's fish sampling, conducted under the Water Framework Directive (WFD) and as part of

[5] Under Article 17, to report to the European Commission every six years on their status and on the implementation of the measures taken under the Directive.

reporting requirements under Article 17 of the Habitats Directive. A review of the EPA Q-value status and WFD surface water quality and risk status for the River Suir was also undertaken.

The desk studies involved thorough reviews of existing information relating to ecology in the vicinity of the proposed development. A number of web-based geographic information systems (GISs) were used to obtain information relating to the natural environment surrounding the proposed development. These included the NPWS *Designations Viewer* (NPWS, 2021), which provided information on the locations of protected sites, the National Biodiversity Data Centre's *Biodiversity Maps* (NBDC, 2021), which provided recent and historic records of rare and protected species in the area, and Ordnance Survey Ireland's *GeoHive*, which provided additional information on the wider environment.

Other resources used during the desk study included the following:

- Irish Wetland Bird Survey (I-WeBS) data from BirdWatch Ireland provided monthly counts for survey sub-sites on the River Suir
- Environmental Protection Agency (EPA) Unified GIS Application provided data in relation to the Water Framework Directive Risk/Status of waterbodies in the Zone of Influence
- IFI fish sampling reports for the Water Framework Directive (2010-2018)
- Environmental Impact Assessment Report and Natura Impact Statement for the River Suir Sustainable Transport Bridge (ROD, 2018a,b)
- Environmental Impact Assessment Report and Natura Impact Statement for the Waterford North Quays Development (Fogarty, 2020a,b)
- Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall (Hydro Environmental Ltd, 2021)
- Waterford Flood Defence West – Intertidal Survey (Brophy, 2021)

As with all desk studies, the data considered were only as good as the data supplied by the recorders and recording schemes. The recording schemes provide disclaimers in relation to the quality and quantity of the data they provide, and these were considered when examining outputs of the desk study.

Consultations

Throughout both the design and the environmental assessment processes, there were consultations both with the NPWS, as the statutory consultee, and with IFI. These included both written correspondence and meetings (all of which were held remotely due to the Covid-19 pandemic).

Consultation allowed for in-depth discussion of ecological sensitivities at specific locations along the proposed development and at specific stages in its construction and operation, as well as discussion of how any ecological impacts would be best mitigated.

A summary of these consultations is given in Table 1.1 below. All issues raised by the consultees have been addressed in this NIS.

Table 1.1 Details of consultations

Consultee	Date	Summary
National Parks & Wildlife Service	2nd November 2020 (informal meeting)	NPWS noted the possibility that 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) may be present within the project extents.
	14th December 2020	Following the meeting of 2nd November 2020, comments were received via the Development Applications Unit: The NPWS acknowledged the necessity for the proposed development and reiterated the expected impacts that the proposed development will have on Annex I habitats and Qualifying Interests within the Lower River Suir SAC.
	1st February 2021	Provided records of rare and protected species and habitats in the study area.
Inland Fisheries Ireland	5th November 2020 (informal meeting)	IFI expressed the view that, while the additional loss of mudflats is not ideal, on balance, the shorter construction programme facilitated by riverside piling may be preferable in terms of avoiding medium- or long-term impacts on recruitment/population structure of Twaite Shad and other species. IFI welcomes the proposed mitigation of an eco-wall or similar textured cladding to the outside of the sheet piles to facilitate faster colonisation of the new hard intertidal substrate by encrusting organisms.
	1st December 2020	IFI provided comments on the two feasible options for the proposed development and considered that Option B could be supported. This was selected as the preferred option. They highlighted that the proposed development will result in direct disturbance of migratory fish species, particularly Twaite Shad, and the loss of Annex I habitats within the Lower River Suir SAC. In addition to this, they advised that during construction, the barge craft should be positioned during high tide to minimise disturbance of benthic sediments and fauna. They also advised that piledriving should be carried out at low tide to minimise disturbance to fish species. It was also mentioned that noise and vibration effects are unavoidable but are likely to have minimal effects on fish species.
National Parks & Wildlife Service and Inland Fisheries Ireland	23rd March 2021 (informal meeting with both consultees)	IFI stated that measures will be required to prevent entry of concrete or other construction materials to the River Suir during raising of the existing quay wall as part of remedial works where this intervention is proposed. NPWS expressed concerns relating to the permanent loss of an area (<100m^2) of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330), which is a qualifying interest of the Lower River Suir SAC, at Ch. 950, where the proposed sheet pile wall transitions back from riverside to landside.

Consultee	Date	Summary
		They also expressed concern about the permanent loss of *c.* 800m^2 of 'Mudflats and sandflats not covered by seawater at low tide' (1140) as a result of riverside piling. It was stated that the conservation status of this habitat is inadequate nationally and that the policy of No Net Loss should apply.

Field Surveys

Multidisciplinary Walkover Survey

The multidisciplinary ecological walkover surveys included habitat/botanical surveys and protected species surveys. They were undertaken on 9th November 2016, 25th September 2018 and 8th April 2021, by ROD ecologists Patrick O'Shea MCIEEM, Owen O'Keefe MCIEEM, Kate Moore GradCIEEM and Kalvin Townsend-Smyth QualCIEEM. Patrick is an ecologist with over 7 years' experience and holds a BA (Mod) Hons in Botany from Trinity College Dublin and an MSc in Ecological Management & Conservation Biology from Queen's University Belfast. Owen is an ecologist with over 5 years' experience and holds a BSc (Hons) in Ecology from University College Cork. Kate is an ecologist with over 5 years' experience and holds a BSc (Hons) in Environmental Biology from University College Dublin. Kalvin is an ecologist with 2 years' experience and holds a BSc (Hons) in Wildlife Biology from the Institute of Technology, Tralee.

Habitats present were classified in accordance with *A Guide to Habitats in Ireland* (Fossitt, 2000) and mapped following *Best Practice Guidance for Habitat Survey and Mapping* (Smith et al., 2011). The whole site and an appropriate buffer (150 m) were systematically and thoroughly walked, and all habitats were classified and sketched onto maps. These surveys also aimed to identify any habitats corresponding to types listed on Annex I to the Habitats Directive using the *Interpretation Manual of European Union Habitats* (EC, 2013). The presence (or signs) of protected fauna, including birds, mammals, amphibians and reptiles was noted during the visits.

Smith et al. (2011) states that the optimal time of year for habitat surveys is April to September, inclusive, as this is the growing season for most plants . Two of the multi-disciplinary walkover surveys were undertaken in April and September, i.e. at either end of the optimal season for habitats. The April survey was also undertaken during the optimal season for breeding birds. A third walkover survey was undertaken in November, towards the beginning of the optimal survey period for wintering waterbirds. The November survey also covered the optimal survey period for terrestrial mammals and physical habitat features, as features are less likely to be obscured by vegetation. Therefore, the three surveys dates are considered to cover key seasonal periods for the aspects of biodiversity of concern in relation to the proposed development.

Watercourses, Fisheries and Aquatic Fauna

Aquatic habitats were assessed as part of the multidisciplinary surveys. Notes were made on the morphology, physical characteristics and potential of the river habitat to support protected flora and fauna. The surveys focussed particularly on the suitability of the River Suir in the vicinity of the proposed development for fish and other aquatic species. The survey also aimed to confirm the presence or likely presence of Qualifying Interests of the Lower River Suir SAC, e.g. Sea Lamprey, River Lamprey, Twaite Shad, Atlantic Salmon and Otter, as well as estuarine Annex I habitats.

Given that the proposed development is located in and adjacent to the Suir Estuary, species which are limited to freshwater habitats, e.g. Freshwater Pearl Mussel and White-clawed Crayfish, were deemed not to be at risk and, therefore, focussed surveys for these species were not deemed appropriate.

Otter

The protected species surveys undertaken as part of the multidisciplinary surveys were designed to record the presence or evidence of Otter and other protected species, following the methodology outlined in *Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes* (NRA, 2008). This included the identification of sensitive features potentially of use to breeding, resting, foraging or commuting otters and to identify any presence or likely presence of this species. A systematic search of the riverbanks for physical evidence of otters, e.g. spraints, prints, slides, trails, couches and holts, was carried out. The methodology was also cognisant of the recommendations in the Otter Threat Response Plan 2009-2011 (NPWS, 2009) which recognises the importance of the riparian buffer (10 m on both banks) for Otter.

Birds

The multidisciplinary walkover surveys included identification of habitats and features likely to be of importance for birds and recording of all incidental observations of birds (by sight and song) during the surveys. The surveys also aimed to identify habitats with potential to support important assemblages or significant populations of birds of conservation concern. Based on the results of the desk study and multidisciplinary walkover survey, it was determined that further surveys specifically for birds were not necessary in this case.

Invasive Alien Plant Species

During the walkover surveys, the presence of invasive species was recorded. The focus was on identifying species subject to restrictions under Section 49 of the Habitats Regulations or which pose a threat to the integrity of European sites. Target notes were taken on any invasive species identified. Information recorded included the area of infestation, plant condition, height and location. Site features that could affect control measures such as adjacent land use, structures and services were also recorded.

Assessment

Once established, the ecological baseline in the receiving environment was used to inform the assessment of the likely ecological effects of the proposed development, particularly with regard to European sites. Any assumptions that had to be made in view of gaps in the ecological data or other information were made in strict accordance with the Precautionary Principle.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Introduction

This chapter provides a description of the proposed Flood Defences West hereafter referred to as the "proposed development". The chapter details land requirements, the construction methodology and operational requirements of the proposed development.

It should be noted that surveys, assessments and information that form the basis of this Environmental Impact Assessment Report (EIAR) are based on the design of the project as described in this chapter, which has been developed to a stage that permits a fully informed Environmental Impact Assessment (EIA) to be carried out by the competent authority. While further detailing will be required to fully inform procurement and construction, no design changes will be permitted that have the potential to undermine the basis of the assessment of the environmental impacts undertaken in this EIAR.

2.2 Project Overview

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figure 1.1 in Volume 2 of this NIS. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD)
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Plate 2.1 and with Figures 4.1 to 4.6 in Volume 2 of this NIS:

- Construction of c. 365m of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 2 of this NIS) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.

- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
  - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
  - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the sheet pile wall within the foreshore will be fitted with pre-cast concrete cladding material ("eco-seawall").
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.11 to Figure 4.20 in Volume 2 of this NIS:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a pumping station (at approx. Ch.380) and a new surface water outfall structure in the River Suir at Ch.390.
- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.

- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.390 (as shown in Figure 4.18 in Volume 2 of this NIS).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

Table 2.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

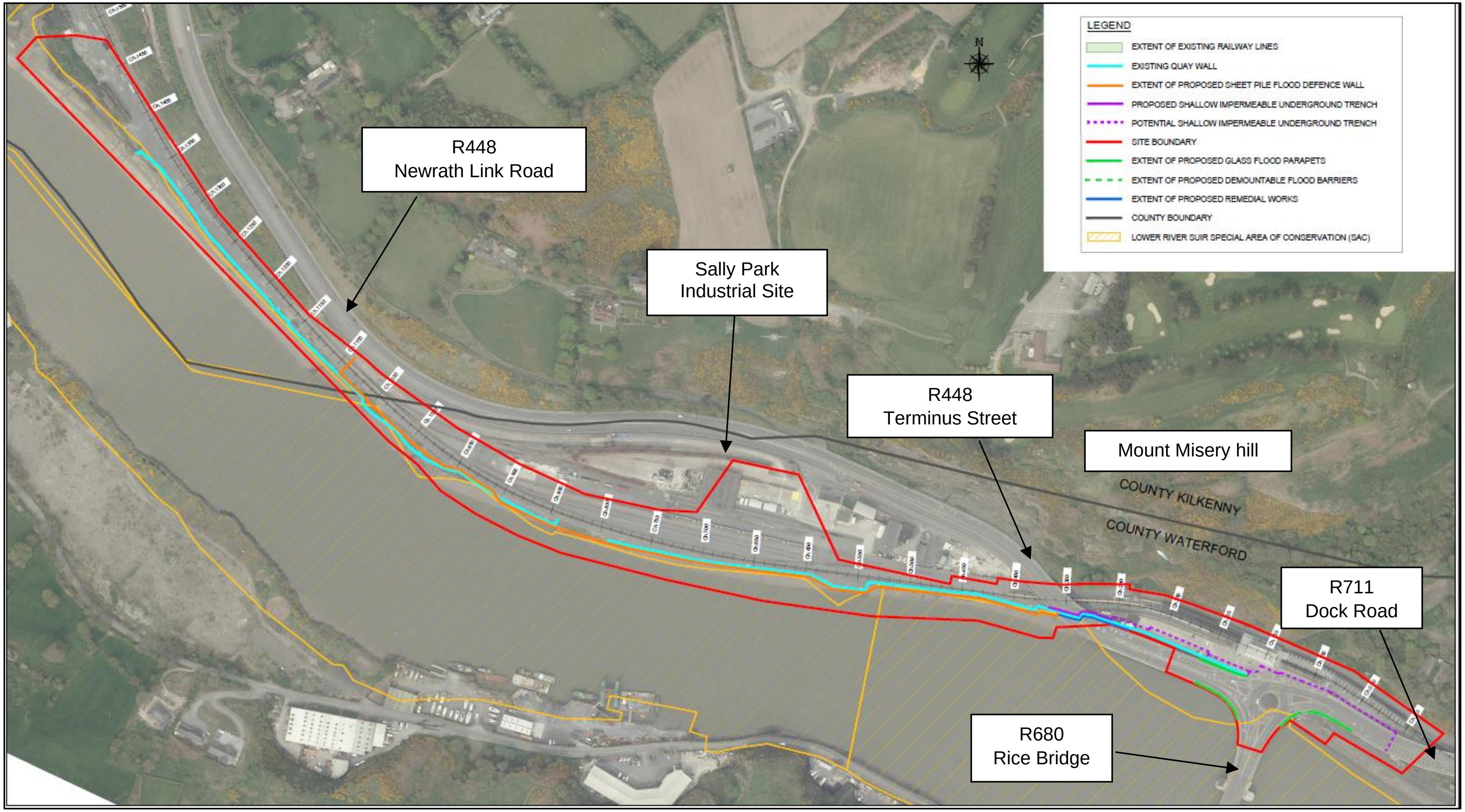


Plate 2.1 **Location of proposed Waterford City Public Infrastructure Project - Flood Defences West (Scale: 1:1400)**

2.3 Description of the Site of the Proposed Development

The site of the proposed development extends for approximately 1500 metres along the north (left) bank of the River Suir, which is designated as the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC, c. 9km downstream of the proposed development.

From Ch.0.0 to Ch.380 (see Figure 4.1 in Volume 2 of the NIS), the site is characterised by transport infrastructure elements, namely by Plunkett Station with car parking area(s) located on both east and west sides of the main building, as well as the Rice Bridge roundabout; R711 Dock Road and R448 Terminus Street/Newrath Link Road, both of which are associated with complex construction elements such as viaducts and bridges. Plunkett Station is the terminus of the Dublin-Waterford line and has a through-platform for the extension to Belview Port. This eastern section of the site contains a considerable amount of buried/underground infrastructure mainly consisting of IÉ utilities in front of the Plunkett Station, and the obsolete remnants of historical infrastructure that include the existing quay wall and the old Newrath Road bridge foundations.

From Ch.380 to Ch.1090, the site is characterised by an existing quay wall, with one or more rail tracks parallel to the north of it, as well as ancillary rail infrastructure such as signalling and drainage. The IÉ lands occupy all of the lands between the existing quay wall and the R448 and include the rail tracks and the Sallypark industrial site.

Historical maps show that the predominant land use of the site between Ch.380 and Ch.1090 consisted of rail infrastructure and it has provided an industrial function for the past 160 years as shown in Plate 2.2 below.

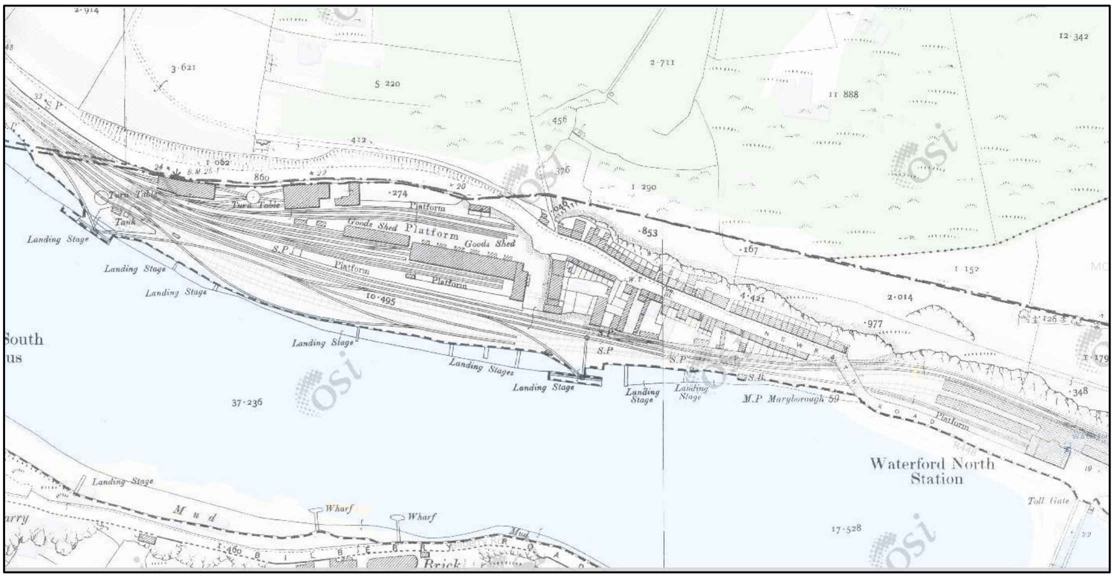


Plate 2.2 Land use within the northern banks of Waterford City between 1888 and 1913. Source: OSi historic map 25 inch (1888-1913) taken from http://map.geohive.ie/

The alignment of the existing quay wall remains largely unchanged throughout the years. Historically, some isolated landing stages projected into mudflats at different locations. Only the isolated remnants of wooden piles in mudflats are visible today. Historical maps from pre-industrial period (1840 and earlier) show the site to be an unoccupied coastal strip, with the extents of the westernmost half of the riverbank largely the same as currently visible. Historical maps however show that the eastern section of the riverbank within the site of proposed development is slightly north of the existing bank. This implies that the area has been reclaimed locally in width of up to 10m during the construction of the rail infrastructure and is composed of non-engineered made ground fill, which has been confirmed by ground investigations.

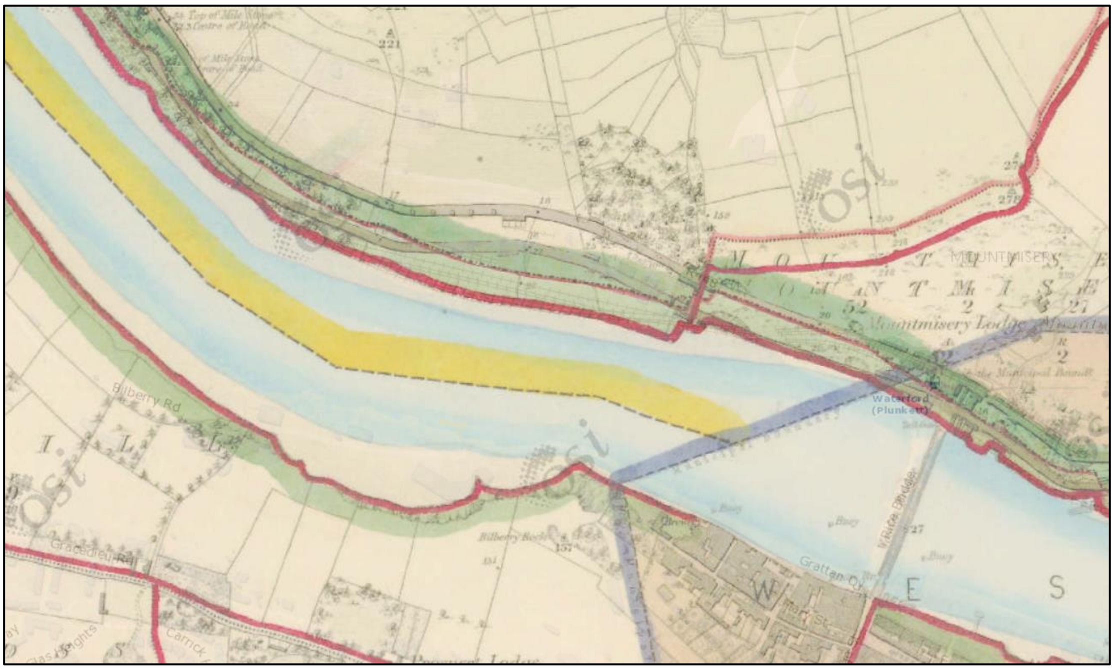


Plate 2.3 **Land use within the northern banks of Waterford City from 1837 - 1842. Source: OSi historic map 6 inch colour (1837-1842) taken from http://map.geohive.ie/**

The topography of the site of the proposed development is flat, with typical elevation between +2.0mOD and +3.5mOD. The mudflats within the foreshore (in front of the existing quay wall) are typically at an elevation of +0.5mOD to -1.0mOD and slope gently towards the river centreline. To the north of the site, behind the rail tracks and the R448, the ground rises steeply up to level of +60 m OD. This geographical feature is known as Mount Misery hill, see Plate 2.1 above for approximate location.

2.3.1 Existing Drainage

The existing drainage catchment is shown on Figure 4.11 in Volume 2 of this NIS. The site is bounded to the north by Mount Misery Hill and falls to the south, draining to the River Suir. The following paragraphs provide a description of the existing drainage network within the site of the proposed development.

From Ch.0.0 to Ch.320 in the vicinity of Plunkett Station (Catchment A), the site is bounded to the north by a steep rock slope which is subject to rock stabilisation works as part of the overall Waterford City Public Infrastructure Project which was granted a Part 8 planning approval by WCCC in January 2019. As part of the Rock Stabilisation works, a cut-off ditch and drainage works are being provided to divert flows from the upper catchment away from the steep rock slope.

There are existing drainage networks in the vicinity of Plunkett Station. At Ch.0.0, an existing drainage network collects drainage from the railway track and platform located to the east of Plunkett Station and the eastern car parking area (below the R711 Dock Road viaduct), before discharging it into the River Suir east of Plunkett Station.

From Ch.160 to Ch.350, there are numerous existing drainage gullies in the western IÉ car park area (to the west of Plunkett Station and under the R448 road overbridge) which have numerous outfalls directly to the River Suir via the existing quay wall.

From Ch.350 to Ch.850, the site of the proposed development is bounded to the north by the remainder of the IÉ lands, the R448, and by the upper drainage catchment and the Sallypark rock cut slopes. The upper catchment drainage at Sallypark rock cut, identified on Figure 4.11 in Volume 2 of this NIS, comprises a series of benching and rock traps, and rock trap collection channels which discharge into the R448 road drainage network. The R448 road drainage network transversely crosses the railway line at approx. Ch.490 and outfalls in the River Suir via an existing 600mm diameter outfall pipe located in the riverbed.

From Ch.350 to Ch.1090, there are existing drainage networks which collect flows from Sally Park industrial site located to the north of the railway line and some trackside areas which transverse the railway line and outfall to the River Suir. There are also numerous outfall pipes visible through the existing quay wall which may be remnants of old drainage networks or railway\groundwater drainage measures.

From Ch.350 to Ch.1090, existing surface water flows from the railway line and adjacent flat areas, flow to the River Suir either through infiltration into the groundwater or over the edge of the existing quay wall in areas where there are significant gaps or cracks in the wall.

2.4 Design of the Proposed Development

The following paragraphs provide a detailed description of proposed flood defence measures and should be read in conjunction with Figures 4.1 to 4.20 of NIS Volume 2.

2.4.1 Flood Defences in front of Plunkett Station

Underground Flood Protection

In front of the existing Plunkett Station building and adjacent to the parking areas (see Plate 2.4), starting from chainage Ch.0.0 and going westwards to approximately Ch.365, the ground conditions are such that the risk of flooding caused by underground seepage of waters from the River Suir during flood events are expected to be comparatively lower than within the rest of the proposed development area. It is envisaged that the potential risk from groundwater flooding is reduced due to this section being dominated by shallow bedrock and an abundance of built structures that pose obstructions to water flow, such as the historical quay walls and new boundary walls. However, with climate change and the risk of rising tide levels there is a risk of increased groundwater flooding at the low points in the railway line in front of Plunkett Station in the future. To prevent groundwater seepage at this location, it is proposed to construct an impermeable shallow trench (approximately 0.35m wide and up to 3m deep trench filled with lean mix concrete); blocking of disused drainage pipes; and retrofitting the other drainage pipes with non-return valves.

Plate 2.4 Western IÉ Car parking area in front of the Plunkett Station

It is noted that groundwater monitoring is currently ongoing as a part of the risk-based approach for this section, and it is possible that parts of these underground flood protection measures may be omitted during detailed design or may be implemented on a phased basis with ongoing monitoring of groundwater levels in the interim. However, for the purposes of the NIS, a full length of impermeable trench is envisaged to be required, and therefore the worst-case impacts have been assessed as part of this NIS.

The impermeable trench's depth and width have been designed on the basis of the local ground and groundwater model, and were determined using long-term monitoring and seepage design in accordance with IS EN 1997-1:2005 Eurocode 7: Geotechnical design General rules (Including Irish National Annex).

Overground Flood Protection

The ground levels at the Rice Bridge roundabout and the entrance to Plunkett Station (between chainages Ch.0.40 and Ch.210) are in parts lower than the design flood level of +4.0mOD. A system of overground flood protection measures is proposed for the Rice Bridge Roundabout and along the three roundabout arms; Rice Bridge (R680), Terminus St. (R448) and Dock Rd. (R711).

The overground flood defence measures will comprise of approximately 170m of glass flood barriers, 15m of demountable flood barriers, sealing of the roundabout and approach structure roadway movement joints, and the provision of flap valves on the existing road drainage outfall to the River Suir (see Section 4.4.4 Drainage for details).

The glass barriers will be located on the river side of the road edge vehicular parapets and will be supported off the existing concrete parapet edge beams (see Plate 2.5 as an example of a similar glass flood barrier).

Plate 2.5 Example of a glass flood barrier installed along a wall

Demountable slot-in flood barriers are required at the entrance on the Rice Bridge roundabout to the North Quays site to ensure access to these lands is maintained at all times (with the exception of at predicted estuary flood events). The demountable flood barriers require the installation of permanent below ground structural foundations at approximately two metre centres. The above ground elements (metal flood barrier posts and infill panels) will only be installed when the risk of flooding arises; the operational need for demountable barriers may only arise in the longer term when the impacts of climate change on tide levels leads to increased risk of flooding at this location. At present there is no record of flooding at this location, and the ground levels are above the current 0.5% AEP flood levels. In the shorter term (20-40 years) it is unlikely that the demountable barriers will be required to be deployed at this location.

Plate 2.6 Demountable Flood Barriers at Clancy Strand, Limerick (Source: www.floodgateireland.com)

The overground flood protection measures proposed will ensure that not only is Plunkett Station and the associated rail infrastructure protected from flooding, but the vital road network for access into Waterford City is also protected.

The proposed underground and overground flood protection measures in front of Plunkett Station will ensure that the Flood Defences West and Flood Defences East (which obtained planning approval in 2019) as part of Transport Hub Part 8 planning application are connected and that there is no gap in the flood defence measures. The Flood Defences East start at Ch.0.0 and continue eastwards. The Flood Defences East will be composed of landside sheet piles, installed south of the rail tracks and running parallel to them. The steel sheet piles will prevent both groundwater and overground flooding, except at Transport Hub development where the overground defence will be provided by the Transport Hub structural elements such as platform walls.

2.4.2 Remedial Works to the Existing Quay Wall

Between Ch.285 and Ch.360, the existing quay wall located in front of the car park (immediately to the west of the existing Plunkett Station) stretching c. 75m to the west under the R448 overbridge will be raised to add between 0.6m and 1.2m in height in order to attain the required height of +4.3mOD.

Between Ch.285 and Ch.300, the works will involve the construction of a reinforced concrete wall add-on, as the existing quay wall is reinforced concrete, and no significant defects were found in this segment of the wall during inspections. This is envisaged to be done as cast in-situ reinforced concrete, using chemically anchored reinforcing bars placed into the top of the existing wall to integrally connect the new add-on section and existing section of wall.

A similar solution will be applied to the existing quay wall between Ch.300 and Ch.360.

The wall add-on will be complemented, as stated in Section 4.4.1 above under the sub-heading of 'Underground Flood Protection', by an impermeable trench filled with lean mix concrete / grout. The impermeable trench will be constructed behind the existing quay wall to prevent the seepage through the deteriorating existing quay wall that is in poor condition at this segment of the wall.

2.4.2.1 Design Standard

The proposed remedial works involve building a reinforced concrete add-on wall on top of the existing quay wall to reach the design (top-of-wall) level of +4.30mOD. The new structure will be connected to the existing wall through chemically anchored reinforcing bars.

The design of the new wall and its connection to the existing structure follows the relevant design standards:

- I.S. EN 1992-1-1:2004+NA:2010 Eurocode–2 - Design of concrete structures - Part 1-1: General Rules and Rules for Buildings;
- I.S. EN 1992-4:2018 Eurocode–2 - Design of concrete structures - Part 4: Design of Fastenings for Use in Concrete;
- IS EN 1997-1:2005 Eurocode 7: Geotechnical design. General rules (Including Irish National Annex).

2.4.3 Sheet-Piled Flood Defence Wall

Riverside Flood Defences

Between Ch.360 and Ch.900, construction of approximately 540m of new flood defence wall within the foreshore of the River Suir will be required (in-river sheet piles). This section of the driven sheet pile wall will be constructed using a piling rig on a jack-up barge situated in-stream for the duration of works as discussed in Section 4.5.4.

The sheet pile wall will be constructed approximately 1m in front of the existing quay wall within the River Suir mudflats and the gap will be backfilled with clean imported granular (TII Specification for Road Works Series 600 Class 6) earthworks fill material. The sheet piles will not be placed closer to the existing quay wall in order to avoid obstacles such as protruding parts of the existing quay wall under the mudline, large erosion protection elements or fallen blocks, and to minimise the potential damage to the quay wall from the proposed works. Historical maps show that some sections of the study area used to contain wooden piles, used as foundations for wooden landing stages. The current visible remains of wooden piles are extremely infrequent, observed as typically isolated and narrow single pile remnant, with no large group of piles observed along the sheet pile alignment (see Plate 2.7 for locations of landing stages along the north bank of River Suir). The only large group of existing wooden piles is observed between Ch.960 to Ch.1020, which is after the transition point between the riverside and landside sheet piles and is thus outside of the sheet pile alignment. Therefore, the landing stage remnants will not be impacted by the sheet pile installation. If the remnants of wooden piles are found to present an obstacle to sheet piling installation elsewhere, the sheet pile alignment may be locally moved. Realignment will be kept to a minimum, with the expected deviation to be within a metre of the current alignment.

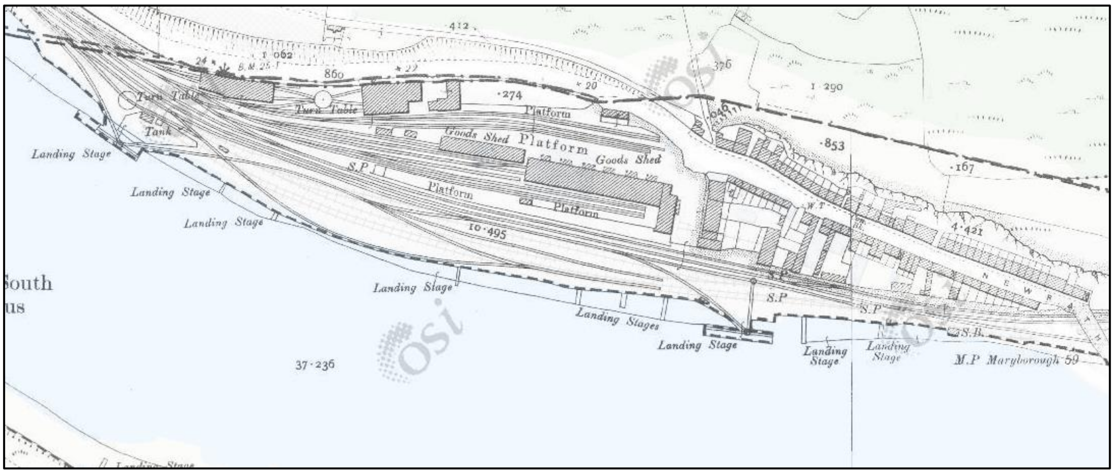
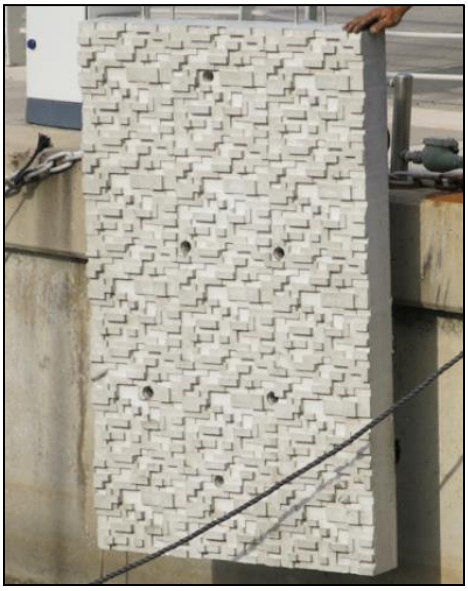


Plate 2.7 **Locations of historic landing stages along the northern bank of River Suir. Source: OSi historic map 25 inch (1888-1913) taken from http://map.geohive.ie/**

Depending on the location, the riverside sheet pile flood defence walls will range in depth of between 14m and 21m in total (including the embedded and above-ground parts). Riverside-installed sheet piles will project above the existing mudline by between 3.3m and 5.3m in order to attain the design (top-of-wall) level of +4.30 m OD.

A section of the riverside sheet piled wall within the intertidal zone of the River Suir (the area between the low- and high-water mark) will be fitted with precast concrete cladding in a form of an "eco-seawall" to enhance marine biodiversity. Example of an eco-seawall is shown in Plate 2.8 below.



a) Installation of an eco-seawall

b) Eco seawall submerged under high tide

Plate 2.8 Example of an eco-seawall. Source: product brochure from econcretetech.

Landside Flood Defences

Between Ch.900 and Ch.1090, the works will involve the construction of a sheet piled flood defence wall on land, 1m behind the existing quay wall, but in front of the rail tracks and will meet the IÉ clearance requirements. The landside sheet piles will be installed using a piling rig as detailed in Section 4.5.4. The permanent works will not encroach into the foreshore of the River Suir. Total height of sheet piles will be up to 10m for the landside works, with up to 8.5m of it embedded in the ground. As such, the sheet piles will project above the existing ground level by between 0.7m and 2.1m in order to attain the design (top-of-wall) level of +4.3 mOD.

For Health and Safety reasons and following IÉ standards, a steel handrail will be provided along the sheet pile wall where the distance between ground level at landside and the top of the sheet pile wall is less than 1.2m.

Underground Isolation Structure

The western end of the flood defences at Ch.1090 is set at a natural high point of the terrain and the rail track. The ground at this point is still slightly below the design flood level of +4.30mOD so an underground transverse isolation structure will be constructed in order to prevent both underground and overground flooding parallel to the rail line, i.e., it will create a cut-off return to complete the flood defences and protect from the floodwaters coming in from west to east along the rail lines. The underground isolation structure across and under the rail-line indicated at Ch.1090, will be approximately 20m in length. The underground isolation structure will consist of a sheet pile wall fully embedded in the ground, to a depth of approximately 6m below ground level. Where the sheet pile footprint is directly below rail tracks, a segment of the rail tracks will be temporarily removed to enable the piling and then reinstated back. The typical width of sheet pile profile is 450mm. The sheet pile wall proposed for the underground transverse isolation structure cannot protrude above ground at this location as its positioned directly below the existing rail tracks and would impede on the operation of the rail line. As such the sheet piles here will include a concrete capping beam finished to existing ground level. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event. The use of demountable barriers at this location is proposed to address the long-term residual risk of flooding (when the impact of climate change on the rising tide level begins to come into effect). The use of overground flood barriers will form part of a long-term strategy to address the flood risk which will include monitoring and operation and emergency planning to be put in place. At present there is no record of flooding at this location, and the ground levels are above the current 0.5% AEP flood levels. In the shorter term (20-40 years) it is unlikely that overground flood barriers will be required to be deployed at this location. Continuing flood defences further to the west of this point would require extending them further, to a minimum distance of 1km until the next natural topographical flood cut off, hence the selection of Ch.1090 for the westernmost end of the flood defences.

2.4.3.1 Design Standard

The proposed sheet pile wall will be executed as an embedded cantilevered retaining wall throughout its length. The top of the wall will be set at +4.30 mOD, to allow for the design flood level of +4.00mOD and 300mm of freeboard to protect from wave overtopping.

The design of the sheet pile wall follows the current design standards:

- IS EN 1997-1:2005 Eurocode 7: Geotechnical design. General rules (Including Irish National Annex); and
- I.S. EN 1993-5:2007+NA:2010 Eurocode–3 - Design of steel structures - Part 5: Piling (Including Irish National Annex)

The design covers the following ultimate and serviceability limit state design checks:

- Structure global stability (overturning)
- Wall steel section capacity (bending, shear)
- Groundwater seepage cut-off
- Horizontal displacements at the top of the wall

The wall design is verified for: both drained and undrained soil geotechnical conditions; the various temporary loading conditions during the construction stage; the permanent loading conditions once constructed (highest and lowest tidal events). The sheet pile embedment (toe level), steel section and steel grade have been selected to satisfy the limit design checks and loading conditions noted above. For durability, the loss in sheet pile wall thickness due to corrosion (over a 120 year wall design life) has been determined in accordance with the design standards and adopted in the selection of the appropriate sheet pile wall section.

Standard vertical rail loading of 150 kN/m' applied over sleeper width has been adopted in the design. The wall alignment was set such that in all locations the above ground section of sheet pile wall is at an adequate distance from the nearest track, in accordance with IÉ standards. In agreement with IÉ, the sheet pile wall is not designed for accidental impact loading (which may occur in the event of a train derailment).

The characteristics of the soil backfill behind the wall and sheet piling operations will conform to the relevant TII Specification for Road Works Standards and Notes for Guidance.

2.4.4 Remedial Works to the Existing Drainage System

Modifications to the existing drainage system will be required as part of the proposed development. The proposed drainage works are described in the following sections with reference to chainages shown in Figures 4.11 – 4.20 in Volume 2 of this NIS.

There are existing drainage networks in the vicinity of Plunkett Station and the associated car parking area (at approx. Ch.0.0) which will have their outfall to the River Suir cut off by a sheet pile wall proposed as part of the separately approved Flood Defence East (part of the Part 8 planning application for SDZ Transport Hub). The existing drainage networks will be upgraded, and the associated flows will be directed into the new drainage network proposed as part of the Flood Defences West.

From Ch.160 to Ch.350, the existing gully outlets through the existing quay wall will be retrofitted with non-return valves to prevent water ingress during high tides. Existing drainage networks in this area will be diverted into the proposed surface water network which will outfall to the River Suir at the proposed drainage outfall at approx. Ch.390 (via a pumping station). See section 4.4.5 for more details on the new drainage system.

From Ch.350 to Ch.1090 the existing local drainage network draining into the River Suir will be upgraded with new outlets to enable drainage pipes to pass through the new sheet pile wall. Non return valves will also be provided to prevent water backflow up through the existing outfalls. Where required, existing drainage pipes will be extended to terminate at the front face of the new sheet pile wall.

Existing drainage outfalls which are located in the riverbed of River Suir (at Ch.470 and Ch.490) will be temporarily removed to allow installation of the sheet pile wall. These surface water outfalls will be re-instated in the riverbank to match their existing footprint / length and upgraded as part of the works. Further details are given in Section 4.4.5.

All manholes (see Figures 4.12 - 4.17 in Volume 2 of this NIS) on existing drainage networks traversing the railway track will be provided with sealed manholes covers to prevent surcharging of these manholes during high tide events. It is likely that with climate change and rising tide levels, these existing drainage networks will require modification in the future to mitigate the increased surface water flood risk; however, such works are not included as part of this development but should be considered as part of a future catchment management plan. The proposed surface water drainage networks for this development are designed to take into account the impacts of climate change on tide levels.

Several other smaller surface water or land drainage outlets were noted along the existing quay wall during a visual inspection. The proposed drainage upgrade works will connect as many of these minor outfalls as possible into the proposed drainage network and a filter drain will collect sub-surface drainage. Where this is not feasible (due to water levels), these minor land drains will be extended to outfall through the new sheet pile wall.

All existing drainage outfalls will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

2.4.5 New Drainage System

The provision of proposed flood defence measures will raise the level of the quay wall and will cut off the existing flow path of over the edge surface water drainage and the existing groundwater flows.

Therefore, additional drainage pipework such as filter drains will be provided and will run linearly behind the proposed flood protection measures to accommodate the surface water and the cut-off groundwater flows.

As part of the proposed development, no significant increase in impermeable areas or changes to the overall catchment is proposed. The upgrade of the drainage networks may facilitate faster run-off of surface water from the site, however the outfall peak flows will not be increased significantly post construction.

In the vicinity of Plunkett Station from Ch.0.0 to Ch.350, a new drainage network will be provided to collect flows from the trackside drainage and also from the low point at Plunkett Station at +2.15m OD. This will reduce the risk of pluvial flooding at this location.

2.4.5.1 Outfalls to River Suir

Outfalls Terminating at the New Sheet Pile Wall

The proposed outfalls to the River Suir at Ch.550 and Ch.900 will consist of an outfall pipe fitted flush with the proposed sheet pile wall and fitted with a flap valve or other non-return valve. Outfall levels will be above the existing mud flat levels.

At new surface water outfall locations which collect surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

Outfalls Extending into the Riverbed of the River Suir

A proposed new outfall structure to the River Suir will be provided at approx. Ch.390 to discharge surface water run-off from the Plunkett Station area. This new surface water outfall structure will extend between 4m and 6m into the River Suir.

At the new surface water outfall location (Ch.390) which collects surface water run-off from the railway area, the surface water run-off shall pass through a Class 1 by-pass separator prior to discharge to the River Suir.

There are 2 no. existing outfall pipes which extend past the existing quay wall into the riverbed i.e., a 750mm diameter pipe at approx. Ch.470, and a 600mm diameter pipe at approx. Ch.490. As part of the proposed works, the existing sections of these pipes which are in the riverbed will be removed and replaced in order to facilitate the construction of the proposed sheet pile wall. The new section of pipe will penetrate the new sheet pile wall and extend into the riverbed the distance required to ensure the pipe outfall invert is above bed level., the distance required to ensure the pipe outfall invert is above bed level. Refer to Figure 4.20 in Volume 2 of this NIS for details of proposed outfall structures to the River Suir.

All three outfalls will be provided with a headwall structure and a flap valve or similar non-return valve at the outlet (see Plate 2.9 for an example). The sections of pipe located in the riverbed will be provided with a piled foundation which will be further assessed at detailed design based on localised geotechnical information. At each outfall location a stone mattress will be placed in the riverbed to prevent erosion. The stone mattress will require minor excavation works to a depth of approximately 500mm into the riverbed and will occupy an area of approximately 1.5m by 3.5m.

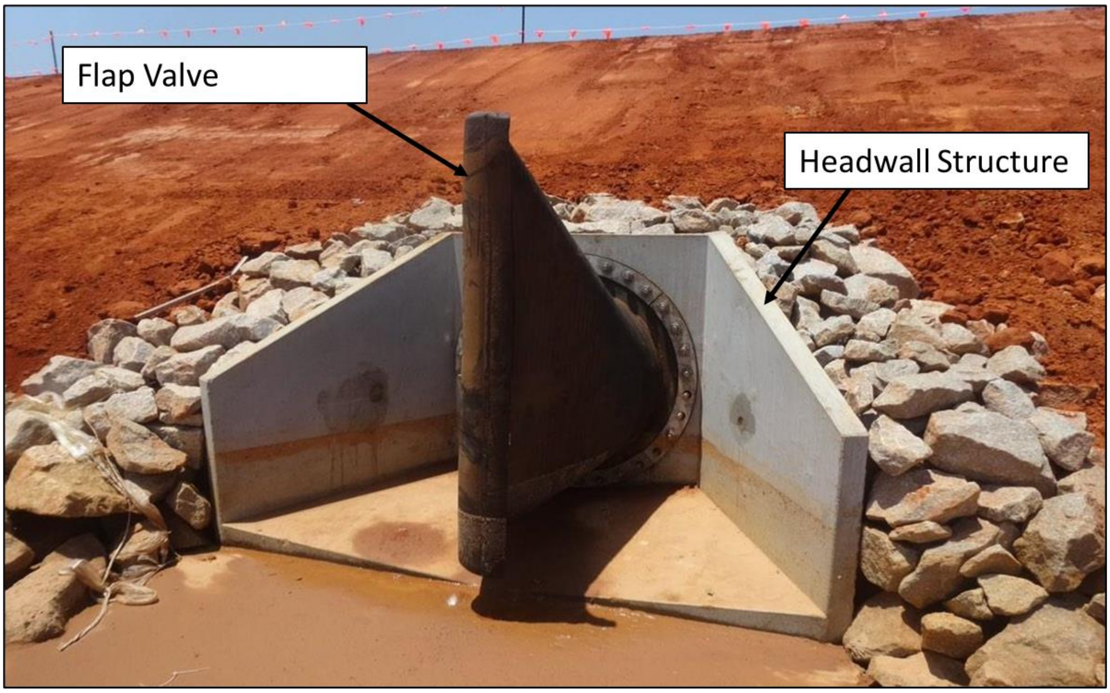


Plate 2.9 **Example of a drainage outfall fitted with a flap valve protruding from a headwall structure**

2.4.5.2 Surface Water Pumping Station

Surface water flows are designed to gravitate to the River Suir during normal operating and tide conditions. In the event of high tide where gravity flows are not possible, flows will pass through the proposed surface water pumping stations.

The proposed underground surface water pumping stations at approx. Ch.380 and Ch.550 are shown in Figures 4.18 and 4.19 in Volume 2 of this NIS respectively. The pumping stations will operate in high tide events, where gravity flows are not possible by pumping the flow to the River Suir via rising mains out-falling through the sheet pile wall.

The pumping stations will discharge surface water flows from the proposed surface water network system which consist of trackside drainage and the groundwater flows cut-off by the proposed sheet pile wall. Existing surface water drainage networks (e.g. R448 road network (including the Sally Park Rock cut (upper catchment area (refer to Figure 4.11 in Volume 2 of this NIS)), the Sallypark Depot area surface water networks) are not included in the proposed pumping station catchment area.

The pumping station will be designed to cater for:

- A design Flood level of +4.0mOD;
- Surface water network flows for the 1 in 30 year return period, critical storm duration.

The design of the pumping stations shall be co-ordinated with IÉ to meet their requirements in relation to maintenance and access, as they are located in vicinity to an operational railway line.

Overflow Chamber

Surface water flows are designed to gravitate to the River Suir during normal operating and tide conditions. The hydraulic design of the surface water outfall at Ch.390 and Ch.550 will discharge under gravity, away from the pumping station to the River Suir so that any flood water or tidal influences do not cause damage to station equipment or loss of functionality. In the event of high tide where gravity flows are not possible, flows will pass through a 2D dynamic storm screen mounted on an overflow weir within the storm overflow chamber. These flows will then enter the wet well chamber whereby the storm pumps will operate, pumping flows to the River Suir via the proposed surface water outfall pipe. As proposed, ground levels along the surface water outfall pipe are below design flood level of +4.0mOD, and all manholes on the surface water outfall pipe shall be sealed. Telemetry and control equipment will be installed to facilitate the above sequence of operations.

Pumping Station Wet Well

The basic configuration of the pumps and motors will consist of a wet well and valve chamber arrangement with wet well submersible pump sets. There will be duty, assist/standby pumps as a minimum requirement complete with automatic switchover facilities.

Preliminary size of the pumping chambers are of circa 20m3 to 50m3 wet well storage volume.

The duty pump stop level will be above the top of the motor for submersible wet-well pumps. The duty pump start level will also be below the crest of the overflow weir.

No fixed man access system shall be provided into the wet well. However, consideration will be given for provision of permanent safe access to the wet well and equipment for essential maintenance purposes.

Site drainage gulley, covers and access covers for manholes, valve chambers and flow meter chambers will comply with IS EN 124.

Lifting equipment will be installed to facilitate safe operation and maintenance of the pumping station.

Kiosks and Cabinets

Insulated cabinets or kiosk housings will be provided for the housing of mechanical, electrical apparatus within the site. They shall be located outside any hazardous areas on the site.

Kiosks shall be installed on a plinth 150mm above ground level to prevent the ingress of water. Typical size of the kiosks shall be 1.2m length by 0.45m wide and approx. 1.4m high. Kiosks and access covers will be locked and secure in their own right.

2.4.5.3 Design Standards

The following Design Standards, *inter alia* will be used for the design of the drainage surface water network:

- Design Manual for Roads and Bridges – Volume 4 Section 2 based on HD33/16, HA 107/04 and HD45/09;
- CIRIA C753 – The SuDS Manual;
- the Greater Dublin Strategic Drainage Strategy (GDSDS), Chapter 3 'The Regional Drainage Policies'

Pipes crossing under the Iarnród Éireann railway line shall comply with :

- Iarnród Éireann CCE-TMS-344"Requirements for Undertrack Crossings and Pressure Pipelines"

Surface water drainage networks are designed for:

- 1 in 1 year return periods, critical storm duration -to be accommodated without surcharge;
- 1 in 30 year return periods, critical storm duration -to be accommodated without surcharge above chamber cover level (e.g. no flooding along the railway corridor);
- 1 in 100 year return period, 6 hour duration event to be accommodated in all storage structures;
- an allowance for climate change to be applied to the drainage design by increasing rainfall intensity by 20%;

The GDSDS recommends that for the design of sewer (surface water) networks affected by river or tidal levels, that flood risk assessment is based on a pragmatic approach to joint probability analysis for combinations of events can be taken initially.

The following event combinations are proposed in the GDSDS, based on providing combined return periods 30 years for flooding from sewerage systems affected by river or tidal levels.

Surface water drainage network system flooding evaluation, with tides (30 years):

- MHWS (mean high water spring tide) with 30 year drainage storm event;
- 1 year tide with 1 year drainage;
- 5 year tide with 0.25 year drainage.

Where the system flooding evaluation identifies a risk of surface water network flooding for the combined tidal\ fluvial and rainfall events; including an allowance for climate change; then it is necessary to provide attenuation storage or pumping systems on the surface water network.

All proposed new drainage networks are designed to gravitate to the River Suir during normal operating and tide conditions. The proposed outfalls from the new drainage networks will be provided with either attenuation storage volume for the 6hr event during high tide in accordance with CIRIA C753, or with an underground surface water pumping station.

As noted in the previous section, the proposed development will include 2 No. underground pumping stations located adjacent to the railway line for the proposed drainage networks within the railway corridor. Additionally, the proposed new outfall at Ch.900 will be provided with oversized pipes to provide attenuation during high tide events.

The protection of watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed works. The River Suir is located along the southern boundary of the site contains surface drainage channels conveying drainage to the river. The proposed development will be designed to protect the water quality of the River Suir and the drainage ditches which border the site. No routes of any natural drainage features will be permanently altered as part of the proposed development. Drainage of the completed development will be directed to a new surface water drainage system and discharged to the River Suir. All new surface water outfalls to the River Suir will be provided with Class 1 by-pass petrol separators.

2.4.6 Demolition of the Existing Quay Wall

Following the construction of the sheet piled flood defence wall the following sections of existing quay wall (and associated handrails) will require demolition to approximately 800mm below the trackside ground level to facilitate the construction of the proposed below ground drainage network;

- The existing reinforced concrete quay wall between Ch.355 and Ch.435 (the top of which is approximately 1.3m above existing ground level (trackside));
- The existing reinforced concrete quay wall between Ch.435 and Ch.555 (the top of which is approximately at existing ground level (trackside));
- The existing stone masonry quay wall between Ch.555 and Ch.590 (the top of which is approximately at existing ground level (trackside)). The removed stone masonry will be salvaged;
- The existing quay wall (stone masonry wall with the top 600mm (approx.) in reinforced concrete) between Ch.590 and Ch.790, and between Ch.840 and Ch.900 respectively (the top of which is approximately at existing ground level (trackside)).

In addition, in the vicinity of Ch.390, the demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station (as shown in Figure 4.18 in Volume 2 of this NIS).

In addition, the demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900. The wall will be demolished in full height over this 3m wide section and the section to the west of the transition point will be rebuilt once sheet piles are installed. The remaining masonry material will be salvaged.

2.4.7 Effect of Flood Defences on Hydrodynamics of River Suir

Project-specific hydrodynamic modelling and analyses have been carried out on behalf of WCCC to assess the effects of the proposed Flood Defences West on hydrodynamics and hydromorphology of the River Suir. The report (see Appendix C of this NIS) has concluded that *"the hydrodynamic simulations both normal tidal conditions and extreme flood events show an increase in velocity magnitude along the middle section of the flood wall alignment on both ebb and flood flows and a reduction in velocity locally in the vicinity of the outfall structures. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the opposite far bankside. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive or significant"*. For more detailed discussion, refer to Chapter 10 Hydrology of the EIAR.

2.5 Construction Methodology

2.5.1 Potential Construction Procurement Method

It is envisaged that the construction of the proposed development will be tendered under a Public Works Contract for Civil Engineering Works Designed by the Employer.

The advantage of the Employer Designed Works contract is that the design team who have undertaken the design and environmental assessment will continue with the detailed design and site supervision, ensuring a continuity of knowledge through the remaining phases of the project through to completion and handover.

2.5.2 Timescale for Construction

Subject to timely completion of the statutory procedures and availability of finance, it is anticipated that construction work could commence in 2022 with a 30 to 35-week construction programme. Table 4.2 at the end of Section 4.5.3 provides a summary of the construction sequence and programme.

2.5.3 Construction sequence

The envisaged construction sequence for the works is as follows:

(i) Site Setup and establishment of construction compounds at locations described in Section 4.5.14;

(ii) Excavation of trenches at Ch.0.0 to Ch.365 (or just in parts of this section, based on the groundwater monitoring and assessment) including:
  - (a) Relocation of underground utilities, where required;
  - (b) Excavation of material from trenches;
  - (c) Filling in trenches with lean mix concrete / grout and reinstatement of pavement.

(iii) Installation of overground flood defences:
  - (a) Glass barriers on the river side of the road edge vehicular parapets on Rice Bridge roundabout and the 3 roundabout arms (R711 Dock Road, R448 Terminus Street, and R680 Rice Bridge).
  - (b) Underground foundations for the demountable flood barriers at R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.

(iv) Remedial works for raising the height of the existing quay wall including:
  - (a) Setup of temporary dry (dewatered) working area in front of the wall using sandbags, Portadam system or waterfilled dams;
  - (b) Setup of temporary works such as formwork, scaffolding and granular base for scaffolding in mudflats;
  - (c) Anchoring and concrete pouring works;
  - (d) Decommissioning of temporary works, including removal of granular base from the mudflats, any building works spoil, and dewatering system.

(v) Installation of permanent sheet pile walls on the riverside. Backfilling of the gap between the riverside sheet pile wall and the existing quay wall can take place simultaneously with sheet piling, after a short segment of the sheet pile wall (assumed 10-30 m) is piled (temporary transversal sheet pile may be installed at the end of segment to prevent fill from being washed out), or once full length of sheet piles is installed. Attaching of eco-seawall panels to the front face of the sheet piles.

(vi) Partial demolition of existing quay wall (from Ch.360 to Ch.900) above ground and to a depth of 800mm below ground (where required) to enable installation of drainage works (to be complete in tandem with step (v) above to ensure demolition takes place before backfilling);

(vii) Installation of landside sheet pile wall from Ch.900 to Ch.1090 to include:

   (a) Demolition of the 3m wide section of the existing quay wall at Ch.900 to enable joining of the riverside and landside sheet piles;

   (b) Installation of permanent landside sheet piles; and

   (c) Installation of transversal underground isolation structure at Ch.1090.

(viii) Drainage – Installation of drainage works from Ch.360 to Ch.1090 as follows:

   (a) Installation of drainage works parallel to the new sheet pile wall in tandem with construction of the sheet piling (step v);

   (b) Installation of surface water outfalls passing through the new sheet pile wall, and fitting of flap valves from the riverside on each outfall (in tandem with step v);

   (c) Demolition of existing surface water outfalls in the riverbed and provision of temporary outfalls (e.g. over pumping) on existing outfalls during the works;

   (d) Construction of new outfall structures in the riverbed (following installation of the sheet pile wall) within a sheet pile cofferdam (temporary works); the outfall structure will include a foundation structure to the outfall pipe (which may need pile supports), a headwall and erosion protection measures (inlcuding a stone mattress at the mouth of the outfall), headwall and erosion protection measures including a stone mattress at the mouth of the outfall;

   (e) Construction of 2 No. underground pumping stations to include an overflow chamber, wet well and valve chamber;

   (f) Installation of pumping station pumps, valves fitting and MEICA commissioning of pumping stations.

(ix) Drainage – Installation of drainage works from Ch.0.0 to Ch.360 at Plunkett Station as follows:

   (a) Installation of the new drainage system and associated railway undertrack crossings. All undertrack crossings will be carried out subject to IÉ agreement and where necessary, localised night-time possessions will be applied to facilitate installation,

   (b) Remedial works to existing drainage networks including retrofitting of flap valves at outfalls.

Due to the linear nature of the works, it is assumed that the works under items (ii) to (ix) above can run in parallel. The list above thus does not indicate that one activity needs to fully finish for the next one to start. It is possible that the works will be done in separate sections. Some limitations however exist, and these are outlined below:

- The sheet pile wall needs to be installed at drainage outlet locations before the outlet can be completed. It is necessary for the drainage outlet to be completed before the backfilling to the sheet pile wall (above the underside of pipe level) can be completed.
- Impermeable trench / grouting in area behind the existing quay wall (where the wall will be raised with remedial works) to be done before the commencement of wall remedial works.

- The upper sections (down to 800mm below ground level) of the existing quay wall are to be demolished after the sheet piles are installed in that location and before the drainage is installed.
- The riverside sheet piles will be installed before the eco-seawall panels are attached to them.

2.5.4 Piling Methodology

Riverside (Ch.360 – Ch.900)

The installation of riverside sheet piles will be carried out from a jack-up barge positioned in river that will move as the work progresses. The typical dimensions of such a barge are 25m x 15m (length x width). The barge will carry a crane and/or long reach excavator equipped with a vibratory hammer that drives piles into the ground by vibration. The stack of sheet piles will be placed on an additional pontoon placed next to the barge, which can be tugged by a tugboat to the main construction compound area at Ch.1340 (see Section 4.5.14) to bring more sheet piles to the barge.

Works will be carried out by two piling rigs located on two separate barges. One barge will start from the east at Ch.360 and work westwards, while the other barge will start either at the western end (Ch.900) and work eastward or start from a suitable location in the middle.

The work process involves the barge anchoring and stabilising itself, after which a line of sheet piles is driven by a crane or excavator. The pile is lowered to a position and the vibrating clamp is attached to the head of the pile. The vibrations generated by vibratory hammer drive the pile into the ground. The vibration and noise generated by this process are continuous during the driving time but are less than those induced by impact driving. After the segment (a line of piles) is completed, the barge is then either self-propelled or tugged to the next position where the next segment is being driven. The barge is assumed to be anchored approximately 6m from the quay wall, to ensure that the barge is not positioned within the tidal mud flats and can move regardless of the tide level. The barge cannot be positioned within the mud flats as it will need to wait for high tide to be able to float to a new position. The barge can, however, be brought closer to the shoreline in some specific locations (to a minimum distance of 3m from the existing quay wall), if required.

The sheet pile alignment is set so that the back side of the sheet piles is at a distance of 1.0m from the front face of the existing quay wall. The front face of the wall includes the protruding blocks or slabs at or near the toe of the wall. This will ensure that the piling is not obstructed by the wall foundation and similar obstacles. Localised obstacles such as dislodged blocks in the mudflats will be removed by an excavator bucket. An allowance is made for localised minor in-situ realignment of the sheet pile where significant obstacles such as remnants of wooden piles of landing stages are present as described in Section 4.4.3.

The gap between the sheet pile wall and the existing quay wall will be backfilled with clean imported granular fill, TII Specification for Road Works Series 600 Class 6. The top of the fill is envisaged to be flush with existing ground level or up to 500mm lower. The backfilling can be carried out once the entire sheet pile wall has been installed or can progress simultaneously with sheet piling – once a short segment (10 - 30m) of sheet piles has been installed, the gap can be filled (subject to the installation of drainage works as outlined above). A temporary transversal pile can be installed at the end of each segment to prevent washout of the backfill. Alternatively, the fill can be placed once all piling is completed. Placing of fill will be coordinated with the drainage outlet works in either case.

The total height of the sheet piles will range between 14 and 21m. The sheet piles will be embedded in the ground over approximately 11 to 16m of total length. The difference in the total sheet pile height and embedment length is due to differences in local ground conditions and retained height encountered along the alignment. All sheet piles will meet the required top of wall level of +4.30 mOD.

The construction is assumed to be carried out during normal working hours (daytime), 6 days a week. The estimated timeframe for riverside sheet pile driving is approximately 12 weeks using two barges. This excludes set up and other activities on site, either prior to, or after pile driving. The piling will occur intermittently throughout the day, with the remainder of the time spent on ancillary processes such as setting up the barge, positioning the piles, checking tolerances, delivering material and personnel, and similar. Piling duration for the temporary and permanent piles at the three drainage outfall locations will take approximately 2 weeks.

While the riverside piling works will not require extended rail possessions and night works, localised short-term possessions may be required during the passage of trains for health and safety reasons where sheet piles alignment is in close vicinity of the rail tracks, such as at Ch.430.

Landside (Ch.900 – Ch.1090, including transversal isolation structure)

The installation of landside sheet piles will be carried out by machinery (excavator with vibratory clamp) situated in the cess between the rail tracks and the existing quay wall. The width of the cess in the section from Ch.900 to Ch.1090 is in excess of 10m, therefore the works can be carried out during the daytime, behind a temporary fence installed at 3.0m distance from the nearest running track, with no rail possession required. Some isolated night-time work (full rail possession) may be required to fully set up the temporary fence, material, and machinery in the works area.

Total height of sheet piles will be 10m for the landside works, with up to 8.5m of it embedded in the ground.

The construction is assumed to be carried out during normal working hours (daytime), 6 days a week. The estimated timeframe for daytime landside sheet pile driving is approximately 4 weeks. This excludes set up and other activities on site carried out prior to or after pile driving. In each day, the piling will occur intermittently throughout the day.

The approximately 20m long transversal isolation structure will have to be constructed overnight in order to avail of full rail possession, as the structure will pass directly under the rail tracks. The nightworks are estimated to be carried out on Monday – Friday lasting approximately 1 to 2 weeks. Night-time working will also be required for the stretch of the landside sheet pile wall between Ch.900 and Ch.950, which was brought to landside to avoid impact on the Annex I Saltmarsh habitat. The works will require approximately 2 weeks of night-time piling works under full possession. A hoarding fence will be erected for these works around the rig's working area to reduce the noise impacts at night-time.

The total duration of landside piling works (Ch.900 to Ch.1090), including isolation structure) will be approximately 7-8 weeks.

Piling durations to satisfy environmental requirements

The following general procedure will be followed for any pilling activities from riverside and landside ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the time expected to be required for the installation of each pile (including ancillary processes), the limits prescribed above will not prolong the proposed programme for riverside or landside piling.

2.5.5 Installation of an eco-seawall

Pre-cast concrete cladding panels ("eco-seawall") will be installed to sections of the riverside sheet pile wall that are within the intertidal zone of the River Suir. The cladding panels of the eco-seawall will be mechanically attached onto the front (riverside) face of the installed sheet pile walls without the use of in-situ concrete. The cladding panels will be attached to the attachment points that will be welded to sheet piles prior to their driving (see Section 4.5.4 for piling methodology). The attaching of the cladding panels to the sheet pile wall will be carried out from a barge. Construction personnel will also be positioned close to the sheet pile wall either from a working platform cantilevered from the barge, or on mudflats to guide the cladding panels to attachment points. Works will be undertaken at low tide.

The height of cladding will be 2.5m on average, and the final height will depend on the mudflat level at the particular section. Installation of the "eco-seawall" to the sheet piles will require approximately 3 weeks.

2.5.6 Construction of Underground Flood Defences in Front of the Plunkett Station

Impermeable trenches will be constructed between Ch.0.0 to Ch.360 using the following methodology:

(i) Traffic management to be set up;

(ii) A segment to be surveyed via CAT scan and shallow slit trenches excavated in order to confirm the position of utilities;

(iii) A main trench with width of 350mm will be excavated for the determined length of the segment (assumed up to 10m);

(iv) Excavated material from the trench will be tested for contamination levels and taken off site for disposal at a suitably licensed facility.;

(v) The trench will be filled with lean mix concrete or grout.

(vi) Points ii) to iv) above are repeated for the next segment.

The construction works are assumed to be carried out in two phases in order to minimise the inconvenience to Plunkett Station car park and station users. The first phase will take place from Ch.160 to Ch.365. This will close the western car park but will retain unimpeded usage of the station building and the eastern car park. The works will be undertaken during normal working hours, with a duration of approx. 2 weeks. From Ch.280 to Ch.365, in consultation with Iarnród Éireann, a temporary fence will be erected at 3.0m distance from the rail line for Health and Safety purposes.

Once works on this section are completed, the western car park will reopen, and the works will commence on the trench at Ch.0.0 to Ch.160. Works on this section are envisaged to be carried out over ten weekend shifts to minimise the effect to working day commuters. The eastern car park will be closed on weekends as a result. Short, localised night-time works may be required to finish the section at Ch.150 where the only entrance to both car parks is situated.

2.5.7 Construction of Overground Flood Defences in the Vicinity of Rice Bridge Roundabout

The installation of the glass flood barrier and support points for the demountable flood barrier will be carried out using the following construction methodology:

Glass flood barriers

(i) Traffic management is set up to suit the location of each section of flood barrier;

(ii) Access scaffolding is installed to the outer face of the existing concrete parapet edge beam or an underbridge access unit (vehicle) is setup on the traffic lane adjacent to the footway/ vehicular parapet;

(iii) The glass barrier posts and associated base plates are fixed to the existing concrete parapet edge beams using a proprietary anchor system;

(iv) The infill glass panels with structural steel surround are installed between the posts as the post installation progresses along the length of proposed flood barrier. A continuous seal is provided between the lower glass panel framing element and the existing concrete parapet edge beam to prevent any water ingress between the elements.

(v) Points i) to iv) above are repeated for each section of barrier to be installed.

Demountable slot-in flood barrier

(i) Traffic management is set up;

(ii) The road pavement and footpath at the entrance to the North Quays site on the roundabout is surveyed via CAT scan in order to confirm the position of utilities;

(iii) The road pavement and footpath at the proposed flood barrier support locations are excavated to the required depth to install the flood barrier post foundations/ support fixings;

(iv) Remedial Works to the existing vehicular parapet at the start of the ramp at the entrance to the North Quays Site and the end of the parapet system on R711 Dock Road are undertaken to facilitate the joining of the permanent and temporary flood protection systems. The remedial works will consist of the following;

a. The section of existing metal parapet railing adjacent to the northern end of the proposed glass flood barrier on Rice Bridge (R680) is cut back to the two adjacent existing parapet posts. Parapet ends are made good (painting etc). A new concrete pillar is constructed on top of the existing concrete parapet edge beam to provide a suitable form of construction to facilitate the interface of the glass barrier and demountable barrier system.

b. A new concrete pillar is constructed on the top of the existing concrete parapet edge beam at the end of the metal parapet system on R711 Dock Road to provide a suitable form of construction to facilitate the interface of the glass barrier and demountable barrier system.

It is assumed that the construction works will be carried out in phases to minimise inconvenience to Plunkett Station and road users.

2.5.8 Remedial Works to the Existing Quay Wall (Ch.285 – Ch.360m)

The remedial works to the existing quay wall (a mixture of masonry and concrete construction) will involve raising the wall height (by between 0.6m to 1.2m) to +4.3mOD.

The new raised section of wall is envisaged to be done using cast in-situ reinforced concrete construction.

The following construction methodology is envisaged:

(i) The existing handrails will be removed from the top of the wall.

(ii) The top of the existing quay walls will be suitably prepared to form a construction joint with the new wall section (i.e., thoroughly cleaned of any loose debris and the existing top of wall concrete surface scabbled (using a handheld three head scabbler or equivalent)).

(iii) Chemically anchored reinforcing bars will be placed into the top of the existing wall to integrally connect the new and existing sections of wall.

(iv) The new wall section reinforcement will be placed

(v) Formwork will be installed for the new wall section and will be supported off the existing sections of wall.

(vi) The in-situ concrete will be poured and the formwork struck once the concrete has hardened.

No permanent works encroachment into the River Suir SAC will be necessary for the works.

The majority of the works are expected to be undertaken from the landside, however temporary access scaffolding on the outer (river) side of the existing wall may be required during construction. The scaffolding may be supported off the existing quay wall, or set up in the mudflats. To ensure the stability of any scaffolding set up in the mudflats, up to a 1m thick layer of coarse granular fill will be placed on top of the mudflats. This material will be fully removed following completion of the works. A temporary dewatering system, using sandbags or Portadam system (engineered above ground cofferdam system), will be set up in front of the wall to enable dry working conditions and shall ensure that no in-situ concrete material or any other building or waste material enters the River Suir.

Railway possessions and night-time works will not be required. The works will take place behind the temporary fence set up minimum 3.0m from the nearest IÉ rail track.

The communication and connectivity to the construction compound will be via the cess, parking lot and the R448 towards the ancillary construction compound at the Sallypark Industrial site, see section 4.5.14.

2.5.9 Drainage

Landside

Landside drainage works consist of:

(i) Upgrading of existing surface water outfalls to River Suir system to be extended where necessary and fitted through the new sheet pile wall (works landside). These works will be carried out in sequence as the sheet piling moves from east to west. (Ch.360 to Ch.1090).

(ii) Construction of filter drains positioned parallel to the proposed new sheet pile wall to collect groundwater flows and surface water run-off cut-off by the new wall.

(iii) Construction of 3 No. new surface water drainage outfalls to the River Suir at approx. Ch.390 (involves both landside and riverside works) and new drainage outfalls at Ch.550 and Ch.900 which will terminate at the new sheet pile wall.

(iv) Construction of 2 No. Surface Water Pumping Stations at proposed surface water drainage outfalls at Ch.390 and Ch.550 which will consist of:

- Excavation and construction of an overflow chamber, wet well chamber and valve chamber;
- Installation of associated pumps, motors, valves, chambers, fittings and pipework, hydraulic surge protection equipment and associated lifting equipment;
- Installation of rising main and associated valves and secondary outfalls from the rising mains terminating at the sheet pile walls;
- Insulation Stations, Kiosks and Cabinets and associated electrical equipment, instrumentation, telemetry, flow monitoring equipment, facility to connect mobile electrical generator and all mechanical and electrical equipment.

The construction of the filter drainage networks can be carried out without the necessity for railway possessions, behind a temporary fence installed at 3.0m distance from the nearest rail track. Trenches for drainage networks will typically be constructed using open cut using a mini excavator. Where required, adequate trench supporting systems will be installed. The construction methodology that will be employed for the majority of the proposed outfall (land-based section) will be conventional open cut methodology. Some isolated night-time work (full rail possession) may be required to fully set up the temporary fence, material and machinery in the works area.

The construction of several elements of the landside drainage works will require extended rail possessions (3-4 weeks of night works):

- Construction of drainage networks for the railway line for the area in front of Plunkett Station and along the railway track (carried out in a westbound direction from Ch.0 to Ch.540).
- Construction of drainage networks which cross the track at various locations from Ch. 540 to Ch.1090) Trenchless methods, such as pipe jacking and micro-tunnelling, will be used at crossings of railways (where required).

- Construction of the surface water pump stations at Ch.380 and Ch. 550. Precast pump sumps, petrol interceptor, valve unit and kiosks require the provision of a crane. Access is only possible from the landside.

Riverside (c. 800m)

Riverside drainage works consist of:

(i) Upgrading of the existing surface water road gully outfalls at the Rice Bridge roundabout to retrofit non-return valves.

(ii) Retrofitting non-return valves to existing surface water outfalls from the IÉ Car Park area west of Plunkett Station (Ch.180 to Ch.360).

(iii) Installation of flap valves \ non-return valves on existing and proposed surface water outfall pipes (Ch.360- Ch.1090) penetrating through the new defence walls.

(iv) Construction of Outfall Structures to/in the River Suir (Ch.390, Ch.470 and Ch.490) to include outfall headwall/riprap/stone mattress at the outfall mouth (refer to Section 4.5.9.2 below).

2.5.9.1 Outfall Structures

Upgrade of existing structures

Upgrade works to 2 no. existing drainage outfall structures located in the riverbed at approx. Ch.470 and Ch.490 are proposed to facilitate installation of the sheet pile wall, and replacement of the existing pipe and an upgrade to outfall mouth e.g., provision of non-return valve, headwall/riprap/stone mattress at the outfall mouth.

Construction of new outfall structures

Construction of 1 no. proposed surface water outfall structure at approx. Ch 390 in the riverbed including installation of outfall pipe and outfall structure to and in the River Suir to include outfall non return valve, headwall/riprap/stone mattress at the outfall mouth.

2.5.9.2 Construction activities for outfall structures

The construction of the 3 no. outfall structures for surface water drainage will be carried out from riverside i.e., within the foreshore. The proposed works within the foreshore will consist of the construction of the outfall pipe and outfall headwall/riprap/stone mattress at the outfall mouth and will be constructed within a temporary sheet pile cofferdam.

The pipe opening will be covered with a non-return valve and the pipe will be encased in suitable fill material overlaid with a two-layer geotextile high strength mattress, grouted with cement or concrete to provide erosion and pipe protection. This will then be bounded by rip rap type rock armour. The pipe opening will be imbedded in a concrete headwall with side walls and floor from the pipe with a steel guard rail positioned on top of this headwall (if required for maintenance).

The following procedure will be followed in order to create a dry working area to facilitate this phase of the construction works.

Construction of the Outfall structures (3 no.)

(i) Existing outfall structures in the riverbed at Ch.470 and Ch.490 will be removed by excavator from the barge prior to the installation of the sheet pile wall\proposed outfall structures. A temporary outfall or over pumping of the flows will be implemented.

(ii) Drive the permanent bearing piles for outfall and headwall. Tubular steel piles to be used, installed by vibratory equipment.

(iii) A dry works area will be created by placing sheet piling or similar into the river from a jack-up barge to construct a temporary cofferdam. The sheet piling works will be carried out from riverside. Sealant will be used to make the cofferdam waterproof.

(iv) Prior to the commencement of any de-watering operations within the cofferdam, adequate and appropriate facilities for the treatment of silt laden water will be designed prior to discharge to ground or back to the River Suir.

(v) Excavate to underside of pilecap level (further assessment will be carried out at detailed design to determine if piles are required or other suitable foundations are appropriate);

(vi) Cut off any excess length at the top of permanent piles and construct the pilecap.

(vii) The outfall headwall will be a pre-cast unit. This will be dropped in place from the riverside barge.

(viii) The pipe will be fitted through the sheet pile wall and laid on the pilecap. The pipe will be encased in suitable fill material overlaid with a two-layer geotextile high strength mattress, grouted with cement or concrete to provide erosion and pipe protection.

(ix) The pipe will be further protected from erosion by using rip rap type rock armour. The rock armour will be placed by a suitable plant all of which will be located within the designated working area.

(x) A minimal amount of concrete will be poured on-site to secure the headwall.

(xi) A stone mattress will be created surrounding the outfall and will extend approximately 1.5m x 3.5m into the Suir River.

(xii) Minor excavations will be carried out to facilitate the stone mattress, extending approximately 500mm into the riverbed.

(xiii) The stone mattress wire mesh cage will be mechanically fastened to the riverbank.

(xiv) Clean, debris free stone will be utilised for the creation of the stone mattress.

(xv) Remove the temporary cofferdam sheet piling (The dry works area will remain in place until all in-stream works have been completed and all concrete material has had sufficient time to cure).

2.5.10 Demolition Works

Existing Quay Wall

From approx. Ch.355 to Ch.950, the existing masonry quay wall shall be demolished above ground level and to a depth of approx. 800mm below ground level to facilitate installation of drainage pipelines and the pumping stations. In addition, in the vicinity of Ch.390, the demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station (as shown on Figure 4.18 in Volume 2 of this NIS). The demolition of the existing quay wall sections will be carried out using an excavator (16 tonne or similar) and a wheeled or track mounted dumper (12 tonne or similar).

Existing Outfall Structures

Existing surface water outfall structures and pipes in the river side at Ch.470 and Ch.490 will be demolished as part of the works to allow installation of the sheet pile wall. The methodology for the replacement of these outfall structures is outlined in

Section 4.5.9.2 above. Existing outfall structures in the riverbed will be removed by excavator from the barge prior to the installation of the sheet pile wall.

2.5.11 Summary of Construction Programme

Table 2.2 below provides the summary of the construction programme for the proposed Flood Defences West.

Table 2.2 Summary of Construction Programme

Construction Element	Chainage	Approx. Duration of task (in weeks)
Mobilisation, compound set up	Compound area	2 weeks
Remedial Works to existing quay wall	Ch.285 to Ch.360	4 weeks
Impermeable trench in front of the Plunkett Station	Ch.0.0 to Ch.160	2.5 months (10 weekends)
	Ch.160 to Ch.360	2 weeks
Works at Rice Bridge Roundabout – Installation of Glass barriers, movement joint sealing & the provision of flap valves on existing road drainage gullies	Ch.0.40 to Ch.210	6-8 weeks
Sheet-pile wall installation (two piling rigs on two barges operating simultaneously)	Ch. 360 to Ch.900 (Riverside)	12 weeks
	Attaching cladding to installed riverside piles	2-3 weeks
	Ch.900 to Ch.1090 (Landside, incl. transverse structure)	7-8 weeks
Drainage Works	Upgrade of existing drainage	9-12 weeks
	New Drainage network and proposed outfall structures	9-12 weeks
	Pumping Stations	9-12 weeks
Total Construction Phase		**30 - 35 weeks**
Notes: Due to linear nature of the works, the majority of the works will be able to be done in parallel. See section 2.5.3 for more details.		

2.5.12 Construction Materials

Steel sheet piles will be grade S355 steel complying with Irish Standard I.S. EN 10025. The steel sheet piles will be between 6 and 21m length. The total length of sheet pile wall, including transversal isolation structure, is assumed to be approximately 770m. Sheet pile section AZ20-700 is assumed throughout the length, with exception of two localities where section AZ42-700 is assumed. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes.

The imported backfill for placing between sheet pile wall and the existing quay wall will be imported granular Class 6 material in accordance with TII Specification for Road Works Series 600.

The concrete and steel reinforcement used to raise the height of the existing quay wall will be C35/45 in accordance with IS EN 206-1 and grade B500B in accordance with I.S. EN 10080 respectively. The chemical anchoring system to fix reinforcing bars into the existing quay wall will be a proprietary product complying with all relevant Irish standards.

The materials used for drainage works will be in accordance with TII Specification for Road Works Series 500.

Table 2.3 Resources to be used During Construction

Element	Resources
Earthworks	Installation of a sheet pile wall will not require excavation of waste material. Imported material to fill the gap between the sheet pile wall and the existing quay wall will be clean granular material Class 6, totalling approximately 2000m^3. Approximately 2,500m^3 of clean imported granular fill material Class 6, will also be required for drainage works.
Structural Works	The project will require import of steel sheet piles for construction of new flood defence walls as well as material for in-situ concrete for remedial works on the existing quay wall. Total length of sheet pile wall will be approximately 770m, with height of piles between 10 and 21m. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes. Approximately 1,500 m^3 of precast concrete eco-seawall panels (with depth of approximately 13 cm) will be attached to riverside sheet pile wall. Approximately 50 m^3 of concrete will be used for remedial works (raising) to the existing quay wall. Minor quantity of reinforcement steel will also be imported. Up to approximately 350m^3 of lean mix concrete / grout will be required to infill the impermeable trench.
Drainage	Drainage pipes (approx. 1,310m), valves, manholes, 2 No. precast pumping chambers, 3 No. precast headwalls, handrails, riprap, stone mattresses etc. 70m^3 fill of concrete surround for pump chambers of the pumping stations will be required.
Construction and Demolition Waste	The removal of the upper section of the existing wall to the level of 800mm below existing ground level will generate approximately 600 m^3 of waste. Material excavated during demolition of a small section of the quay wall for the purpose of joining the riverside and landside sheet piles, will amount to approximately 50m^3. Another approximately 70 m^3 of wall will be demolished during the construction of a pumping station. All of this waste will be considered waste for disposal off-site. The waste will be disposed of in licensed landfills and will receive inert WAC and material exceeding inert WAC. Up to c.350m^3 of waste material will be generated during shallow excavations for the impermeable trench. The material with undergo environmental testing to determine the level of potential contaminants and disposed off-site in the suitably licensed facility. Approximately 2,600m^3 of in-situ ground and ballast will be excavated during the drainage outlet remediation works and other drainage works such as installation of filter drains, with approximately half of it expected

Element	Resources
	to be used again as a backfill across the site for ground levelling purposes. As such, approximately 1,300m^3 of surplus excavation, will also have to be disposed off-site to a suitably licensed facility.

2.5.13 Sourcing of Imported Earthworks Materials and Disposal of Waste

The deficit of material for the construction of the earthworks, and the need for stone to establish haulage routes, will require quarried material to be sourced. All imported material will be sourced from the nearest possible locations. There are a number of commercial quarries in the vicinity of the proposed development, which may be utilised in the sourcing of this material including:

- Oaklands Quarry in Ballykelly, New Ross, Co. Wexford; and
- Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford.

There may be other suitable quarries, in addition to those identified above, that the Contractor may select as the source for construction materials. Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor. For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals. The haulage route for access into the proposed road development has been determined to be restricted to use of the national and regional roads that are connected to the site, and other unsuitable local roads may not be used for such traffic.

2.5.14 Temporary Construction Compound Areas

The main temporary construction compound area is situated at Ch.1340, approximately 300 m northwest of the proposed development works, in a very wide cess area between River Suir and rail lines. The land is in Córas Impair Éireann (CIÉ) ownership and is operated by Iarnród Éireann (IÉ). A public level crossing is situated nearby which facilitates access to the works area.

An ancillary site compound is proposed in the IÉ's Sally Park yard, currently used for material storage, situated across from the rail lines from Ch.640.

Refer to Figure 4.21 in Volume 2 of this NIS for locations of the two temporary construction compound areas.

2.5.15 Enabling Works and Site Access

2.5.15.1 Site Access Routes

The material for the construction of sheet pile wall will be stored at the main construction compound located at Ch.1340. It will be loaded by crane to a barge. The main access route to the main construction compound is the R448 Regional Road which has a direct connection to the N25 National Road. A local road off the R448, near Newrath roundabout, goes directly to the assumed construction compound location.

An ancillary construction compound at Sally Park depot can be reached directly from the R448.

2.5.15.2 *Construction Traffic Routing*

No construction traffic will be permitted to enter the construction site via Waterford City Centre. Material and machinery for remedial works to the existing quay wall and impermeable trenching will be routed from the ancillary compound at Sally Park depot via R448 (Terminus Street) to the works area in front of the Plunkett station. It is envisaged that the loading of the pontoon with the steel sheet piles can be carried out by crane over the riverbank from the main construction compound area. From the main construction compound, the machinery can also track down the cess into the working area for the purpose of landside sheet piling and associated drainage works. Signal cables running on the surface perpendicular to the cess from a signal cabin at approximately Ch.1190 present an obstacle, but it is envisaged that movements will be minimised and that a suitable temporary crossing bridge/mechanism or usage of localised night-time possessions will be applied.

2.5.16 Working Hours

Daytime working hours will be Monday to Saturday, 07:00 to 19:00 hrs. Where works during full rail possessions are required, night-time works will be required and will be carried out from Monday evening to Friday morning, 21:30 to 05:30 hrs.

Works on Sundays and Bank Holidays will only be permitted with the approval of the Waterford City and County Council (WCCC) and within the hours of 08:00 to 16:30 hrs.

2.6 Operation of Proposed Development

Drainage maintenance works will be required during the operation phase of the proposed development to include inspection of outfall structures and inspection of wall mounted flap valves and replacement where necessary. The exposed parts of sheet pile wall above the cladding will require periodical corrosion protection by painting (approximately every 10 years). No night-time works will be required for this.

2.7 Project Change and Decommissioning

There are no plans proposed for the decommissioning of the project given the nature of the project – i.e. the development of flood defence measures can in this instance, be considered as a 'permanent' operation. The decommissioning of the flood defences is likely to form part of subsequent planning consent procedures and in the unlikely event that specific decommissioning requirements are necessary, appropriate mitigation can be applied to those consents.

2.8 Receiving Natural Environment

General Description and Context

The site of the proposed development begins at the eastern side of Plunkett Station and extends west for c. 1.5km along the northern bank of the River Suir. The principal habitat types that exist along the footprint of the proposed development include mudflats, buildings and artificial surfaces, and a tidal river. The River Suir is designated as the Lower River Suir SAC and is hydrologically connected to the River Barrow and River Nore SAC, which is located c. 9km downstream of the proposed development.

'Estuaries' (1130) and 'Mudflats and sandflats not covered by sea water at low tide' (1140) are protected habitats listed on Annex I to the Habitats Directive and are present within the footprint of the proposed development, but are not Qualifying Interests of the Lower River Suir SAC. These habitats support a range of benthic invertebrates and macroalgae, as well as other species which feed on them. In addition to this, the tidal river also hosts a number of rare and protected species, most of which are listed as Qualifying Interests of the Lower River Suir SAC, including lamprey species, Atlantic salmon, Twaite Shad and Otter. 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) are also present between the bottom of the existing quay wall and the high-water mark between Ch 925 and Ch. 975.

Designated sites

Designated sites within the vicinity of the proposed development and the surrounding area include eight nationally designated sites (pNHAs) and two European sites (SACs). The two European sites are the River Suir SAC (002137) and the River Barrow and River Nore SAC (002162). The locations of these sites in relation to the proposed development are shown in Figure 3.1 and the two sites are described in detail in Section 3.2.

Habitats

This section describes the habitats recorded during the field survey within the study area (the proposed development footprint and a 150m buffer). A total of 16 different Fossitt (2000) habitats and habitat mosaics were identified in the study area. These habitats are listed below and mapping of these habitats is presented in Appendix F in Volume 2 of this NIS:

- (Mixed) broadleaved woodland (WD1)
- Exposed siliceous rock (ER1)
- Scrub/Exposed siliceous rock (WS1/ER1)
- Siliceous scree and loose rock (ER3)
- Dry meadows and grassy verges/Scrub (GS2/WS1)
- Buildings and artificial surfaces (BL3)
- Scrub (WS1)
- Recolonising bare ground (ED3)
- Dry meadows and grassy verges (GS2)
- Wet grassland (GS4)
- Tidal rivers (CW2)
  - Sea walls, piers and jetties (CC1)
  - Lower salt marsh (CM1)
  - Upper salt marsh (CM2)
  - Mud shores (LS4)
  - Estuaries (MW4)
- Wet grassland/Scrub (GS4/WS1)

(Mixed) broadleaved woodland (WD1)

Some examples of '(Mixed) broadleaved woodland' are present at the top of the rock face north of the railway line in the vicinity of Plunkett Station. Other than the River Suir and adjacent saltmarshes, these small areas of woodland are the habitats of highest biodiversity value in the field study area. However, they are outside the proposed development boundary and will not be affected.

Exposed siliceous rock (ER1)

The exposed cliff face north of the railway line in the vicinity of Plunkett Station is an outcrop of the Ballylane geological formation and corresponds to the Fossitt (2000) habitat 'Exposed siliceous rock'. This feature provides suitable habitat for roosting bats and nesting birds, particularly Peregrine. Works to stabilise this cliff face have received planning permission (WCCC Part VIII) and are not part of the proposed development.

Scrub/Exposed siliceous rock (WS1/ER1)

Part of the cliff face described above is interspersed with Gorse (*Ulex europaeus*) and other shrubs, forming a mosaic of 'Scrub/Exposed siliceous rock'. This provides suitable habitat for nesting birds and other fauna. As noted above, works in this location have planning permission as part of the cliff stabilisation works and are not part of the proposed development.

Siliceous scree and loose rock (ER3)

Exposed rock on the cliff face north of Plunkett Station is subject to weathering which results in occasional rockfalls. The build-up of scree and loose rock at the bottom of the cliff corresponds to the Fossitt (2000) habitat 'Siliceous scree and loose rock'.

Dry meadows and grassy verges/Scrub (GS2/WS1)

The wide sloping road verge north of the R448 comprises dry grassland habitat with a mosaic of Gorse-dominated scrub. This habitat is of low-moderate biodiversity value and will not be affected by the proposed development as it is outside the site boundary and will not experience any disturbance as a result of the construction works.

Buildings and artificial surfaces (BL3)

Much of the land surrounding the proposed development, particularly on the northern side, is built land consisting of roads, railways, buildings and bridges. Further away from the river, the majority of the surrounding area comprises built areas including the urban centre of Waterford. Generally, built habitats are not considered to be of high ecological significance.

Plate 2.10 Buildings, railway tracks, roads, bridges, walls and other artificial surfaces make up a significant portion of the study area.

Scrub (WS1)

The main area of scrub in the field study area is immediately north of the railway and south of the R488 road (on the sloped embankment). This area comprises a narrow, elongated strip of low-growing trees and shrubs, including many non-native Sycamore and Butterfly Bush. This area extends northwest to the commercial estate near the Newrath level crossing. While this habitat is of some biodiversity value in terms of providing habitat for birds, bats and invertebrates, this is limited by its position almost entirely enclosed by buildings and artificial surfaces. Furthermore, no works or disturbance to this area is proposed as part of the proposed development.

Smaller areas of scrub are also present between the railway line and the River Suir. One very small area, comprising an immature Sycamore and some Hawthorn is found adjacent to the signal cabin at Ch.1155. A larger area is found adjacent to the proposed construction site compound at the north-western end of the site. This area is heavily infested with invasive alien species, most notably Japanese Knotweed, but also Butterfly Bush, Montbretia and Cotoneaster.

Recolonising bare ground (ED3)

Areas of railway ballast which are >5m from the track contain many species which are typical of ruderal vegetation, e.g. Nettle, Dandelion and other asters, willowherbs, and ragworts. Ivy, Ivy-leaved Toadflax and Wild Strawberry are also common, as well as Creeping Cinquefoil, Bramble and other opportunistic species. This habitat forms part of the transition from railway ballast to dry grassy verges to wet grassland to the quay wall. This habitat will be lost during construction but will recover during the operation of the proposed development.

Plate 2.11 'Recolonising bare ground' with horsetail (Equisetum sp.) at Ch. 950.

Dry meadows and grassy verges (GS2)

A number of small strips of grassy vegetation are found in the vicinity of the proposed development, generally at the sides of roads and also between the railway line and quay wall. Very small areas of this habitat will be lost during construction of the proposed development but will eventually recover.

Wet grassland (GS4)

This habitat is present between the railway line and the River Suir, mostly between Ch. 780 and Ch. 1100. It is most notable where the existing quay wall has fallen onto the mud (the influence of the river at this point is not sufficient to promote the development of this habitat into saltmarsh). In the study area, there are only poor examples of this habitat, dominated by Common Couch with occasional Red Fescue and shrubs (including the invasive Butterfly Bush). Therefore, these habitats are of low biodiversity value.

Plate 2.12 'Wet grassland' at Ch. 850, with Butterfly Bush and Gorse visible.

Wet grassland /Scrub (GS4/WS1)

On the southern side of the River Suir, directly opposite the proposed development, the riverbank upstream of the boatyards comprises 'Wet grassland' interspersed with areas of Gorse, forming a grassland-scrub mosaic. This area will not be affected at all be the proposed development.

Tidal rivers (CW2)

The proposed development runs along the northern bank of the River Suir. The river within the extents of the proposed development is subject to the influence of the tides and is designated as part of the Lower River Suir SAC. This habitat class contains other habitat types within it, namely 'Sea walls, piers and jetties' (CC1), 'Lower salt marsh' (CM1), 'Upper salt marsh' (CM2), 'Mud shores' (LS4), and 'Estuaries' (MW4), which are discussed in the following paragraphs. Specialist surveys of these habitats were undertaken by BEC Consultants Ltd on 15th March 2021 (Brophy, 2021) and the results are included as relevant.

Plate 2.13 The River Suir at Ch. 960, comprising 'Tidal rivers', including 'Sea walls, piers and jetties, 'Lower salt marsh', 'Mud shores' and 'Estuaries'. More detailed photos of these habitats are presented in the Intertidal Survey Report (Brophy, 2021) in Appendix B to this NIS.

<u>*Sea walls, piers and jetties (CC1)*</u>

This category is used for all coastal constructions that are partially or totally inundated by sea water at high tide. This habitat was recorded along footprint of the proposed development as a masonry and concrete sea walls. The banks of the river on the southern side of the River Suir opposite the location of the proposed development consists of a series of floating jetties where many vessels are moored.

Brophy (2021) surveys the hard intertidal surfaces within the extents of the new riverside flood defence wall in March 2021. Brophy's description of these habitats is reproduced below and the full data are presented in Appendix B to this NIS.

> "*The hard substrata biotopes of the study area were limited to artificial surfaces in the form of the historical retaining wall separating the estuary from the rail line. The biotopes here were typical of the sheltered location in a reduced salinity environment on an artificial substratum. The eastern end of the study area showed the most developed zonation of intertidal hard substratum biotopes. From bottom to top, this area included a band of '*Ascophyllum nodosum *and* Fucus vesiculosus *on variable salinity mid eulittoral rock' (LR.LLR.FVS.AscVS) up to 1.5 m wide* […]*, '*Fucus ceranoides *on reduced salinity eulittoral rock' (LR.LLR.FVS.Fcer) approximately 30 cm wide* […]*, sparse and intermittent '*Enteromorpha *spp. on freshwater-influenced and/or unstable upper eulittoral rock' (LR.FLR.Eph.Ent)* […] *and 'Yellow and grey lichens on supralittoral rock' (LR.FLR.Lic.YG)* […]*, which is similarly sparse and intermittent. Heading west, the LR.LLR.FVS.AscVS zone rapidly disappears, as the upper mud shore covers its potential substratum along the base of the retaining wall, leaving only the upper three biotopes. There is often*

a strip of bare stone between the LR.LLR.FVS.Fcer and the LR.FLR.Eph.Ent above it.

The barnacle Austrominius modestus *was recorded on some of the wooden posts found emerging from the mudflat […] and occasionally on rocks on the mud.*"

The remaining supports of former landing stages along the proposed development extent and supports for the R448 flyover also fall into this habitat class. However, these areas are too small to be mapped at the scale required.

These habitats are considered to be of moderate biodiversity value as, while they are not species-rich or of a very natural or locally distinct character, they are one of the principal ecosystem features which define this part of the River Suir and support the integrity of habitats and species of conservation interest in the Lower River Suir SAC.

Plate 2.14 Existing quay wall surface with Fucus spp. community.

Lower salt marsh (CM1) and Upper salt marsh (CM2)

An area of 106m^2 of saltmarsh, comprising mostly 'Lower salt marsh' (CM1) with a smaller band of 'Upper salt marsh' (CM2) higher up the shore, was identified between the existing quay wall and the mudflats from Ch. 925 to Ch. 975. The species present in the lower zone included Common Saltmarsh-grass (*Puccinellia maritima*) and Sea Plantain (*Plantago maritima*), while the upper zone contained Creeping Bent (*Agrostis stolonifera*). Sea Aster (*Tripolium pannonicum*) was present in both zones. The invasive Common Cordgrass was not present at the time of survey. This habitat corresponds to the Annex I habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330), which is listed as a Qualifying Interest of the Lower River Suir SAC. Brophy (2021) noted that this saltmarsh has formed in the shelter provided by an outward projection of the existing quay wall.

A similar area was also observed further up the River Suir (northwest), adjacent to the proposed construction compound. However, this area is not within the works footprint and, due to its distance from the proposed riverside flood defence wall, it will not be affected in any way.

Borrer's Saltmarsh-grass (*Puccinellia fasciculata*), which is listed as Near Threatened in *Ireland Red List No. 10: Vascular Plants* (Wyse Jackson et al., 2016) and protected under the Flora (Protection) Order, 2015, was not observed during any of the surveys.

While these are not "best examples" of saltmarsh habitats, they are considered to be of very high biodiversity value as they conform to a type listed on Annex I to the Habitats Directive and are Qualifying Interests of the Lower River Suir SAC.

Plate 2.15 Saltmarsh habitats at Ch. 925 to Ch. 975.

Mud shores (LS4)

Mud shores are formed primarily of very fine sediment and usually occur along the most sheltered sections of coastline. The silt/clay fraction of the sediment is typically found in the upper reaches of estuaries. They are subject to variable, reduced or low salinity conditions. Mud shores are often characterised by elevated mudflats that are dissected by networks of shallow channels associated with flooding and drainage. This habitat is present in the intertidal areas of the River Suir, including within the footprint of the proposed development.

This habitat corresponds to the Annex I habitat 'Mudflats and sandflats not covered by seawater at low tide' (1140). However, this habitat is not listed as a Qualifying Interest of the Lower River Suir SAC.

Brophy (2021) surveyed the mudflats within the extents of the new riverside flood defence wall in March 2021. Brophy's description of the mudflats is reproduced below and the full data are presented in Appendix B to this NIS.

> "*The intertidal mud of the study area is all classified as '*Tubificoides benedii *and other oligochaetes in littoral mud' (LS.LMu.UEst.Tben) under the JNCC Marine Biotope Classification* […]*. This biotope is species-poor and found in upper estuarine locations where the salinity is reduced, with wave exposure ranging from sheltered to extremely sheltered (Connor et al., 2004). The substratum is one of fine sandy mud, and extends from the lower shore to the upper shore (Connor et al., 2004). Within the study area, the nature of the mudflat in the upper shore differed from lower down. The upper shore along much of the length comprised firm, anoxic mud, with rubble and debris dumped onto it from the land side, with quite a steep profile* […]*. Burrows were visible in this upper shore mud surface and Horned Wrack (*Fucus ceranoides*) was growing on rocks scattered along the shore. The lower shore was one of soft mud, with the anoxic layer often deeper than the 25 cm reached by the core and a flatter profile* […]*.*
>
> *In the current survey, only four species were recorded across the five sampling locations* […]*. The oligochaete worm* Baltidrilus costatus *was recorded at the uppermost sample station S1, which was located on the upper shore. The true fly (Diptera) larva of the Family Dolichopodidae was found at sample station S2, forming burrows in the upper shore. A single mayfly* Baetis rhodani *was recorded at sample station S3; this must have washed down from upstream as there is no suitable habitat present in the estuary for this species. Similarly, a larva of the water beetle* Esolus parallelepipedus *recorded at S5 must also have been washed down, as, again, no suitable habitat for this species is present within the estuary. No fauna were recorded from sample station S4.* […]
>
> *The granulometric analysis classified all stations as 'Sandy Mud', with the mud content ranging from 59.6% (S3) to 79.3% (S1)* […]*. Total Organic Carbon ranged from 7.37% (S2) to 8.20% (S5)* […]*.*"

While the mudflat habitats at this location are very species-poor and do not represent best examples of this habitat type, they are the principal feature which defines this part of the River Suir and support the integrity of habitats and species of conservation interest in the Lower River Suir SAC, though they are not a Qualifying Interest in their own right. Therefore, they are considered to be of high biodiversity value.

Plate 2.16 **'Mud shores' at the western end of the proposed extent of the new riverside flood defence wall.**

Estuaries (MW4)

For the purposes of this assessment, the River Suir below the low-water mark has been classed as the Fossitt (2000) habitat type 'Estuaries' (MW4). In addition, the River Suir at this location corresponds to the Annex I habitat 'Estuaries' (1130) which is not listed as a Qualifying Interest of the Lower River Suir SAC. EC (2013) describes this habitat as the downstream part of a river valley, subject to the tide and extending from the limit of brackish waters. Therefore, the Annex I type applies to the intertidal areas also, corresponding to the Fossitt (2000) habitat type 'Tidal rivers' (CW2).

Character and Significance of Habitats

The site of the proposed development has been highly modified from its natural state over centuries of urbanisation, navigation, dredging and reclamation. Its character is typical of urbanised or industrialised estuarine environments. The River Suir itself, although highly modified, is the habitat with the highest biodiversity value within the site as it supports a number of habitats and species of conservation importance, some of which are Qualifying Interests of the Lower River Suir SAC and other connected sites. Other habitats are of considerably lower significance.

Ecological Corridors

Article 10 of the Habitats Directive recognises the importance of ecological networks as corridors and steppingstones for wildlife, including for migration, dispersal and genetic exchange of species of flora and fauna. The Directive requires that ecological connectivity and areas of ecological value outside the Natura 2000 network are maintained and it recognises the need for the management of these areas through land use planning and development policies.

Ecological corridors are important in connecting areas of local biodiversity with each other and with nearby designated sites to prevent islands of habitat from becoming isolated. Ecological corridors include linear features such as treelines, hedgerows, disused railway lines, rivers, streams, canals and ditches. They are particularly important for mammals, especially bats, and small birds. The River Suir provides a number of important ecological corridors including an aquatic corridor and some associated intertidal and fringing habitat corridors such as mudflats and saltmarsh. The River Suir provides a range of habitats and facilitates networks or linkages to the surrounding countryside for flora and fauna.

While ecological corridors are essential for the movement and conservation of native biodiversity, they can also act as conduits for the spread of invasive alien species. This is particularly the case for rivers and other aquatic corridors. Therefore, biosecurity is of paramount importance for development along ecological corridors, especially rivers.

Watercourses, Fisheries and Aquatic Fauna

Water Quality

The Water Framework Directive (WFD) requires that each EU Member State protects and improves water quality in all waters so that good ecological status is achieved. Additionally, proposed actions (within discrete River Basin Management Plans) are also required, to secure national natural water resources for the future. The EPA is the competent authority responsible for monitoring, protecting and improving the water environment in the Republic of Ireland. In accordance with WFD guidelines, water quality 'Status' is assigned using a variety of available data on aquatic flora and fauna (including fish), the availability of nutrients, and aspects like salinity, temperature and pollution by chemical pollutants. Morphological features, such as quantity, water flow, water depths and structures of the riverbeds, are also taken into account.

The original EPA water quality classification (Quality Rating System (Q-values)) is also used to assess water quality in Irish rivers, taking into account aquatic macrophytes, phytobenthos and hydromorphology. The Q-value system has been shown to be a robust and sensitive measure of riverine water quality and has been linked with both chemical status and land-use pressures in catchments. Individual macroinvertebrate taxa are ranked for their sensitivity to organic pollution and the Q-value of the watercourse is based primarily on the relative abundance of these taxa within a biological sample. A review of both the Q-value status and WFD status for the watercourses was undertaken.

The online EPA Unified GIS Application provides access to information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters], and coastal waters) or to groundwater. Table 2.4 below shows the information recorded regarding water quality status at the location of the proposed development.

Table 2.4 EPA water quality results

Transitional Waterbody	WFD Status (2013-2018)	WFD Status (2010-2012)	WFD Risk (2020)
Middle Suir Estuary	Poor	Poor	At Risk
Lower Suir Estuary (Little Island - Cheekpoint)	Good	Moderate	At Risk
Barrow Suir Nore Estuary	Moderate	Good	At risk

The River Suir at Waterford City (Middle Suir Estuary Transitional Waterbody) had a WFD Status of 'Eutrophic' in the 2010-2012 reporting period and 'Poor' in 2013-2018. The 'Poor' Status is indicated to be as a result of poor Phytoplankton Status as per the EPA Catchments website. Additionally, there appears to have been a deterioration across some parameters from the 2010-2015 to the 2013-2018 monitoring periods, these include Nutrient and Hydromorphological conditions.

Fisheries

The River Suir catchment is internationally important for the presence of fish species including lamprey species, Twaite Shad (*Alosa fallax*), Atlantic Salmon (*Salmo salar*), European Eel (*Anguilla anguilla*) and Smelt (*Osmerus eperlanus*).

Lamprey Species

Sea Lamprey (*Petromyzon marinus*) and River Lamprey (*Lampetra fluviatilis*) are both likely to be present at the proposed development location in significant numbers during their upstream spawning migrations and downstream migrations following metamorphosis. The major upstream movements of Sea Lamprey occur in April, May and, to a lesser extent, June, while those of River Lamprey occur earlier, beginning in August and continuing over the winter and spring. The downstream migration of Sea Lamprey occurs in September and October, while that of River Lamprey occurs over an extended period from late winter to early summer. Salinity levels measured during the site investigations for the River Suir Sustainable Transport Bridge (ROD, 2018b) varied from 3.1 ppt to 18 ppt across 5 samples, which is not considered suitable for juvenile lampreys.

Further literature review

Two lamprey species, Sea Lamprey and River Lamprey, migrate past the proposed development. Brook Lamprey is restricted to the freshwater stretches of the River Suir and, therefore, will not be affected by the proposed development. Sea Lamprey is present at the proposed development location at two key phases in its life cycle: 1) adults migrate upstream from the sea to their spawning grounds in the freshwater stretches of the river; and 2) newly-metamorphosed adults migrate downstream from their juvenile habitats to the sea to feed as adults. River Lamprey is also present at the proposed development location during its migrations between its spawning and juvenile habitats in the freshwater reaches and its adult habitats in the estuary, as well as during its adult phase, when it resides in the estuary. All lamprey species are semelparous (Maitland, 2003), i.e. adults undergo a single spawning event and then die. Thus, no spent adults occur in the vicinity of the proposed development.

The upstream migration of adult Sea Lamprey is concentrated in the months of April, May and June (Maitland, 2003; King et al., 2008). The upstream migration period of River Lamprey is less well-known and may occur over a long period beginning in August and continuing throughout autumn and winter, until the spawning season in spring (King et al., 2008). Peak migration periods have been proposed as being from

October to December (Maitland, 2003) or August to November followed by a second peak in March and April (MOR, 2010). In the case of both Sea Lamprey and River Lamprey, upstream migration is almost exclusively nocturnal (Maitland, 2003; Andrade et al., 2007; Quintella et al., 2009; Vrieze et al., 2011).

Lamprey larvae, known as "ammocoetes", burrow into fine sediments at the bottom of fresh waters and live as filter-feeders. Metamorphosis occurs after c. 5 years in Sea Lamprey and after 3-5 years in River Lamprey (Maitland, 2003). The downstream migration of recently-metamorphosed lampreys, known as "macrophthalmia", is not well-studied, but it appears to vary between years and river systems. MOR (2010) stated that Sea Lamprey begin their downstream migration once metamorphosis is complete (usually by September) and most arrive in the estuary in October. MOR (2010) also suggested that newly-metamorphosed River Lamprey "*begin their downstream migration over an extended period from late winter to early summer*". Downstream migration by both Sea Lamprey and River Lamprey is predominantly nocturnal (Maitland, 2003; Potter, 1980; Lucas & Bracken, 2010; Silva et al., 2013; Moser et al., 2014; Dawson et al., 2015).

Twaite Shad

Adult shad move from the sea into estuaries in spring and spawn just above the top of tidal waters in May and June. During the breeding season, large numbers of adult shad move up and down the estuary with the tide. Most adults return to the lower estuary within days of spawning and to sea by the end of the summer. Juvenile shad spend one or two years in the estuary, moving up and down with the tides and feeding on planktonic crustaceans and other invertebrates. Twaite Shad is classed as vulnerable to extinction in Ireland and anecdotal reports indicate a substantial decline in the River Suir (King et al., 2011).

Inland Fisheries Ireland Data

As part of its national monitoring programme for Habitats Directive: Annex II and Red Data Book fish species, IFI has been studying the ecology and behaviour of Twaite Shad in the estuaries of the larger rivers in the South-East of Ireland since 2010. The following reports describe the methods used to survey for shads and their respective degrees of success:

- King, J.J. and Linnane, S.M. (2004) The status and distribution of lamprey and shad in the Slaney and Munster Blackwater SACs. *Irish Wildlife Manuals* 14. National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin.
- Kelly, F., Harrison, A., Connor, L., Matson, R., Morrissey, E., Feeney, R., Wogerbauer, C., O'Callaghan, R. and Rocks, K. (2011) *Sampling Fish for the Water Framework Directive – Summary Report 2010*. Inland Fisheries Ireland, Dublin.
- IFI (2011) *Sampling Fish for the Water Framework Directive – Transitional Waters 2010: Barrow, Nore and Suir Estuaries.* Inland Fisheries Ireland, Dublin.
- IFI (2012) *National Programme: Habitats Directive and Red Data Book Fish species. Executive Report 2011. IFI Report Number: IFI/2012/1-4103.* Inland Fisheries Ireland, Dublin.
- Rooney, S.M., O'Gorman, N.M., King, J.J. (2013) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2012.* Inland Fisheries Ireland, Dublin.

- Rooney, S.M., O'Gorman, N.M., Cierpial, D. and King, J.J. (2014) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2013.* Inland Fisheries Ireland, Dublin.
- O'Gorman, N.M., Rooney, S.M., Cierpial, D. and King, J.J. (2015) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2014.* Inland Fisheries Ireland, Dublin.
- Rooney, S. and King, J.J. (2015) *A poster on acoustic tracking of twaite shad by the Habitats Directive and Red Data Book Species team presented at the 3rd International Conference on Fish Telemetry (ICFT) in Halifax, Nova Scotia in 2015.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coughlan, B., and King, J.J. (2016) *National Programme: Habitats Directive and Red Data Book Species Executive Report 2015.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B., and King, J.J. (2017) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2016.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., Coghlan, B., and King, J.J. (2019) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2017.* Inland Fisheries Ireland, Dublin.
- Gallagher, T., O'Gorman, N.M., Rooney, S.M., and King, J.J. (2020) *National Programme: Habitats Directive and Red Data Book Species Summary Report 2018.* Inland Fisheries Ireland, Dublin.
- IFI (2021a) *Twaite Shad* <https://www.fisheriesireland.ie/fish-species/twaite-shad .html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.
- IFI (2021b) *Juvenile Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/juvenile-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.
- IFI (2021c) *Adult Shad Monitoring* <https://www.fisheriesireland.ie/Habitats-and-Red-Data-Book/adult-shad-monitoring.html> [Accessed 01/03/2021]. Inland Fisheries Ireland, Dublin.

Monitoring of juvenile Twaite Shad is challenging due to the small size of the fish and large extent of their estuarine habitat, as well as other environmental factors such as flooding and tidal influences. Given these challenges, IFI's monitoring programme has focussed primarily on sampling young-of-the-year fish in Waterford Harbour and the Suir, Barrow and Nore Estuaries. The main survey technique used to target post-larval and young-of-the-year fish is fine-mesh zooplankton or bongo netting. Other techniques include beach seining, fyke netting and beam trawling, though only bongo and seine netting have produced positive results.

Bongo netting

Sampling using bongo nets is carried out 4-8 weeks after spawning, which occurs in June. Samples are collected in a pair of bongo nets mounted at the front of a boat moving against the tide for 10 minutes. These trawls are carried out along the margins of depositional banks at 1-2km intervals along the estuary/harbour. This technique has had mixed success over the years, with the highest numbers of fish (178 young-of-the-year shad) captured in 2011 and only small numbers in later years, with none being recorded using this method in some years. This is despite considerable annual survey effort (70 trawls in 2014). The low catch-per-unit-effort may be accounted for by poor timing, inadequate technique or some other underlying cause. The fact that many of these surveys have formed part of IFI's National Bass Programme may point to suboptimal tidal conditions for surveying.[6]

Beach seining

IFI carries out seine netting surveys in August each year as part of the National Bass Programme and in September-October on a three-year rolling program during WFD surveillance monitoring of transitional waters. These surveys have been successful in recording young-of-the-year shads 50-100mm in length and have highlighted the wide distribution of juvenile shads within the Suir, Barrow and Nore Estuaries. In August 2016, sixteen seine net samples were collected from four locations in the Suir and Barrow Estuaries over two days. A total of 90 shads were recorded during this survey. Of the three techniques used in October 2016, juvenile shads were only captured in beach seine nets. A total of 42 shad was recorded in seine net samples from the mouth of Waterford Harbour to the upper tidal limits of the Rivers Suir, Barrow and Nore.

As part of its monitoring of adult shad, IFI has collected data from a wide variety of sources, including surveys and information and samples submitted by third parties. IFI has sampled adult shad via trawling surveys and an acoustic telemetry study. In addition, samples of shad from by-catch in commercial netting and from surveys by other agencies, as well as angling logbooks have also contributed to IFI's monitoring of Twaite Shad.

Trawling surveys

Since 2014, trawling surveys using commercial trawlers with IFI officers on board have been carried out in the Lower Suir and Barrow Estuary and Waterford Harbour as part of the National Bass Programme. Sampling takes place in September and each trawl lasts 10-15 minutes. This technique usually captures larger specimens in comparison with seine netting. In 2014, a total of 26 shad (61-28 mm in length) was recorded in three of the 34 trawls. In 2015, a total of only three shad (215-320mm in length) was recorded in three of the 36 trawls undertaken.

Acoustic telemetry

Since 2012, IFI has been using acoustic telemetry to study the behavioural ecology of spawning and post-spawning Twaite Shad in the Suir, Barrow, Nore and Munster Blackwater Estuaries. Fish are first captured by drift netting or recreational angling and external acoustic transmitters are fitted. The fish's movements are then detected up by acoustic receivers within the estuaries. The telemetry study is ongoing, and future work will examine knowledge gaps regarding residency and behaviour in the outer estuaries, as well as site fidelity in repeated spawning migrations.

Angling surveys and logbooks

IFI staff conduct angling surveys to determine the distribution of adult shad and also attended shad angling competitions to measure the size distribution of fish caught by anglers. These methods have yielded information regarding the locations and timing of spawning events and the sizes and ages of spawning fish, as well as establishing iteroparity in this species. This data is supplemented by records submitted by third parties, e.g. district fisheries inspectors, and such data has included particularly interesting records, such as a rod-caught shad from Careysville, c. 25km upstream of the tidal limit of the Munster Blackwater.

[6] A study in Cornwall (Hillman, 2003) has identified that the optimal time for bass surveys are near high water while the optimal time for surveying shad and other clupeomorphs is near low water.

Commercial netting by-catch

Commercial netsmen using seasonal drift, draft and snap nets in the Suir, Barrow, Nore, Slaney and Muster Blackwater Estuaries (and coastal waters) are the most significant source of information and material for studies of shads. These netsmen operating in the SAC estuaries regularly make records and samples of shad by-catch available to IFI for inclusion in its ongoing monitoring of these species.

Marine fisheries surveys

Fisheries monitoring is also carried out in the marine environment by Bord Iascaigh Mhara and the Marine Institute. As with commercial netsmen, these agencies also make shad records and samples available to IFI for inclusion in its studies.

Kick sampling for shad eggs

In 2017 and 2018, IFI used kick sampling as a technique for confirming the occurrence of shad spawning in the Barrow, Nore, Suir and Munster Blackwater. This technique is recommended in the Common Standards Monitoring Guidance for Freshwater Fauna (JNCC, 2015). The methodology involves repeated 15-second kick samples upstream of a handheld 250µm net in a transect across the river. Eggs are collected and sent for genetic analysis to confirm species. In 2017, this method confirmed shad spawning in the River Barrow near St Mullin's and in the River Nore near Inistioge. In 2017, it confirmed shad spawning in the River Barrow near St Mullin's, in the River Suir near Carrick-on-Suir and in the Munster Blackwater near Lismore. It is expected that IFI will continue to employ this method as part of its annual monitoring of shad.

Environmental DNA analysis

In 2018, IFI undertook a pilot study on the use of eDNA to identify the presence of shad in four rivers for which there are recent or historical records of these species, but which are not known to support significant populations, namely the Boyne, Liffey, Lee and Ilen. The samples taken had not yet been analysed for eDNA at the time of the most recently published reporting (Gallagher et al., 2020).

Notwithstanding the significant ongoing survey effort in IFI's monitoring programme over the last 8 years, gaps remain in the understanding of the ecology and behaviour of Twaite and Allis Shad, particularly in relation to juveniles during their residency in estuaries, and anecdotal records from anglers and commercial netsmen remain the most significant source of information. However, having thoroughly reviewed existing literature relating to this species, it was considered that sufficient information was available to inform this NIS. Furthermore, having examined the survey methods used by IFI and others, it was considered that any additional surveys carried out to inform this NIS would not contribute any significant additional information regarding the distribution, densities and movement patterns of post-larval and juvenile Twaite Shad in the Lower Suir Estuary.

Further literature review

Adult Twaite Shad gather outside estuaries in April and enter rivers in May and June (Maitland & Hatton-Ellis, 2003; Freyhof & Kottelat, 2008; Rooney & King, 2015). This can vary with water temperature, tides and fluvial conditions (Doherty et al., 2004). Twaite Shad are commonly recorded congregating in Waterford Harbour in March and occasionally in February (Doherty et al., 2004; Gallagher et al., 2016). Upstream migration from the estuaries peaks at water temperatures of 10-14°C (IFI, 2021a). Acoustic telemetry studies by IFI (Rooney & King, 2015; IFI, 2021c) have found that shads are highly mobile during their spawning migration, moving up to 35km upstream and downstream with the tides.

Spawning occurs over gravel (IFI, 2021a) at the top of tidal waters (King et al., 2011). Once the adults reach the spawning grounds in late May and early June, they remain there for 1-2 weeks, when there is a steady rise in water temperatures from 13°C to 19°C (Rooney & King, 2015; IFI, 2021c). Fish move onto the breeding area at dusk (IFI, 2021a) and spawning takes place throughout the night in large, noisy schools (Maitland & Hatton-Ellis, 2003; Doherty et al., 2004; Freyhof & Kottelat, 2008; King et al., 2011). The eggs sink into the gravel or float downstream, hatching 4-8 days later (Maitland & Hatton-Ellis, 2003; Doherty et al., 2004). Most juveniles move to the lower estuary during their first summer and migrate to sea at end of their second year (Freyhof & Kottelat, 2008). Once in brackish water, these fish feed primarily mysids and copepods (Maitland & Hatton-Ellis, 2003). The movements and ecology of Twaite Shad during their residency in estuaries are not fully understood (IFI, 2021a) and are the subject of ongoing research (IFI, 2021c).

Twaite Shad is an iteroparous species, i.e. individuals can spawn multiple times over their lifespan (Rooney & King, 2015, IFI, 2021a). Examination of scales by King & Roche (2008) showed that repeat spawning is the norm and angling returns from the River Barrow also reveal a relatively well-established population of repeat-spawners there (King et al., 2011). After spawning, spent fish migrate back to sea (Freyhof & Kottelat, 2008) and most surviving adults return to sea almost immediately (Doherty et al., 2004; IFI, 2021a). As part of IFI's acoustic telemetry studies, Rooney & King (2015) found that, following presumed spawning, tagged shad returned to the lower part of Suir Estuary within 1-3 days (IFI, 2021c).

Apart from the nocturnal spawning habit, the diel activity patterns of Twaite Shad are not well defined/studied. However, it appears that, with the exception of the spawning period, Twaite Shad is a mainly diurnal species. Gregory & Clabburn (2003) found that the numbers of adult shad migrating upstream and downstream were much reduced between 21:00 and 03:00 and that a peak in activity occurred around dawn. Esteves & Andrade (2008) found that shad larvae were more common during daylight hours, particularly in the afternoon, than they were at night.

Twaite Shad, like all members of the herring family, is considered a "hearing specialist" as it has a much greater auditory range than other fishes (Teague & Clough, 2011). As Twaite Shad is a hearing specialist and predominantly diurnal, and as both adults and juveniles are likely to be pass by the proposed development location in significant numbers, this species is considered to be the most sensitive receptor in terms of noise impacts.

<u>*Summary*</u>

During the period from March to May, inclusive, adult Twaite Shad are expected to migrate upstream through the works area in significant numbers during daylight hours. Later in the summer, i.e. in June and July, spent adult shad are likely to be present in significant numbers on their return from their spawning grounds to the lower estuary and, eventually, the sea. The timing of the arrival of young-of-the-year (0+) shad at the location of the proposed development is not known, but it is thought that they gradually move down the tidal reaches of the river from June to August/September. Similarly, little is known of the behaviour and ecology of juvenile Twaite Shad during their residency in the estuary. Therefore, following the Precautionary Approach, juveniles are assumed to move upstream and downstream through the works area at all times of the year and to be most active during daylight. Owing to their sensitive auditory systems, diurnal habit and year-round presence, as well as their small body size, juvenile Twaite Shad are considered highly vulnerable to noise impacts arising from pile driving.

Salmonids

While the River Suir at the location of the proposed development does not provide suitable spawning habitat for salmonids, e.g. Atlantic Salmon (*Salmo salar*) and Brown Trout (*S. trutta*), it is an important link between the estuarine, coastal and oceanic feeding grounds for these species and their spawning beds further upstream. Salmonid species may be present at the proposed development location at any time of year but occur in most significant numbers during their upstream spawning migration (predominantly in autumn and winter) and out-migration of smolts (almost entirely in spring). In addition, sea or slob trout (Brown Trout with a marine or estuarine adult phase) may be present at any time of the year.

Further literature review

Like lampreys and shads, Atlantic Salmon is an anadromous species, i.e. the adult life stage is marine, with mature fish returning to their natal freshwater streams to spawn. Adults can begin their spawning migration at any time of year, but there are two main migration periods: fish who have spent one winter at sea, known as "grilse", ascend rivers in late winter, while fish who have spent more than one winter at sea, known as "multi-sea-winter (MSW)" (or "spring" salmon, if they enter fresh water before 1st June), generally enter rivers earlier in the year. In the River Suir, the main grilse run occurs in December and MSW salmon run mostly in the period from July to October (MOR, 2010). Movement of spawning salmon upstream through the estuary is predominantly nocturnal and usually occurs on the ebb tide (Smith & Smith, 1997). Once spawning has occurred, most adults die, though as many as 36% may survive and return to sea as kelts (Hendry & Cragg-Hine, 2003). Only 3-6% survive to spawn in subsequent years (Mills, 1989; Hubley et al., 2008).

The eggs hatch in spring and the young, known as "alevins", remain within the gravel interstitia until the yolk-sac is depleted, which takes a number of weeks, at which point the rise to the surface and begin their free-swimming phase. At this point the juvenile fish are known as "fry". At the end of their first summer these fish develop parr marks on their sides and are thereafter known as "parr". J uveniles spend 2-4 years in fresh waters (Hendry & Cragg-Hine, 2003), normally undergoing smoltification (a series of physiological changes or metamorphosis which prepares the young salmon for life in the marine environment) and migrating to sea in the spring (April-June) of their third year (King et al., 2011). MOR (2010) stated that the main smolt movement in the Suir Estuary is from March to mid-June. Out-migrating smolts are predominantly nocturnal (Moore et al., 1995). However, they become increasingly active during daylight hours with increasing water temperatures (Thorpe et al., 1994; Ibbotson et al., 2006, 2011; Haraldstad et al., 2017). Smolts do not require a period of acclimation to saline conditions and so tend not to delay in the estuary, preferring to move directly to sea (Moore et al., 1995; MOR, 2010).

As the up-estuary section of the migration of adult Atlantic Salmon is predominantly nocturnal, the vast majority of individuals will migrate past the proposed development location during the hours of darkness. Similarly, any out-migrating kelts are likely to migrate at night. In addition, these fish are likely to spend only a very short time in the estuary, instead migrating directly from the river to the sea.[7] Furthermore, only a very small portion of kelts contribute to future spawning, and so impacts on kelts are generally imperceptible at the population scale.

[7] Atlantic Salmon kelts occasionally spend longer periods (up to several weeks) in estuaries on their post-spawning migration to the sea (Lindberg, 2011).

Smolts are likely to pass through the construction area in significant numbers on their migration from the river to the sea in the period from March to May, inclusive. As with adult salmon, smolts migrate mostly at night. As with kelts, smolts do not tend to delay in the estuary, preferring to migrate directly to sea.

European Eel

Unlike salmonids and lampreys, European Eel (*Anguilla anguilla*) has a catadromous life history, i.e. spawning occurs at sea and juveniles migrate into fresh waters to feed and mature. The major influx of juvenile eels occurs in early spring. Large numbers of eels are expected to be present at the proposed development location during this time.

European Smelt

Another species which is known to use the River Suir in the vicinity of the proposed development is European Smelt (*Osmerus eperlanus*). This estuarine species is most likely to be present in significant numbers at the proposed development location during March and April.

Migration Periods

Based on the literature review above, Table 2.5 below illustrates the known migration patterns of these species through the Suir Estuary.

Table 2.5 Indicative migration periods for Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon species in the Suir Estuary. Blue shading indicates mostly nocturnal activity, orange indicates mostly diurnal activity, shade indicates relative abundance of fish.

Category	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sea Lamprey												
Upstream												
Downstream												
River Lamprey												
Upstream												
Downstream												
Twaite Shad												
Upstream												
Downstream (spent)												
Downstream (0+)												
Juveniles (<2 years)												
Atlantic Salmon												
Upstream												
Downstream (kelts)												
Downstream (smolts)												

Otter

There are frequent and widespread records of Otter in the vicinity of the proposed development, (NBDC, 2021; NPWS, 2021). Additionally, evidence of Otter in the form of spraints and prints was recorded during surveys carried out to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018), c. 500m downstream of the proposed development. However, no holts or couches were observed. Nevertheless, records and data reviewed as part of the desk study strongly indicate that Otter are present at the location of the proposed development.

During the three walkover surveys, signs of Otter activity were recorded within the study area. Evidence of Otter activity included prints along the mudflats outside the existing quay wall. No spraints or any potential holts or couches were recorded within 150m of the proposed development.

Plate 2.17 Otter prints on the mudflats at Ch. 980.

Birds

The data retrieved from NBDC (2021) contains records of a considerable number of bird species within the likely zone of impact which are Red-listed or Amber-listed in *Birds of Conservation Concern in Ireland 2020–2026* (Gilbert et al., 2021) and some of which are listed on Annex I to the Birds Directive. Many of these birds are wetland species which spend the winter in the Suir-Barrow-Nore Estuary, while others are riparian species more likely to occur along the freshwater stretches of the River Suir, e.g. Kingfisher. Raptors such as Peregrine are also included, and have been recorded in Waterford City in the past.

BirdWatch Ireland provided Irish Wetland Bird Survey (I-WeBS) data for the three subsites close to the proposed development. The subsites and the years for which data was received are present in Table 2.6 below.

Table 2.6 I-WeBS Subsites reviewed.

Subsite name	Code	Years of surveys	Distance from the proposed development
Fiddown Bridge (only)	OM303	2012/13	c. 19km upstream
Derrigal-Portnascully	OM361	2012/13; 2013/14; 2014/15; 2015/16; 2016/17; 2017/18; 2018/19	c. 15km upstream
Barrow Bridge-Passage East	OM496	2013/14	c. 8km downstream

Subsite OM361 is situated along the River Suir, at least 15km upstream of Waterford City. This site consists of fields which provide habitat for wetland water birds. Nationally important numbers of Greylag Goose have been recorded here. No species have been recorded occurring in nationally or internationally important numbers at subsite OM303 or OM496, which are located 19km upstream and 8km downstream of the proposed development, respectively. There was no data available from subsite OM390 (Belview-Little Island-Faithlegg, c. 2.5km downstream) or OM498 (Barrow Bridge-Creadan Strand, c. 10km downstream).

The I-WeBS data shows that subsite OM361 is used by large numbers of wintering birds. However, the location of the proposed development has been highly modified and is subjected to frequent disturbance from the passage of trains and boats, and does not provide suitable habitat for species that are present within the wider environment in significant numbers.

The habitat assessment undertaken as part of the multidisciplinary walkover survey did not identify habitats that support important assemblages or significant populations of breeding or wintering birds. There is no Kingfisher nesting habitat in the study area and Kingfisher movement will not be restricted.

Flora

Historical records of rare flora protected under the Flora (Protection) Order, 2015 for hectads in the area of the proposed development (S51 and S61) include Borrer's Saltmarsh-grass (*Puccinellia fasciculata*), Meadow Barley (*Hordeum secalinum*) and Divided Sedge (*Carex divisa*). No species protected under the Flora (Protection) Order, 2015 were recorded within the study area. Table 2.7 below provides a list of plant species recorded during the multidisciplinary walkover surveys.

Table 2.7 Plant species recorded during the surveys.

Common name	Scientific name
Sycamore	*Acer pseudoplatanus*
Creeping Bent	*Agrostis stolonifera*
Lords-and-Ladies	*Arum maculatum*
Daisy	*Bellis perennis*

Common name	Scientific name
Sea Beet	*Beta vulgaris* subsp. *Maritima*
Rape	*Brassica napus*
Butterfly Bush	*Buddleja davidii*
Pot Marigold	*Calendula officinalis*
Hairy Bittercress	*Cardamine hirsute*
Red Valerian	*Centranthus ruber*
Spear-thistle	*Cirsium vulgare*
Traveller's Joy	*Clematis vitalba*
Scurvygrass	*Cochlearia* sp.
Cotoneaster	*Cotoneaster* sp.
Hawthorn	*Crataegus monogyna*
Montbretia	*Crocosmia × crocosmiiflora*
Ivy-leaved Toadflax	*Cymbalaria muralis*
Wild Teasel	*Dipsacus fullonum*
Common Couch	*Elytrigia repens*
Willowherbs	*Epilobium* spp.
Horsetails	*Equisetum* spp.
Japanese Knotweed	*Fallopia japonica*
Wild Strawberry	*Fragaria vesca*
Cleavers	*Galium aparine*
Herb-Robert	*Geranium robertianum*
Crane's-bills	*Geranium* spp.
Ivy	*Hedera helix*
St John's Wort	*Hypericum* sp.
Holly	*Ilex aquifolium*
Red Dead-nettle	*Lamium purpureum*
Himalayan Honeysuckle	*Leycesteria Formosa*
Common Mallow	*Malva sylvestris*
Winter Heliotrope	*Petasites fragrans*
Common Reed	*Phragmites australis*
Ribwort Plantain	*Plantago lanceolata*
Sea Plantain	*Plantago maritima*
Polypody	*Polypodium* sp.
Creeping Cinquefoil	*Potentilla reptans*
Primrose	*Primula vulgaris*
Cherry Laurel	*Prunus laurocerasus*
Common Saltmarsh-grass	*Puccinellia maritima*

Common name	Scientific name
Bramble	*Rubus fruticosus* agg.
Willow	*Salix* sp.
Groundsel	*Senecio vulgaris*
Smooth Sowthistle	*Sonchus oleraceus*
Rowan	*Sorbus aucuparia*
Dandelion	*Taraxacum vulgaria*
Wood Sage	*Teucrium scorodonia*
Sea Arrowgrass	*Triglochin maritima*
Sea Mayweed	*Tripleurospermum maritimum*
Sea Aster	*Tripolium pannonicum*
Bulrush	*Typha latifolia*
Gorse	*Ulex europaeus*
Common Nettle	*Urtica dioica*
Laurustinus	*Viburnum tinus*
Vetches	*Vicia* spp.

Invasive Alien Species

During the invasive species survey carried out to inform the EIAR for the River Suir Sustainable Transport Bridge (ROD, 2018a), two species restricted under Section 49 of the Habitats Regulations, namely Common Cord-grass (*Spartina anglica*) and Japanese Knotweed (*Fallopia japonica*), were recorded on the bank of the River Suir c. 500m downstream of the proposed Flood Defences West. A number of examples of other invasive but not legally restricted species, including Butterfly Bush (*Buddleja davidii*) and Traveller's Joy (*Clematis vitalba*), were also recorded.

Chinese Mitten Crab (*Eriocheir sinensis*) was recorded in the Waterford Estuary in 2009 (Invasive Species Ireland, 2021) and is presumed to still be present there. This is the only record of this species in Ireland. However, it is much more widespread in Great Britain (NIEA, 2020) and remains a threat.

One species restricted under Section 49 of the Habitats Regulations, namely Japanese Knotweed (*Fallopia japonica*), was recorded during the multidisciplinary surveys for the proposed flood defences. One stand of this species was recorded between the IÉ property boundary and the river in the vicinity of the proposed main construction compound at the north-western end of the proposed development boundary (ITM Grid Reference: 659127, 613604). This stand covered an area of c. 40m^2 and was mostly between the fence and the river, though one plant was in at least its second year of growth in the railway ballast inside the fence at the southern corner of the abandoned iron bridge span. Further stands are known from further up the railway line (beyond the level crossing which is proposed to be used as a haul route) but these are outside the proposed development boundary and not on haul routes.

A number of examples of other invasive but not legally restricted species, including Himalayan Honeysuckle, Butterfly Bush, Traveller's Joy, Cherry Laurel, Cotoneaster, Montbretia, and Winter Heliotrope were recorded within the study area.

2.9 Likely Effects on the Natural Environment

Construction Stage

Disturbance

The use of barges or vessels and sheet piling poses a risk of hydroacoustic impacts on fauna in the River Suir, most notably Twaite Shad, which is particularly sensitive to hydroacoustic impacts given that it is a hearing-specialist species and that juveniles are likely to be present in the estuary at all times of the year.

Artificial lighting poses a risk of negative impacts on biodiversity, particularly Otter, bats and fish, by fragmentation of commuting/foraging corridors, disruption of circadian rhythms and increased risk of predation. Over a prolonged period, such impacts can lead to reduced reproductive success/recruitment. The requirement for nightworks for parts of the construction of the proposed development poses a risk of such impacts.

Water Quality

Due to the use of barges and other construction machinery on and in close proximity to the River Suir, there is a risk of pollution to the river during construction. This could be in the form of spilled fuel, oil, concrete or grout or disturbance of contaminated ground. The aspects of the construction of the proposed development which pose the greatest risk of such impacts include:

- Delivery of piles by barge and driving of piles;
- Remedial works to the existing quay wall where these are proposed;
- Demolition of the existing quay wall at the tie-in points between the landside and riverside sections of the new wall and to 800 mm below ground level from Ch. 360 to Ch. 900; and,
- Works to accommodate one new drainage outfall, as well as existing outfalls to the River Suir where these cross the proposed flood wall.

Given the naturally high sediment load in the River Suir at this location, sedimentation is not considered to pose a significant risk. However, the synergistic effects of the naturally occurring sediment with any pollutants must be considered. Any pollution incident could have significant negative impacts on aquatic and shoreline life depending on the severity of the pollution. Pollution can also have indirect negative impacts on water-dependent terrestrial habitats and species that are hydrologically connected to the source of the pollution.

Dust Deposition

Construction activities will result in the mobilisation of dust into the air. The main sources of dust include:

- Demolition of sections of the existing quay wall;
- Excavations for the proposed impermeable trench through the Plunkett Station car park;
- Excavations as part of drainage works;
- Earthworks (i.e. fill behind the riverside section of the new flood defence wall);
- Sheet piling on land; and,
- Movement of construction vehicles.

This dust will be deposited on the surrounding land, including habitats that are listed as Qualifying Interests of the Lower River Suir SAC. Dust deposition can have negative effects on the vegetation it covers as it reduces the ability of plants to photosynthesise. However, due to the very small quantities of demolition and earthworks, the nature of the fill material (i.e. clean), the fact that construction routes will be on railway ballast rather than dust roads, and short duration of works, as well as the likely washing away of any dust deposited in the estuarine environment during spring tides (every fortnight), this impact will be imperceptible and temporary. Therefore, it does not warrant further consideration in terms of its effect on biodiversity.

Invasive Alien Species

Construction activities pose a risk of the spread of invasive non-native species to, from or within the vicinity of the works. A species of particular concern in this case is Chinese Mitten Crab, which could be spread within the Suir-Barrow-Nore Estuary by barges and other vessels associated with the construction of the proposed development. There is also a risk that poor siting of the construction compound or other construction-related activities could facilitate the spread of Japanese Knotweed, particularly along the railway line, where this species has been recorded.

Design and Operational Stage

Habitat Loss

The proposed development will result in the loss of c. 800m^2 of intertidal mudflats on the northern bank of the River Suir, west of Rice Bridge. This habitat is of a type listed on Annex I to the Habitats Directive, namely 'Mudflats and sandflats not covered by seawater at low tide' (1140), and the area that would be lost is within the Lower River Suir SAC. While not listed as a Qualifying Interest of the SAC, intertidal mudflats are important for the achievement of the conservation objectives for Twaite Shad and other Qualifying Interests of the SAC.

A small area (106m^2) of the Annex I saltmarsh habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) is present at the bottom of the existing quay wall from Ch. 925 to Ch. 975. The riverside sheet pile flood defence wall was originally proposed to tie back into the existing wall at this location. However, in order to avoid any loss of this habitat, which is a Qualifying Interest of the Lower River Suir SAC, the design has been amended so that the new wall will now revert back behind the existing wall c. 50 m earlier, at Ch. 900. This will avoid any direct loss of Annex I saltmarsh habitat.

A small area of hard intertidal substrate (i.e. the existing quay wall) and its associated biological communities will be permanently lost as a result of the proposed development. However, this habitat will be replaced by another hard intertidal surface (either steel sheet pile or highly structured or bio-active pre-cast concrete cladding) and there is potential for enhancement to result in a net increase in the total area and diversity of hard intertidal biodiversity at this location.

Habitat Connectivity

The proposed development also provides for reduced habitat connectivity along the intertidal mudflat corridor due to constriction by c. 1.0-1.5m over a length of c. 540m and associated reduction in the portion of the tidal cycle when there is exposed mudflat. The loss and fragmentation of intertidal mudflat habitat associated with the proposed development are likely to be permanent. This presents a potential negative impact on species which move up and down this corridor, e.g. Otter.

<u>Zonation and Habitat Heterogeneity</u>

The loss of upper intertidal mudflat and c. 540m length of hard upper intertidal and splash zone habitat constitutes a potential reduction in habitat heterogeneity/zonation and, consequently, species diversity. However, there is scope for enhancement of the design to ensure that there is No Net Loss of biodiversity in terms of zonation and habitat heterogeneity.

<u>Hydraulic Impacts</u>

Hydrodynamic modelling was carried out by Hydro Environmental Ltd. (2021) in order to predict any hydraulic changes that the proposed flood defences would create within the River Suir. The model indicated that there would be a slight increase in flow velocity immediately adjacent to the sheet piled wall. However, the increased rate of flow is of insufficient magnitude to provide shear stress that would result in any significant erosion of consolidated sediments within or along the banks of the River Suir. Therefore, the proposed flood defences do not pose a significant risk of creating hydraulic changes that will threaten intertidal mudflats or any other habitats located along the banks of the River Suir, including the Annex I habitat 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)'. Nevertheless, a slight reduction in silt deposition adjacent to the flood will is anticipated. The hydraulic modelling report can be found in Appendix C of this NIS.

<u>Disturbance</u>

There is no new artificial lighting or any other source of ongoing disturbance impacts proposed for the operational phase of the proposed development. Therefore, there will be no ongoing disturbance impacts.

3. IDENTIFICATION OF LIKELY SIGNIFICANT EFFECTS

3.1 Establishing the Likely Zone of Impact

Section 3.2.3 of *Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities* (DEHLG, 2010) outlines the procedure for selecting the European sites to be considered in AA. It states that European sites potentially affected should be identified and listed, bearing in mind the potential for direct, indirect, and cumulative effects. It also states that the specific approach in each case is likely to differ depending on the scale and likely effects of the plan or project. However, it advises that the following sites should generally be included:

- All European sites within or immediately adjacent to the plan or project area;
- All European sites within the likely zone of impact of the plan or project; and
- In accordance with the Precautionary Principle, all European sites for which there is doubt as to whether or not they might be significantly affected.

The "likely zone of impact" of a plan or project is the geographic extent over which significant ecological effects are likely to occur. In the case of plans, this zone should extend to a distance of 15km in all directions from the boundary of the plan area. In the case of projects, however, the guidance recognises that the likely zone of impact must be established on a case-by-case basis, with reference to the following key variables:

- The nature, size, and location of the project;
- The sensitivities of the ecological receptors; and,
- The potential for cumulative effects.

For example, in the case of a project that could affect a watercourse, it may be necessary to include the entire upstream and/or downstream catchment in order to capture all European sites with water-dependent features of interest.

Having regard to the above key variables, the likely zone of impact was defined as the entire area within 500m of the proposed development as well as the entire extent of the transitional waters of the River Suir upstream and downstream of the proposed development. This area was defined as the likely zone of impact because it extends to the maximum distance at which potential impacts may occur, including the extent at which potential impacts may be carried via identified pathways.

A geographical representation of the likely zone of impact was produced in ArcGIS 10.5 using the proposed development boundary and publicly available Ordnance Survey Ireland maps. This was used in combination with NPWS shapefiles to identify the boundaries of European sites in relation to the likely zone of impact (see Plate 3.1 below and Appendix E in Volume 2 of this NIS). It was determined that two European sites occur within the likely zone of impact. Table 3.1 assesses if and how these sites are connected to the proposed development. Detailed descriptions of these sites are given in Section 3.2.

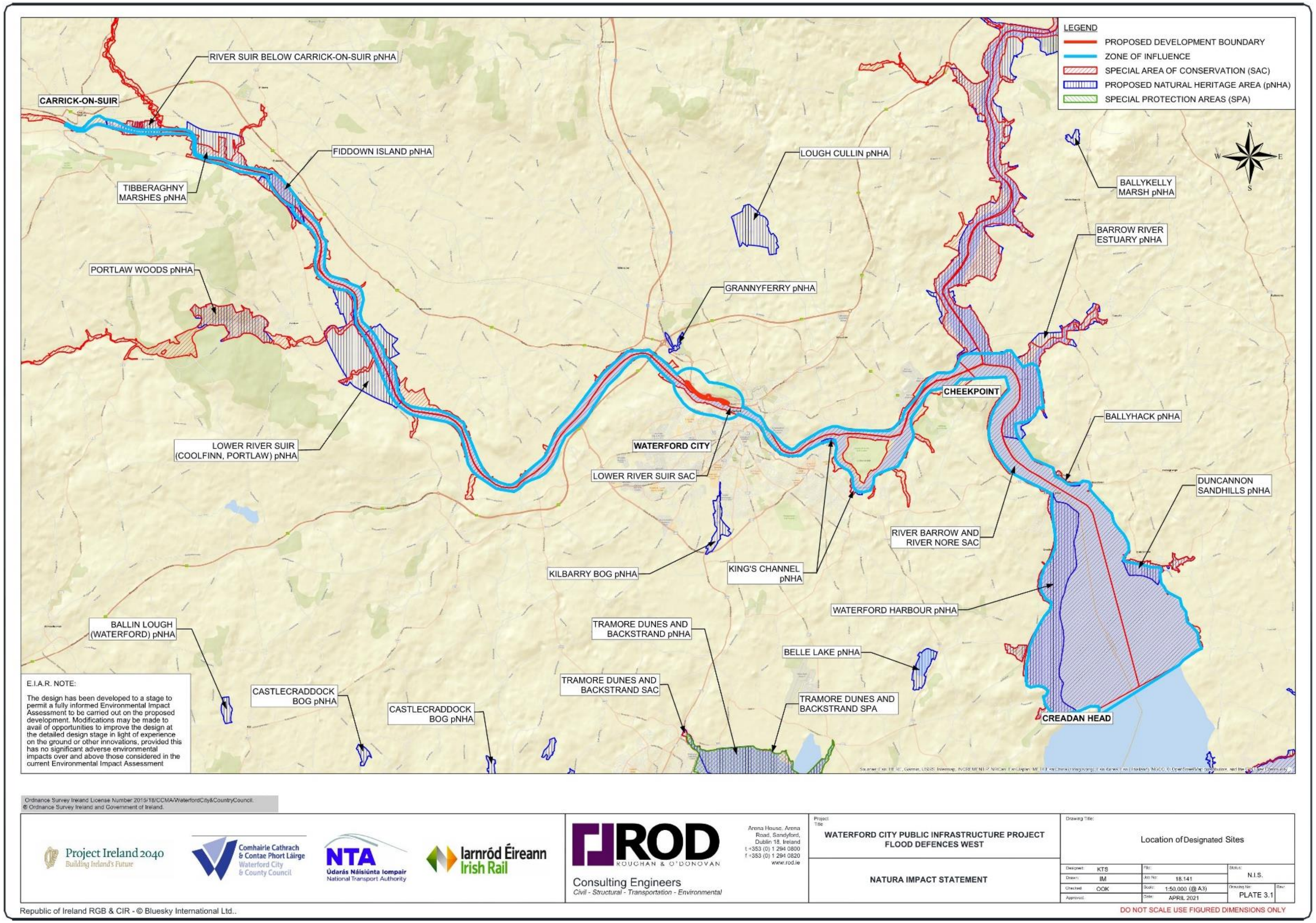


Plate 3.1 **Location of European sites in relation to the likely zone of impact of the proposed development.**

Table 3.1 European sites located within the likely zone of impact

European site [site code]	Are there potential pathways for impacts from the proposed development to this site?
Lower River Suir SAC [002137]	**Yes**. The proposed development itself intersects this European site.
River Barrow and River Nore SAC [002162]	**Yes.** The shortest overland distance from the proposed development to this European site is c. 7.1km (greater than the 500 m likely zone of impact for overland impacts). However, the shortest distance via a hydrological connection is c. 9 km. Therefore, the effective distance to the site is considered to be 9 km. As this site includes part of the transitional waters of the River Suir, there are considered to be pathways for impacts from the proposed development.

3.2 Site Descriptions

3.2.1 Lower River Suir SAC

Site Overview

The Lower River Suir SAC consists of the freshwater stretches of the River Suir south of Thurles, the tidal stretches as far as the confluence with the Barrow/Nore east of Cheekpoint, and many tributaries including the Clodiagh, Lingaun, Anner, Nier, Tar, Aherlow and Multeen. The River Suir and its tributaries flow through the counties of Tipperary, Kilkenny and Waterford.

The Lower River Suir SAC contains excellent examples of a number of Annex I habitats, including the priority habitats[8] alluvial forest and yew woodland. The site also supports populations of several important animal species, some listed on Annex II to the Habitats Directive or in *Ireland Red List No. 12: Terrestrial Mammals* (Marnell et al., 2019). The presence of two plant species protected under the Flora (Protection) Order, 2015 and the ornithological importance of the site adds further to its ecological interest and importance.

Qualifying Interests of the Site

[1330] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

[1410] Mediterranean salt meadows (*Juncetalia maritimi*)

[3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

[6430] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

[91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

[91E0] *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

[91J0] **Taxus baccata* woods of the British Isles

[1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)

[1092] White-clawed Crayfish (*Austropotamobius pallipes*)

[1095] Sea Lamprey (*Petromyzon marinus*)

[8] An asterisk (*) in the title of an Annex I habitat denotes that it is a "priority habitat", i.e. an Annex I habitat in danger of disappearing and for the conservation of which the EU has particular responsibility in view of the proportion of its natural range which falls within the European territory of Member States.

[1096] Brook Lamprey (*Lampetra planeri*)

[1099] River Lamprey (*Lampetra fluviatilis*)

[1103] Twaite Shad (*Alosa fallax*)

[1106] Atlantic Salmon (*Salmo salar*)

[1355] European Otter (*Lutra lutra*)

'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) and 'Mediterranean salt meadows (*Juncetalia maritimi*)' (1410) occur below Waterford City in old meadows where the embankment is absent, or has been breached, and along the tidal stretches of some of the in-flowing rivers below Little Island. There are very narrow, non-continuous bands of this habitat along both banks. More extensive areas are also seen along the south bank at Ballinakill, the east side of Little Island, and in three large salt meadows between Ballinakill and Cheekpoint. The Atlantic and Mediterranean sub-types are generally intermixed. The species list is extensive and includes Red Fescue, oraches, Sea Aster, Sea Couch, frequent Sea Milkwort, occasional Wild Celery, Parsley Water-dropwort, English Scurvygrass and Sea Arrowgrass. These species are more representative of the Atlantic sub-type of the habitat. Common Cord-grass is frequent along the main channel edge and up the internal channels. Meadow Barley, which is protected under the Flora (Protection) Order, 2015, grows at the landward transition of the saltmarsh. Sea Rush, an indicator of the Mediterranean salt meadows, also occurs.

'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' (3260) is evident in the freshwater stretches of the River Suir and along many of its tributaries. Typical species found include Canadian Pondweed, water-milfoils, Fennel Pondweed, Curled Pondweed, Perfoliate Pondweed, Pond Water-crowfoot, other crowfoots and the Greater Water-moss. At a couple of locations along the river Opposite-leaved Pondweed occurs. This species is protected under the Flora (Protection) Order, 2015.

'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' (6430) occurs in association with the various areas of alluvial forest and elsewhere where the floodplain of the river is intact. Characteristic species of the habitat include Meadowsweet, Purple Loosestrife, Marsh Ragwort, Ground Ivy and Hedge Bindweed.

'Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles' (91A0) are also of importance at the site. The best examples are seen in Portlaw Wood on both sides of the Clodiagh River. On the south side, the stand is more open and the oaks (mainly Pedunculate Oak) are well grown and spreading. Ivy and Bramble are common on the ground, indicating relatively high light conditions. Oak regeneration is dense, varying in age from 0-40 years, and Holly is common but mostly young. Across the valley, the trees are more closely spaced and poorly grown. There are no clearings; large oaks extend to the boundary wall. In the darker conditions, Ivy is much rarer and Holly much more frequent, forming a closed canopy in places. Oak regeneration is uncommon since there are few natural clearings. The shallowness of the soil on the north-facing slope probably contributes to the poor tree growth there. The acid nature of the substrate has induced a mountain-type oakwood community to develop. The site is quite species-rich, including an abundance of mosses, liverworts and lichens. The rare lichen *Lobaria pulmonaria*, an indicator of ancient woodlands, is found here.

The best examples of '*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)' (91E0) are found on the islands just below Carrick-on-Suir and at Fiddown Island. Species occurring here include Almond

Willow, White Willow, Rusty Willow, Osier, Yellow Iris, Hemlock Water-dropwort, Wild Angelica, Pendulous Sedge, Meadowsweet and Common Valerian. The terrain is littered with dead trunks and branches and intersected with small channels that carry small streams to the river. The bryophyte and lichen floras appear to be rich. A small plot is currently being coppiced and managed by the NPWS. In the drier areas, species such as Ash, Hazel, Hawthorn and Blackthorn occur.

Two stands of '**Taxus baccata* woods of the British Isles' (91J0), a rare habitat in Ireland and the EU, occur within the site. These are on limestone ridges at Shanbally and Cahir Park.

Other habitats within the Lower River Suir SAC include wet and dry grassland, marsh, reed swamp, improved grassland, coniferous plantations, deciduous woodland, scrub, tidal river, stony shore and mudflats. The most dominant habitat adjoining the river is improved grassland, although there are wet fields with species such as Yellow Iris, Meadowsweet, rushes, Meadow Buttercup and Cuckooflower.

The site is of particular conservation interest for the presence of a number of Annex II species, including Freshwater Pearl Mussel, White-clawed Crayfish, Salmon, Twaite Shad, Sea Lamprey, Brook Lamprey and River Lamprey and Otter. This is one of only three known spawning grounds in the country for Twaite Shad.

Parts of the Lower River Suir SAC have been identified as of ornithological importance for a number of Annex I (Birds Directive) species, including Greenland White-fronted Goose, Golden Plover, Whooper Swan and Kingfisher. Flocks are seen in Coolfinn Marsh and along the reedbeds and saltmarsh areas of the Suir. Coolfinn supports nationally important numbers of Greylag Goose on a regular basis. Other species occurring include Mallard, Teal, Wigeon, Tufted Duck, Pintail, Pochard, Little Grebe, Black-tailed Godwit, Oystercatcher, Lapwing, Dunlin, Curlew, Redshank, Greenshank and Green Sandpiper. Nationally important numbers of Lapwing were recorded at Faithlegg in the winter of 1996-1997. Kingfisher, a species listed on Annex I to the Birds Directive, occurs along some of the many tributaries throughout the site.

Sensitivities of the Lower River Suir SAC and its Qualifying Interests

Land use within the site consists mainly of agricultural activities including grazing, silage production (with the use of fertilisers) and land reclamation. The grassland is intensively managed and the rivers are, therefore, vulnerable to pollution from run-off of fertilisers and slurry. Arable crops are also grown. Fishing is one of the main tourist attractions along stretches of the River Suir and some of its tributaries, and there are a number of angling clubs, some with a number of beats. Fishing stands and styles have been erected in places. Both commercial and leisure fishing takes place on the rivers. The Aherlow River is a designated Salmonid Water under the Freshwater Fish Directive (2006/44/EC). Other recreational activities such as boating, golfing and walking are also popular. Several industrial developments, which discharge into the river, border the site, including three dairy-related operations and a tannery.

3.2.2 River Barrow and River Nore SAC

Site Overview

This site consists of the freshwater stretches of the Barrow and Nore River catchments as far upstream as the Slieve Bloom Mountains, and it also includes the tidal elements and estuary as far downstream as Creadan Head. The site passes through eight counties: Offaly, Kildare, Laois, Carlow, Kilkenny, Tipperary, Wexford and Waterford. Towns along the edge of the site include Mountmellick, Portarlington, Monasterevin, Stradbally, Athy, Carlow, Leighlinbridge, Graiguenamanagh, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow, and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore.

Overall, the River Barrow and River Nore SAC is of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II to the Habitats Directive. Furthermore, it is of high conservation value for the populations of bird species that use it. The occurrence of several plant species listed in *Ireland Red List No. 10: Vascular Plants* (Wyse Jackson et al., 2016), including three rare plants in the salt meadows and the population of the hard water form of the Freshwater Pearl Mussel, which is limited to a 10km stretch of the Nore, add further interest to this site.

Qualifying Interests of the Site

[1130] Estuaries

[1140] Mudflats and sandflats not covered by seawater at low tide

[1170] Reefs

[1310] *Salicornia* and other annuals colonising mud and sand

[1330] Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)

[1410] Mediterranean salt meadows (*Juncetalia maritimi*)

[3260] Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation

[4030] European dry heaths

[6430] Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

[7220] *Petrifying springs with tufa formation (*Cratoneurion*)

[91A0] Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles

[91E0] *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)

[1016] Desmoulin's Whorl Snail (*Vertigo moulinsiana*)

[1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)

[1092] White-clawed Crayfish (*Austropotamobius pallipes*)

[1095] Sea Lamprey (*Petromyzon marinus*)

[1096] Brook Lamprey (*Lampetra planeri*)

[1099] River Lamprey (*Lampetra fluviatilis*)

[1103] Twaite Shad (*Alosa fallax*)

[1106] Atlantic Salmon (*Salmo salar*)

[1355] European Otter (*Lutra lutra*)

[1421] Killarney Fern (*Trichomanes speciosum*)

[1990] Nore Freshwater Pearl Mussel (*Margaritifera durrovensis*)

'Estuaries' (1130) and the other Annex I habitats within it form a large component of the site. Extensive areas of 'Mudflats and sandflats not covered by seawater at low tide' (1140), comprised of substrates ranging from fine, silty mud to coarse sand with pebbles/stones are present. Good quality intertidal sand and mudflats have developed on a linear shelf on the western side of Waterford Harbour, extending for over 6km from north to south between Passage East and Creadan Head and are over 1km wide in places. The sediments are mostly firm sands, though grade into muddy sands towards the upper shore. They have a typical macro-invertebrate fauna, characterised by polychaetes and bivalves. Common species include *Arenicola marina*, *Nephtys hombergii*, *Scoloplos armiger*, *Lanice conchilega* and *Cerastoderma edule*. An extensive area of Honeycomb Worm biogenic reef, i.e. 'Reefs' (1170), occurs adjacent to Duncannon, on the eastern shore of the estuary.

'*Salicornia* and other annuals colonising mud and sand' (1310) are found in the creeks of the saltmarshes and at their seaward edges. The habitat also occurs in small amounts on some stretches of the shore free of stones.

'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) and 'Mediterranean salt meadows (*Juncetalia maritimi*)' (1410) 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 below Stokestown House, in a narrow band on the channel side of Common Reed beds and in narrow fragmented strips along the open shoreline. In the larger areas of salt meadow, notably at Carrickcloney, Ballinlaw Ferry and Rochestown on the west bank, and Fisherstown, Alderton and Great Island to Dunbrody on the east bank, the Atlantic and Mediterranean sub-types are generally intermixed. At the upper edge of the salt meadow, in the narrow ecotonal areas bordering the grasslands where there is significant percolation of salt water, the legally protected Borrer's Saltmarsh-grass and Meadow Barley are found. The very rare and also legally protected Divided Sedge is also found. Sea Rush is also present. Other plants recorded and associated with salt meadows include Sea Aster, Thrift, Sea Couch, Spear-leaved Orache, Lesser Sea-spurrey, Sea Arrowgrass and Sea Plantain.

'Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation' (3260) are well represented in the River Barrow and in the many tributaries of the site. In the River Barrow, the species found include water-starworts, Canadian Pondweed, Bulbous Rush, water-milfoils, the pondweed *Potamogeton* × *nitens,* Broad-leaved Pondweed, Fennel Pondweed, Perfoliate Pondweed and crowfoots. The water quality of the River Barrow has improved since the vegetation survey was carried out in 1996.

'European dry heaths' (4030) 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. The dry heath vegetation along the slopes of the riverbank consists of Bracken and Gorse, with patches of acidic grassland vegetation. Additional typical species include Heath Bedstraw, Foxglove, Common Sorrel and Creeping Bent. On rocky outcrops, Bilberry and Great Wood-rush are present. At Ballyhack, a small area of dry heath is interspersed with patches of lowland dry grassland. Dry heath at the site generally grades into wet woodland or wet swamp vegetation lower down the slopes on the riverbank.

'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' (6430) occurs in association with the various areas of alluvial forest and elsewhere where the floodplain of the river is intact. Characteristic species of the habitat include Meadowsweet, Purple Loosestrife, Marsh Ragwort, Ground Ivy and Hedge Bindweed. Himalayan Balsam, an alien invasive species, is abundant in places.

A good example of '*Petrifying springs with tufa formation (*Cratoneurion*)' (7220) occurs at Dysart Wood along the River Nore. This is a rare habitat in Ireland and one listed with priority status on Annex I of the Habitats Directive. These hard-water springs are characterised by lime encrustations, often associated with small waterfalls.

A rich bryophyte flora is typical of the habitat and two diagnostic species, *Palustriella commutata* and *Eucladium verticillatum*, have been recorded.

The best examples of 'Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles' (91A0) are seen in the ancient Park Hill woodland in Abbeyleix Estate, at Kyleadohir on the Delour, Forest Wood House, Kylecorragh and Brownstown Woods along the River Nore, and at Cloghristic Wood, Drummond Wood and Borris Demesne along the River Barrow, though other patches occur throughout the site.

Good examples of '*Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)' (91E0) occur at Rathsnagadan, Murphy's of the River, Abbeyleix Estate and along other shorter stretches of both the tidal and freshwater elements of the site. Typical species seen include Almond Willow, White Willow, Rusty Willow, Crack Willow and Osier, along with Yellow Iris, Hemlock Water-dropwort, Wild Angelica, Thin-spiked Wood-sedge, Pendulous Sedge, Meadowsweet, Common Valerian and the Red Data Book species Nettle-leaved Bellflower.

Other habitats found throughout the site include wet grassland, marsh, reed swamp, improved grassland, arable land, quarries, coniferous plantations, deciduous woodland, scrub and ponds.

Seventeen Irish Red List plant species have been recorded within the site: Killarney Fern, Divided Sedge, Clustered Clover, Basil Thyme, Red Hemp-nettle, Borrer's Saltmarsh-grass, Meadow Barley, Opposite-leaved Pondweed, Meadow Saffron/Autumn Crocus, Wild Clary/Sage, Nettle-leaved Bellflower, Saw-wort, Bird Cherry, Blue Fleabane, Fly Orchid, Ivy Broomrape and Greater Broomrape. Of these, the first nine are protected under the Flora (Protection) Order, 2015. Other plants that do not have a wide distribution in the country are found in the site, including Thin-spiked Wood-sedge, Field Garlic and Summer Snowflake. Six rare lichens, indicators of ancient woodland, are found including *Lobaria laetevirens* and *L. pulmonaria.* The rare moss *Leucodon sciuroides* also occurs.

The site is very important for the presence of a number of Annex II species, including Freshwater Pearl Mussel (both *Margaritifera margaritifera* and *M. durrovensis*), White-clawed Crayfish, Atlantic Salmon, Twaite Shad, Sea Lamprey, Brook Lamprey, River Lamprey, Desmoulin's Whorl Snail and European Otter. This is the only site in the world for the hard-water margaritiferid, the Nore Freshwater Pearl Mussel, and one of only a handful of spawning grounds in the country for Twaite Shad. The freshwater stretches of the River Nore (main channel) is a designated salmonid river. The River Barrow/ River Nore is mainly a grilse fishery though spring salmon fishing is good in the vicinity of Thomastown and Inistioge on the River Nore. The upper stretches of the River Barrow and River Nore, particularly the Owenass River, are very important for spawning.

The site supports many other important animal species. Those which are listed in the Irish Red Lists include Daubenton's Bat, Badger, Irish Hare and Common Frog. The rare Red List fish species Smelt occurs in estuarine stretches of the site. In addition to Freshwater Pearl Mussel, the site also supports two other freshwater mussel species, *Anodonta anatina* and *A. cygnea*.

The site is of ornithological importance for a number of Annex I (Birds Directive) species, including Greenland White-fronted Goose, Whooper Swan, Bewick's Swan, Bar-tailed Godwit, Peregrine and Kingfisher. Nationally important numbers of Golden Plover and Bar-tailed Godwit are found during the winter. Wintering flocks of migratory birds are seen in Waterford Harbour. There is also an extensive autumnal roosting site in the reedbeds of the Barrow Estuary used by Swallows before they leave the country. The reedbed at Woodstown supports populations of typical waterbirds including Mallard, Snipe, Sedge Warbler and Water Rail.

Sensitivities of the River Barrow and River Nore SAC and its Qualifying Interests

Land use within the SAC consists mainly of agricultural activities, mostly intensive and principally grazing and silage production. Slurry is spread over much of the area. Arable crops are also grown. The spreading of slurry and fertiliser poses a threat to water quality and populations of Annex II species within the site. Many of the woodlands along the rivers belong to old estates and support many non-native species. Fishing is a main tourist attraction along stretches of the main rivers and their tributaries and there are a number of angling clubs, some with a number of beats. Both commercial and leisure fishing takes place on the rivers. There is net fishing and a mussel bed in the estuary. Other recreational activities such as boating, golfing and walking, particularly along the Barrow towpath, are also popular. There is a golf course on the banks of the River Nore at Mount Juliet and sports pitches at Inistioge and Thomastown. There are active and disused sand and gravel pits throughout the site. Several industrial developments, which discharge into the river, border the site. New Ross is an important shipping port and shipping to and from Waterford and Belview ports also passes through the estuary.

The main threats to the SAC and current damaging activities include high inputs of nutrients into the river system from agricultural run-off and several sewage plants, over-grazing in the woodland areas, and invasion by non-native species, e.g. Cherry Laurel and Rhododendron. Water quality remains vulnerable. Good quality water is necessary to maintain the populations of Annex II species and is dependent on controlling fertilisation of the grasslands, particularly along the River Nore. It also requires that sewage be properly treated before discharge. Drainage activities in the catchment can lead to flash floods which can damage the many Annex II species present. Capital and maintenance dredging within the lower reaches of the system pose a threat to migrating fish species such as Lamprey and Shad. Land reclamation also poses a threat to the salt meadows and the protected species therein.

3.3 Evaluation against Conservation Objectives

Tables 3.2 and 3.3 below detail the evaluation of the likely effects of the proposed development, as outlined in Section 2.7 above, in view of the Conservation Objectives of the sites identified in Section 3.1 and described in section 3.2. As explained in Sections 1.2 and 1.3, AA is carried out in view of the Conservation Objectives of the relevant European sites, which are in turn defined by detailed Attributes and corresponding Targets. Therefore, the evaluation of whether or not a likely effect is significant (in view of the Conservation Objective in question) is made with regard to these Attributes and Targets.

Table 3.2 Evaluation of the likely effects of the proposed development in view of the Conservation Objectives of the Lower River Suir SAC.

Qualifying Interest	Conservation Objective as per NPWS (2017)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	"*To restore the favourable conservation condition of Atlantic salt meadows (Glauco-Puccinellietalia maritimae) in Lower River Suir SAC*"	Atlantic and Mediterranean salt meadows occur on the banks of the River Suir within the likely zone of impact and there is one area of Atlantic salt meadows present within the boundary of the proposed development. These habitat types are sensitive to changes in sediment supply and hydrological regime. The permanent changes to the profile and structure of the intertidal benthos along the extent of the proposed development present a risk of such impacts. Therefore, adverse effects on the Conservation Objectives for these Qualifying Interests cannot be ruled out at this stage.	Yes
Mediterranean salt meadows (*Juncetalia maritimi*)	"*To restore the favourable conservation condition of Mediterranean salt meadows (Juncetalia maritimi) in Lower River Suir SAC*"		
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	"*To maintain the favourable conservation condition of Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation in Lower River Suir SAC*"	This habitat type is found throughout the freshwater stretches of rivers in Ireland and also occurs in the upper part of river estuaries. The salinity levels in the River Suir in the vicinity of the proposed development are considered too high for this habitat to occur and no evidence of this habitat type was observed during the surveys. Given the dilution capacity of the River Suir, any water quality impacts are likely to be imperceptible at such a distance upstream of the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	"*To maintain the favourable conservation condition of Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels in Lower River Suir SAC*"	No examples of hydrophilous tall herb fringe communities occur within the footprint of the proposed development. Therefore, there will be no direct effect on this Qualifying Interest. However, it is likely to be present along the River Suir and connected watercourses in the likely zone of impact. Owing to the nature of the proposed development and the sensitivity of this habitat type to hydrological impacts, e.g. pollution or changes in hydrological regime, there is potential for indirect effects. Therefore, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes

Qualifying Interest	Conservation Objective as per NPWS (2017)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	"*To restore the favourable conservation condition of Old sessile oak woods with Ilex and Blechnum in the British Isles in Lower River Suir SAC*"	Old sessile oak woods do not occur within the footprint of the proposed development or in close proximity thereto. While this habitat may be present within the wider likely zone of impact, it is an entirely terrestrial habitat and not sensitive to the types of remote or indirect impacts likely to arise from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the project will not adversely affect the Conservation Objectives for this Qualifying Interests.	No
***Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)**	"*To restore the favourable conservation condition of Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae) in Lower River Suir SAC*"	No examples of alluvial forests occur within the footprint of the proposed development. Therefore, there will be no direct effect on this Qualifying Interest. However, it is likely to be present along the River Suir and connected watercourses in the likely zone of impact. Owing to the nature of the proposed development and the sensitivity of this habitat type to hydrological impacts, e.g. changes in hydrological regime, there is potential for indirect effects. Therefore, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes
****Taxus baccata* woods of the British Isles**	"*To restore the favourable conservation condition of Taxus baccata woods of the British Isles in Lower River Suir SAC*"	Yew woods do not occur within the footprint of the proposed development or in close proximity thereto. While this habitat may be present within the wider likely zone of impact, it is an entirely terrestrial habitat and not sensitive to the types of remote or indirect impacts likely to arise from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the project will not adversely affect the Conservation Objectives for this Qualifying Interests.	No
Freshwater Pearl Mussel (*Margaritifera margaritifera*)	"*To restore the favourable conservation condition of Freshwater Pearl Mussel in Lower River Suir SAC*"	Freshwater Pearl Mussel and White-clawed Crayfish are exclusively freshwater species and, therefore, are not located within the likely zone of impact. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objectives for these Qualifying Interests.	No
White-clawed Crayfish (*Austropotamobius pallipes*)	*"To maintain the favourable conservation condition of White-clawed Crayfish in Lower River Suir SAC"*		
Sea Lamprey (*Petromyzon marinus*)	*"To restore the favourable conservation condition of Sea Lamprey in Lower River Suir SAC"*	Lamprey species and Atlantic Salmon are known to migrate through the River Suir estuary, past the site of the proposed development. These species are sensitive to water quality and lighting impacts. Lamprey species will also be particularly vulnerable to hydroacoustic disturbance during the day as they rest near the edge of the channel	Yes

Qualifying Interest	Conservation Objective as per NPWS (2017)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Brook Lamprey (*Lampetra planeri*)	*"To restore the favourable conservation condition of Brook Lamprey in Lower River Suir SAC"*	where sheet piling will take place. Considering the likelihood of a spillage of pollutants to occur, the use of artificial lighting and the close proximity of the works to the river, adverse effects on the Conservation Objectives for these Qualifying Interests cannot be ruled out at this stage.	
River Lamprey (*Lampetra fluviatilis*)	*"To restore the favourable conservation condition of River Lamprey in Lower River Suir SAC"*		
Atlantic Salmon (*Salmo salar*)	*"To restore the favourable conservation condition of Atlantic Salmon in Lower River Suir SAC"*		
Twaite Shad (*Alosa fallax fallax*)	*"To restore the favourable conservation condition of Twaite Shad in Lower River Suir SAC"*	Twaite Shad is known to be present in immediate proximity to the proposed development. This species is sensitive to water quality and lighting impacts and highly sensitive to hydroacoustic impacts. The estuary is particularly important for juveniles as they spend the first two years of their lives moving up and down the estuary feeding on copepods and other zooplankton found at the transition between fresh and salt water. These fish are generally found in the centre of the channel during the day and closer to the edges at night. Thus, hydroacoustic impacts and night-time disturbance pose a particularly high risk to these fish. Given the sensitivity of this species to the impacts associated with the construction of the proposed development, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes
European Otter (*Lutra lutra*)	*"To maintain the favourable conservation condition of Otter in Lower River Suir SAC"*	Otter is known to occur in the immediate vicinity of the proposed development. As the proposed development provides for significant noise and visual disturbance during the construction phase and potential impacts on prey species, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes

Table 3.3 Evaluation of the likely effects of the proposed development in view of the Conservation Objectives of the River Barrow and River Nore SAC.

Qualifying Interest	Conservation Objective as per NPWS (2011a)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Estuaries	"*To maintain the favourable conservation condition of Estuaries in the River Barrow and River Nore SAC*"	Estuaries and mudflats occur within the River Barrow and River Nore SAC c. 9 km downstream of the proposed development. Hydrodynamic, hydrological, sedimentation and water quality impacts arising from the proposed development have the potential to adversely affect the Conservation Objectives for these Qualifying Interests.	Yes
Mudflats and sandflats not covered by seawater at low tide	"*To maintain the favourable conservation condition of the Mudflats and sandflats not covered by seawater at low tide in the River Barrow and River Nore SAC*"		
Reefs	NPWS (2011a) does not contain a site-specific Conservation Objective for Reefs. Therefore, as per advice from the NPWS, the Conservation Objective for Reefs in another European site, in this case the Hook Head SAC [000764], was used: "*To maintain the favourable conservation condition of Reefs*" (NPWS, 2011b).	Reefs are present in the River Barrow and River Nore SAC downstream of the proposed development. Changes in sediment transportation patterns arising from the proposed development have the potential to impact on reef communities. Therefore, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes
***Salicornia* and other annuals colonising mud and sand**	"*To maintain the favourable conservation condition of* Salicornia *and other annuals colonizing mud and sand in the River Barrow and River Nore SAC*"	The habitat type '*Salicornia* and other annuals colonising mud and sand' occurs within the River Barrow and River Nore SAC c. 9 km downstream of the proposed development. Hydrodynamic, hydrological, sedimentation and water quality impacts arising from the proposed development have the potential to adversely affect the Conservation Objective for this Qualifying Interest.	Yes

Qualifying Interest	Conservation Objective as per NPWS (2011a)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	"*To restore the favourable conservation condition of Atlantic salt meadows in the River Barrow and River Nore SAC*"	Atlantic and Mediterranean salt meadows are considered likely to occur within the River Barrow and River Nore SAC downstream of the proposed development. Hydrodynamic, hydrological, sedimentation and water quality impacts arising from the proposed development have the potential to adversely affect the Conservation Objectives for these Qualifying Interests.	Yes
Mediterranean salt meadows (*Juncetalia maritimi*)	"*To restore the favourable conservation condition of Mediterranean salt meadows in the River Barrow and River Nore SAC*"		
Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation	"*To maintain the favourable conservation condition of Water courses of plain to montane levels with the* Ranunculion fluitantis *and* Callitricho-Batrachion *vegetation in the River Barrow and River Nore SAC*"	This habitat type is found throughout the freshwater stretches of rivers in Ireland and also occurs in the upper part of river estuaries. The salinity levels in the River Suir in the vicinity of the proposed development are considered too high for this habitat to occur and no evidence of this habitat type was observed during the surveys. Given the dilution capacity of the River Suir, any water quality impacts are likely to be imperceptible at such a distance from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
European dry heaths	"*To maintain the favourable conservation condition of European dry heaths in the River Barrow and River Nore SAC*"	European dry heaths are not known to occur within the likely zone of impact of the proposed development and are not sensitive to the types of remote or indirect impacts likely to arise from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	"*To maintain the favourable conservation condition of Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels in the River Barrow and River Nore SAC*"	No examples of hydrophilous tall herb fringe communities occur within the footprint of the proposed development. Therefore, there will be no direct effect on this Qualifying Interest. However, it is likely to be present along the River Suir and connected watercourses in the likely zone of impact. Owing to the nature of the proposed development and the sensitivity of this habitat type to hydrological impacts, e.g. pollution or changes in hydrological regime, there is potential for indirect effects. Therefore, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes

Qualifying Interest	Conservation Objective as per NPWS (2011a)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
***Petrifying springs with tufa formation (*Cratoneurion*)**	"*To maintain the favourable conservation condition of Petrifying springs with tufa formation (*Cratoneurion*) in the River Barrow and River Nore SAC*"	Petrifying springs are not known to occur within the likely zone of impact of the proposed development and are not sensitive to the types of remote or indirect impacts likely to arise from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	"*To restore the favourable conservation condition of Old oak woodland with* Ilex *and* Blechnum *in the River Barrow and River Nore SAC*"	Old sessile oak woods do not occur within the footprint of the proposed development or in close proximity thereto. While this habitat may be present within the wider likely zone of impact, it is an entirely terrestrial habitat and not sensitive to the types of remote or indirect impacts likely to arise from the proposed development. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objectives for this Qualifying Interests.	No
***Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)**	"*To restore the favourable conservation condition of Alluvial forests with* Alnus glutinosa *and* Fraxinus excelsior *(*Alno-Padion*,* Alnion incanae*,* Salicion albae*) in the River Barrow and River Nore SAC*"	No examples of alluvial forests occur within the footprint of the proposed development. Therefore, there will be no direct effect on this Qualifying Interest. However, it is likely to be present along the River Suir and connected watercourses in the likely zone of impact. Owing to the nature of the proposed development and the sensitivity of this habitat type to hydrological impacts, e.g. changes in hydrological regime, there is potential for indirect effects. Therefore, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes
Desmoulin's Whorl Snail (*Vertigo moulinsiana*)	"*To maintain the favourable conservation condition of Desmoulin's whorl snail in the River Barrow and River Nore SAC*"	Desmoulin's Whorl Snail may occur in the tall herb swamps and saltmarshes fringing the estuary or on connected watercourses of the proposed development. Potential impacts on these habitats arising from the proposed development, e.g. water quality or hydrological regime, may give rise to adverse effects on the Conservation Objective for this Qualifying Interest.	Yes

Qualifying Interest	Conservation Objective as per NPWS (2011a)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Freshwater Pearl Mussel (*Margaritifera margaritifera*)	"*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. The outcome of this review will determine whether a site-specific conservation objective is set for this species.*"	Freshwater Pearl Mussel is exclusively a freshwater species and, therefore, does not occur within the likely zone of impact of the proposed development. Thus, there are no pathways for impacts from the proposed development to this species. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
White-clawed Crayfish (*Austropotamobius pallipes*)	"*To maintain the favourable conservation condition of White-clawed crayfish in the River Barrow and River Nore SAC*"	White-clawed Crayfish is exclusively a freshwater species and, therefore, does not occur within the likely zone of impact for the proposed development. Thus, there are no pathways for impacts from the proposed development to this species. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
Sea Lamprey (*Petromyzon marinus*)	"*To restore the favourable conservation condition of Sea lamprey in the River Barrow and River Nore SAC*"	Lamprey species, Twaite Shad and Atlantic Salmon are known to migrate through the Suir-Barrow-Nore Estuary during their migrations, and juvenile Twaite Shad spend the first two years of their lives in the estuary. All of these species are sensitive to water quality and lighting impacts. As the proposed development provides for such impacts, adverse effects on the Conservation Objectives for these Qualifying Interests cannot be ruled out at this stage.	Yes
Brook Lamprey (*Lampetra planeri*)	"*To restore the favourable conservation condition of Brook lamprey in the River Barrow and River Nore SAC*"		
River Lamprey (*Lampetra fluviatilis*)	"*To restore the favourable conservation condition of River lamprey in the River Barrow and River Nore SAC*"		
Twaite Shad (*Alosa fallax*)	"*To restore the favourable conservation condition of Twaite shad in the River Barrow and River Nore SAC*"		

Qualifying Interest	Conservation Objective as per NPWS (2011a)	Does the proposed development provide for any potential delay or interruption in the achievement of this Conservation Objective, as defined by its Attributes and Targets?	Potential Adverse Effect
Atlantic Salmon (*Salmo salar*)	"*To restore the favourable conservation condition of Salmon in the River Barrow and River Nore SAC*"		
European Otter (*Lutra lutra*)	"*To restore the favourable conservation condition of Otter in the River Barrow and River Nore SAC*"	European Otter is known to occur in the immediate vicinity of the proposed development. As the proposed development provides for significant noise and visual disturbance during the construction phase and potential impacts on prey species for otters, adverse effects on the Conservation Objective for this Qualifying Interest cannot be ruled out at this stage.	Yes
Killarney Fern (*Trichomanes speciosum*)	"*To maintain the favourable conservation condition of Killarney Fern in the River Barrow and River Nore SAC*"	Killarney Fern is not known to occur in the likely zone of impact of the proposed development and suitable habitat for this species is not found in the vicinity of the proposed development. Thus, there are no pathways for impacts from the proposed development to Killarney Fern. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No
Nore Freshwater Pearl Mussel (*Margaritifera durrovensis*)	"*To restore the favourable conservation condition of the Nore freshwater pearl mussel in the River Barrow and River Nore SAC*"	Nore Freshwater Pearl Mussel is found only in the River Nore near Durrow. It does not occur in the likely zone of impact of the proposed development. Thus, there are no pathways for impacts from the proposed development to this species. Therefore, it can be concluded beyond reasonable scientific doubt that the proposed development will not adversely affect the Conservation Objective for this Qualifying Interest.	No

3.4 Summary of Potential Adverse Effects

In Section 3.1, it was established that two European sites, namely the Lower River Suir SAC and the River Barrow and River Nore SAC, occur within or adjacent to the likely zone of impact of the proposed development and that there are no pathways for effects between the proposed development and any other European sites.

In Section 3.3, it was established that, in the absence of appropriate mitigation, interruptions or delays in achieving certain Conservation Objectives for those sites, i.e. adverse effects on the integrity of those sites, as a result of the proposed development, cannot be ruled out. A summary of the potential adverse effects identified is given in Table 3.4 below.

Table 3.4 Summary of the European sites and their Qualifying Interests for which, in view of their Conservation Objectives, adverse effects cannot be ruled out at this stage.

European site	Qualifying Interest
Lower River Suir SAC	Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Mediterranean salt meadows (*Juncetalia maritimi*) Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) Sea Lamprey (*Petromyzon marinus*) Brook Lamprey (*Lampetra planeri*) River Lamprey (*Lampetra fluviatilis*) Atlantic Salmon (*Salmo salar*) Twaite Shad (*Alosa fallax*) European Otter (*Lutra lutra*)
River Barrow and River Nore SAC	Estuaries Mudflats and sandflats not covered by seawater at low tide Reefs *Salicornia* and other annuals colonising mud and sand Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) Mediterranean salt meadows (*Juncetalia maritimi*) Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels *Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*) Desmoulin's Whorl Snail (*Vertigo moulinsiana*) Sea Lamprey (*Petromyzon marinus*) Brook Lamprey (*Lampetra planeri*) River Lamprey (*Lampetra fluviatilis*) Twaite Shad (*Alosa fallax*) Atlantic Salmon (*Salmo salar*) European Otter (*Lutra lutra*)

4. ASSESSMENT OF ADVERSE EFFECTS

4.1 Attributes and Targets

In Section 3.0 of this NIS, potential adverse effects of the proposed development on the integrity of the Lower River Suir SAC and the River Barrow and River Nore SAC were identified. In accordance with EC (2001), the identification of these effects was focussed on and limited to the Conservation Objectives of the sites concerned.

Section 4.0 provides a detailed analysis and evaluation of the adverse effects identified in Section 3.0 (as summarised in Section 3.4). In order to fully assess the implications of the proposed development for the European sites concerned, each of the potential adverse effects is evaluated with reference to the Attributes and Targets which define the Conservation Objectives of those sites.

4.2 Lower River Suir SAC

4.2.1 Annex I Saltmarsh Habitats

The two types of Annex I saltmarsh habitats listed as Qualifying Interests of the Lower River Suir SAC and potentially adversely affected by the proposed development are 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' and 'Mediterranean salt meadows (*Juncetalia maritimi*)'. The Conservation Objectives for these habitats in the Lower River Suir SAC are stated in Table 3.2 above and the Attributes of these are summarised as follows:

- Habitat area and distribution;
- Physical structure (sediment supply; creeks and pans; flooding regime);
- Vegetation structure (zonation; sward height; vegetation cover); and,
- Vegetation composition (typical species and subcommunities; negative indicator species, i.e. *Spartina anglica*).

Habitat Area and Distribution

Of the two Annex I saltmarsh habitat types listed as Qualifying Interests of the Lower River Suir SAC, only the 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' (1330) type occurs within the proposed development boundary. An area of 106m^2 of this habitat is present between the existing quay wall and the high-water mark from approximately Ch. 925 to Ch. 975.

Direct impacts on this area have been avoided entirely by moving the western tie-in point of the new flood defence wall with the existing quay wall, which was originally proposed at Ch. 950, to its new position at Ch. 900, which is 25m further east than the most westerly point of this area of this habitat. There are no other areas of Annex I saltmarsh habitats within the extents of the proposed development.

Potential indirect impacts on this area and areas of Annex I saltmarsh habitats outside the proposed development boundary are discussed under the headings of physical structure, vegetation structure and vegetation composition below.

Physical Structure

Sediment Supply

The sediment mobility assessment undertaken in *Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall* (Hydro Environmental, 2021), which is included in Appendix C to this NIS, found that "*under both existing and proposed cases sufficient velocities are generated* […] *to mobilise only the fresher unconsolidated fine silts that might at slack tides temporarily deposit along the channel bank in the vicinity of the proposed flood wall*" and that "*the computed velocity increases* […] *are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments /muds on the channel bed and banks in the vicinity of the affected area*". Therefore, the proposed flood will not cause any change to sediment supply to any examples of Annex I saltmarsh habitats in the Lower River Suir SAC.

Creeks and Pans

As the proposed development does not involve any physical disturbance within Annex I saltmarsh habitats, does not provide for any change to the hydrological regime at, or sediment supply to, any Annex I saltmarsh habitats, it can be concluded on the basis of best scientific knowledge that the proposed development will not adversely affect the creek-and-pan morphology of any examples of Annex I saltmarsh habitats.

Flooding Regime

Chapter 10 Hydrology of the EIAR states that the volumes of water displaced by the proposed flood defences during the construction phase are "*extremely small relative to the volumes of the receiving waterbodies and will result in an imperceptible impact on flood levels and subsequent flood risk in the vicinity of the subject site*". Therefore, there will be no change to the flooding regime in any example of Annex I saltmarsh habitats as a result of the proposed development.

Vegetation Structure and Composition

Water Quality

As the proposed development does not involve any physical disturbance to saltmarsh habitats, it will not cause any direct change in the structure or composition of any such vegetation, e.g. by clearing vegetation, encouraging grazing, removing characteristic species or introducing invasive species. However, there is considered to be a risk of pollution to this habitat, which could adversely affect these Attributes, in the event that potential impacts from the proposed development on water quality are conveyed to these habitats by inundation or interaction with ground water. Potential impacts of the construction and operation of the proposed development on water quality, insofar as they are relevant for saltmarsh habitats, are discussed below.

Construction Phase

Construction activities within and adjacent to surface waters, e.g. rivers, can negatively impact water quality. In the case of the proposed Flood Defences West, the construction of the proposed development, if not properly managed, has the potential to impact on water quality as follows:

- Elevated silt/sediment loading within the River Suir from construction site run-off and sheet piling:
  - Run-off from landside construction will be limited due to the existing high-infiltration surfaces of the railway and the associated lands. The exception to this is the hardstanding areas in the vicinity of Rice Bridge and Plunket station.
  - Sheet piling will be undertaken both from the land side and from barges for river-side installation. Additionally, 3 No. temporary cofferdams will be required to construct 1 No. proposed surface water outfall structure and to upgrade 2 No. existing outfall structures.

  - Other pollutants in the watercourse can bind to silt which can lead to increased bioavailability of these pollutants. As noted above, naturally high levels of suspended sediment in the River Suir at this location have the potential to magnify the effects of other pollutants.
- Spillage of concrete, grout and other cement-based products: Cement-based products are highly alkaline (releasing fine highly alkaline silt) and extremely corrosive and can result in significant impact to watercourses altering their pH, smothering the stream bed and physically damaging fish through burning and clogging of gills due to the fine silt.
- Accidental spillage of hydrocarbons from construction plant and refuelling operations at storage depots/construction compounds.
- Faecal contamination arising from inadequate treatment of on-site toilets and washing facilities.

Given the scale and duration of the construction works for the proposed development, the risk and magnitude of any effects on saltmarsh habitats arising from impacts on water quality are considered to be low. However, as such effects cannot be quantified, they are assumed to be significant and, therefore, require mitigation.

Operational Phase

The proposed development does not provide for any change to the existing drainage paths, including those within contributing catchments. While the installation of new trackside filter drains and carrier drains may decrease (imperceptibly) the time taken for surface water pollutants to enter the River Suir, there are no changes to the sources of pollution on the drainage network. Therefore, the minor amendments to the existing drainage network will have an imperceptible impact on water quality, which will not give rise to any adverse effect on Annex I saltmarsh habitats or other receptors.

As noted in Section 2.0, maintenance painting of the exposed parts of the sheet pile flood defence wall will be required approximately every 10 years. Paints can contain toxic compounds which can negatively impact on aquatic life and water-dependent habitats. While the volumes of paint used will be low and there will be c. 10 years between applications, there remains potential for water quality impacts. Therefore, mitigation is required to control the risk of adverse effects on Annex I saltmarshes and other water-dependent habitats and species in the Lower River Suir SAC.

Invasive Alien Species

The movement of vehicles, vessels, plant, equipment, materials and personnel to, from and within the construction site poses a risk of the introduction or spread of invasive alien species to or within habitats of conservation importance in the vicinity of the construction site or haul routes (terrestrial and marine). With regard to the 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' adjacent to the construction site, there is a risk that Common Cordgrass (*Spartina anglica*), which is present within 500m of the proposed development, could be imported to the adjoining mudflats and invade the lower saltmarsh community, altering the vegetation structure and composition of this habitat. If this were to occur, it would constitute an adverse effect on the Conservation Objective for this Qualifying Interest of the Lower River Suir SAC. Therefore, mitigation will be required to control the risk of such an introduction.

Conclusion

In the absence of appropriate mitigation, the construction of the proposed development has the potential to adversely affect the Conservation Objectives for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' and 'Mediterranean salt meadows

(*Juncetalia maritimi*)' in the Lower River Suir SAC through the introduction or spread of invasive alien species and through impacts on water quality, both of which could affect the vegetation structure and composition of these Qualifying Interests. During the operational phase, the proposed development has the potential to adversely affect the Conservation Objectives for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' in the Lower River Suir SAC through impacts on sediment supply, which could affect the physical structure of one example of this habitat type, specifically that at Ch. 925 to Ch. 975. Therefore, mitigation is required to avoid such effects.

The proposed development does not provide for any other adverse effects on the Conservation Objectives for these Qualifying Interests during either the construction phase or the operational phase.

4.2.2 Hydrophilous Tall Herb Communities

The Annex I habitat 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' does not occur in the vicinity of the proposed development. However, it may occur in freshwater marshes or along watercourses in the wider likely zone of impact. The Conservation Objective for this habitat in the Lower River Suir SAC is stated in Table 3.2 above and the Attributes of the same are summarised as follows:

- Habitat area and distribution;
- Hydrological regime (flooding depth/height of water table);
- Vegetation composition (positive indicator species; non-native species; negative indicator species; scrub, bracken and heath);
- Vegetation structure (height); and,
- Physical structure (bare soil; grazing and disturbance).

Habitat area and Distribution

As there are no examples of this Annex I habitat type occurring in close proximity to the proposed development, there will be no reduction in the area of this habitat in the River Suir SAC or any change in the distribution of this habitat type in the River Suir SAC as a result of the proposed development.

Hydrological Regime

As detailed in Section 4.2.1 above, the construction and operation of the proposed development will give rise to slight or imperceptible impacts on the local hydrological regime. Given the distance of any examples of hydrophilous tall herb communities from the proposed development, any impacts at these locations would be imperceptible and, therefore, would not give rise to adverse effects on the Conservation Objective for these habitats. Therefore, it can be concluded on the basis of best scientific knowledge that neither the construction nor the operation of the proposed development will adversely affect the hydrological regime in any example of hydrophilous tall herb communities.

Vegetation Structure and Composition

The potential adverse effects of the proposed development on vegetation structure and composition in hydrophilous tall herb communities are considered to be the same as those for saltmarsh habitats, as per Section 4.2.1 above. Thus, it is concluded that, in the absence of appropriate mitigation, there is a risk of adverse effects as a result of water quality impacts and invasive alien species arising from the construction of the proposed development, but not its operation.

Physical structure

Owing to the nature of the proposed development and as there are no examples of this Annex I habitat type occurring in close proximity to the proposed development, it does not have any potential to change the cover of bare soil or levels of grazing or disturbance in any example of this habitat type. Therefore, it is can be concluded that the proposed development will not affect this Attribute in any example of this Annex I habitat type.

Conclusion

In the absence of appropriate mitigation, the construction of the proposed development has the potential to adversely affect the Conservation Objective for 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' in the Lower River Suir SAC through impacts on water quality and invasive alien species which may affect the vegetation structure and composition of this Qualifying Interest. Therefore, mitigation is required to avoid this adverse effect.

The proposed development does not provide for any other adverse effects on this Conservation Objective during either the construction phase or the operational phase.

4.2.3 Alluvial Forests

The priority Annex I habitat 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)' does not occur in the vicinity of the proposed development. However, it may occur in along watercourses in the wider likely zone of impact. The Conservation Objective for this habitat in the Lower River Suir SAC is stated in Table 3.2 above and the Attributes of the same are summarised as follows:

- Habitat area and distribution;
- Woodland size;
- Woodland structure: cover and height, community diversity and extent, natural regeneration, dead wood, veteran trees, indicators of local distinctiveness;
- Vegetation composition: native tree cover, typical species, negative indicator species; and,
- Hydrological regime: flooding depth/height of water table.

Habitat Area and Distribution, Woodland Size and Structure

As there are no examples of alluvial forests in the vicinity of the proposed development, there is no risk of impacts on habitat area and distribution or woodland size and structure. However, given the hydrological connectivity between the proposed development and areas supporting examples of this habitat type, there is potential for negative impacts in terms of vegetation composition (through water quality impacts or invasive alien species) and hydrological regime (through hydraulic changes associated with the presence of new structures in the river channel).

Vegetation Composition

The potential adverse effects of the proposed development on vegetation composition in alluvial forests are considered to be the same as those for saltmarsh habitats and hydrophilous tall herb communities, as per Section 4.2.1 above. Thus, it is concluded that, in the absence of appropriate mitigation, there is a risk of adverse effects as a result of water quality impacts and invasive alien species arising from the construction of the proposed development, but not its operation.

Hydrological Regime

As detailed in Section 4.2.1 above, the construction and operation of the proposed development will give rise to slight or imperceptible impacts on the local hydrological regime. Given the distance of any examples of alluvial forests from the proposed development, any impacts at these locations would be imperceptible and, therefore, would not give rise to adverse effects on the Conservation Objective for these habitats. Therefore, it can be concluded on the basis of best scientific knowledge that neither the construction nor the operation of the proposed development will adversely affect the hydrological regime in any example of alluvial forests.

Conclusion

In the absence of appropriate mitigation, the construction of the proposed development has the potential to adversely affect the Conservation Objective for 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)' in the Lower River Suir SAC through impacts on water quality and invasive alien species which may affect the vegetation structure and composition of this Qualifying Interest. Therefore, mitigation is required to avoid this adverse effect.

The proposed development does not provide for any other adverse effects on this Conservation Objective during either the construction phase or the operational phase.

4.2.4 Fish Species

The fish species which are listed as Qualifying Interests of the Lower River Suir SAC and are potentially adversely affected by the proposed development are Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon. The Conservation Objectives for each of these species given in Table 3.2 above. The Attributes of these Conservation Objectives can be summarised as follows:

- Extent of anadromy/barriers to migration;
- Distribution, quantity and quality of spawning habitat;
- Number and distribution of redds;
- Availability of juvenile habitat;
- Abundance of individuals at different life stages/population structure; and,
- Water quality.

Anadromy and Barriers to Migration

The presence of structures within the River Suir represents a partial obstruction of the channel. This reduces the cross-sectional area open for passage by fish and constricts the flow of water, thereby increasing flow velocities. The partial obstruction and higher flow velocities have the potential to form a barrier to migratory fish species, including anadromous lampreys, Twaite Shad, Atlantic Salmon and Sea Trout (*Salmo trutta*), as well as catadromous European Eel (*Anguilla anguilla*). Other effective barriers to fish migration may arise from acoustic or lighting impacts. These impacts are discussed in detail in the following paragraphs.

Physical Obstruction

The presence of the new sheet pile flood defence wall represents a permanent loss of a small portion of the cross-sectional area of the river channel over a length of c. 540m. The cross-sectional area occupied by the new flood defence structure varies with the tidal conditions/river levels and location along the proposed development. At low tide, there will be no encroachment into the river channel except for a very small length at Ch. 400, where the face of the new wall will be <2m out into the channel. At high tide, the full length of the riverside flood defence wall will encroach into the channel, but by no more than 4.5m at any location (generally 1.5m over the full length). Based on a minimum channel width (at low tide) of 140m, 4.5m represents just over 3% of the total width, and given that this is at the edge (shallowest part) of the channel, the percentage of the cross-sectional area will be significantly smaller. The obstruction of such a small portion of the channel by the new flood defence wall will not pose any significant barrier to fish passage past the proposed development.

During construction, additional areas of the channel will be temporarily obstructed by cofferdams which are necessary to facilitate the installation of drainage outfalls. These will extend a further 9m into the channel, representing a worst-case obstruction of c. 13.5 m or <10% of the minimum channel width. However, given the short duration of their presence in the river channel (4 weeks for each cofferdam, 12 weeks in total) and the fact that they are located on one side of the channel only and only one cofferdam will be in place at any one time, they will not pose any significant barrier to fish passage. The sandbags or aqua-dam which will be in place for the remedial works to the existing quay wall (as mitigation to control the risk of pollutants entering the River Suir during remedial works) will not extend further into the channel than either the permanent flood defence wall or the temporary cofferdams. Therefore, it will not present any significant barrier to fish migration or movement.

Hydraulic Changes

Russon & Kemp (2011) studied the swimming performance of European Eel and River Lamprey. They found that all individuals of both species were able to move upstream against flow velocities of 1.75 m s^{-1}. The authors also found that swimming speed generally increased with body size. Based on these findings, it is estimated that Sea Lamprey, which has a very similar morphology as River Lamprey and which also utilises the same anguilliform locomotion, can swim upstream against flows of at least 1.75 m s^{-1}. Hoover & Murphy (2018) found that Sea Lamprey can achieve speeds in excess of 4 m/s for short periods. In a technical paper published by the Environment Agency, Clough et al. (2004) studied the swimming speeds of Twaite Shad. The authors found that the average critical burst swimming speed for adults of this species is just over 1.7 m s^{-1}, meaning that most individuals of this species can maintain swimming at this speed without having to resort to burst swimming. In 2005, the then Central and Regional Fisheries Boards and the Department of Communications, Marine and Natural Resources jointly published *Guidelines on the Construction & Operation of Small Scale Hydro-Electric Schemes and Fisheries* (CRFB & DCMNR, 2005). These guidelines provide indicative swimming speeds of 2 m s^{-1} for Atlantic Salmon and 1.5 m s^{-1} for Brown Trout.

The increase in flow velocities resulting from the constriction of the river flow during the operation of the proposed development were modelled in a hydraulic study '*Hydraulic Modelling of the flood Defences West Scheme River Suir Flood Wall'* (Hydro Environmental Ltd, 2021), which is presented in Appendix C to this NIS. This report stated that existing velocities adjacent to the proposed flood defence wall reached 0.6 m s^{-1} to 0.7 m s^{-1} on the neap tides and 0.9 m s^{-1} to 1.0 m s^{-1} on spring tides towards the centre of the channel and that the addition of the proposed flood wall will provide a general local increase of 0.05 m s^{-1} and larger increases along the toe of the wall of 0.075 m s^{-1} to 0.1 m s^{-1} . This remains to be below the critical velocity for adults of all of the fish species of interest at any location in the river within the vicinity of the proposed flood defences. These local changes and are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the far bank. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive. Furthermore, flow velocities will be lower still close to the riverbed where the flow is subject to friction. Therefore, it can be concluded on the basis of best scientific knowledge that increased flow velocities resulting from the constriction of the flow by the proposed development will not impede the movements of adult migratory fish even during peak flow conditions.

The passage of juvenile fish past the proposed development must also be considered. In the case of juveniles, particularly Twaite Shad, it is known that these fish move up and down the estuary with the tides. Therefore, the movements of juvenile fish will not be affected by the increased flow velocities resulting from the constriction of the flow by the proposed development as they will continue to move through the area in the direction of the flow.

Hydroacoustic Impacts

The effects of noise on fish species include, in order of increasing severity: behavioural change, auditory tissue damage, which can be temporary, i.e. temporary threshold shift (*TTS*), or permanent, i.e. permanent threshold shift (*PTS*), non-auditory tissue damage and death. Effects vary greatly between individuals of different sizes or life stages, with smaller/younger individuals being more vulnerable to injury and death, and between different species, i.e. between species classed as "hearing generalists", e.g. salmonids, and those classed as "hearing specialists", e.g. clupeids, including the shads. The effects of noise on a wide range of fish species have not been studied extensively and so any predictive assessment of such noise impacts on fish must rely on extrapolations from what studies have been carried out and thereafter follow the Precautionary Approach when making any necessary assumptions.

It is considered that the elements of the construction of the proposed development which present the highest risk of significant noise and vibration impacts on migratory fish species are the piling activities necessary to install the new sheet pile food defence wall. The assessment of the effects of piling noise on migratory fish species in the Lower River Suir SAC during the construction of the proposed development drew upon the following documents:

- *Environmental Impact Report* (MOR, 2010) for the Grattan Quay, Bilberry Road and Quarry Road Improvement Works in Waterford City, which specifically addressed the effects of piling noise in the River Suir.
- *Natura Impact Statement* (ROD, 2018b) for the River Suir Sustainable Transport Bridge in Waterford City, which assessed the hydroacoustic effects of impact piling of large tubular steel piles for the bridge.
- *Hydroacoustic Assessment* (Mason, 2020) for the Waterford North Quays Development, which assessed the hydroacoustic effects of rotary piling of large tubular piles for the reconstruction of the wharf structure.
- The California Department of Transportation's *Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish* (Caltrans, 2020), which synthesises a broad range of recent literature on acoustic sensitivities of fish and empirical data from a large number of different construction projects in different environments and using different pile types and piling methods.

Sound intensity level (*SIL*) or "loudness" is usually expressed in decibels (dB), which is a logarithmic scale of the ratio of the measured pressure to a reference pressure. In water, this reference pressure is 1 µPa. Three main metrics of *SIL* are used to assess hydroacoustic impacts: peak and root-mean-square sound pressure levels (SPL_{peak} and SPL_{RMS}, respectively), both of which are expressed in dB re 1 µPa, and sound exposure level (*SEL*), which is expressed in dB re 1 µPa^2 s. Reference values for these metrics are usually given for a distance (D_1) of 10 m from the sound source. SPL_{peak} is the maximum *SIL* produced by a single event and SPL_{RMS} is the average of the squared pressures over the time containing 90% of the energy, whereas *SEL* is the energy of the sound emitted averaged over 1 s. In addition, for a sound that is repetitive or continuous, e.g. multiple pile strikes or vibration for more than 1 s, the cumulative *SEL* (SEL_{cum}) is used and this is calculated as $SEL_{cum} = SEL + 10 \log(n)$, where n = the number of strikes or duration of vibration in seconds.

In order to assess the likely hydroacoustic impacts of the construction of the proposed development on fish, this subsection:

1. Examines the ambient noise levels in the River Suir at this location;
2. Predicts the noise levels associated with the proposed piling operations;
3. Calculates the precautionary distances from these piling operations at which fish are likely to be impacted;
4. Considers the likely effects on fish species of concern in this case, namely Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon, but focussing on Twaite Shad as by far the most sensitive to hydroacoustic impacts; and,
5. Determines the risk of adverse effects on these species in the case of deviation from the piling methodology proposed.

Ambient Noise Levels

No empirical data is available on ambient noise levels in the River Suir. An ambient SPL_{RMS} of 125 dB re 1 µPa was used in the assessment of the hydroacoustic impacts of piling for the River Suir Sustainable Transport Bridge (An Bord Pleanála Planning Ref. ABP-303274-18). This was carried forward to the assessment of the Waterford North Quays Development (WCCC Planning Ref. 19/928), where underwater noise specialists Subacoustech Environmental Ltd agreed with the precautionary estimate (Mason, 2020). Based on the examples provided in Caltrans (2020), it is considered that the narrow width of the River Suir and relatively heavy boat traffic would likely increase this estimate towards 135 dB re 1 µPa. Therefore, the ambient SPL_{RMS} is taken to be in the range of 125-135 dB re 1 µPa.[9]

Underwater Noise from Piling

There are a number of factors which need to be considered when attempting to predict the likely noise levels produced from piling in water. These include:

- The type of pile driver or piling method – For the proposed development, almost all pile driving will be by vibratory hammer. This is generally quieter than impact piling. Noise levels from vibratory piling rise slowly, and for this reason vibratory piling is frequently employed as a mitigation measure where impact piling was originally proposed. In this case, while almost all piling is expected to be vibratory piling, some piles may require a number of strikes (maximum 200 strikes) from an impact hammer to drive them to the desired depth below ground.
- Type and size of piles – The proposed flood wall requires the use of sheet piles. Specifically, for piling on the river side the existing quay wall, it is intended to use AZ 20-700 and AZ 42-700 sheet piles. Both types are 700mm wide. The lighter AZ 20-700 piles are to be driven to an average of 10m below ground level over a distance of 480m and the heavier AZ 42-700 piles are to be driven to 11.5-17 m below ground level over a distance of 110 m. Based on a conservative drive

[9] In the River Tay in Scotland, Subacoustech Environmental Ltd measured an average ambient SPL_{RMS} of 135 dB re 1 µPa mid- river over a stony substrate, and 127 dB re 1 µPa in quieter waters near the bank (Mason, 2020).

speed of 1 m per minute, it would take 10 minutes to drive each AZ-20 pile and up to 17 minutes to drive AZ-42 pile. Approximately 10m of wall (14-15 piles) can be driven per day, representing a total of c. 2.5 hours of active piling each day (the remainder of the time being taken up by ancillary processes).

- Additional piling is required for drainage works. Three drainage outfall pipes and associated headwall structures will sit on piled foundations. For each outfall, the foundations will include 6 hollow tubular steel piles of 273mm diameter. These piles will be driven into the riverbed (mud) by a piling rig operating from a barge and will be fully embedded c. 16m into the riverbed. Each pile will take c. 16 minutes of vibratory piling to install. A small number of strikes from an impact hammer may be necessary to drive some piles to the required depth. It will take less than 1 day to drive the 6 foundation piles for each outfall.
- Once the piles for the foundations of drainage outfalls are installed, a temporary cofferdam will be erected to provide a dry works area for the construction of the outfall. Cofferdams will be formed from AZ-26-700 steel sheet piles (70mm in diameter) and will be c. 5m wide and extend c. 9m into the river channel (to allow sufficient clearance to construct the outfall structures). This will require c. 35 piles for each cofferdam (the landward side being formed by the flood defence wall), taking c. 4 days to install. Once each outfall is constructed, the temporary sheet piles will be extracted (pulled out) and reused for the next cofferdam (only one cofferdam will be in place at any one time) and, once all of the outfalls are complete, the sheet piles will be reused as permanent piles in the flood defence wall.
- All riverside piling will take place during the day, whereas landside piling will take place partly during the day and partly at night. Landside piling is assessed in more detail further below.
- All riverside piling will take place in the intertidal zone. Consequently, riverside piles installed at low tide will not be driven in the water, but directly into the mud. The hydroacoustic impacts from these piles will be reduced compared with those installed during other phases of the tide.
- The durations of the various elements of piling activities are shown in Table 4.1 below.

Table 4.1 Durations of elements of piling activities.

Element	Daytime	Night-time	Total
Riverside	*Flood wall: 5-6 weeks** *Drainage: 2 weeks* Total: 7-8 weeks	Nil	7-8 weeks
Landside	4 weeks	*Isolation unit: 1-2 weeks* *Flood wall: 2 weeks* Total: 3-4 weeks	7-8 weeks
Total	11-12 weeks	3-4 weeks	14-16 weeks

**Based on two piling rigs operating simultaneously, increasing to 8-11 weeks if a single rig is used.*

Based on the information and examples provided in Caltrans (2020), the precautionary noise levels from vibratory and impact piling for the riverside sections of the new flood wall are as set out in Table 4.2 below. The hydroacoustic impacts of the landside piling are discussed further on in this section. Data in Caltrans (2020) for tubular steel piles 60-120mm wider than those which will be used for the foundations of drainage outfalls indicates that the noise levels from these piles will be at the very least 6 dB lower than for the specified sheet piles (in the case of vibratory piling) and at least 18 dB lower (in the case of any impact piling).

Table 4.2 Precautionary noise levels from riverside sheet piling for the new flood defence wall. Based on 24-inch steel sheet piles, 15 m depth of water, and a D_1 of 10 m.

Piling method	SPL_{peak} dB re 1 µPa	SPL_{RMS} dB re 1 µPa	$SEL_{n=1}$ dB re 1 µPa^2 s
Vibratory	190	165	165
Impact	205	190	180

As the propagation of sound in water is complex and dependent on a large number of unknowns, a simplified spreading model is typically used to estimate the attenuation of underwater sound over a given distance. This model is represented by the following equation $TL = F \log(D_2/D_1)$. To solve for D2 where a target TL is known, this equation can be modified to $D_2 = D_1 \times 10$^(TL/F).

The attenuation coefficient (F) can be expressed as a transmission loss per doubling in distance, e.g. an F of 15 is equivalent to a loss of 4.5 dB every doubling in distance from the sound source. F is dependent on a large number of factors, notably depth, with larger F values (i.e. greater attenuation of sound) in shallower water. The National Marine Fisheries Service (NMFS) (part of the Unites States Department of Commerce) recommends that an F of 15 is applied where location-specific data is lacking. The examples provided in Caltrans (2020) indicate that this value is very conservative, even where water depth exceeds 15m, which is the case for most examples and forms the basis for the noise levels predicted in Table 4.2 above. Furthermore, given the very shallow water depths in the intertidal zone of the River Suir, the local F value is likely to be much higher. Nonetheless, in accordance with the Precautionary Principle, an F of 15 is applied in this assessment.

To shorten the overall construction programme, it is possible that two piling rigs may operate simultaneously. The implications of this in terms of underwater noise levels must also be assessed. The combination of sound from two sources emitting sound of the same properties results in an observed increase of 3 dB in the sound level emitted by either source individually. This cumulative impact is assessed in more detail in the following paragraphs.

Predicting Effects on Fish

Hydroacoustic impacts on individual fish range from provoking a behavioural response, through *TTS*, sub-lethal injury (including *PTS*) and delayed mortality, to immediate mortality. For the purposes of assessing impacts from piling noise, it is most useful to establish the distances from the piling activity at which behavioural responses and *TTS* could be expected.

Behavioural Response

The NMFS and the United States Fish and Wildlife Service (USFWS) generally use an SPL_{RMS} of 150 dB re 1 µPa as a precautionary threshold for temporary behavioural changes (startle and stress). Figure 4.1 below illustrates the modelled attenuation of SPL_{RMS} in the River Suir.

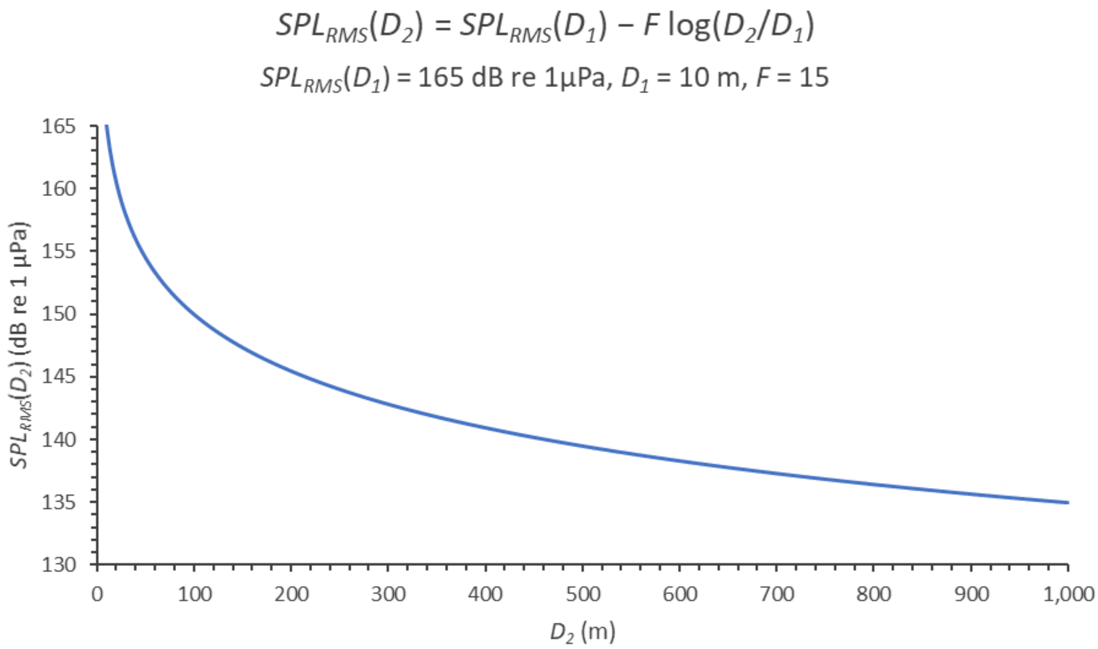


Figure 4.1 Attenuation of root mean square sound pressure level with increasing distance from vibratory piling, assuming a root mean square sound pressure level of 165 dB re 1 µPa at 10 m from pile.

As illustrated in Figure 4.1 above, an output SPL_{RMS} of 165 dB re 1 µPa at 10 m from vibratory piling would attenuate to the threshold SPL_{RMS} for behavioural response of 150 dB re 1 µPa within 100 m of the piling activity. The shortest distance between the proposed sheet pile wall and the opposite bank of the River Suir (at low tide) is c. 140m. Therefore, at least 4 m of the channel width would remain unaffected. The same output would attenuate to the upper boundary of the ambient SPL_{RMS} range of 125-135 dB re 1 µPa within 1km (beyond this distance it would be inaudible). A total output SPL_{RMS} of 168 dB re 1 µPa from two simultaneous vibratory pile drives would attenuate to the threshold SPL_{RMS} for behavioural response of 150 dB re 1 µPa within 158 m of the piling activity.

In respect of impact piling, the precautionary output SPL_{RMS} of 190 dB re 1 µPa at 10m from the pile would take more than 1km to attenuate to the behavioural response threshold of 150 dB re 1 µPa. However, the duration of any impact piling which might be necessary will be short and any negative behavioural effect on fish will be almost immediately recoverable.

Temporary Threshold Shift

Bases on data in the literature, as synthesised in Caltrans (2020), regarding the relative sensitivity of fish of different species and sizes to underwater noise, it was determined that juvenile Twaite Shad fell into the most sensitive category. As juvenile Twaite Shad are present in the Lower River Suir at all times of the year, the threshold values for this most sensitive category are used in this assessment. Therefore, the *TTS* threshold is set at 206 dB re 1 µPa for SPL_{peak} and 183 dB re 1 µPa^2 s for SEL_{cum}. As, the *TTS* threshold for SPL_{peak} is above the predicted SPL_{peak} for all pile driving in this case, there is not predicted to be any effect in terms of this criterion. Thus, the remainder of this assessment focusses on SEL_{cum} only.

It should be noted that SEL_{cum} is not used by many authorities as it is recognised that fish are not stationary and as there is little to no evidence of any *TTS* or other injury occurring in fish exposed to the prescribed threshold values. In fact, there is ample evidence of fish being injured by mitigation measures which have been employed to protect them from exposure to those SEL_{cum} levels. Furthermore, it is important to note that these criteria were developed for impact pile driving only and it is advised in Caltrans (2020) that they should not be used to assess sound from vibratory pile driving because the injury thresholds for vibratory piling are likely to be much higher for the non-impulsive, continuous sounds emitted by vibratory drivers. Popper et al. (2019) also highlighted that the simplified spreading model generally leads to overestimation of the size of the affected area. Therefore, use of this model and these thresholds is extremely precautionary.

The cumulation of SEL from continuous vibratory piling emitting 165 dB re 1 µPa^2 s for each second is illustrated in Figure 4.2 below.

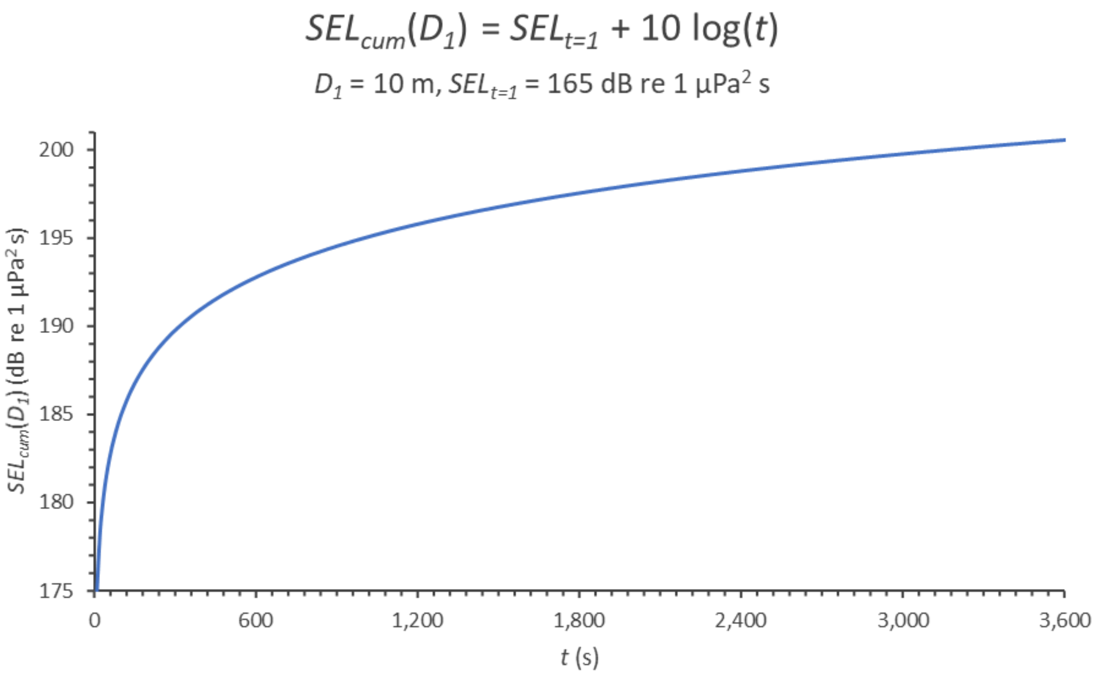


Figure 4.2 Cumulation over time of sound exposure level.

As shown in Figure 4.2 above, based on an *SEL* of 165 dB re 1 µPa for 1 s of vibratory piling, a 10-minute (600 s) pile drive would have an SEL_{cum} of 193 dB re 1 µPa^2 s, a 17-minute (1,020 s) drive would have an SEL_{cum} of 195 dB re 1 µPa^2 s, and a 20-minute (1,200 s) drive would have an SEL_{cum} of 196 dB re 1 µPa^2 s. In the case of two simultaneous vibratory drives, these values are increased by 3 dB re 1 µPa^2 s.

Figure 4.3 below illustrates how SEL_{cum} (or other measure of noise levels) attenuates with increasing distance from the source, as per the simplified spreading model. This is based on 20 minutes of continuous vibratory piling from a single piling rig.

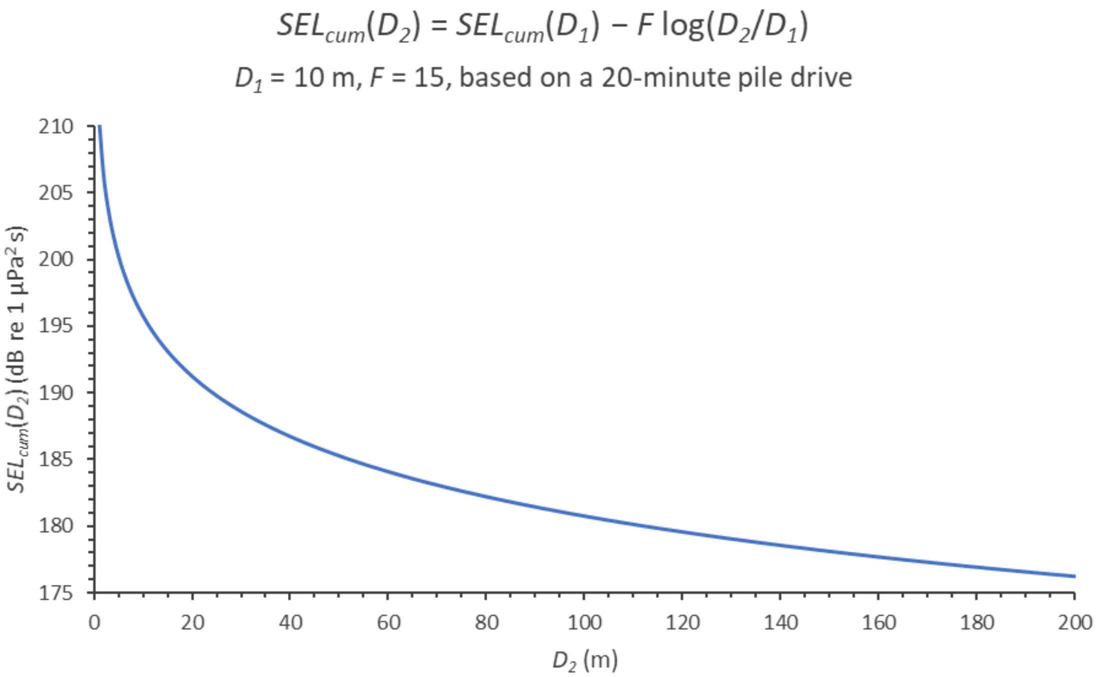


Figure 4.3 **Attenuation of sound exposure level with increasing distance from vibratory piling following 20 minutes of continuous piling.**

As shown in Figure 4.3 above, an output $SEL_{cum}(D_1)$ of 196 dB re 1 µPa^2 s at 10m from the pile (produced by a 20-minute pile drive) would attenuate to the precautionary *TTS* threshold of 183 dB re 1 µPa^2 s within 71m of the pile. In this case, at least half of the channel width would remain unaffected. In the case of two simultaneous vibratory drives, a total output $SEL_{cum}(D_1)$ of 199 dB re 1 µPa^2 s would attenuate to the precautionary *TTS* of 183 dB re 1 µPa^2 s within 113 m of the piling activity, leaving at least 25 m of the channel width unaffected.

For any impact piling which might be necessary to drive a pile to the required depth below ground, a single-strike *SEL* of 180 dB re 1 µPa equates to a 200-strike SEL_{cum} of 203 dB re 1 µPa^2 s (equivalent to 10 minutes of impact piling at a rate of 1 strike every 3 seconds). This SEL_{cum} would attenuate to the precautionary *TTS* of 183 dB re 1 µPa^2 s within 216m of the pile. In the case of two impact hammers operating simultaneously, this distance increases to a maximum of 342m (c. 2.5 times the channel width at low tide).

Figure 4.4 below illustrates how the radius (D_2) of the *TTS* impact area increases in size with longer periods of continuous vibratory piling (based on a single pile).

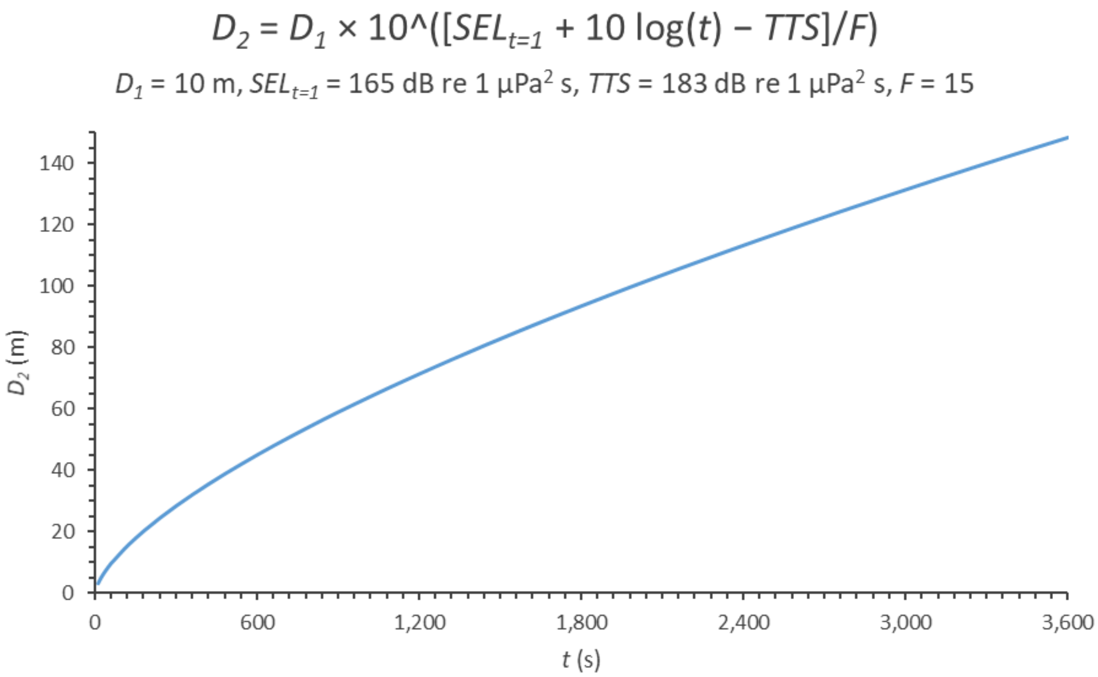


Figure 4.4 **Increase over time of the distance from continuous vibratory piling at which the sound exposure level exceeds the recoverable injury threshold.**

As shown in Figure 4.4 above, based on a minimum channel width of 140m, it would take a continuous vibratory pile drive of at least 55 minutes to extend the *TTS* impact area across the full width of channel. With two vibratory piling rigs operating simultaneously, it would still take at least 28 minutes for the *TTS* impact area to extend across the full width of the channel.

Based on the above analysis, the principal risk to fish species from piling activities is from continuous vibratory piling for more than 1 hour for a single piling rig or more than 30 minutes for two piling rigs operating simultaneously, and from impact piling for more than 10 minutes.

Effects on Species of Concern

The main fish species of concern at the location of the proposed development are those which are listed as Qualifying Interests of the Lower River Suir SAC, namely Sea Lamprey, River Lamprey, Twaite Shad, and Atlantic Salmon. As a hearing-specialist species and due to the importance of the Suir Estuary to juvenile fish, Twaite Shad is by far the most sensitive of these species in terms of hydroacoustic impacts.

Twaite Shad is predominantly a diurnal species and most of its activity during the day is concentrated in deeper water in the centre of the channel. Based on the analysis above, the installation of individual piles poses almost zero risk to shad moving up and down the river mid-channel during the day. Only continuous piling for extending periods could cause a significant risk. At night, shad tend to move into the shallow waters at the edge of the channel to rest. This places shad at some risk of hydroacoustic impacts from landside piling. The hydroacoustic impacts of landside piling are analysed in detail in the next sub-section.

The other species are all mostly hearing-generalist and nocturnal species and are not present in the Suir Estuary during their larval or very early life stages. As such, they are very unlikely to be negatively affected by the hydroacoustic impacts analysed above. The only exception to this may be where prolonged continuous piling creates an effective barrier to migration during specific periods, or where nocturnally migrating fish resting at the side of the channel during the day are disturbed by riverside piling. Table 2.4 in Section 2.6 illustrates the migration patterns of these species through the Suir Estuary

On examination of Table 2.4, at least one of these species is likely to be present in the vicinity in significant numbers at any time of the year. As outlined above, the periods of upstream migration by lamprey species and salmon may be slightly more sensitive due to the possibility of disturbance to resting fish by riverside piling during the day (if piling is undertaken during these periods). However, given the slow build-up of sound exposure from vibratory piling, the small area affected and the fact that these fish are larger and hearing-generalist, the risk of disturbance to more than a very small numbers of individuals is negligible. Therefore, there is no necessity for seasonal restrictions on piling activity.

Considering the analysis carried out in this section so far, the only mitigation which will be necessary to avoid or reduce the hydroacoustic impacts of riverside piling on fish species will be to set a maximum duration of continuous piling activity and a minimum duration of effective quiet between pile drives.

Piling on Land near Water

The same principles as detailed above apply to piling on land. However, modelling of the spread of sound through land is much more difficult due to the different degrees of attenuation through different materials. In all cases, F through land is greater than in water, ranging from 20 (equivalent to a TL of 6 dB per doubling in distance) through rock, to 28 (equivalent to a TL >8 dB per doubling in distance) through mud. As such, any land between the pile and the water will provide significant attenuation of noise and reduce the hydroacoustic impact.

Landside piling for the proposed development will use AZ 20-700 sheet piles only and will comprise 190m of new flood wall and a further 30m for the isolation structure (a total of 220m). Based on a conservative drive speed of 1m per minute, it would take 8 minutes to drive each pile. Approximately 150m of the landside piling will take place during normal (daytime) working hours. Based on 15m of wall (22 piles) per day, this represents a worst-case scenario of 4 weeks of daytime landside piling with a total of c. 3 hours of active piling each day. The installation of the transverse isolation structure will require full railway possession, which necessitates working at night. Allowing for significantly reduced efficiency of nightworks relative to daytime working, i.e. maximum 6 m of wall (8-9 piles) per night, this represents 1-2 weeks of night-time piling with just over 1 hour of active piling each night. Due to the proximity of landside piling to the live railway line from Ch. 900 to Ch. 950, railway possession and, consequently, night-time working, will be required for these works also. This represents a further 2 weeks of night-time piling. Therefore, the total duration of landside piling works is 7-8 weeks (4 weeks of daytime piling and 3-4 weeks of night-time piling).

Due to the shorter duration of each pile drive for landside piling compared with riverside piling (due to the shallower depth required for these piles), the area which will be subject to hydroacoustic impacts (in terms of SEL_{cum}) as a result of landside piling will be smaller still. While the overall duration of piling per day is slightly longer, the expected gaps between each pile drive are likely to allow for full dissipation of the impact before the next pile is started. Furthermore, with regard to night-time piling, the total duration of piling per shift is significantly smaller and, therefore, extremely unlikely to negatively impact on any fish.

While night-time piling presents an increased risk to species which are diurnal and/or more likely to be present near the channel edge at night, notably Twaite Shad, only a very small proportion of these species' habitats will be subject to any hydroacoustic impacts, and the works in question are of a short duration (just over 1 hour per night for 3-4 weeks). Therefore, as for riverside piling, the only mitigation which necessary to avoid or reduce hydroacoustic impacts on fish will be to limit the maximum duration of continuous piling activity and ensure adequate breaks between pile drives.

Total Duration of Piling Activities

The total duration of all piling activities, riverside and landside, for permanent piles and the temporary cofferdams, is 17-21 weeks, assuming that only one piling rig is used (in practice, two piling rigs will be used for riverside piling of the new flood defence wall, reducing this by 3-5 weeks). Given a precautionary maximum duration of piling activities of 21 weeks, the risk of any adverse effects on fish populations, including Twaite Shad, from piling impacts of this magnitude, assuming that two piling rigs are used at all times, over such a short period (<1 year) is negligible.

Operational phase

There are no noise-generating activities associated with the operation of the proposed development. Therefore, there will be no noise-related sources of disturbance, delayed migration injury or mortality as a result of the operation of the proposed development.

Artificial Lighting

Construction phase

Artificial lighting during construction, particularly during nightworks, would negatively impact on migrating fish through disruption of circadian rhythms and normal patterns of upstream and downstream migrations. In particular, species such as Sea Lamprey, River Lamprey and Atlantic Salmon, which generally migrate nocturnally, may halt their migrations should they encounter elevated light levels in the river. Artificial lighting of the river channel at night would, thus, form an effective barrier to the migration of such species. In the case of the proposed development, however, the duration of nightworks is short (6-8 weeks) and is located at the edge of a wide river channel, leaving the majority of the channel unaffected. As such, the risk of any effective barrier to migration through lighting impacts is minimal. Nonetheless, mitigation is required to ensure that lighting impacts are minimised.

With regard to Twaite Shad, this species generally migrates during daylight hours and, therefore, will not be halted in its migration by lighting impacts. There is potential for lighting impacts on juvenile Twaite Shad during their residence in the estuary. These are discussed under juvenile habitat and population structure below.

Operational phase

The operation of the proposed development will not include any change to the existing lighting of the River Suir or adjacent habitats. Therefore, the operation of the proposed development will not adversely affect any of the Qualifying Interests of the Lower River Suir SAC through artificial lighting.

Spawning Habitat and Redds

There are no suitable spawning habitats for lampreys, shad or salmon within the likely zone of impact of the proposed development. Thus, there are no pathways for impacts from the proposed development to such habitats. It can be concluded, therefore, that the proposed development will not have any effect on the distribution, quantity or quality of spawning habitats for these species. Nor will it cause any change the number and distribution of redds.

Juvenile Habitat

Juveniles (ammocoetes) of the three lamprey species are restricted to fresh waters. As no habitat for lamprey ammocoetes is present within the likely zone of impact of the proposed development, the availability of this habitat will not be affected.

Owing to scale of the proposed development, it will not significantly reduce the quantity of juvenile habitat available to Twaite Shad in the Lower River Suir SAC. However, in the event of accidental pollution during construction, water quality impacts (detailed in Section 4.2.1) would reduce the quality of the habitat for juvenile Twaite Shad in the short term. In particular, water quality impacts may affect the availability of the mysids and other zooplankton on which juvenile shad prey. In addition, artificial lighting during construction has the potential to reduce the suitability of the channel edge for juvenile Twaite Shad sheltering at night. Therefore, appropriate mitigation is required to prevent water quality and lighting impacts.

The early juvenile life stages of Atlantic Salmon, i.e. alevin, fry and parr, occur only in fresh water, generally higher up in the catchment. As no habitat suitable for these life stages occurs within the likely zone of impact of the proposed development, the availability of the same will not be affected by the proposed development. The final juvenile life stage of Atlantic Salmon, i.e. smolts, will be present within the vicinity of the proposed development during their migration from fresh water to the sea. As for Twaite Shad, the proposed development does not provide for a significant reduction in the quantity of habitat available for salmon smolts in the Lower River Suir SAC but does provide for a potential reduction in habitat quality, particularly in terms of the availability of prey species, through water quality impacts. Therefore, the same requirement for mitigation applies in the case of Atlantic Salmon.

Population Structure

Water Quality

Water quality impacts likely to arise from the construction of the proposed development are detailed in Section 4.2.1 above. These impacts are of short duration and restricted extent and are considered to have potential to affect the population structure of species which have prolonged residence times in the estuary, namely River Lamprey and Twaite Shad. Water quality impacts may have direct effects on these species or indirect effects via food availability or oxygen depletion. Ultimately, this may result in lower survival rates among adult River Lamprey and juvenile Twaite Shad, reducing the proportion of individuals of those life stages in their local populations. Therefore, mitigation is required to avoid significant water quality impacts.

Sea Lamprey and Atlantic Salmon, however, spend only a short time in the estuary (during their migrations) and generally do not feed there.[10] Therefore, these species are unlikely to be affected by any water quality impacts which might arise during the construction of the proposed development.

[10] Atlantic Salmon kelts occasionally spend longer periods (up to several weeks) in estuaries on their post-spawning migration to the sea (Lindberg, 2011). However, as these individuals are very unlikely to contribute to future spawning, any effects of water quality impacts on kelts will be imperceptible in terms of the overall population structure of salmon in the Lower River Suir SAC.

<u>Hydroacoustic Impacts</u>

Construction phase

The effects of hydroacoustic impacts on Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon are discussed in relation to barriers to migration (above). Owing to the migration patterns and predominantly nocturnal nature of lamprey species and Atlantic Salmon and the proposed scheduling of construction works, any effects of noise and vibration on these species will be slight to imperceptible and not significant in terms of population structure.

In the case of Twaite Shad, however, the diurnal nature of this species, its auditory sensitivity and the fact that juveniles are present in the estuary year-round mean that the project has the potential to negatively impact both upstream-migrating adults and resident juveniles. Owing to the potential for impacts at these critical life-stages, hydroacoustic impacts have the potential to significantly affect the survival of juvenile shad and, if this impact is sustained over a prolonged period, the overall population structure of this species in the Lower River Suir SAC. Therefore, mitigation is required to minimise the effects of piling on juvenile and migrating Twaite Shad.

Operational phase

The operational phase of the proposed development does not provide for any increase in underwater noise. Therefore, there will be no effect on the population structure of fish species as a result of noise and hydroacoustic impacts arising from the operation of the proposed development.

<u>Artificial Lighting</u>

Inappropriate artificial lighting of the construction area during hours of darkness has the potential to spill onto the river channel, causing elevated light levels in the water column. Any effect of lighting on the survival rates of Sea Lamprey, River Lamprey and Atlantic Salmon are considered to be imperceptible as these species prefer to migrate at night and so are unlikely to be present at the side of the channel where any light spill would be concentrated.

However, lighting of the river channel has the potential to negatively affect the survival rate of juvenile Twaite Shad by causing these fish to become more active at night and, consequently, subject to higher predation pressure by nocturnal predators. This may result in an adverse effect on the population structure of this species, as the proportion of 0+ and 1+ fish in the population would be reduced. Therefore, mitigation is required during construction to eliminate adverse effects of artificial lighting on the river channel. As noted previously, there is no new artificial lighting proposed as part of the operation of the proposed development.

Owing to the scale of the proposed development, neither its construction nor its operation has the potential to give rise to significant shading impacts on the River Suir and the migratory fish species present. Therefore, no mitigation is required with respect to shading.

Water quality

All of the water quality impacts potentially arising from both the construction and the operation of the proposed development have been assessed and evaluated in terms of their effects on the relevant Attributes of the Conservation Objectives for the migratory fish species listed as Qualifying Interests of the Lower River Suir SAC (see the discussion under the preceding sub-headings). There are not considered to be any additional water quality impacts with potential to adversely affect those Conservation Objectives.

Conclusion

In the absence of appropriate mitigation, the proposed development has the potential to adversely affect the Conservation Objective for Sea Lamprey, River Lamprey, Twaite Shad, Atlantic Salmon and other fish species in the Lower River Suir SAC through water quality, hydroacoustic and lighting impacts arising from construction activities, particularly piling. Therefore, mitigation is required to eliminate or minimise these impacts such that they would not constitute adverse effects on the relevant Conservation Objectives.

4.2.5 European Otter

The Conservation Objective for European Otter in the Lower River Suir SAC is shown in Table 3.2 above. The Attributes of this Conservation Objective are summarised as follows:

- Distribution;
- Extent of terrestrial, marine and freshwater habitats;
- Couching sites and holts;
- Fish biomass available; and,
- Barriers to connectivity.

Distribution, Habitats, and Couching Sites and Holts

Owing to the location and scale of the proposed development, neither its construction nor its operation have the potential to cause a significant decline in the distribution of otters or the extent of terrestrial, marine and freshwater habitats for this species across the Lower River Suir SAC. Similarly, no potential or confirmed couching sites and holts were recorded during the surveys carried out to inform the assessments of the proposed development and the habitats in the vicinity of the proposed development are not considered to provide good opportunities for couching or holting. Therefore, it can be concluded that the proposed development will not significantly affect the Conservation Objective for European Otter in the Lower River Suir SAC in terms of these Attributes.

Fish Biomass Available

Fish species, particularly salmonids and eels, form the majority of the diet of European Otter in Ireland (Chanin, 2003; Bailey & Rochford, 2006; Reid et al., 2013). The diet of otters is, however, highly adaptable and varies considerably between habitats (Reid et al., 2013). The diets of otters in both freshwater and coastal habitats have been studied extensively (Chanin, 2003). While the feeding habits of otters in estuaries are less well-known, the importance of salmonids, eels and crustaceans, e.g. White-clawed Crayfish (*Austropotamobius pallipes*), in freshwater habitats suggests that migratory fishes, i.e. Atlantic Salmon, European Eel, Sea Lamprey, River Lamprey and Twaite Shad, when available, are important for otters in estuarine habitats. Other fish species found in estuaries, e.g. European Smelt (*Osmerus eperlanus*), rocklings (Lotidae) and wrasses (*Lubrus* spp.), and invertebrates, e.g. Shore Crab (*Carcinus maenas*), are likely to be of importance outside of these periods.

The effects of the proposed development on fish species for which the Lower River Suir SAC is selected are assessed in Section 4.2.4 above and the effects on other fish species which form part of the diet of European Otter, e.g. European Smelt, rocklings and wrasses, are similar in nature and scale. While the effects of the proposed development are considered unlikely to significantly reduce the total fish biomass available to otters, the scale of this effect cannot be quantified and, thus, in accordance with the Precautionary Principle, it is considered to be potentially significant. Mitigation is, therefore, required to prevent any adverse effect on prey availability for otters.

Barriers to Connectivity

During the surveys carried out to inform this assessment, prints on the mudflats within the extent of the proposed development indicated that otters commute along the mud at this location. The proposed development has the potential to form a barrier to connectivity between different areas of otter habitat by creating a physical obstruction to otter movements or by disturbance, i.e. by emitting noise and light such as to deter otters from passing the proposed development area.

Physical Obstruction

As explained in Section 4.2.4, neither the construction nor the operation of the proposed development will lead to a significant obstruction of the river channel. As shown in Appendix D in Volume 2 of this NIS, the majority of the surface of the river will also remain unobstructed for otters moving at this level. The increased flow velocities described in the Hydro Environmental (2021) in Appendix C and summarised in Section 4.2.4 will not pose any challenge to otters as this species can achieve speeds of well over 2 $m\,s^{-1}$ and up to 4.8 $m\,s^{-1}$ (Garcia de Leaniz et al., 2006). Therefore, neither the construction nor the operation of the proposed development will result in any new physical barrier to aquatic connectivity for European Otter.

As evidenced by otter prints observed on the mudflats during the surveys carried out to inform this assessment, otters commute along the intertidal corridor in the proposed development site. The width of this corridor varies from 0m at high tide to a maximum of c. 25m at low tide at the northern end of the site (more typically the width of this corridor is c. 10m at low tide, but is as narrow as 2.5 m at Ch. 400). The width of this corridor will be reduced by c. 1.5m along the length of the proposed riverside flood defence wall. This will result in a loss of the approximately the upper half of the intertidal commuting corridor for otters. Notwithstanding this, given the predicted flow velocities from Hydro Environmental (2021) and the swimming speeds of European Otter stated in the previous paragraph, and that the lower half of this corridor will remain unaffected over the majority of the length of the riverside flood defence wall, it is concluded that otters will continue to be able to move past this area unimpeded. During construction, the intertidal corridor on the northern side of the channel will be completely cut off by the temporary cofferdams, of which there are three in total, but only one in place at a time. However, this will be for a short duration (4 weeks for each outfall, 12 weeks in total) so will not significantly affect otters.

Due to the highly fragmented nature of the terrestrial or riparian habitats which will be affected by the proposed development, as well as their isolation from the river channel within the proposed development extents, these do not currently provide suitable commuting habitat for otter. Therefore, the loss of these habitats or access to them does not represent a significant effect on connectivity for otters.

The availability of terrestrial/riparian and intertidal commuting corridors for otters on the southern bank of the River Suir will not be affected by the construction or the operation of the proposed development, at any stage in the tidal cycle or different water levels.

Based on the analysis above, any physical obstruction of terrestrial/riparian, intertidal or aquatic commuting corridors associated with the construction or operation of the proposed development will not give rise to barriers to connectivity for European Otter. Furthermore, any hydraulic impacts, particularly increased flow velocities, associated with the proposed development will not present a barrier to connectivity for otters.

Disturbance

European Otter is generally considered to be a nocturnal or crepuscular species, i.e. individuals are predominantly active at night, with peaks in activity shortly after dusk at just before dawn (Chanin, 2003; OPW, 2006; Garcia de Leaniz, 2006). Therefore, apart from at their breeding and resting sites, otters are not considered to be sensitive to noise and light impacts during daylight hours. Furthermore, the occurrence of otters in towns and cities suggests that this species is able to habituate to human activities.

Noise and lighting from construction, especially pile driving and floodlighting, have the potential to cause disturbance to otters, leading to reduced connectivity between areas upstream and downstream of the proposed development for the duration of the construction phase. Given the nocturnal or crepuscular nature of this species, the significance of any effects resulting from noise and lighting impacts depends on the daily programming and total duration of the construction activities and lighting of the construction area. As construction of the proposed development requires 6-8 weeks of nightworks, which will involve artificial lighting of the works area and noise from construction activities, including piling, there is potential for these works to form a barrier to connectivity for otters during construction. Therefore, mitigation is required to minimise these impacts and thereby avoid adverse effects on European Otter in terms of barriers to connectivity as a result of disturbance.

During its operation, the proposed development does not provide for any increase to baseline levels of noise or artificial lighting. Therefore, there is no risk of disturbance as a result of the operation of the proposed development and, consequently, there is no requirement for mitigation in respect of such impacts.

Conclusion

In the absence of appropriate mitigation, the proposed development has the potential to adversely affect the Conservation Objective for European Otter in the Lower River Suir SAC. Specifically, effects on fish species during construction have the potential to reduce the total biomass available to otters as food and poor management of night-time construction may cause an effective barrier to connectivity. Therefore, appropriate mitigation is required to prevent such adverse effects.

4.3 River Barrow and River Nore SAC

4.3.1 Annex I Habitats

The 8 No. Annex I habitats for which potential adverse effects were identified in Section 3 were 'Estuaries', 'Mudflats and sandflats not covered by seawater at low tide', 'Reefs', '*Salicornia* and other annuals colonising mud and sand', 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', 'Mediterranean salt meadows (*Juncetalia maritimi*)', 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' and 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)'. The Conservation Objectives for these Qualifying Interests are stated in Table 3.3 above.

The effects of the proposed development on saltmarsh habitats, hydrophilous tall herb communities and alluvial forests in the Lower River Suir SAC are analysed and evaluated in Sections 4.2.1 to 4.2.3, inclusive. The effects on these Qualifying Interests in the River Barrow and River Nore SAC are considered to be of the same nature as those for the Lower River Suir SAC, except that they will be of a lower magnitude owing to the distance between the proposed development and this site.

This section assesses the likely effects of the construction and operation of the proposed development on 'Estuaries', 'Mudflats and sandflats not covered by seawater at low tide', 'Reefs' and '*Salicornia* and other annuals colonising mud and sand' in the River Barrow and River Nore SAC, which have not previously been dealt with in this NIS. The Conservation Objectives for these Qualifying Interests are stated in Table 3.3 above.

The Attributes of the Conservation Objectives for 'Estuaries' and 'Mudflats and sandflats not covered by seawater at low tide' are summarised as follows:

- Habitat area; and
- Community extent and distribution.

The Attributes of the Conservation Objective for 'Reefs' (taken from the Hook Head SAC, as explained in Table 3.3) are summarised as follows:

- Distribution;
- Habitat area; and
- Community structure (biological composition) and extent.

The Attributes of the Conservation Objective for '*Salicornia* and other annuals colonising mud and sand' are summarised as follows:

- Habitat area and distribution;
- Physical structure (sediment supply; flooding regime; creeks and pans);
- Vegetation structure (zonation; height; cover); and,
- Vegetation composition (typical species and subcommunities; negative indicator species, i.e. *Spartina anglica*).

Owing to the distance of c. 6 km between the proposed development and any of these habitats within the River Barrow and River Nore SAC, the only potential impacts arising from the proposed development with potential to affect these Conservation Objectives are those relating to hydrological regime, sediment supply, water quality, and invasive alien species.

Hydrological Regime

As detailed in Section 4.2.1, the proposed development will give rise to only slight or imperceptible impacts on the local hydrology. Therefore, it can be concluded on the basis of best scientific knowledge that neither the construction nor the operation of the proposed development will lead to any adverse effect on the hydrological regime associated with any of these habitats within the River Barrow and River Nore SAC.

Sediment Supply

The sediment mobility assessment undertaken in *Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall* (Hydro Environmental, 2021), which is included in Appendix C to this NIS, found that "*under both existing and proposed cases sufficient velocities are generated* […] *to mobilise only the fresher unconsolidated fine* *silts that might at slack tides temporarily deposit along the channel bank in the vicinity of the proposed flood wall*" and that "*the computed velocity increases* […] *are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments /muds on the channel bed and banks in the vicinity of the affected area*". Therefore, it can be concluded on the basis of best scientific knowledge that there will be no adverse effect on sediment supply to any of these habitats within the River Barrow and River Nore SAC.

Water Quality

The effects of water quality impacts associated with the construction and operation of the proposed development on habitats is discussed in relation to saltmarsh habitats in Section 4.2.1 above. In the case of habitats in the River Barrow and River Nore SAC, the types/nature of the water quality impacts which may arise from the proposed development on these habitats is considered to be the same as those discussed in Section 4.2.1. The significance of any such effects is limited, however, due to the greater distance between the proposed development and the River Barrow and River Nore SAC and the high dilution factor provided by the volume of the estuary between the proposed development location and this site. Therefore, appropriate mitigation will be required to manage the risk of water quality impacts so as to eliminate any potential for adverse impacts on the Conservation Objectives for these Qualifying Interests.

Invasive Alien Species

There is a risk that aquatic invasive species such as Chinese Mitten Crab and Common Cordgrass could be spread within the estuary by barges and other vessels during the construction of the proposed development. If this were to occur it would constitute a significant reduction in the quality and a threat to the integrity of the aquatic Annex I habitats for which this SAC is selected. Therefore, mitigation is required to prevent the import or spread of invasive species.

Conclusion

The only impacts likely to arise from the proposed development which have any potential to adversely affect the Conservation Objectives for the Annex I habitats for which the River Barrow and River Nore SAC is selected are water quality impacts and invasive alien species. As such, appropriate mitigation is required to eliminate beyond reasonable scientific doubt the risk of such effects occurring.

4.3.2 Desmoulin's Whorl Snail

There is currently no information available in relation to the presence or absence of Desmoulin's Whorl Snail in the likely zone of impact of the proposed development. While there is no suitable habitat for this species within the study area, the presence of such habitat adjoining the Lower River Suir SAC or the River Barrow and River Nore SAC in the wider area upstream or downstream cannot be ruled out. Therefore, in accordance with the Precautionary Principle, it is assumed that this species occurs in natural and semi-natural wet grassland and marsh habitats within the likely zone of impact.

The Conservation Objective for Desmoulin's Whorl Snail in the River Barrow and River Nore SAC is shown in Table 3.3 above. The Attributes of this Conservation Objective are summarised as follows:

- Distribution (occupied sites);
- Population size (adults) and density;

- Area of occupancy; and,
- Habitat quality (vegetation and soil moisture levels).

As there is no suitable habitat for Desmoulin's Whorl Snail in close proximity to the proposed development, there will be no direct impacts on this species or its habitats. However, there is potential for the proposed development to cause a reduction in the quality of habitats occupied by this species in the wider area through impacts on water quality or invasive alien species. The effects of water quality impacts and invasive alien species associated with the proposed development on saltmarsh habitats bordering the River Suir and other connected water bodies are assessed in Section 4.2.1. Due to the similar pathways for impacts and degree of connectivity between the proposed development and saltmarsh habitats and the proposed development and habitats for Desmoulin's Whorl Snail, it is considered that effects on any habitats for this species which may be present within the likely zone of impact are the same as those discussed in Section 4.2.1.

Therefore, the only potential impacts from the proposed development with the potential to give rise to adverse effects on the Conservation Objective for Desmoulin's Whorl Snail in the River Barrow and River Nore SAC are an impact on water quality or invasive alien species affecting the vegetation composition in this species' habitats (if present within the likely zone of impact). As mitigation will be necessary to manage the risk of water quality impacts and invasive alien species in any case, no additional or specific mitigation is required in respect of Desmoulin's Whorl Snail.

4.3.3 Fish Species

The only migratory fish species listed as Qualifying Interests of the River Barrow and River Nore SAC which are potentially present within the likely zone of impact of the proposed development are Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon. The effects of the proposed development on individuals and populations of these species in the vicinity of the proposed development are assessed and evaluated, in view of the Conservation Objectives of the Lower River Suir SAC, in Section 4.2.4 above.

The River Barrow and River Nore SAC is located c. 9km downstream of the proposed development and the proposed development does not provide for any barrier to migratory fish moving between the sea and the freshwater stretches of the Rivers Barrow and Nore. Furthermore, underwater noise or artificial lighting from the proposed development will not directly affect fish in the River Barrow and River Nore SAC. Therefore, the only impacts from the proposed development with potential to affect migratory fish species in this European site are water quality impacts.

Owing to the distance between the proposed development and the River Barrow and River Nore SAC, any water quality impacts from the proposed development will be of a significantly lower magnitude at this site than in the immediate vicinity of the proposed development. Therefore, any mitigation which is effective in terms of avoiding adverse effects on migratory fish species in the Lower River Suir SAC will be more than adequate to eliminate such effects in the River Barrow and River Nore SAC.

4.3.4 European Otter

The effects of the proposed development on European Otter in the Lower River Suir SAC are analysed and evaluated in Section 4.2.5 of this NIS. The effects on this Qualifying Interest in the River Barrow and River Nore SAC are considered to be the same as those for the Lower River Suir SAC, except that there will be no barrier to connectivity and no direct impacts on individuals. Therefore, any mitigation which is effective in terms of avoiding adverse effects on European Otter in the Lower River Suir SAC will be more than adequate to eliminate such effects in the River Barrow and River Nore SAC.

5. MITIGATION

5.1 Principles and Approach

Section 4.0 of this NIS identified adverse effects likely to arise from the proposed development on the specific Attributes and Targets which define the Conservation Objectives for a number of Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. This section (Section 5.0) prescribes measures and a protocol to ensure their full and proper implementation aimed at mitigating these adverse effects, thereby protecting the integrity of these European sites during the construction and operation of the proposed development.

The mitigation measures prescribed in this NIS have been designed according to the principle of a mitigation hierarchy, as outlined in the European Commission's guidance document *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* (EC, 2001). According to this hierarchy, the following mitigation approaches were adopted, in order of decreasing preference:

1. Avoiding impacts at their source;
2. Reducing impacts at their source;
3. Abating impacts on site; and,
4. Abating impacts at their receptor.

As mitigation measures are related directly to impacts and only indirectly to receptors and as, in this case, all of the affected receptors have been identified as being affected the same set of impacts, to describe mitigation measures under the headings of the relevant receptors would lead to undue repetition. Therefore, the measures prescribed in this NIS are described under the headings of the types of impacts which they are intended to mitigate.

The mitigation measures are prescribed in Section 5.2 and a protocol to ensure their full and proper implementation is prescribed in Section 5.3. The significance of any residual effects following the inclusion of mitigation measures is evaluated in Section 5.4. As per the assessment of adverse effects in Section 4.0, this evaluation is made in view of the relevant Conservation Objectives.

5.2 Mitigation Measures

5.2.1 Habitat Loss and Fragmentation

The attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the river face of the new flood defence wall has been included as part of the ecological enhancement of the proposed development. The "rough" surface of the cladding, which will slightly reduce flow velocities immediately adjacent to the wall, safeguarding the saltmarsh habitats in the vicinity of the proposed flood wall from the effects of erosion. As the biological communities, particularly seaweeds, e.g. *Fucus* spp., develop on the cladding, the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion.

Depending on the magnitude of this effect, over time, this may lead to an increased deposition of sediment immediately adjacent to the edge of the new riverside flood defence wall and upstream of the wall between Ch. 900 and Ch. 950, where the new alignment of the bank will form a light alcove. There is potential for this increased sedimentation to eventually lead to a slight expansion of the 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' at this location.

In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this NIS shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.

The flow velocity moderation provided by the cladding will also benefit small fish and other mobile species, including Twaite Shad and Otter, which are Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. An additional benefit of this mitigation is that, once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir (including Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC) and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the estuary.

5.2.2 Water Quality

Construction Phase

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan (CEMP) have been prepared for the proposed development and are included in Appendix A to this NIS. These will be developed by the Contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

- An Incident Response Plan (see Appendix A) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for the provision of the flood defences will be obtained prior to the commencement of construction.
- Inform and consult with Inland Fisheries Ireland.

During construction, regard will be had to the following guidance documents for construction work on, over or near water.

- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016)
- *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001)
- *CIRIA C648 C648 Control of water pollution from linear construction projects: technical guidance* (CIRIA, 2006)

- *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (NRA, 2006)

Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase:

General Measures

- Site works will be limited to the minimum required to construct the necessary elements of the proposed development.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
- Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses.
- Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
- The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and CEMP in Appendix A to this NIS for further detail.
- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.

Specific Measures - Concrete Works

Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:

- Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete.
- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water.

- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used.
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters.
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW).
- The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.
- There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse.
- Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses.
- On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds.
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer).
- Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site.
- Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.

Operational Phase

The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.

5.2.3 Hydroacoustic Impacts

Fish Species

Seasonal Restrictions on Piling

As noted previously, at least one of the fish species of concern is likely to be present in significant numbers in the vicinity of the works at any time of the year, with by far the most sensitive fish hydroacoustic impacts, namely juvenile Twaite Shad, are present year-round, and other species being far less sensitive to the predicted impacts. Therefore, there is no specific benefit to or requirement for seasonal restrictions on piling activity.

Limits on Working Hours for Piling

The assessment in Section 4.2.4 above identifies a particular sensitivity with regard to night-time piling operations, which present an increased risk of impacts on juvenile Twaite Shad which are likely to shelter by the channel edge at night. This risk was also highlighted at the options appraisal stage and informed the decision to select the option which facilitated almost all piling taking place during the day. 3-4 weeks of night-time piling are still required due to other constraints, chiefly the need for railway possessions. However, as noted in Section 4.2.4, this piling will take place on land only. Based on the fact that this piling will take place on land and its short duration, it can be concluded beyond reasonable scientific doubt that it will not give rise to adverse effects on Twaite Shad or other Qualifying Interests of the Lower River Suir SAC or the River Barrow and River Nore SAC. Nonetheless, mitigation should be included to ensure that night-time piling is minimised and limited to landside works.

Breaks in Piling

There is a considerable amount of preparation required to ensure that piles are in the correct position etc. before driving begins. Therefore, once one pile is complete, it is estimated that it will take c. 35 minutes to prepare for the next pile, during which time there will be no piling noise. As detailed in Section 4.2.4 above, the area impacted by each pile drive is very small (less than the width of the channel), the impact (TTS) is of a low magnitude and fully recoverable, and fish are not stationary. Therefore, a quiet period of c. 30 minutes between periods of piling noise will be adequate to allow for recovery of fish and/or movement away from or through the affected area. This is based on a worst-case scenario of 55 minutes of continuous vibratory piling by a single piling rig or 28 minutes with two rigs operating simultaneously, or 200 strikes from an impact hammer (either one or two operating at any time). Mitigation specifying such quiet periods will be required to ensure that they are implemented.

In order to guarantee these gaps in piling noise, particularly if there is more than one piling rig in operation at the site, it shall be a requirement that all breaks between piling be of at least 30 minute's duration and, in the case of two piling rigs being operational simultaneously, that such breaks are concurrent. This mitigation will ensure that any hydroacoustic impacts will not give rise to a significant barrier to the movements of Twaite Shad or other species, or other significant effects on such species, in the Suir Estuary.

Soft-start/Ramp-up Procedure

Given the slow build-up of energy from vibratory piling, there is no requirement for the use of a soft-start or ramp-up procedure. Where impact piling is necessary to achieve the required depth for some piles, the vibratory piling preceding it will act as an effective soft-start or ramp-up procedure. Therefore, no specific measures are required to regulate the build-up of sound energy under water.

European Otter

The mitigation prescribed in this section in relation to hydroacoustic impacts are more than adequate to eliminate any risk of significant noise and vibration impacts on otters during the construction of the proposed development. Therefore, no further mitigation is required in respect of noise and vibration impacts on this species.

Summary

In short, the mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts.

5.2.4 Lighting

Fish Species

The likely effects of artificial lighting on the migratory fish species listed as Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC are discussed in detail in Section 4.2.4 above. In summary, light spill onto the river channel during hours of darkness has the potential to form a barrier to the migration of nocturnal species and to encourage night-time activity of diurnal species, causing them to become more vulnerable to nocturnal predators.

Therefore, the following limits on construction lighting is proposed:

- Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
- Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
- In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to any impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.

European Otter

The mitigation prescribed in this section in relation to the impacts of artificial lighting are more than adequate to eliminate any risk of adverse effects in this regard on otters (including via prey availability) during the construction and operation of the proposed development. Therefore, no further mitigation is required in respect of lighting impacts on this species.

5.2.5 Invasive Alien Species

Terrestrial Plant Species

In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance* (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS.
- All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present.

If possible, the known stand of Japanese Knotweed at the location of the proposed construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control.

If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7m from all visible parts of the plant) at the outside and the access prohibited except for monitoring or treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.

Pioneer Species

The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site. According to the *Saltmarsh Monitoring Project 2007-2008* (McCorry & Ryle, 2009):

> "*A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended.* […] *It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary*

policy should be that any available resources should be used to prevent the spread of this species to new sites."

In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats:

- Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the Sustainable Transport Bridge and North Quays Development, without first having been inspected by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM).
- Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.

Aquatic Species

The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic invasive alien species and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall:

- Provide documentary evidence (in the form of a completed and signed Marine Institute "*Cleaning and Disinfection Declaration Form*") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and,
- Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development.

In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic invasive alien species to the Suir-Barrow-Nore Estuary. He/she shall do so by:

- Boarding the vessel;
- Speaking with the skipper;
- Inspecting the relevant documents; and,
- Carrying out a final inspection of the vessel.

In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document *Biosecurity Protocol for Field Survey Work* (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.

5.2.6 Other Measures

Fish Rescue

During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.

5.2.7 Monitoring

Water Quality

Monitoring of water quality shall be undertaken in the River Suir, with samples taken, monthly for at least 6 months prior to commencement, weekly for the entire duration of construction and monthly for at least 24 months post-completion. The parameters which shall be monitored include, but are not limited to:

- Suspended solids and turbidity;
- Total hydrocarbons;
- Ammonia, nitrates, nitrites and total nitrogen;
- Phosphates and total phosphorus;
- Dissolved oxygen and biological oxygen demand; and,
- Temperature and salinity.

Samples shall be taken from at least two different locations, including at least one location at an appropriate distance upstream of the proposed development and at least one other at an appropriate distance downstream of the proposed development. The final number and location of sampling points will be determined by the Site Environmental Manager. Given the strong tidal influence at the location of the proposed development, the date and exact time at which each sample is taken, as well as the water level and direction of flow, must be recorded in order to ensure that comparative analysis of samples can control for tidal influence, as well as other variables, e.g. fluvial conditions.

The results of the water quality monitoring programme will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation shall be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.

Record of Habitats

In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 50m upstream of the new flood defence wall to 50m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.

In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix B).

Hydroacoustic Impacts

In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the duration of the proposed development's construction during which piling activities will take place. This monitoring shall establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) prior to and after construction and more accurately characterise the sound outputs in terms of SPL_{peak}, SPL_{RMS} and *SEL* at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

5.3 Implementation

In order to give effect to the mitigation prescribed in this NIS, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this NIS be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.

During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:

- The Schedule of Commitments.
- The mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS.
- Any conditions which might be attached to the proposed development's planning consent.
- Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
  - *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- All applicable legislative requirements in relation to environmental protection.
- All relevant construction industry guidelines, including:
  - *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001).
- Any biosecurity requirements arising from the preceding points.
- The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
  - *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.*
  - *Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.*
  - *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.*
  - *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.*

- *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*
- *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.*
- *Management of Waste from National Road Construction Projects.*
- *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.*

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.

5.3.1 Environmental Operating Plan

Appendix A of the NIS contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.

The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.

Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

- All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
- Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- A detailed Biosecurity Protocol.
- A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
- Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

The EOP has been appended (Appendix A). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

Appendix A: Construction Environmental Management Plan (CEMP)

Appendix B: Construction and Demolition Waste Management Plan (CDWMP)

Appendix C: Incident Response Plan (IRP)

Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.

Construction Environmental Management Plan

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared, see Appendix A of this NIS. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP).

The CEMP will contain the following information of general importance:

- An overview of the proposed development.
- An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members.
- The Contractor's communications strategy.
- The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services.
- A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines.

In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following:

- Details of working hours and days.
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services.
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages).
- Details of construction plant storage, temporary offices.
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff).

- Dust management to prevent nuisance (demolition & construction).
- Control of sediment, run-off, erosion and pollution.
- Noise and vibration management to prevent nuisance (demolition & construction).
- Landscape management.
- Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel.
- Management of waste arising from construction and demolition.
- Minimisation of artificial lighting and shading.
- Management of risk from invasive alien species
- Stockpiles.
- Project procedures & method statements for:
    - Site clearance, site investigations, excavations
    - Diversion of services.
    - Excavation and blasting (through peat, soils & bedrock).
    - Piling.
    - Temporary hoarding & lighting.
    - Borrow Pits & location of crushing plant.
    - Storage and Treatment of peat and soft soils.
    - Disposal of surplus geological material (peat, soils, rock etc.).
    - Earthworks material improvement.
    - Protection of watercourses from contamination and silting during construction.
    - Works from a barge, including protection of watercourses from contamination when working in-river
- Site Compounds.
- Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

Construction and Demolition Waste Management Plan

The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.

The finalised CDWMP will contain the following information:

- Material transport routes;
- Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:

- An analysis of the different waste streams expected to be generated;
- A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
- Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
- Details of storage areas for waste materials and containers;
- Details of how unsuitable excess materials will be disposed of, where necessary; and
- Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

- Estimates of waste management costs;
- Specific waste management objectives for the project;
- Identification of the roles and responsibilities of the relevant personnel regarding waste management;
- Procedures for communication and training in relation to on-site waste management;
- Record keeping procedures; and
- Details of an audit system to monitor implementation of the CDWMP.

The CDWMP is appended to the EOP (see Appendix A of the NIS). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.

Incident Response Plan

The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances.

The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum:

- Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and,
- Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to,

details of removal of site materials, fuels, tools, vehicles and persons from flood zones.

- The measures to be taken to avoid or reduce the incident risk potential;
- Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Persons responsible for dealing with incidents and their contact details;
- Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same;
- Standby / rota systems; and
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

An IRP has been appended to the EOP (see Appendix A of this NIS). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.

5.3.2 Site Environmental Manager

To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of peak water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.

- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

5.3.3 Ecological Clerk of Works

In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS;
- To highlight the sensitivity of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of this NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.

During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

5.4 Residual Effects

5.4.1 Annex I Habitats

Following the inclusion of the mitigation measures in Section 5.2 above, the probability of impacts on water quality arising from the construction of the proposed development are very low and the significance of any such impacts, if they were to occur, would be slight to imperceptible. The probability and significance of any such impacts arising from the operation of the proposed development are lower still. In addition, the inclusion of a Biosecurity Protocol and enforcement of the same by the ECoW will ensure that the risk posed by invasive species is effectively managed during construction. Thus, it can be concluded beyond reasonable scientific doubt that any residual impacts on water quality arising from the proposed development will not constitute adverse effects on any of the Annex I habitats.

Therefore, given the full and proper implementation of the mitigation prescribed in this NIS, it can be concluded beyond all reasonable scientific doubt that construction and operation of the proposed development will not adversely affect the integrity of either the Lower River Suir SAC, in view of its Conservation Objectives for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', 'Mediterranean salt meadows

(*Juncetalia maritimi*)', 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' and 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)', or the River Barrow and River Nore SAC, in view of its Conservation Objectives for 'Mudflats and sandflats not covered by seawater at low tide', 'Reefs', '*Salicornia* and other annuals colonising mud and sand', 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', 'Mediterranean salt meadows (*Juncetalia maritimi*)', 'Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels' and 'Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)'.

5.4.2 Desmoulin's Whorl Snail

The mitigation prescribed in respect of water quality impacts and invasive species will provide for the protection of any riparian habitat for Desmoulin's Whorl Snail present within the likely zone of impact of the proposed development. As stated in Section 5.4.1 above, any residual impacts on these habitats will not constitute adverse effects.

Therefore, given the full and proper implementation of the mitigation prescribed in this NIS, it can be concluded beyond all reasonable scientific doubt that construction and operation of the proposed development will not adversely affect the integrity of the River Barrow and River Nore SAC, in view of its Conservation Objective for Desmoulin's Whorl Snail.

5.4.3 Fish Species

Following the inclusion of the mitigation measures in Section 5.2 above, the probability of impacts on water quality arising from the construction of the proposed development are very low and the significance of any such impacts, if they were to occur, would be slight to imperceptible. The probability and significance of any such impacts arising from the operation of the proposed development are lower still. Thus, it can be concluded beyond reasonable scientific doubt that any residual impacts on water quality arising from the proposed development will not constitute adverse effects on fish species.

The mitigation prescribed in Section 5.2 above in respect of hydroacoustic impacts will ensure that any residual hydroacoustic impacts on Sea Lamprey, River Lamprey, Twaite Shad, Atlantic Salmon and other fish species are slight to imperceptible and temporary. Therefore, it can be concluded that these residual impacts do not constitute adverse effects on these species.

Any residual impacts of artificial lighting arising from the proposed development are restricted to the construction stage and will occur over a small extent and minimal duration. Owing to the mitigation prescribed, these impacts are characterised as an imperceptible impact on the movement of nocturnal species, i.e. Sea Lamprey, River Lamprey and Atlantic Salmon, and a slight to imperceptible impact of increased predation risk on juvenile Twaite Shad. Given the small scale and short duration of these residual impacts, it can be concluded that they will not constitute adverse effects on these species.

Therefore, given the full and proper implementation of the mitigation prescribed in this NIS, it can be concluded beyond all reasonable scientific doubt that construction and operation of the proposed development will not adversely affect the integrity of either the Lower River Suir SAC or the River Barrow and River Nore SAC, in view of their Conservation Objectives for Sea Lamprey, River Lamprey, Twaite Shad and Atlantic Salmon.

5.4.4 European Otter

As stated in Sections 5.2.2 and 5.2.3 above, the mitigation prescribed in relation to the impacts of piling noise and artificial light on fish species are considered more than adequate to address disturbance impacts on European Otter. Thus, it can be concluded that any residual impacts of disturbance to otters do not constitute adverse effects on this species.

Similarly, as explained in Section 4.2.5 above, the impact of the proposed development on fish biomass available to otters was treated as a potentially significant impact on this species. However, as the residual impacts on fish species have been shown to be slight to imperceptible, it can now be concluded that there will not be a significant reduction in the fish biomass available to otters. Thus, any residual impact in terms of fish biomass will not constitute an adverse effect on this species.

Therefore, given the full and proper implementation of the mitigation prescribed in this NIS, it can be concluded beyond all reasonable scientific doubt that the construction and operation of the proposed development will not adversely affect the integrity of either the Lower River Suir SAC or the River Barrow and River Nore SAC, in view of their Conservation Objectives for European Otter.

6. IN-COMBINATION EFFECTS

6.1 Introduction

Article 6(3) of the Habitats Directive requires that AA be carried out in respect of plans and projects that are likely to have significant effects on European sites, "either individually or in combination with other plans or projects". Therefore, the combined effects of the plan or project under assessment and other past, present or foreseeable future plans or projects must also be examined, analysed and evaluated.

6.2 Methodology

A geographical boundary of 15km was selected for the assessment of in-combination effects. This comprises a viable study area with reasonable potential for cumulative impacts whilst excluding those areas which are non-viable because of issues such as topography and distance. Significant projects known to WCCC that are not yet within the planning system but have the potential to interact with the proposed development are also considered.

In-combination or cumulative effects result from incremental changes caused by other past, present or reasonably foreseeable projects together with the proposed Flood Defences West. Such effects were assessed by examining previous plans and projects, current plans and projects in planning and proposed future plans and projects within 15km of the proposed development from 2010 to the present. There is too much uncertainty associated with proposals beyond 5 years into the future and this NIS must be based on data that is readily available. The assessment in this NIS has considered in-combination effects that are:

(a) Likely;

(b) Significant; and,

(c) Relating to a future event which is reasonably foreseeable.

The following data sources have been consulted to identify the plans and projects within the 15 km boundary:

- Waterford City and County Council;
- Kilkenny County Council;
- Wexford County Council;
- EIA Portal;
- An Bord Pleanála website (planning searches);
- Web search for major infrastructure projects in Waterford City and County and Co. Kilkenny;
- Waterford City Development Plan 2013-2019 (as extended);
- Waterford County Development Plan 2011-2017 (as extended);
- Draft Kilkenny County Development Plan 2021-2027;
- North Quays SDZ Planning Scheme 2018; and,
- Ferrybank Belview Local Area Plan 2009-2020 (including Amendment 1).

6.3 Assessment of Effects

Table 6.1 below details the assessment of the likelihood of significant effects arising from the proposed development in combination with other plans or projects. This assessment was undertaken in view of the Conservation Objectives of the relevant European sites and found that, given the implementation of the mitigation measures in Section 5.0 of this NIS, the proposed development does not have the potential to significantly affect any European site in combination with other plans or projects.

Table 6.1 Assessment of adverse effects arising from the proposed development in combination with other plans or projects.

Name of plan/project	Description of plan/project	Likely in-combination effects
Project Ireland 2040- National Planning Framework **(Distance: 0 m)**	The National Planning Framework (NPF) is the Government's high-level strategic plan for shaping the future growth and development of the country out to the year 2040. The NPF with the National Development Plan also set the context for each of Ireland's three regional assemblies to develop their Regional Spatial and Economic Strategies taking account of and co-ordinating local authority County and City Development Plans in a manner that will ensure national, regional and local plans align. An SEA and AA have been completed to support the plan. The proposed development will also support the implementation of a number of NSOs and NPOs identified in the NPF and NDP respectively.	This is a high-level strategic planning framework which sets out policies and objectives. Considering the nature of the planning framework and the conclusion of its NIS and that any future projects stemming from the framework will be subjected to their own AA if necessary, there will be no adverse effects on any European site in combination with the proposed development.
National Adaptation Framework: Planning for a Climate Resilient Ireland **(Distance: 0 m)**	The National Adaptation Framework (NAF) has been developed to address current and future risks associated with climate change, including impacts attributed to increase in heavy rainfall events; intensity of storms; sea level rise etc. The NAF recognises that climate change will have a negative impact on a number of key socio, economic and environmental sectors including critical infrastructure: transport, emergency, water, energy, and communications services and are at risk from a range of climate induced impacts such as sea level rise, changing rainfall patterns, increasing temperature and extreme weather events. In response to climate change, the NAF aims to set up effective adaptation strategies to reduce the vulnerability of Ireland's environment, society, and economy and to increase its resilience to the effects of climate change. The NAF identified an array of adaptation measures that "enhance adaptive capacity of social, industrial and environmental infrastructures and mitigate the effects of climate change". Adaption measures have been categorised as soft, green and grey adaptation measures. Building new or raising the level of existing flood defences is an example of 'grey' adaptation measures. The proposed development will provide protection of the rail corridor, a critical infrastructure against existing and future flood risk and will support Waterford City in building its resilience to climate change.	This is a high-level strategic planning framework which sets out policies and objectives. Considering the nature of the planning framework and the conclusion of its biodiversity assessment and that any future projects stemming from the framework will be subjected to their own AA if necessary, there is no potential for adverse effects on any European site in combination with the proposed development.
Southern Region Regional Spatial and Economic Strategy (SRRSES) **(Distance: 0 m)**	Arising under the Local government Reform Act 2014, the Southern Regional Assembly has assumed a number of new functions. Chief among these responsibilities is the preparation of a Regional Spatial and Economic Strategy (RSES) for the Southern Region. The Southern Regional Assembly prepared the Regional Spatial and Economic Strategy (RSES) in 2020. The Southern RSES seeks to align with the National Policy Objectives (NPOs) and goals set out in the NPF including NPO 7 which seeks to accelerate the development of Waterford, Cork, and Limerick to grow by at least half of the 2016 Census population, i.e., by 50% to 60% by 2040. The Waterford Metropolitan Area Strategic Plan (MASP) was developed as part of the RSES to *"develop a concentric city both north and south of the River Suir"*. The proposed development is	This high-level strategy sets out policies and objectives for the southern region. Considering the nature of the SRRSES and the conclusion of its NIR and that any future projects stemming from the strategy will be subjected to their own AA if necessary, there will be no adverse effects on any European site in combination with the proposed development.

Name of plan/project	Description of plan/project	Likely in-combination effects
	in line with this objective by minimising flood risk to the north quays area which will facilitate sustainable development of the City. The proposed development is also in line with the Regional Policy Objective **RPO 9** which aims to *"ensure investment and delivery of comprehensive infrastructure packages to meet growth targets that prioritise the delivery of compact growth".* The infrastructure packages *include "climate change adaptation and future proofing infrastructure including flood risk management measures, environmental improvements*". The proposed development is consisted with the Southern RSES and will protect the existing and future built infrastructure from climate changed induced flood risk. An AA and SEA had been completed for the strategy with the Natura Impact Report (NIR) concluding that "*the RSES would not adversely affect the integrity of a European site (whether individually or in combination with other plans or projects) subject to application of all of the mitigation measures identified in this NIR*."	
Waterford City Development Plan 2013-2019 (as extended)	The Waterford City Development Plan 2013- 2019 sets out an overall strategy for the proper planning and sustainable development of the functional area of Waterford City, pursuant to section 9 of the Planning and Development Act 2000 (as amended). The purpose of the Plan is to inform the public, statutory authorities, service providers, developers and other interested parties, of the policy framework that will guide development decisions within the city over the Plan period. The Plan provides: • *A sustainable strategy to guide the location and pattern of development* • *Guidance on the phased release of housing land for development* • *A framework for infrastructural provision.* • *A framework for the conservation and protection of the heritage, built and natural, whilst facilitating appropriate use* • *A framework for the integration of development with the social, community and cultural requirements of the population* • *Guidance for the public and developers on development.* The Plan also includes the following policy in relation to alleviating flood risk: • *To seek to alleviate flood risk in areas currently liable to flooding (POL 11.5.10)* An SEA , SFRA and AA have been completed to support the plan.	This is a high-level strategic plan which sets out policies and objectives. Considering the nature of the plan and the conclusion of its biodiversity assessment and that any future projects stemming from the plan will be subjected to their own AA if necessary, there is no potential for adverse effects on any European site in combination with the proposed development.
Waterford Heritage Plan 2017-2022 **(Distance: 0 m)**	The Heritage Plan sets out the priorities for Heritage in Waterford over the next 5 years and is a cross agency plan with input from as wide a sector as possible who are involved in heritage projects, policy and work programmes across the city and county along with an extensive public consultation process. The plan also sets the framework for the Heritage Council allocation that we apply for through the annual Heritage Plan Fund.	This is a high-level strategic plan which sets out policies and objectives for the conservation and enhancement of local heritage including biodiversity in Waterford. Therefore, there is no potential for adverse

Name of plan/project	Description of plan/project	Likely in-combination effects
	The plan sets out a Vision to: *To increase engagement with, and access to, all aspects of heritage in Waterford City and County and promote conservation, best practice, appreciation and enjoyment of our shared heritage.* The Mission Statement for this plan is: *To set out a strategic and co-ordinated approach for heritage in recognition of the benefits that heritage delivers; identifying a sense of place for Waterford, learning lessons from our past to plan for the future and added value for the development of Waterford City and County*	effects on any European site in combination with the proposed development.
Waterford North Quays Strategic Development Zone Planning Scheme 2018 **(Distance: 0 m)**	The Government designated lands at North Quays in Waterford City as Strategic Development Zone (SDZ) on 20th January 2016. SDZ designations are created to facilitate development which in the opinion of the Government is of economic or social importance to the State. Waterford City and County Council as the 'Development Agency' prepared the North Quays SDZ Planning Scheme which was adopted by the elected members of Waterford City and County Council in February 2018. The Planning Scheme sets out a Vision to: • To create a sustainable, compact extension to the City Centre that will serve a future population of 83,000 people. • Creation of an integrated multi-modal transport hub designed to sustainably meet the access requirements of The City. The Planning Scheme vision is supported by a range of principal goals, including, but not limited to, the following: • To promote the expansion of the City Centre to the north of the River Suir in a manner that enhances and supports balanced and sustainable growth in Waterford City and encourages its vitality and viability • To provide sustainable solutions that address and manages the risk of flooding and climate change. The proposed Flood Defences West will form a continuation of the flood defences east which received a planning approval as part of the SDZ Transportation Hub and will cumulatively protect the Waterford City north quays area against existing and future flood risk. As such, the proposed development will complement the sustainable development of the Waterford SDZ site. AA was carried out for the SDZ, with the NIR concluding that "*given the full and proper implementation of the mitigation contained in the Planning Scheme, there will be no adverse effect on the integrity of Natura 2000 sites arising from the adoption and implementation of the Planning Scheme, either individually or in combination with other plans or projects*."	While the proposed development adjoins the North Quays SDZ, the Planning Scheme is a high-level strategic document which sets out the requirements for development within the SDZ and is not an authorisation for any such development. The NIR for the Planning Scheme concluded that there would be no adverse effect on any European site arising from its adoption and implementation. Furthermore, PSI 26 of the Planning Scheme provides: "*Any plan or project with the potential to give rise to significant direct, indirect, secondary impacts or through indirect or cumulative impact, on a Natura 2000 site(s) shall be subject to an Appropriate Assessment in accordance with Article 6 of the EU Habitats Directive (92/43EEC) and associated legislation and guidelines informing decision making. All proposals are required to consider the mitigation measures contained in the Natura Impact Report of the Planning Scheme.*" Therefore, there will be no adverse effects in combination with the proposed development.
Waterford Planning Land Use and Transportation Study 2004	The Waterford Planning Land Use and Transportation Strategy (PLUTS) was adopted by Waterford and Kilkenny Councils in 2004 in order to provide a vision and strategy for the development of Waterford City and Environs up to the year 2020. The core provisions of PLUTS are:	This is a high-level strategic plan which sets out policies and objectives. Considering the nature of the study, there is no potential for

Name of plan/project	Description of plan/project	Likely in-combination effects
(Distance: 0 m)	• Provision for a population increase of almost 30,000 people (or 57% population growth) in Waterford City and Environs; • Investment needed for almost 12,800 new jobs or 46% growth; • Requirement for approximately 11,500 new dwellings transitioning predominantly to the north of the River Suir; • Significant retail expansion in the expanding City Centre; • A Downstream River Crossing to facilitate the extension of the Outer Ring Road northwards to the N25; • A new City Centre Bridge for pedestrians and cyclists to link the redeveloped North Quays with the existing City Centre; • Provision of a rail-passenger platform on the North Quays as part of a new Public Transport Interchange; • Development of a high-quality bus-based public transport system in the City supported by Park and Ride facilities located north and south of the River; Waterford has developed some of this infrsatructure since 2004, most notably the provision of the Waterford Bypass and up river crossing of the River Suir and the Outer Ring Road. A number of these projects have received planning within the past few years and are considered further within this table.	adverse effects on any European site in combination with the proposed development.
Transforming Waterford Integrated transport proposals **(Distance: 0 m)**	This document relates to costing relating to transportation proposals some of which are based on the PLUTS Strategy and strategic City infrastructure, necessary for the future development of the City. They are consistent with the Planning Land Use and Transportation Strategy for the City and with Regional and National Planning Policies. The proposed transportation components include: • City centre – Enabling City Growth • City Centre Improvement – Building On The Essential Character • Sustainable Transport Corridor/Regional Greenway • Abbey Road Improvement Works • Dock Road Improvement Works • Integrated Transport Hub – Redefining Urban Transport Modal Integration As above, a number of these projects have received planning within the past few years and are considered further within this table.	This is a high-level strategic plan which sets out policies and objectives. Considering the nature of the plan, there is no potential for adverse effects on any European site in combination with the proposed development.
Port of Waterford Waste Management Plan 2017	The Port's waste management plan outlines the Port's policies and procedures in relation to the management of waste. The plan describes the Port's current facilities in terms of waste management and also how the adequacy of these facilities will be reviewed. In the context of the	This is a high-level strategic plan which sets out policies and objectives. Considering the nature of the plan and how it will minimise the

Name of plan/project	Description of plan/project	Likely in-combination effects
(Distance: 5.5 km)	plan, "waste" includes waste originating both from ships using the Port and from the Port itself. Procedures for the handling of different types of waste (e.g. general waste, galley waste, international catering waste, cargo waste, hazardous waste and electrical waste) are described. Procedures for how incoming ships must notify the Port regarding their waste reception needs and how Port users may lodge complaints about waste management are also included. The small volume of waste associated with the proposed Flood Defences West, will be disposed of as per the mitigation measures in Chapter 8 Soils and Geology.	negative impacts of mismanaged waste disposal on the environment and biodiversity, there is no potential for adverse effects on any European site in combination with the proposed development.
Port of Waterford Company – Dumping at Sea / Dredging (EPA Licence No. S0012-03) **(Distance: c. 15 m)**	This permit is for the loading and dumping at sea of dredged material (consisting of sand, silt and gravel) arising from maintenance dredging by Port of Waterford Company at a number of discrete locations in the Suir Estuary Waterford Harbour over a six-year timeframe (2020 - 2025). The licence provides the Port of Waterford Company a Dumping at Sea Permit from the Environmental Protection Agency to maintain the shipping corridor through dredging and dispose of the dredged material in an approved disposal site located c. 2.5km west of Hook Head and c. 2.8km southeast of Dunmore East within the Port's limits. The licence provides for three areas of dredging within the River Suir at Waterford City. These three locations are located downstream of Rice Bridge, namely North Wharf, Frank Cassin Wharf and Forde Wharf & Merchant's Quay Marina. The Port of Waterford have commissioned numerous environmental assessments over the past two decades, as included in the application, to ensure that the impact of the development is minimal. A Natura Impact Statement (NIS) was prepared as part of the application and concluded that the proposed dredging and disposal operations will not negatively impact on the integrity of the Natura 2000 sites, their qualifying interests or marine mammals.	Considering the conclusion of the NIS for the licence, particularly with regard to impacts on sediment supply to Annex I habitats, there will be no adverse effects in combination with the proposed development.
The Southern Waste Management Plan 2015-2021 **(Distance: 0 m)**	The Southern Waste Management Plan 2015-2021 is a statutory planning document whose objective is to set out a framework for the prevention and management of wastes for the Southern region. The overarching strategic objectives of the SRWMP as presented in June / July of 2014 were: 1. *Policy & Legislation The Region will implement EU and national waste and related environmental policy, legislation, guidance and codes of practice to improve management of material resources and wastes.* *2. Prevention Natura Impact Report: Southern Region Waste Management Plan MDR0998RP0015F02 9 Prioritise waste prevention through behavioural change activities to decouple economic growth and resource use.* *3. Resource Efficiency. The Region will encourage the transition from a waste management economy to a green circular economy to enhance employment and increase the value, recovery and recirculation of resources.* *4. Coordination Coordinate the activities of the Regions and to work with relevant stakeholder to ensure the effective implementation of objectives.*	This high-level strategic plan sets out policies and objectives for the southern region. Considering the nature of the plan and the conclusion of its NIR and that any future projects stemming from the plan will be subjected to their own AA if necessary, there will be no adverse effects on any European site in combination with the proposed development.

Name of plan/project	Description of plan/project	Likely in-combination effects
	5. Infrastructure Planning. The Region will promote sustainable waste management treatment in keeping with the waste hierarchy and the move towards a circular economy and greater self sufficiency. *6. Enforcement & Regulations. The Region, will implement a consistent and coordinated system for the regulation and enforcement of waste activities in cooperation with other environmental regulators and enforcement bodies* *7. Protection Apply the relevant environmental and planning legislation to waste activities to protect and reduce impacts on the environment, in particular European Sites, and human health from the adverse impact of waste generated.* *8. Other Wastes. The Region will establish policy measures for other waste streams not subject to EU and national waste management performance targets.* An SEA, NIR and SFRA have been completed to support the plan. The NIR concluded that "*The final text of the SRWMP now ensures that the protection of the Natura 2000 network is integrated into the Plan*." and that "*AA of the potential impact of such waste sites on the integrity of a European designated site and its conservation objectives, will be determined through plan and project level AA at a time when location, mode and design specific proposals are developed*."	
Suir River Basin Flood Risk Management Plan **(Distance: 0 m)**	The purpose of the Plan is to set out the strategy, including a set of proposed measures, for the cost-effective and sustainable, long-term management of flood risk in the River Basin, including the areas where the flood risk has been determined as being potentially significant. This Plan, which is for the period of 2018-2021, is one of 29 Plans being published; each setting out the feasible range of flood risk management measures proposed for their respective River Basins. The preparation of these Plans addresses Ireland's obligations under the 2007 EU 'Floods' Directive (EU, 20074). The Plan includes feasible measures developed through a range of programmes and policy initiatives including: • *Non-structural flood risk prevention and preparedness measures that are applicable nationally, aimed at reducing the impacts of flooding, that have been and are being developed to implement Government policy on flood risk management (OPW, 2004).* • *Structural flood protection measures proposed for communities at significant flood risk, aimed at reducing the likelihood and/or degree of flooding, identified through the National Catchment Flood Risk Assessment and Management (CFRAM) Programme.* The CFRAM Programme has examined the flood risk, and possible measures to address the risk, in 300 communities throughout the country at potentially significant flood risk. These communities were identified through the Preliminary Flood Risk Assessment, which was a national screening assessment of flood risk. The communities identified through the PFRA process as being at potentially significant flood risk in the Suir River Basin, along with the sources of flood risk that were deemed to be significant for each community. A set of flood maps, indicating the areas prone to flooding, has been developed and published for each of the communities. The Plan builds on	This high-level strategic plan sets out objectives and measures for the management of flood risks in the Suir River. Considering the nature of the plan and the conclusion of its NIS and that any future projects stemming from the plan will be subjected to their own AA if necessary, there will be no adverse effects on any European site in combination with the proposed development.

Name of plan/project	Description of plan/project	Likely in-combination effects
	and supplements the national programme of flood protection works completed previously, that are under design and construction at this time or that have been set out through other projects or plans, and the ongoing maintenance of existing drainage and flood relief schemes. A Strategic Environmental Assessment, and an Appropriate Assessment under the Habitats Directive where appropriate, have been undertaken as part of the preparation of, and have been published with the Plan. The NIS concluded that following the avoidance and mitigation measures suggested, the FRM measures would not have a significant adverse impact on any European sites.	
Ferrybank Local Area Plan (LAP) 2017 – 2023 **(Distance: 0 m)**	The Ferrybank- Belview Local Area Plan (LAP) 2017 – 2023 outlines a strategy for the proper planning and sustainable development of an area of land stretching from Grannagh to Belview and from the River Suir to the line of the Waterford bypass, adjacent to the proposed Waterford Flood Defences West. The Ferrybank LAP supports the development strategy set out in the Waterford Planning, Land Use and Transportation Study (PLUTS) to achieve a balanced and sustainable growth of Waterford. The PLUTS proposed to bring the "*North Quays and the Suburbs fully into the social and economic domain of the City*". To achieve this overarching objective, the study advocated for future growth to be distributed between the north and south quays of the city, including Ferrybank. The proposed development will assist Ferrybank LAP to realise its sustainable growth objectives by protecting the north quays area from potential flood events. An AA Screening was carried out for the LAP which concluded that "*the proposed Draft LAP will not have a significant effect on European Sites and a Stage 2 Appropriate Assessment is not required*."	This is a high-level strategic plan which sets out policies and objectives. Considering the nature of the plan and the conclusion of its AA Screening and that any future projects stemming from the plan will be subjected to their own AA if necessary, there is no potential for adverse effects on any European site in combination with the proposed development.
Waterford-New Ross Greenway **(Distance: 1.1 km)**	The development of the disused railway line on lands which extend from within Waterford City and County Council's administrative boundary through to Rosbercon, New Ross as a cycle and pedestrian route. The route which is 22km in length will begin at Abbey Road, Ferrybank, Waterford and will follow the disused line through or in close proximity to the townlands of Abbeylands, Rathculliheen, Gorteens, Drumdowney Lower, Rathpatrick, Luffany, Curraghmore, Ballyrowragh, Scartnamoe, Rathinure, Rochestown, Aylwardstown, Carrickcloney, Ballyverneen, Forestalstown, Shanbogh Upper and Raheen (Rosbercon), Co. Kilkenny. The project screened out for Appropriate Assessment.	Considering the nature, scale and location of the greenway, there will be no adverse effects in combination with the proposed development.
Bilberry to Waterford City Centre Greenway Link **(Distance: 0.2 km)**	Part 8 application was submitted to WCCC in 2019 to carry out works at existing greenway car park at Bilberry, to the Clock Tower on Merchants Quay. • Construction of an approximate 4000mm wide cycle and pedestrian corridor from the Greenway car park at Bilberry, along Bilberry Road, Grattan Quay and Merchants Quay, to the proposed South Quay Plaza • Road widening along Bilberry Road, erection of railings and fences and provision of accommodation works where necessary for adjoining landowners • Provision of 2 No. 4000 mm wide boardwalks at the eastern end of Bilberry Road	Considering the nature, scale and location of the greenway, there will be no adverse effects in combination with the proposed development.

Name of plan/project	Description of plan/project	Likely in-combination effects
	• Upgrade the existing facilities on Grattan Quay and Merchants Quay, and upgrade the existing facilities in the car parks in Merchants Quay The proposed development has undergone Appropriate Assessment Screening under the Habitats Directive (92/43/EEC) and the Planning and Development Act 2000, as amended, and the Planning Authority has determined that a Stage 2 Appropriate Assessment is not required in this instance. In addition, the proposal has also undergone screening for Environmental Impact Assessment under the EIA Directive 2014/52/EU (and the relevant provisions of the Planning and Development Act, as amended), and the Planning Authority has determined that there will be no likelihood of significant effects on the environment arising from the proposed development and therefore, an Environmental Impact Assessment is not required.	
River Suir Sustainable Transport Bridge **(Distance: 440 m)**	Planning Permission was granted in 2019 (ABP ref no. ABP-303274-18) for construction of a 5-span, 8m wide sustainable transport bridge which will be a shared space for pedestrians, cyclists and a public transportation service. The bridge crossing point is approximately 550m downriver of the existing Rice Bridge. The Lower River Suir is in the region of 207m wide at this location and is part of the Lower River Suir Special Area of Conservation (SAC). The proposed development is located approximately adjacent to Barronstrand Street (commercial partially pedestrianised and in front of the existing Clock Tower on the south quays in Waterford city centre. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement were submitted to An Bord Pleanála with the River Suir Sustainable Transport Bridge (RSSTB) Application. **Biodiversity** The residual impacts identified in the RSSTB EIAR during operation phase include permanent, slight negative impact on KER 1 River Suir as a result of the permanent loss of estuarine habitat. The residual impacts predicted on the estuarine habitats of River Suir as a result of the proposed development constitutes a Permanent Slight Positive Impact on the River Suir. As such, no significant cumulative impacts likely to arise from the combination of this project with the proposed development. **AA** The NIS for the River Suir Sustainable Transport Bridge concluded that the "*Project, either individually or in combination with other plans or projects, will not adversely affect the integrity of the Lower River Suir SAC, the River Barrow and River Nore SAC or any other European site*." Furthermore, the NIS recommends *"that it be a binding condition of any consent granted in respect of the Project that the mitigation prescribed in this NIS be fully and properly implemented*."	No – This project is in close proximity to the proposed flood defences, and both are located within the River Suir. However, given the mitigation measures prescribed for the sustainable transport bridge (ensured by the Conditions of its planning consent) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects. **Notwithstanding this, the ECoW appointed for the construction of the proposed flood defences shall coordinate with their counterpart for the sustainable transport bridge to ensure the effectiveness of the mitigation measures for both projects, particularly with regard to underwater noise and biosecurity.**
Falcon Real Estate Development Ireland Ltd **(Distance: 0 m)**	Planning Permission was granted in 2020 (WCCC ref no. 19928) to a single 10 year planning application for development of lands that is required to conform with the Waterford NQ SDZ Planning Scheme. The proposed development will comprise a mixed-use development consisting of nine blocks of between 1 to 18 storeys. The development described below on a block by block basis will be built	No – This project is in close proximity to the proposed flood defences, and both are located within the River Suir. However, given the mitigation measures prescribed for the Falcon Real Estate project (ensured by the

Name of plan/project	Description of plan/project	Likely in-combination effects
	on a new raised podium structure, which establishes new ground/ street formation levels, which varies from 8.075m OD to 9.3m OD across the site. This is to ensure the floorspace of the proposed development is above the flood level of the River Suir. The proposed development also includes various areas of landscaping and public realm, infrastructure to connect to the surrounding road network and the City Centre, services infrastructure and all associated site and development works. The proposed development will include the following elements: • 220 bed Hotel, 15 storey building (Block A); • A Mixed-use Commercial Building (Block B) contained over three levels comprising a Visitor Centre (tourism / cultural use), retail (including a licenced supermarket), Foodcourt and individual food and beverage units with associated outdoor seating areas, Leisure/ entertainment, cinema and associated circulation and ancillary areas. Some ancillary accommodation associated with Block B is located below podium. The maximum building height is 32.45m (41.2m OD). This is the height of the portal building at the main entrance to Block B, adjacent to the proposed Sustainable Transport Bridge landing point. Generally, the building height is c.17m (25.65m OD) rising at the western and eastern ends to c21.7m (30.45m OD). There are three main access points to Block B from the south elevation and two on the north elevation (the northern entrances onto Dock Road will be opened in tandem with the proposed Transport Hub development by WCCC). Vehicular access / egress to the carpark is provided from the eastern and western access points off Dock Road. • A seven-storey office block Office Development (Block C) located on the eastern side of the site. • A Residential (Blocks D1-D5) comprising five apartment blocks with a total of 298 apartments with associated balconies, ancillary accommodation, resident support facilities, services and amenities are proposed at the eastern end of the site. • Energy Building (Block E) is a standalone single level building (11.45m) located to the west of the Hotel (Block A). The building contains utilities and plant to service the proposed development. A green roof and PV panels are proposed on the roof structure. Carparking: A car park and services / plant associated with the Blocks A-D will be provided below podium, beneath Blocks A – D on a new formation level of 4.75m OD. A total number of 1,481 parking spaces will be provided across the development site. This includes parking and basement accommodation (GFA) directly associated with the relevant block above, vehicle and pedestrian circulation, stair cores, lifts, plant and storage, service/ delivery yards and other ancillary accommodation. The below podium floor level of 4.75m OD is 2 metres above the existing deck level at 2.75m OD. Associated Infrastructure and Public Utilities: Transport: The development connects to the 'SDZ Access and Public Road Infrastructure' project (WCCC Part VIII approved in January 2019) which provides two vehicular access points into the site off Dock Road / Fountain Street (R711) – the	Conditions of its planning consent) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects. **Notwithstanding this, the ECoW appointed for the construction of the proposed flood defences shall coordinate with their counterpart for the Falcon Real Estate project to ensure the effectiveness of the mitigation measures for both projects, particularly with regard to underwater noise and biosecurity.**

Name of plan/project	Description of plan/project	Likely in-combination effects
	western access point is located opposite the entrance to the former Ard Rí Hotel; the eastern access connects to the site from a realigned Abbey Road. This proposed development will connect to the approved New Ross to Waterford Greenway and vehicular access points with minor modifications within the site at the tie-in points. The proposed development has incorporated this design of the proposed Sustainable Transport Bridge (proposed by WCCC and was granted planning permission by ABP (ref no. ABP-303274-18) in) that will tie in at the Central Plaza. Drainage: The development will also include all related infrastructure and associated site and development works and connections to water services and public utilities outside the SDZ site. The proposed works include decommissioning of the existing Ferrybank Pumping Station which is located on the SDZ lands and provision of a new pumping station and associated stormwater tanks on the combined sewer network serving Waterford City (Rockshire Area). The new pumping station is proposed on lands north of the railway line, on the former Dunlop Tyres site. A new connection from the SDZ lands, under the railway line, is proposed east of the eastern access to the lands. An emergency outfall and stormwater outfall from the new pumping station to the River Suir is proposed at the eastern boundary of the SDZ lands. This will replace the outfall from the existing pumping station. These ancillary infrastructure works for the pumping station are located east of Blocks D1-5. WCCC will divert the existing 900mm combined sewer, from a point north of the existing railway crossing to drain by gravity to the proposed pumping station location. The Council will also upgrade (if required) the existing rising main to Abbey Road. All floorspace associated with the building blocks (Blocks A – E) are within the Waterford North Quays Planning Scheme boundary on a site of c 7.3 ha. The ancillary infrastructure works outside the Planning Scheme boundary relate to an area of 0.5 ha and include the proposed new pumping station and related infrastructure. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement were submitted to the Planning Authority with the Application.	
SDZ Transport Hub **(Distance: 0 km)**	Waterford City and County Council granted planning permission in September 2019 for a Part VIII Planning Application for the construction of a Transport Hub at Ferrybank, Waterford. The new Transport Hub is to include; a Rail station to replace the existing Plunkett Train Station along the existing Waterford City to Rosslare Iarnród Éireann railway (active only to Belview Port); re-configuration to the layout of the existing Bus Éireann depot site; construction of additional parking for Bus Éireann at an adjoining site (former Dunlop site); construction of drainage network upgrades along the Dock Road and in the vicinity of the Transport Hub and construction of Flood Defences East along the southern boundary of the Iarnród Éireann railway.	No – The construction of this project and the proposed development are likely to overlap. However, given the mitigation measures prescribed for the transport hub project (ensured by the Conditions of its Part VIII permission) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects on the Lower River Suir SAC or any other European site.

Name of plan/project	Description of plan/project	Likely in-combination effects
Rock Stabilisation and Rock Protection measures Plunkett Railway Station (Distance: 10 m)	Waterford City and County Council granted planning permission for a Part VIII Planning Application in January 2019 for Rock Stabilisation and Rock Protection measures at Plunkett Railway Station. The rockface running parallel to the railway line behind Plunkett station requires works to reduce the risk of global slope instability and of rockfalls which could affect railway infrastructure, Irish Rail personnel or the public. The project comprises of approximately 380 metres of rockface remedial works consisting of a combination of rock face stabilisation measures (rock bolting and netting) and rock fall protection systems (metal rockfall barriers fixed to the rockface or rockfall strengthened earth embankments). Other works which are anticipated to be required to facilitate the construction include the temporary removal of the existing signal cabin adjacent to the rockface (to be reinstated following the works), construction of a temporary access embankment from imported & site won material in front of sections of the rockface to enable rockface reprofiling, installation of a cut off drain at the top of the rockface and its connection into the existing station drainage network, excavation of existing rockfall debris at the place of the proposed rockfall embankment and de-vegetation of the rock face where required.	Owing to the nature and scale of these works and their removal from the River Suir, they will not give rise to any adverse effects in combination with the proposed development.
SDZ Access and Public Road Infrastructure (Distance: 0 m)	Part VIII planning consent was granted in January 2019 for the proposed SDZ road and access infrastructure improvement that will consist of modifying and upgrading the existing R711 dual carriageway and Abbey Road to facilitate the connection of the existing and proposed future planned road, cycling and pedestrian network with a future planned internal road, cycle and pedestrian network within the NQ SDZ. Connection into the SDZ is proposed through two bridge access points located at the eastern and western ends of the SDZ respectively. The eastern access will connect into a realigned Abbey Road and the western access will connect to the R711 opposite the currently unoccupied 'Ard Rí Hotel' entrance. The site is set back from the existing Dock Road and adjacent properties and is also set back from the River Suir.	No – Given the location of this project and the mitigation measures prescribed for the same (ensured by the Conditions of its Part VIII permission) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects on the Lower River Suir SAC or any other European site.
Gracedieu LIHAF Scheme **(Distance: 900 m)**	Part VIII planning planning approval was granted to the Gracedieu LIHAF Scheme which consists of Public Infrastructure: An access road and Housing Delivery: Located in the Electoral Division of Gracedieu, north west suburbs of Waterford City on the south bank of River Suir. It is proposed to develop roads infrastructure to support the initial development of 200 housing units. The roads infrastructure will serve a site of approx. 7.4 ha, part of which is in WCCC / HSCA ownership and part of which is privately owned. The proposal is to construct an access road along with roundabouts at the northern and southern end of the Phase 1 road proposal.	Given the nature and scale of this LIHAF project, there will be no adverse effects in combination with the proposed development.
Kilbarry LIHAF Scheme **(Distance: 3.4 km)**	Part VIII planning approval was granted to the Kilbarry LIHAF Scheme which consists of Public Infrastructure: A ring and distributor road in the Electoral Division of Kilbarry, approximately 3.4km south of proposed Flood Defences West. Housing Delivery: This proposal relates to the provision of a distributor road network to open up a landbank in the Lacken/Kilbarry area of Waterford City. This involves opening up of a large tract of residentially zoned lands consisting of c. 105 ha. The land is zoned as High Density and Low Density housing with mixed use, open space and community facilities. It will provide community facilities, amenity spaces, parkland and	Owing to the nature and scale of this LIHAF project and its removal from the River Suir, there will be no adverse effects in combination with the proposed development.

Name of plan/project	Description of plan/project	Likely in-combination effects
	neighbourhood services along with the development potential of 450 housing units by 2021 with a longer-term potential of 1500 units.	
Ferrybank LIHAF Scheme **(Distance: 600 m)**	Part VIII planning approval was granted to the Ferrybank LIHAF Scheme which consists of Public Infrastructure: Provision of community and amenity facilities. Housing Delivery: This proposal relates to the provision of a Neighbourhood Park at Ferrybank in South Kilkenny. This is a joint venture between Kilkenny County Council and Waterford City & County Council. Housing supply in this area has been almost stagnant since mid-2000. The provision of a park will increase the attractiveness of the area and lead to the activation of housing supply. In addition, Ferrybank District shopping centre is located across the Belmount Road from the proposed park. This is constructed, but largely vacant apart from Kilkenny County Council Area office and library.	Given the nature and scale of this LIHAF project, there will be no adverse effects in combination with the proposed development.
Nevin Construction - Development at Waters Gate, Bilberry, Waterford **(Distance: 180 m)**	Planning permission was granted in 2018 (WCCC ref no. 17780) for demolition of an existing dwelling and construction of 9 No. dwelling houses comprising 6 No. semi-detached 3-storey 4-bed units, 2 No. semi-detached 2-storey 3-bed units and 1 No. detached 2-storey 3-bed unit together with a 2 m high boundary wall/railing and all associated site works at Waters Gate, Bilberry, Waterford. This development is located on the southern bank of the River Suir, 180m southwest of the proposed development. A Natura Impact Statement (NIS) was submitted as part of the application which proposed a number of mitigation measures to protect the Lower River Suir SAC. The NIS concluded that the development would not have an adverse effect on the integrity of the Lower River Suir SAC or any other Natura site.	No – Given the scale of this project and the mitigation measures prescribed for the same (in the NIS submitted with the planning application) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.
Glanway Ltd. **(Distance: 5.3 km)**	Planning Permission was granted in 2019 (KCC ref no. 19328) for a change of use at units 3 and 4 Belview Port. It is intended to change its current warehousing use to allow for the acceptance and processing of non-hazardous waste into Solid Recovered Fuel (SRF) and for the composting of organic fines. The application will allow for acceptance and processing of up to 98,500 tonnes per annum at the facility. The application is accompanied by An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS).	No – Given the mitigation measures prescribed for this project (detailed in the NIS submitted with the planning application) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.
Jackie Green Construction Ltd – Strategic Housing Development **(Distance 5.4 km)**	Planning permission was granted in 2019 (ABP ref no. ABP-304423) for construction of 361 no. units comprising 207 no. houses (13 no. 2-beds, 116 no. 3-beds, 78 no. 4-beds), 154 no. apartments within 15 no. 4 storey blocks (providing 53 no. 1-beds, 90 no. 2-beds and 11 no. 3-beds); A creche of c.574 sq.m.; 7 no. internal/external communal waste storage facilities (total floor area c.214.3 sq.m); 638 car parking spaces and 390 no. bicycle parking spaces within 15 no storage facilities (total floor area c.232 sq.m). Additional visitor bicycle parking provided in the public realm; 2 no. ESB sub-stations/switchrooms (totalling c.10 sq.m); and Vehicular / pedestrian/cyclist accesses to the public road (Ballygunner Hill/St. Mary's Place). An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) accompany the planning application. The NIS concluded that *"the proposed development will not have significant effects on the WFD environmental objectives associated with the Lower Suir*	No – Given the nature of this housing project, its distance from the River Suir, the mitigation measures prescribed for the same (ensured by the Conditions of its planning consent), and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.

Name of plan/project	Description of plan/project	Likely in-combination effects
	Estuary, nor is it likely to impact on the qualifying habitats and species of the Lower River Suir SAC or the River Nore and River Barrow SAC".	
Kilbarry Developments Ltd – Housing Development (Distance: 4.4km)	Planning permission was granted by WCCC for a permission for the construction of a residential development (ref no. 18734) at Kilbarry, Co. Waterford (phase 3). The Project will comprise construction of 90 no. dwellings consisting of: 24 no. apartments in 3 no. 2 storey blocks containing 4 no. 2-bed and 4 no. 1-bed apartments in each block; 46 no. 2 storey 3-bed semi-detached dwellings; 20 no. 2 story 4-bed semi-detached dwellings; and all associated works. The application is accompanied by An Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). The NIS concludes that "*whilst it has been acknowledged that there is the potential for the project to have significant indirect impacts on two European sites, with the implementation of the detailed mitigation measures identified in this NIS, it is concluded beyond reasonable scientific doubt that the proposed development shall not result in a significant impact to any European sites."*	No – Given the nature of this housing project, its distance from the River Suir, the mitigation measures prescribed for the same (ensured by the Conditions of its planning consent), and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.
Kilbarry Developments Ltd – Housing Development (Distance: 4.4 km)	Planning permission was granted in 2019 (WCCC ref no. 18735) for the construction of a residential development within the townland of Lacken, Kilbarry, Co. Waterford (phase 4) comprising of the following: 92 no. dwellings consisting of: 24 no. apartments in 3 no. 2 storey blocks containing 4 no. 2-bed and 4no. 1-bed apartments in each block; 46 no. 2 storey 3-bed semi-detached dwellings with optional attic conversion and/or ground floor sunroom; 22 no. 2 storey 4-bed semi-detached dwellings with optional attic conversion and/or ground floor sunroom. Permission is also sought for access from the proposed new Kilbarry LIHAF Road; drainage and water connections to include pumphouse, rising main and associated access road with new entrance from the public road (Lacken Road); all associated site works; landscaping and boundary treatments, at Kilbarry, Co. Waterford. This application is associated with a concurrent planning application being lodged with Waterford City and County Council for 90 no. dwellings on adjoining lands. A Natura Impact Statement (NIS) and Environmental Impact Assessment Report (EIAR) accompany this application. The NIS concludes that "*whilst it has been acknowledged that there is the potential for the project to have significant indirect impacts on two European sites, with the implementation of the detailed mitigation measures identified in this NIS, it is concluded beyond reasonable scientific doubt that the proposed development shall not result in a significant impact to any European sites."*	No – Given the nature of this housing project, its distance from the River Suir, the mitigation measures prescribed for the same (ensured by the Conditions of its planning consent), and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.
JHOK Ltd Company **(Distance: 4.3 km)**	Planning Permission was granted to JHOK Limited in 2019 (KCC ref no. 19668) for a seven-year planning permission for a Continental Cheese manufacturing plant at the IDA Ireland, Belview Science and Technology Park, Gorteens, Slieverue, Co Kilkenny. The development will include a part single storey and part two storey production building approximately 14 metres high with intakes, processing plant and equipment, packing, stores, despatch, offices, laboratories, utilities and personnel facilities; a 10 bay milk intake and cream despatch building approximately 11 metres high and associated plant and equipment with office, milk testing and personnel facilities; storage silos up to 28 metres high for milk, whey and water; pipe and service bridges, salt silos and brine	No – Given the the mitigation measures prescribed for this project (detailed in the NIS submitted with the planning application) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.

Name of plan/project	Description of plan/project	Likely in-combination effects
	mixing; sprinkler storage tank and pumphouse; waste water treatment plant comprising balancing, waste water treatment and sludge drying and a truck wash; waste recovery compound and store and a monitoring building. The development consists of an activity for which an Industrial Emissions Licence is required. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) have been submitted to the Planning Authority with the Application. The NIS concludes that the project "*alone or in-combination with other projects, will not adversely affect the integrity and conservation status of any of the qualifying interests of the Lower River Suir SAC and the River Barrow and River Nore SAC*."	
Solas Éireann Development Ltd **(Distance: 8.7 km)**	Application (WCC ref no. 20170330) was granted for the construction of a solar PV panel array at Kilmannock & Great Island, Kilmokea, Co. Wexford. The development comprises photovoltaic panels on ground mounted frames within a site area of 28.14 ha, 11 no. single storey mv substations, 1 no. single storey DSO substation, 1 no. single storey customer. An Environmental Impact Assessment Report (EIAR) accompanies the planning application.	No – Given the nature and location of this solar energy project, there will be no adverse effects in combination with the proposed flood defences.
Waterford Institute of Technology **(Distance: 2.5 km)**	Planning permission was granted in 2019 (WCCC ref no. 19669) for a development consisting of a third level educational building comprising of engineering, computing and general teaching facilities of a floor area of 12,894 m^2. The application site is located within the Waterford Institute of Technology Campus which is generally bounded by Paddy Browne's Road on the west and the Cork Road to the south. The building consists of a five storey over lower ground floor building, together with roof top plant and architectural screening. The application includes for 2 no. new disabled access parking bays, 294 no. cycle spaces, removal of existing campus service road, soft landscaping and footpath connections to the existing campus landscaping, hard landscaped entrance area, seating and lighting stands. An Ecological Impact Assessment (EcIA) was submitted with the planning application. The EcIA concluded that "*provided that the proposed development is constructed and operated in accordance with the design and best practice that is described within this application, significant effects on ecology are not anticipated at any geographical scale*."	No – Given the nature and scale of this project, and its distance from the River Suir, there will be no adverse effect in combination with the proposed flood defences.
Smartply Europe DAC **(Distance: 5.8 km)**	A planning permission was granted to Smartply Europe DAC in 2019 (KCC ref no. 19509) for amendments to planning permission ref: 11/443, as extended by Extension of Duration of planning permission ref: 19/8, in respect of buildings containing a blending plant, for external drying, screens and associated equipment, structural steel support structures and associated platforms, for site works including alterations to existing road and drainage layout and to relocate the energy plant permitted by permission 09/635. The proposed amendments involve repositioning permitted external plant, changes to the layout and design of external plant (primarily the external energy plant and dryer), relocation of the fuel mix area and fuel bin structures and all associated site works. The planning application is for development of lands at Gorteens, Belview Port, Slieverue, Co. Kilkenny.	No – Given the scale of this project, the mitigation measures detailed in the NIS for the same, and the restrictions arising from the EPA licensing of the facility, there will be no adverse effect in combination with the proposed flood defences.

Name of plan/project	Description of plan/project	Likely in-combination effects
	A Natura Impact Statement (NIS) was submitted with the planning application. The NIS concluded that the "*project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC*."	
Smartply Europe DAC **(Distance: 5.8 km)**	A planning application was submitted in 2020 (KCC ref no. 20700) by Smartply DAC to develop a log yard and associated works. The log yard will extend the area available for stockpiling and handling of logs for use in SmartPly's oriented strand board mill which adjoins the site at Gorteens, Slieverue, Co. Kilkenny. A Natura Impact Statement (NIS) accompanies the Application. The NIS concluded that the "*project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC*."	No – Given the nature and scale of the log yard extension works, there will be no adverse effect in combination with the proposed flood defences.
Suir Shipping Ltd **(Distance: 5.4 km)**	A planning permission was granted in 2021 (KCC ref no. 20552) for a 7-year planning permission for Bulk Stores, an uncovered storage yard and associated offices, personnel facilities and site works including earthworks, road works, entrance, gates, and fencing, concrete paving, water services, borewell, drainage works, site lighting and landscaping. The stores will be used to store Port related products such as bulk goods, break bulk and unitised products. The yard will be used to store Port related break bulk products at Gorteens, Slieverue, Co. Kilkenny. Entry and exit will be via a new entrance and also via the adjacent site (Planning Ref. No. PD18/317) for trucks to be weighed. A Natura Impact Statement (NIS) accompanies this application. The NIS concluded that the "*project, alone or in-combination with other projects, will not adversely affect the integrity, and conservation status of any of the qualifying interests of the Lower River Suir SAC or River Barrow and River Nore SAC"*.	No – Given the nature and scale of this project and the mitigation measures in the NIS and EcIA for the same, and the mitigation measures described above for the proposed flood defences, there will be no adverse in-combination effects.
Roadstone Limited **(Distance: 3.6 km)**	A planning permission was granted in 2017 (KCC ref no. 16700) for a development consisting of continuation of quarrying activities at Aglish North, Granny, Kilmacow, Co. Kilkenny within the red line application area of 62.04 ha to include the extension of the existing excavation by an additional 2 x 15m high benches from the current floor level of ca.-15m AOD to -45 m AOD within the permitted extraction footprint area of 27.06 ha. The proposed development will involve the continuation of stripping of overburden and its storage for use in site restoration; the extraction of rock by means of blasting, the crushing of blasted rock on the quarry floor, and subsequent processing of crushed rock in the existing aggregate plant to produce a range of aggregates. The proposed development will also include the continuation of use of the existing wheel-wash and associated hardstanding area, bunded fuel tank and associated refueling area. An Environmental Impact Statement (EIS) and Natura Impact Statement (NIS) have been prepared and submitted to the Planning Authority with this Planning Application. Chapter 6 (Water) of the EIS predicts that surface and groundwater quality and quantity will not be adversely affected by the Site extension proposals. The NIS concluded that "*the implementation of the committed*	No – Given the distance from this quarry project from the River Suir and the mitigation measures ensured through the Conditions of its planning consent and environmental licensing, there will be no adverse effects in combination with the proposed flood defences.

Name of plan/project	Description of plan/project	Likely in-combination effects
	mitigation measures outlined herewith will ensure that no significant impacts are considered likely on ecological features present on receiving waters that extend downstream to the Lower River Suir SAC.". Furthermore, the Applicant will continue to carryout environmental monitoring in compliance with current Discharge and Planning conditions while meeting EPA and Dept. of Housing, Local Government and Heritage Guidelines.	
Bellvue Port Services (Waterford) Ltd **(Distance: 6.2 km)**	A planning permission was granted in 2017 (KCC ref. no. 17623) for extension of duration for a previously granted permission (KCC ref no. 10363) for a development at Gorteens and Drumdowney Upper, Belview Port, Slieverue, Co. Kilkenny. The planning permission is for a tank farm for the storage and distribution of petroleum products including petroleum, diesel and kerosene. The tank farm will include six large tanks each 35 metres diameter and 16 metres high, a range of smaller vertical and horizontal tanks, bunded areas, truck loading canopy, vapour recovery building, pumps, gantries, pipelines throughout the site and from the site to Belview Port, firewater tank, store, offices, parking, roads, drains, outfalls to the river, services, landscaping, wastewater treatment plant and fencing. The application also includes a large store for the temporary storage of non-perishable imported goods prior to distribution or for the temporary storage of non-perishable goods prior to export. An Environment Impact Assessment (EIS) and a Seveso II Land Use Planning Risk Assessment accompany the Application. The 'Flora and Fauna' chapter of the EIS concluded that "*provided the mitigation measures are implemented, the project will not adversely affect the integrity and conservation status of the Lower River Suir SAC and the River Barrow and River Nore SAC"*. The Hydrology Chapter in the EIS concluded that "*provided the mitigation measures are implemented, there will be a negligible impact on surface water and groundwater during the construction and operational phases of the project*."	No – Given the the mitigation measures prescribed for this project (in the EIS for the same) and the mitigation described above for the proposed flood defences, there will be no adverse in-combination effects.

WCCC is currently progressing a number of projects in support of the North Quays (Waterford) SDZ. Based on this knowledge, consideration of likely future planned projects was deemed to be required, as far as is practicable at this stage in the process. Projects are at different stages in the design process with some nearing completion and others at Scoping Stage. However, in the interests of ensuring that all known likely and potential in-combination effects are identified, Table 6.2 assesses the potential in-combination effects as a result of these projects. Each of these projects will also be the subject of their own Screening process and EIA and AA where required.

Table 6.2 Assessment of adverse effects arising from the proposed development in combination with other plans or projects.

Name of plan/project	Description of plan/project	Likely in-combination effects
Upgrade of Rail Line east of Plunkett Station to the Proposed Transport Hub **(Distance: 0 m)**	In order to facilitate the passenger trains at the SDZ Transport Hub Iarnród Éireann will undertake an upgrade to the rail line east of Plunkett Station to the approved SDZ Transport Hub. The primary works to be carried out by Iarnród Éireann are track works, including the reinstatement and realignment of double track in the vicinity of the proposed new train station; and signalling works to facilitate the proposed train station and track layout.	Owing to the nature and scale of the proposed road works and their removal from the River Suir, they will not give rise to adverse effects in combination with the proposed development.

7. CONCLUSION

This NIS has been prepared in accordance with the relevant provisions of the Habitats Directive, the Habitats Regulations and the Planning and Development Act, as well as the relevant case law and current guidance. It has demonstrated that, in the absence of appropriate mitigation, the proposed Waterford Flood Defences West, individually or in combination with other plans or projects, would adversely affect the integrity of two European sites, namely the Lower River Suir SAC and the River Barrow and River Nore SAC. In light of this finding, this NIS has prescribed appropriate mitigation to eliminate or minimise such effects. Any residual effects, either individually or in combination with other plans or projects, have been assessed as not constituting adverse effects on the integrity of any European site. This assessment has been undertaken on the basis of the best scientific knowledge in the field and the Precautionary Principle and no reasonable scientific doubt remains as to the absence of such effects.

It is the considered opinion of ROD, as the author of this NIS, that, in making its AA in respect of the proposed Waterford Flood Defences West, An Bord Pleanála, as the Competent Authority in this case, should determine that, given the full and proper implementation of the mitigation prescribed in this NIS, the proposed development, either individually or in combination with other plans or projects, will not adversely affect the integrity of the Lower River Suir SAC, the River Barrow and River Nore SAC or any other European site.

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Appendix A
Environmental Operating Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie   www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Environmental Operating Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400045_[S3-P01] W Flood Def EOP

Client:
Waterford City & County Council
35 The Mall
Waterford

ROD
ROUGHAN & O'DONOVAN

Waterford City Public Infrastructure Project

Flood Defences West

Environmental Operating Plan

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1.0 INTRODUCTION

This document is a project-specific Environmental Operating Plan (EOP). It is presented to inform and provide practical experience of developing, submitting, and maintaining an EOP for the Flood Defences West.

1.1 Purpose and Scope

This EOP sets out the mechanism by which environmental protection is to be achieved on the proposed Waterford City Public Infrastructure Project - Flood Defences West development. This EOP describes the Environmental Management System (EMS) of the proposed development, which will be devised according to the criteria of ISO 14001:2004 – Environmental Management Systems and developed in line with the NRA *"Guidelines for the creation and maintenance of an Environmental Operating Plan".* This EOP will be complemented by General Procedures, Work Procedures and Operations Instructions. These documents will be in place within the site administration offices and appropriate site locations during works.

This EOP covers the activities of the [*Successful Contractor Name*] and that of its sub-contractors. It outlines the environmental commitments in relation to the construction works and how these commitments are to be managed, including details of the monitoring systems and mitigation measures to be employed by the successful contractor. It also assigns responsibilities for ensuring the effective implementation of this EOP.

1.2 Environmental Policy Statement

Environmental Management is fundamental to the successful operation of construction activities. Therefore, the Environmental Policy must, as a priority, be understood by all parties involved in the contract and adhered to throughout the course of the works to allow for legal compliance and continuous improvement.

[*Successful Contractor Name*] Environmental Policy Statement is detailed below.

[*Insert policy statement*]

2.0 GENERAL PROJECT DETAILS

This section will be completed by the successful contractor once appointed:

- Brief overview;
- Location of the Project;
- Location of compounds;
- Contact Sheets for site, employer and third party contacts;
- Register of all applicable legislation, including relevant standards, Codes of Practice and Guidelines;
- Organisational chart; and,
- Duties and responsibilities.

Project details which have been identified prior to appointment of the contractor are described in the subsequent subsections:

2.1 Concrete Works

2.1.1 Introduction

The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. Alternate construction methods have been proposed where possible, e.g. use of pre-cast units, use of cofferdams/ diversions/ over pumping (or other) to place concrete in the dry, and permanent formwork will reduce the risks associated with concreting works. Where the use of in-situ concrete near and in watercourses cannot be avoided the following control measures will be employed:

- The use and management of concrete in or close to watercourses will be carefully controlled to avoid spillage. Washout from concrete mixing plant will be carried out only in a designated contained impermeable area.
- All shuttering shall be securely installed and inspected for leaks prior to cement being poured and all pouring operations shall be supervised monitored for spills and leaks at all times.
- All pouring of concrete, sealing of joints, application of water-proofing paint or protective systems, curing agents etc. for outfalls shall be completed in dry weather.
- Any concrete used in or over the River Suir shall be pre-cast, where possible.
- All concrete pouring will be conducted under controlled conditions to prevent any potential runoff to the River Suir.
    - All shuttering will be adequately constructed and sealed to prevent leakage or spillage and will have sufficient capacity to support all poured concrete.
    - The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area.
    - There will be no wash out of concrete vehicles on site.
    - No discharge of water which may contain cement or residues will be permitted to any watercourses.
- Where concrete or other wet materials are to be used over water, appropriate bunded platforms shall be in place to capture any spilled concrete, sealants or other materials.

- A geotextile screen and boom with oil barrier will be required around such marine works to prevent runoff, silt, oil or other deposits generated by construction activities such as boring in overburden or rock from polluting the river.
- Any materials collected on these platforms shall be transferred to the landside construction areas and disposed of in accordance with the CDWMP.
- When working in or near the surface water and the application in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used;
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters;
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW);
- There will be no hosing into surface water drains of spills of concrete, cement, grout or similar materials. Such spills shall be contained immediately, and runoff prevented from entering the watercourse;
- Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses;
- On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas;
- Washout from concrete lorries will not be permitted on site.
- In order to attenuate flows and minimise sediment input into River Suir through run-off, all surface water run-off from the construction site shall be directed to a temporary facility, where the flow will be attenuated and sediment allowed to settle, before passing through a hydrocarbon interceptor and being discharged to River Suir. An impermeable membrane overlaid with suitable fill will be provided to storage areas to prevent contamination or pollution of the groundwater.

2.2 Construction Compounds

2.2.1 Introduction

It is likely that two construction compounds will be set up within lands in the ownership of Córas Impair Éireann (CIÉ) and operated by Iarnród Éireann (IÉ) as identified in the EIAR.

The construction compound(s) may include stores, offices, materials storage areas, material processing areas, plant storage, parking of site and staff vehicles, and other ancillary facilities and activities.

2.2.2 Control Measures

The compound will have appropriate levels of security to deter vandalism, theft and unauthorised access.

Surface runoff from the compound will be minimised by ensuring that the paved/ impervious area is minimised. All surface water runoff will be intercepted and directed to appropriate treatment systems (settlement facilities and oil trap) for the removal of pollutants prior to discharge. The site compound will be fenced off as part of the site establishment period.

Wastewater drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner to prevent water pollution and in accordance with the relevant statutory requirements.

The storage of all fuels, other hydrocarbons and other chemicals shall be within the construction compound only and shall be in accordance with relevant legislation and best practice. In particular:

- Fuel storage tanks shall have secondary containment provided by means of an above ground bund to capture any oil leakage.
- Storage tanks and associated provision, including bunds, will conform to the current best practice for oil storage and will be undertaken in accordance with *Best Practice Guide BPGCS005 – Oil Storage Guidelines* (Enterprise Ireland).

The Incident Response Plan shall include arrangements for dealing with accidental spillage and relevant staff shall be trained in these procedures.

2.3 Site Environmental Manager (SEM)

In order to ensure the successful development, implementation and maintenance of the EOP, the Contractor will be required to appoint an independent Site Environmental Manager (SEM).

He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in Environmental Science, environmental Management, Hydrology or Engineering.

The principal functions of the SEM will be to ensure that the mitigation prescribed in the NIS, this EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.
- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

2.4 Ecological Clerk of Works (ECoW)

In order to ensure the successful development and implementation of the EOP, the Contractor will appoint an independent Ecological Clerk of Works (ECoW). The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in the NIS;
- To highlight the sensitivity of ‘Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)’, and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor’s Biosecurity Protocol.

During the preparation of the Contractor’s EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

3.0 PLANNING CONSENT

If planning permission is granted for the proposed development, the entire contents of the planning consent are inserted at this location.

[*Waterford City and County Council / successful Contractor shall insert planning consent*]

4.0 SCHEDULE OF COMMITMENTS

The Schedule of Commitments will comprise:

(1) The mitigation measures as outlined in Chapter 19 Mitigation Measures of the EIAR for the proposed development, with the addition of any additional mitigation measures set out in the NIS for the proposed development;

(2) Any commitments arising during the statutory planning process up to and including the Oral Hearing, and any conditions imposed by the Board on the approval of the proposed development;

(3) Any relevant specifications and / or methodologies required to implement the prescribed measures / commitments properly; and

(4) Any procedures for the monitoring of the implementation of the stated measures / commitments, which may identify whether (i) the measure / commitment will be implemented by the Contractors and (ii) once implemented, whether the measure/ commitment is effectively addressing the environmental impact it was prescribed to address.

The current Schedule of Commitments is as follows:

[*Waterford City and County Council / successful contractor shall Insert Schedule of Commitments, as described above*]

In addition, the Contract documents, the conditions imposed by An Bord Pleanála, the Schedule of Commitments, and relevant environmental legislation all prescribe environmental performance criteria.

The following table lists the complete suite of Environmental Commitments together with the relative specification and evidence of how each commitment will be met. An example of the layout of this table and potential entries is given below.

Table 1 Environmental Commitments

Environmental Commitment	Legislation / Specific Ref.	Action Owner	Evidence	Target Date	Close Date
Noise and Vibration	EIAR Volume 2, Chapter 12 Noise and Vibration; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager / Noise Specialist / Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data / Environmental Control Measure Sheet	Ongoing	End of contract
Biodiversity (Flora and Fauna)	EIAR Volume 2, Chapter 7 Biodiversity; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Ecological Walkover / Pre-surveys / agreement from IFI / Site Inspections	Ongoing	End of Contract

Environmental Commitment	Legislation / Specific Ref.	Action Owner	Evidence	Target Date	Close Date
Soils and Geology	EIAR Volume 2 Chapter 8 Soils and Geology; EIAR Volume 2, EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Hydrology and Hydrogeology	EIAR Volume 2, Chapter 7 Biodiversity; EIAR Volume 2 Chapter 10 Hydrology; EIAR Volume 2, Chapter 9 Hydrogeology; EIAR Volume 2, Chapter 19 Mitigation Measures	Env. Manager/ Specialist Ecologist/ Env. Designer / Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Air Quality and Climate	EIAR Volume 2, Chapter 13 Air Quality and Climate; EIAR Volume 2, Chapter 19 Mitigation Measures;	Env. Manager/ Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract
Archaeology and Cultural Heritage	EIAR Volume 2, Chapter 14 Archaeological and Cultural Heritage; EIAR Volume 2, Chapter 19 Mitigation Measures;	Env. Manager/ Site Agent / Foreman	Method Statement / Site Inspections / Monitoring Data	Ongoing	End of Contract

5.0 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

The Construction Environmental Management Plan (CEMP) provides the environmental management framework for the appointed Contractors and Sub-contractors to ensure that the works are carried out with minimal impact on the environment.

The CEMP for the proposed development is contained in **Appendix A**. This document will need to be finalised by the Contractor prior to the commencement of the proposed works.

6.0 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

A Construction and Demolition Waste Management Plan (CDWMP) is prepared to ensure that waste arising during the construction and demolition phase of the development on site will be managed and disposed of in a way that ensures the provisions of the Waste Management (Amendment) Acts, 1996-2011 and associated Regulations (1996-2011) are complied with and to ensure that optimum levels of reduction, re-use and recycling are achieved.

The CDWMP, consistent with mitigation measures as contained within the EIAR and the Schedule of Commitments, at this time is contained in **Appendix B**.

7.0 INCIDENT RESPONSE PLAN

This document describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts are prompt, efficient, and appropriate to particular circumstances.

An Incident Response Plan consistent with mitigation measures as contained within the EIAR and the Schedule of Commitments at this time is contained in **Appendix C**.

APPENDIX A

Construction and Environmental Management Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Construction Environmental Management Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400035_[S3-P01]
W Flood Def CEMP

Client:
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Waterford City Public Infrastructure Project

Flood Defences West

Construction Environmental Management Plan

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1. INTRODUCTION

This Construction Environmental Management Plan (OCEMP) is prepared for the construction of the proposed Waterford City Public Infrastructure Project - Flood Defences West ("the Project") on behalf of Waterford City and County Council (WCCC).

This CEMP applies to all works associated with the construction of the proposed civil works and buildings works including the pre-construction site clearance works.

As a Contractor has not yet been appointed, this CEMP has not been formally adopted and further development and commitment to the CEMP will be undertaken following selection of Contractors and before commencement of site works.

The CEMP provides the environmental management framework for the appointed Contractors and Sub Contractors as they incorporate the mitigating principles to ensure that the work is carried out with minimal impact on the environment. The construction management staff as well as Contractors and Sub Contractors staff must comply with the requirements and constraints set forth in this CEMP in developing their Construction Environmental Management Plan (CEMP). The key environmental aspects associated with the construction of the proposed Flood Defences West, the appropriate mitigation and monitoring controls, are identified in the CEMP and its supporting documentation.

The implementation of the requirements of the CEMP will ensure that the construction phase of the Project is carried out in accordance with the commitments made by WCCC in the planning application process for the development, and as required under the planning approval. Once adopted, the CEMP is considered a living document that will be updated according to changing circumstances on the proposed development and to reflect current construction activities. The CEMP will be reviewed on an ongoing basis during the construction process and will include information on the review procedures.

1.1 Roles and Responsibilities

The Contractor is responsible to ensure that all members of the Project Team, including sub-contractors comply with the procedures set out in the CEMP. The Contractor will ensure that all persons working on site are provided with sufficient training, supervision and instruction to fulfil this requirement.

The Contractor will ensure that all persons allocated specific environmental responsibilities are notified of their appointment and confirm that their responsibilities are clearly understood. The principal environmental responsibilities for key staff can be identified as follows:

1.1.1 Site Manager

The Site Manager's environmental management responsibilities include, but are not limited to:

- Preparation and implementation of the CEMP;
- Close liaison with the Site Environmental Manager (SEM) to ensure adequate resources are made available for implementation of the CEMP;
- Ensuring that the risk assessments for control of noise and environmental risk are prepared and effectively monitored, reviewed and communicated on site;

- Managing the preparation and implementation of method statements; and
- Ensuring that the SEM reviews all method statements and that relevant environmental protocols are incorporated and appended.

1.1.2 Site Environmental Manager (SEM)

The responsibilities of the SEM include, but are not limited to:

- Maintaining environmental records;
- Providing guidance for the site team in dealing with environmental matters, including legal and statutory requirements affecting the works;
- Reviewing environmental management content of method statements;
- Reporting environmental performance to the Site Manager;
- Liaising with statutory and non-statutory bodies and third parties with an environmental interest in the proposed development; and
- Collecting and collating of CEEQUAL evidence.

1.1.3 Engineering Staff

The Engineering Staffs' environmental management responsibilities include but are not limited to:

- Reporting any operations and conditions that deviate from the CEMP to the Site Manager;
- Taking an active part in site safety and environmental meetings; and
- Ensuring awareness of the contents of method statements, plans, Supervisors' meetings or any other meetings that concern the environmental management of the site.

1.1.4 Supervisors

The Supervisors' environmental management responsibilities include but are not limited to:

- Ensuring all personnel affected by a method statement are briefed and fully understand its content;
- Monitoring operatives for compliance, including sub-contract operatives;
- Implementing environmental management activities required by the CEMP and works method statements; and
- Ensuring that all inspections are carried out as prescribed in the CEMP.

1.2 Training and Induction

1.2.1 Site Induction

All personnel involved in the proposed Flood Defences West development will receive environmental awareness training. The environmental training and awareness procedure will ensure that staff are familiar with the principles of the CEMP, the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

1.2.2 Specific Training and Awareness Raising

A project specific training plan that identifies the competency requirements for all personnel allocated with environmental responsibilities will be produced by the Contractor. Training will be provided by the Contractor to ensure that all persons working on site have a practical understanding of environmental issues and management requirements prior to commencing activities. A register of completed training is to be kept by the SEM. The Site Manager will ensure that environmental emergency plans are drawn up and the SEM will conduct the necessary training/inductions.

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Project Description

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of this EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Construction of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events. It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 3) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.
- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).

  - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material ("eco-seawall").
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.
- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).

- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.
- All ancillary works.

Table 2.1.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

2.2 Construction Programme Sequence

The construction methodology is preliminary and subject to change following the detailed design and preparation of the CEMP by the appointed Contractor. Irish Rail operations will be maintained throughout the construction phase. However, there may be restrictions to Plunket station car park, and/or disruption to utilities during certain periods but these will be minimised to avoid significant impacts. These will be detailed as part of the CEMP which will be developed by the Contractor and agreed with WCCC at contract award stage.

The anticipated construction duration for the proposed Flood Defences West will be 30-35 weeks. The construction of the proposed development is anticipated to take place in the following sequence:

The envisaged construction sequence for the works is as follows:

(i) Site Setup and establishment of construction compounds;

(ii) Excavation of underground trenches (or just in parts of this section, based on the groundwater monitoring and assessment) including:
 (a) Relocation of underground utilities, where required;
 (b) Excavation of material from trenches;
 (c) Filling in trenches with lean mix concrete / grout and reinstatement of pavement.

(iii) Installation of overground flood defences:
 (a) Glass barriers on the river side of the road edge vehicular parapets on Rice Bridge roundabout and the 3 roundabout arms (R711 Dock Road, R448 Terminus Street, and R680 Rice Bridge).
 (b) Underground foundations for the demountable flood barriers at R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.

(iv) Remedial works for raising the height of the existing quay wall including:
 (a) Setup of temporary dry (dewatered) working area in front of the wall using sandbags, Portadam system or waterfilled dams;

(b) Setup of temporary works such as formwork, scaffolding and granular base for scaffolding in mudflats;

(c) Anchoring and concrete pouring works;

(d) Decommissioning of temporary works, including removal of granular base from the mudflats, any building works spoil, and dewatering system.

(v) Installation of permanent sheet pile walls on the riverside. Backfilling of the gap between the riverside sheet pile wall and the existing quay wall can take place simultaneously with sheet piling, after a short segment of the sheet pile wall (assumed 10-30 m) is piled (temporary transversal sheet pile may be installed at the end of segment to prevent fill from being washed out), or once full length of sheet piles is installed. Attaching of eco-seawall panels to the front face of the sheet piles.

(vi) Partial demolition of existing quay wall (from Ch.360 to Ch.900) above ground and to a depth of 800mm below ground (where required) to enable installation of drainage works (to be complete in tandem with step (v) above to ensure demolition takes place before backfilling);

(vii) Installation of landside sheet pile wall from Ch.900 to Ch.1090 to include:

(a) Demolition of the 3m wide section of the existing quay wall at Ch.900 to enable joining of the riverside and landside sheet piles;

(b) Installation of permanent landside sheet piles; and

(c) Installation of transversal underground isolation structure at Ch.1090.

(viii) Drainage – Installation of drainage works from Ch.360 to Ch.1090 as follows:

(a) Installation of drainage works parallel to the new sheet pile wall in tandem with construction of the sheet piling (step v);

(b) Installation of surface water outfalls passing through the new sheet pile wall, and fitting of flap valves from the riverside on each outfall (in tandem with step v);

(c) Demolition of existing surface water outfalls in the riverbed and provision of temporary outfalls (e.g. over pumping) on existing outfalls during the works;

(d) Construction of new outfall structures in the riverbed (following installation of the sheet pile wall) within a sheet pile cofferdam (temporary works); the outfall structure will include a foundation structure to the outfall pipe (which may need pile supports), a headwall and erosion protection measures (including a stone mattress at the mouth of the outfall), headwall and erosion protection measures including a stone mattress at the mouth of the outfall;

(e) Construction of 2 No. underground pumping stations to include an overflow chamber, wet well and valve chamber;

(f) Installation of pumping station pumps, valves fitting and MEICA commissioning of pumping stations.

(ix) Drainage – Installation of drainage works from Ch.0.0 to Ch.360 at Plunkett Station as follows:

(a) Installation of the new drainage system and associated railway undertrack crossings. All undertrack crossings will be carried out subject to IÉ agreement and where necessary, localised night-time possessions will be applied to facilitate installation,

(b) Remedial works to existing drainage networks including retrofitting of flap valves at outfalls.

Due to the linear nature of the works, it is assumed that the works under items (ii) to (ix) above can run in parallel. The list above thus does not indicate that one activity needs to fully finish for the next one to start. It is possible that the works will be done in separate sections. Some limitations however exist, and these are outlined below:

- The sheet pile wall needs to be installed at drainage outlet locations before the outlet can be completed. It is necessary for the drainage outlet to be completed before the backfilling to the sheet pile wall (above the underside of pipe level) can be completed.
- Impermeable trench / grouting in area behind the existing quay wall (where the wall will be raised with remedial works) to be done before the commencement of wall remedial works.
- The upper sections (down to 800mm below ground level) of the existing quay wall are to be demolished after the sheet piles are installed in that location and before the drainage is installed.
- The riverside sheet piles will be installed before the eco-seawall panels are attached to them.

Table 2.2.2 Draft Construction Program

Works element		**Duration of task (approx.)**
Start July 2023		
Mobilisation, site clearance and compound set up		2 weeks
Remedial works for raising the height of the existing concrete wall		4 weeks
Impermeable trenches Ch.0.0 to Ch.160 (eastern car park, in front of the Plunkett Station and the Rice Bridge Roundabout)		2.5 months (10 weekends)
Impermeable trenches Ch.160 to Ch. 360 (western car park and under Terminus Street Viaduct)		2 weeks
Works at Rice Bridge Roundabout – Installation of Glass barriers, movement joint sealing & the provision of flap valves on existing road drainage gullies		6-8 weeks
Sheet pile installation	Ch. 360 to Ch. 900 (riverside)	12 weeks (two rigs)
	Attaching cladding to installed riverside piles	2-3 weeks
	Ch.900 to Ch.1090 (Landside, incl. transverse structure)	7-8 weeks
Drainage works	Upgrade of existing drainage	9-12 weeks
	New drainage network and proposed outfall structures	9-12 weeks
	Pumping stations	9-12 weeks
Total Construction Phase		**7 months approx.**
End February 2023		

Works element	Duration of task (approx.)
Start July 2023	
Notes: Due to linear nature of the works, the majority of the works will be able to be done in parallel.	

2.2.1 Sourcing of Materials

There are several registered/authorised quarries near the proposed development which may be utilised in the sourcing of the required imported granular fill material, to include:

- Oaklands Quarry in Ballykelly, New Ross, Co. Wexford; and
- Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford.

Only those quarries that conform to all necessary statutory consents will be used in the construction phase.

It is assumed that the Contractor will source the sheet piles directly from the manufacturer/supplier. While Irish-based sheet pile suppliers exist, the larger quantities of heavy sheet piles, typically required on large projects such as this one, are typically obtained from a number of large-scale manufacturers/suppliers that exist in the UK.

2.2.2 Construction Traffic Management

Temporary traffic management arrangements are to be implemented to facilitate ongoing access to construction access points throughout the works.

Some works will require night-time works when railway track possessions are needed.

As part of the Waterford City Public Infrastructure Project, it is likely that a number of infrastructure projects will take place concurrently. Traffic management and phasing of works and transport / haulage routes will be required to be co-ordinated by all stakeholder through the various construction stages.
The following restrictions will be adhered to unless agreed otherwise with Waterford City & County Council's Roads Department:

- The Contractor shall provide and maintain temporary traffic management in accordance with the Department of Transport Traffic Signs Manual.
- Access to local properties shall be maintained at all times. Works to any accesses shall be planned in consultation with the property owners to minimise disruption.
- Existing footways and cycle tracks shall be maintained at all times except where such footways and cycle tracks are at the point of being removed for the completion of the Works. In such circumstances, the Contractor shall provide temporary footpath or cycle track diversions, with sufficient advance signage informing people of the diversions.
- Fuel for vehicles will be stored in a mobile double skinned tank.
- The contractor will be required to submit a Construction and Demolition (C&D) Waste Management Plan Council to WCCC for approval which should address all types of material to be disposed of.

- Roads used by construction traffic will be monitored visually and a road sweeper used to remove debris from construction activities when required.
- Loads of materials leaving site shall be assessed and covered where necessary to reduce dust impacts.
- Development of a detailed construction programme that gives consideration to traffic flows and aims to avoid coincidentally high volumes of traffic using the same roads where possible.
- The Contractor shall allow for variable message signs (VMS) in accordance with Chapter 8 paragraph 8.2.4 of the Traffic Signs Manual on approach routes affected by traffic management measures, restrictions or road closures.
- The Contractor shall liaise with the Roads Authority in respect of any temporary road closures, lane closures, and other traffic management controls required to be carried out to ensure the safety of the workforce and the general public during the duration of the works.
- Where floodlighting of the works area is required in poor daylight conditions, the positioning of the lighting units must not be such as to cause glare to drivers.

Visual inspections will also be undertaken and recorded at regular, frequent intervals, to ensure that the existing road infrastructure remains in an acceptable condition throughout the duration of construction activities or should evidence of any defects arise during the construction period, remedial actions and/or works can be put in hand forthwith. Wheel washes for construction vehicles will be provided (if necessary) at the development site to prevent mud and dust being brought onto the public road. The site entrance and the immediate approach roads will be monitored and swept clean when necessary.

Construction vehicles and site personnel will be required to adhere to the approved access routes and timing restrictions. Construction plant, equipment and vehicles will be parked onsite. No vehicles associated with the proposed development will be parked on the public roads.

2.3 Operation Stage

The live rail line Dublin – Waterford will remain open at all times during the construction phase. Where railway possessions will be required for some elements of work, such as for landside sheet pile installation and for some drainage segments, night-time rail possessions will be arranged, that will not affect the normal train operations.

Once the development is constructed and handover completed, the live rail line will continue to operate according to the normal timetable.

3. CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

This CEMP will be used to develop the CEMP by the Contractor to meet the requirements of ISO 14001 and all site works will be undertaken in compliance with the CEMP. The CEMP will include details of the topics listed below:

- Environmental Policy;
- Environmental Aspects Register;

- Project Organisation and Responsibilities;
- Project Communication and Co-ordination;
- Training;
- Operational Control;
- Checking and Corrective Action;
- Environmental Control Measures; and
- Complaints Procedure.

The CEMP will detail all the environmental aspects and impacts associated with this contract such as waste management, pollution prevention and protection of flora and fauna with particular emphasis on the nearby Special Area of Conservation (SAC), Special Protection Area (SPA), proposed Natural Heritage Area (pNHA) and water quality in the watercourses. The Register of Impacts provides the framework for identifying the potential environmental impacts generated by construction and the associated works. The Environmental Operational Control Procedures and activity-specific method statements will detail the working methods necessary for managing and mitigating these impacts, whether it is by prevention or mitigation. Prior to the commencement of construction activities, the Environmental Operational Control Procedures and activity-specific method statements will be completed so as to conform to precise site-specific requirements at the location of the proposed Flood Defences West.

3.1 Environmental Policy

The Contractor will complete an Environmental Policy with consideration for impacts on the natural and built environment. All project personnel will be accountable for the environmental performance of the Project and will be made aware of the Environmental Policy at induction. The environmental policy will consider and make commitments with regard to the protection of Natura 2000 sites, and any pNHA and/or Natural Heritage Area (NHA) sites, emissions to the atmosphere, maintenance of water quality, resource usage, energy consumption and waste management.

3.2 Environmental Aspect Register

Once appointed, the Contractor will prepare a register of all sensitive environmental features which have the potential to be affected by the construction works, together with details of commitments and agreements made during the EIAR planning process (i.e. commitments contained within the EIA Report and An Bord Pleanála conditions) and the Contract Documentation, with regards mitigation of potential environmental impacts.

The Environmental Aspects Register provides the relevant information for the preparation of construction method statements and will be regularly updated during the works.

The Environmental Aspects Register will consider sensitive environmental features as listed below (please note this list is not exhaustive and will be amended and expanded upon as required by the Contractor):

- Identification off all waterways and drainage outlets for the protection against ingress of suspended solids or any pollutant;
- Air emissions;

- Noise emissions
- Vibration emissions;
- Light emissions;
- Waste generation;
- Treatment of contaminated materials;
- Treatment of invasive species;
- Use of hazardous materials;
- Energy usage;
- Water usage;
- Discharge of wastewater;
- Traffic generation;
- Biodiversity (terrestrial and aquatic ecology);
- Landscape and Visual impacts;
- Soils, Geology and Hydrogeology;
- Hydrology; and
- Archaeology, Architectural and Cultural Heritage.

3.3 Project Organisation and Responsibilities

The adopted CEMP will define the roles and responsibilities of the project team. The overall responsibility lies with the Site Manager whose responsibility it will be to approve key personnel required for employment on the Project. He/She will liaise with the SEM.

The Project Manager will lead the works on site. He/She will be responsible for the management and control of the activities and will have overall responsibility for the implementation of the CEMP. He/She will be assisted by the SEM who will act as his/her deputy.

The SEM will prepare and implement all aspects of the CEMP.

Site Manager

The Site Manager's main duties and responsibilities in relation to the CEMP include liaising with the Project Team in assigning duties and responsibilities in relation to the CEMP to individual members of the main Contractor's project staff.

Site Environmental Manager (SEM)

The main duties and responsibilities of the SEM include and are not limited to the following:

- Liaise with the Site Manager during the finalisation of the CEMP to assign individual duties and responsibilities bearing in mind the overall organisational structure, the nature of the Environmental Commitments and Requirements and the proposed Flood Defences West development specific characteristics;
- Ensuring that the CEMP is finalised, implemented and maintained;
- Liaising with WCCC's Environmental Manager on all Method Statements, any alterations to live documents and any other works to ensure protection of water quality;

- Being familiar with the information in the pre-construction surveys, construction requirements, the competent authority's decision and all relevant Method Statements;
- Being familiar with the contents, environmental commitments and requirements continued within the reference documentation listed in this CEMP;
- Being familiar with the baseline data collated during the compilation of the EIAR;
- Assisting management in liaising with the Engineers and WCCC and the provision of information on environmental management during the construction of the proposed development;
- Liaising with the Project Team in assigning duties and responsibilities in relation to the CEMP, to individual members of the main Contractor's project staff;
- Overseeing, ensuring coordination and playing a lead role in third party consultations required statutorily, contractually and in order to fulfil best practice requirements;
- Liaising with management in agreeing site specific Method Statements with Third Parties;
- Ensuring that all relevant works are undertaken in accordance with the relevant legislation in the Republic of Ireland;
- Bring any legal constraints that may occur during certain tasks to the attention of management;
- Hold copies of all permits and licenses provided by waste contractors;
- Ensuring that any operations or activities that require certificates of registration, waste collection permits, waste permits, waste licences, etc have appropriate authorization;
- Gathering and holding documentation with respect to waste disposal;
- Keeping up to date with changes in environmental practices and legislation and advising staff of such changes and incorporating them into the CEMP;
- Liaising with contactors and consultants prior to works;
- Procuring the services of specialist environmental contactors when required;
- Ensuring that all specialist environmental contactors are legally accredited and proven to be competent;
- Coordinating all the activities of the specialist environmental contractors;
- Ensuring that environmental induction training is carried out on all personnel on site and ensuring that toolbox talks include aspects of environmental awareness and training;
- Respond to all environmental incidents in accordance with legislation, the CEMP and company policy/procedures;
- The SEM is responsible for notifying the relevant statutory authority when environmental incidents occur and producing the relevant reports as required;
- Ensuring that all relevant works have (and are being carried out in accordance with) the required permits, licenses, certificates and planning permissions;
- Liaising with the designated licence holders and specific agent defined in the licence with respect to licences granted pursuant to the European Commission (EC) (Natural Habitats) Regulations 1997;

- Carrying out regular documented inspections of the site to ensure that work is being carried out in accordance with the Environmental Control Measures and relevant site-specific Method Statements;
- The SEM should prepare and be in readiness to implement at all times the Emergency Incident Response Plan;
- Responsible for reviewing all environmental monitoring data and ensuring that they all comply with stated guidelines and requirements; and
- Liaising with management in preparing and inspection of site-specific method statements for activities where there is a risk of pollution or adverse effects on the environment.

Design Manager

The main duties and responsibilities of the Design Manger having regard to the implementation of the CEMP:

- Be familiar with the CEMP and relevant documentation referred to within; and
- Participate in Third Party Consultations and liaising with third Parties through the SEM.

Section Managers and Agents

The Section Managers and Agents are responsible for the following:

- Ensuring Forepersons under his/her control adhere to the relevant Environmental Control Measures and relevant site-specific Method Statements, etc.;
- Ensuring that the procedures agreed during third party consultations are followed;
- Reporting immediately to the SEM any incidents where there has been a breach of agreed environmental management procedures, where there has been a spillage of a potentially environmentally harmful substance, where there has been an unauthorised discharge to ground, water or air, damage to habitat, etc.; and
- Attending environmental review meetings and preparing any relevant documentation as required by management.

Forepersons

The forepersons on site are responsible for the following:

- Ensuring personnel under his/her control adhere to the relevant environmental control measures and relevant site-specific Method Statements; and
- Reporting immediately to the site agents and SEM any incidents where there has been a breach of agreed procedures e.g., spillages and discharges.

All Project Personnel

All project personnel have the following responsibilities:

- Attend environmental training as required; and
- Reporting immediately to the Forepersons/Agents or SEM any spillage incidents or observations regarding adverse effects to the environment.

3.4 Project Communication and Co-ordination

Environmental issues and performance aspects will be communicated to the workforce on a regular basis. Weekly project meetings, which follow a set agenda incorporating the environment, will be held alongside overall management meetings.

All staff and sub-contractors involved in all phases of the Project will be encouraged to report environmental issues.

3.5 Training

All employees and subcontractors involved on site will be given a comprehensive induction prior to commencement of the works. This environmental training can be run concurrently with safety awareness training.

Training will include:

- Overview of the goals and objectives of the Environmental Policy and Environmental Management Plan;
- Awareness in relation to risk, consequence and methods of avoiding environmental risks as identified within the Register of Aspects and with the planning conditions;
- Awareness of roles and individual environmental responsibilities and environmental constrains to specific jobs;
- Location of and sensitivity of Special Area Conservation Special Protection Areas, protected monuments, structures etc.; and
- Location of habitats and species to be protected during construction, how activities may affect them and methods necessary to avoid impacts.

A record will be kept of a signed register on the project files of all attendees of the environmental induction.

Toolbox talks based on specific activities being carried out will be given to personnel by the nominated project representative. These will be based on specific activities being carried out and will include environmental issues, particularly due to the proposed development, including the impact on water quality namely:

- Oil/Diesel spill prevention and safe refuelling practice;
- Storage of materials including oil/diesels and cement;
- Emergency response processes used to deal with spills;
- Minimising disturbance to wildlife;
- Emergency response to include water pollution hotline to the Environmental Protection Agency (EPA) /WCCC for regulator response. Identification of registered / accredited spill clean-up company for oil etc.; and
- Consideration of importance of containment of vehicle washing, containments of concrete /cement / grout washout etc, bank protection using hessian to prevent excessive scour and mobilisation of suspended solids, maintenance of vegetation corridors etc.

3.6 Operational Control

Site works will be checked against the CEMP requirements. Any mitigation measures that have been agreed with the statutory authorities, or are part of planning conditions, will be put into place prior to the undertaking of the works for which they are required, and all relevant staff will be briefed accordingly.

Method statements that are prepared for the works will be reviewed / approved by the Client Project Manager and where necessary the relevant Environmental Specialist. All method statements for works in, near or liable to impact on a waterway must have prior agreement with Inland Fisheries Ireland (IFI).

A Quality Management System (QMS) will also be put into operation for the Project. Document control will be in accordance with this QMS and copies of all audits, consents, licences, etc will be finalised by the SEM and their team and kept on site for review at any time.

3.7 Checking and Corrective Action

Daily inspections of the site and the works will be undertaken to minimise the risk of environmental damage and to ensure compliance with the CEMP. Any environmental incidents are to be reported immediately to the Site Foreman. The SEM will undertake periodic inspections and complete an assessment of the Project's environmental performance with regard to the relevant standards/legislation and the contents of the CEMP. Following these inspections, the SEM will produce a report detailing the findings which will be provided to the Client Project Manager and reviewed at the monthly project meeting.

3.8 Environmental Control Measures

Licensing requirements will be in place and specific procedures to manage the key environmental aspects of the Project will be developed by the Contractor prior to work commencing.

3.9 Complaints Procedure

A liaison officer will be available to allow for a member of the pubic or interested parties to make complaints about the construction works. The CEMP will contain details of the complaints procedures and a monitoring system will be implemented to ensure that any complaints are addressed, and satisfactory outcome is achieved for all parties.

3.10 Compliance with Project Consents

If planning permission is granted for the proposed development, the entire contents of the planning consent, and other consents and conditions, will be appended as received.

4. ENVIRONMENTAL COMMITMENTS

Project environmental mitigation has been set out in the application documentation, in the EIAR and NIS in particular, and will be detailed in the final Construction Environmental Management Plan (CEMP), in accordance with this CEMP. The final CEMP will provide a framework for compliance auditing and inspection to ensure that these construction practices and mitigation measures, as set out in the EIAR and NIS and the conditions in the planning approval, are adhered to. It should be noted that Appendix A of this CEMP details the key mitigation measures which are outlined in the NIS, while Appendix B details the key mitigation measures which are outlined in the EIAR.

APPENDIX A

Natura Impact Statement
Mitigation Measures

5. MITIGATION

5.1 Principles and Approach

Section 4.0 of this NIS identified adverse effects likely to arise from the proposed development on the specific Attributes and Targets which define the Conservation Objectives for a number of Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. This section (Section 5.0) prescribes measures and a protocol to ensure their full and proper implementation aimed at mitigating these adverse effects, thereby protecting the integrity of these European sites during the construction and operation of the proposed development.

The mitigation measures prescribed in this NIS have been designed according to the principle of a mitigation hierarchy, as outlined in the European Commission's guidance document *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* (EC, 2001). According to this hierarchy, the following mitigation approaches were adopted, in order of decreasing preference:

1. Avoiding impacts at their source;
2. Reducing impacts at their source;
3. Abating impacts on site; and,
4. Abating impacts at their receptor.

As mitigation measures are related directly to impacts and only indirectly to receptors and as, in this case, all of the affected receptors have been identified as being affected the same set of impacts, to describe mitigation measures under the headings of the relevant receptors would lead to undue repetition. Therefore, the measures prescribed in this NIS are described under the headings of the types of impacts which they are intended to mitigate.

The mitigation measures are prescribed in Section 5.2 and a protocol to ensure their full and proper implementation is prescribed in Section 5.3. The significance of any residual effects following the inclusion of mitigation measures is evaluated in Section 5.4. As per the assessment of adverse effects in Section 4.0, this evaluation is made in view of the relevant Conservation Objectives.

5.2 Mitigation Measures

5.2.1 Habitat Loss and Fragmentation

The attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the river face of the new flood defence wall has been included as part of the ecological enhancement of the proposed development. The "rough" surface of the cladding, which will slightly reduce flow velocities immediately adjacent to the wall, safeguarding the saltmarsh habitats in the vicinity of the proposed flood wall from the effects of erosion. As the biological communities, particularly seaweeds, e.g. *Fucus* spp., develop on the cladding, the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion.

Depending on the magnitude of this effect, over time, this may lead to an increased deposition of sediment immediately adjacent to the edge of the new riverside flood defence wall and upstream of the wall between Ch. 900 and Ch. 950, where the new alignment of the bank will form a light alcove. There is potential for this increased sedimentation to eventually lead to a slight expansion of the 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' at this location.

In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this NIS shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.

The flow velocity moderation provided by the cladding will also benefit small fish and other mobile species, including Twaite Shad and Otter, which are Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC. An additional benefit of this mitigation is that, once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir (including Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC) and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the estuary.

5.2.2 Water Quality

Construction Phase

As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan (CEMP) have been prepared for the proposed development and are included in Appendix A to this NIS. These will be developed by the Contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts.

The following will be implemented as part of this plan:

- An Incident Response Plan (see Appendix A) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks.
- All necessary permits and licenses for in stream construction work for the provision of the flood defences will be obtained prior to the commencement of construction.
- Inform and consult with Inland Fisheries Ireland.

During construction, regard will be had to the following guidance documents for construction work on, over or near water.

- *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016)
- *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001)
- *CIRIA C648 C648 Control of water pollution from linear construction projects: technical guidance* (CIRIA, 2006)

- *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* (NRA, 2006)

Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase:

General Measures

- Site works will be limited to the minimum required to construct the necessary elements of the proposed development.
- Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
- Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
- Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses.
- Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
- The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and CEMP in Appendix A to this NIS for further detail.
- Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses.
- Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
- The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.

Specific Measures - Concrete Works

Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed:

- Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete.
- Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water.

- When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used.
- Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters.
- Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW).
- The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.
- There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse.
- Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses.
- On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds.
- Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer).
- Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site.
- Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.

Operational Phase

The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.

5.2.3 Hydroacoustic Impacts

Fish Species

<u>Seasonal Restrictions on Piling</u>

As noted previously, at least one of the fish species of concern is likely to be present in significant numbers in the vicinity of the works at any time of the year, with by far the most sensitive fish hydroacoustic impacts, namely juvenile Twaite Shad, are present year-round, and other species being far less sensitive to the predicted impacts. Therefore, there is no specific benefit to or requirement for seasonal restrictions on piling activity.

Limits on Working Hours for Piling

The assessment in Section 4.2.4 above identifies a particular sensitivity with regard to night-time piling operations, which present an increased risk of impacts on juvenile Twaite Shad which are likely to shelter by the channel edge at night. This risk was also highlighted at the options appraisal stage and informed the decision to select the option which facilitated almost all piling taking place during the day. 3-4 weeks of night-time piling are still required due to other constraints, chiefly the need for railway possessions. However, as noted in Section 4.2.4, this piling will take place on land only. Based on the fact that this piling will take place on land and its short duration, it can be concluded beyond reasonable scientific doubt that it will not give rise to adverse effects on Twaite Shad or other Qualifying Interests of the Lower River Suir SAC or the River Barrow and River Nore SAC. Nonetheless, mitigation should be included to ensure that night-time piling is minimised and limited to landside works.

Breaks in Piling

There is a considerable amount of preparation required to ensure that piles are in the correct position etc. before driving begins. Therefore, once one pile is complete, it is estimated that it will take c. 35 minutes to prepare for the next pile, during which time there will be no piling noise. As detailed in Section 4.2.4 above, the area impacted by each pile drive is very small (less than the width of the channel), the impact (TTS) is of a low magnitude and fully recoverable, and fish are not stationary. Therefore, a quiet period of c. 30 minutes between periods of piling noise will be adequate to allow for recovery of fish and/or movement away from or through the affected area. This is based on a worst-case scenario of 55 minutes of continuous vibratory piling by a single piling rig or 28 minutes with two rigs operating simultaneously, or 200 strikes from an impact hammer (either one or two operating at any time). Mitigation specifying such quiet periods will be required to ensure that they are implemented.

In order to guarantee these gaps in piling noise, particularly if there is more than one piling rig in operation at the site, it shall be a requirement that all breaks between piling be of at least 30 minute's duration and, in the case of two piling rigs being operational simultaneously, that such breaks are concurrent. This mitigation will ensure that any hydroacoustic impacts will not give rise to a significant barrier to the movements of Twaite Shad or other species, or other significant effects on such species, in the Suir Estuary.

Soft-start/Ramp-up Procedure

Given the slow build-up of energy from vibratory piling, there is no requirement for the use of a soft-start or ramp-up procedure. Where impact piling is necessary to achieve the required depth for some piles, the vibratory piling preceding it will act as an effective soft-start or ramp-up procedure. Therefore, no specific measures are required to regulate the build-up of sound energy under water.

European Otter

The mitigation prescribed in this section in relation to hydroacoustic impacts are more than adequate to eliminate any risk of significant noise and vibration impacts on otters during the construction of the proposed development. Therefore, no further mitigation is required in respect of noise and vibration impacts on this species.

Summary

In short, the mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):

- Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
- In-stream (riverside) piling shall be restricted to daytime shifts only.
- Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
- No more than two piling rigs shall operate simultaneously at any time.
- The duration of any *vibratory* piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
- The length of any *impact* piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from *each* of two piling rigs, if piling simultaneously).
- Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
- The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.

Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts.

5.2.4 Lighting

Fish Species

The likely effects of artificial lighting on the migratory fish species listed as Qualifying Interests of the Lower River Suir SAC and the River Barrow and River Nore SAC are discussed in detail in Section 4.2.4 above. In summary, light spill onto the river channel during hours of darkness has the potential to form a barrier to the migration of nocturnal species and to encourage night-time activity of diurnal species, causing them to become more vulnerable to nocturnal predators.

Therefore, the following limits on construction lighting is proposed:

- Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours.
- Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction.
- In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities.

Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to any impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works.

As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.

European Otter

The mitigation prescribed in this section in relation to the impacts of artificial lighting are more than adequate to eliminate any risk of adverse effects in this regard on otters (including via prey availability) during the construction and operation of the proposed development. Therefore, no further mitigation is required in respect of lighting impacts on this species.

5.2.5 Invasive Alien Species

Terrestrial Plant Species

In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance* (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS.
- All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present.

If possible, the known stand of Japanese Knotweed at the location of the proposed construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control.

If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7m from all visible parts of the plant) at the outside and the access prohibited except for monitoring or treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.

Pioneer Species

The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site. According to the *Saltmarsh Monitoring Project 2007-2008* (McCorry & Ryle, 2009):

> "*A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended.* […] *It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary*

policy should be that any available resources should be used to prevent the spread of this species to new sites."

In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats:

- Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the Sustainable Transport Bridge and North Quays Development, without first having been inspected by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM).
- Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.

Aquatic Species

The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic invasive alien species and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall:

- Provide documentary evidence (in the form of a completed and signed Marine Institute "*Cleaning and Disinfection Declaration Form*") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and,
- Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development.

In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic invasive alien species to the Suir-Barrow-Nore Estuary. He/she shall do so by:

- Boarding the vessel;
- Speaking with the skipper;
- Inspecting the relevant documents; and,
- Carrying out a final inspection of the vessel.

In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document *Biosecurity Protocol for Field Survey Work* (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.

5.2.6 Other Measures

Fish Rescue

During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.

5.2.7 Monitoring

Water Quality

Monitoring of water quality shall be undertaken in the River Suir, with samples taken, monthly for at least 6 months prior to commencement, weekly for the entire duration of construction and monthly for at least 24 months post-completion. The parameters which shall be monitored include, but are not limited to:

- Suspended solids and turbidity;
- Total hydrocarbons;
- Ammonia, nitrates, nitrites and total nitrogen;
- Phosphates and total phosphorus;
- Dissolved oxygen and biological oxygen demand; and,
- Temperature and salinity.

Samples shall be taken from at least two different locations, including at least one location at an appropriate distance upstream of the proposed development and at least one other at an appropriate distance downstream of the proposed development. The final number and location of sampling points will be determined by the Site Environmental Manager. Given the strong tidal influence at the location of the proposed development, the date and exact time at which each sample is taken, as well as the water level and direction of flow, must be recorded in order to ensure that comparative analysis of samples can control for tidal influence, as well as other variables, e.g. fluvial conditions.

The results of the water quality monitoring programme will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation shall be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.

Record of Habitats

In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 50m upstream of the new flood defence wall to 50m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion.

In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix B).

Hydroacoustic Impacts

In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the duration of the proposed development's construction during which piling activities will take place. This monitoring shall establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) prior to and after construction and more accurately characterise the sound outputs in terms of SPL_{peak}, SPL_{RMS} and *SEL* at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

5.3 Implementation

In order to give effect to the mitigation prescribed in this NIS, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this NIS be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.

During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:

- The Schedule of Commitments.
- The mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS.
- Any conditions which might be attached to the proposed development's planning consent.
- Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
    - *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- All applicable legislative requirements in relation to environmental protection.
- All relevant construction industry guidelines, including:
    - *C532 Control of water pollution from construction sites: guidance for consultants and contractors* (CIRIA, 2001).
- Any biosecurity requirements arising from the preceding points.
- The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
    - *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.*
    - *Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.*
    - *Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.*
    - *The Management of Invasive Alien Plant Species on National Roads – Technical Guidance.*

- *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*
- *Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.*
- *Management of Waste from National Road Construction Projects.*
- *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.*

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.

5.3.1 Environmental Operating Plan

Appendix A of the NIS contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.

The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.

Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

- All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
- Any requirements of statutory bodies such as the NPWS and IFI, including adherence to *Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters* (IFI, 2016).
- A detailed Biosecurity Protocol.
- A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
- Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.

The EOP has been appended (Appendix A). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:

Appendix A: Construction Environmental Management Plan (CEMP)

Appendix B: Construction and Demolition Waste Management Plan (CDWMP)

Appendix C: Incident Response Plan (IRP)

Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.

Construction Environmental Management Plan

Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared, see Appendix A of this NIS. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP).

The CEMP will contain the following information of general importance:

- An overview of the proposed development.
- An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members.
- The Contractor's communications strategy.
- The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services.
- A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines.

In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following:

- Details of working hours and days.
- Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services.
- Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages).
- Details of construction plant storage, temporary offices.
- Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements;
- Truck wheel wash details (including measures to reduce and treat runoff).

- Dust management to prevent nuisance (demolition & construction).
- Control of sediment, run-off, erosion and pollution.
- Noise and vibration management to prevent nuisance (demolition & construction).
- Landscape management.
- Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel.
- Management of waste arising from construction and demolition.
- Minimisation of artificial lighting and shading.
- Management of risk from invasive alien species
- Stockpiles.
- Project procedures & method statements for:
  - Site clearance, site investigations, excavations
  - Diversion of services.
  - Excavation and blasting (through peat, soils & bedrock).
  - Piling.
  - Temporary hoarding & lighting.
  - Borrow Pits & location of crushing plant.
  - Storage and Treatment of peat and soft soils.
  - Disposal of surplus geological material (peat, soils, rock etc.).
  - Earthworks material improvement.
  - Protection of watercourses from contamination and silting during construction.
  - Works from a barge, including protection of watercourses from contamination when working in-river
- Site Compounds.
- Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.

The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

Construction and Demolition Waste Management Plan

The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.

The finalised CDWMP will contain the following information:

- Material transport routes;
- Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:

- An analysis of the different waste streams expected to be generated;
- A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
- Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
- Details of storage areas for waste materials and containers;
- Details of how unsuitable excess materials will be disposed of, where necessary; and
- Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

- Estimates of waste management costs;
- Specific waste management objectives for the project;
- Identification of the roles and responsibilities of the relevant personnel regarding waste management;
- Procedures for communication and training in relation to on-site waste management;
- Record keeping procedures; and
- Details of an audit system to monitor implementation of the CDWMP.

The CDWMP is appended to the EOP (see Appendix A of the NIS). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.

Incident Response Plan

The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances.

The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum:

- Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and,
- Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to,

details of removal of site materials, fuels, tools, vehicles and persons from flood zones.

- The measures to be taken to avoid or reduce the incident risk potential;
- Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Persons responsible for dealing with incidents and their contact details;
- Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same;
- Standby / rota systems; and
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

An IRP has been appended to the EOP (see Appendix A of this NIS). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.

5.3.2 Site Environmental Manager

To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.

Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.

- Daily reporting on weather and flood forecasting and daily reporting on the monitoring of peak water levels in the River Suir.
- Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
- Daily inspections of surface water treatment measures.
- Daily inspections of all outfalls to watercourses.
- Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
- Weekly inspections of wheel-wash facilities.

- Daily monitoring of any stockpiles.
- Auditing at least six times per quarter of the Contractor's EOP monitoring results.

5.3.3 Ecological Clerk of Works

In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:

- An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
- Demonstrable experience in the protection of European sites.

The principal functions of the ECoW are:

- To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in this NIS;
- To highlight the sensitivity of 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
- To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of this NIS);
- To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
- To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.

During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.

APPENDIX B

Chapter 19 Mitigation Measures (Volume 2 of EIAR)

Chapter 19 Mitigation Measures

19.1 Introduction

Mitigation measures are the measures proposed in order to avoid, reduce or, where possible, remedy the significant adverse environmental effects of the proposed Flood Defences West. Mitigation measures have been incorporated into the design of the proposed bridge and will be applied during both the construction and operation phase where they have been assessed as necessary.

This chapter provides a summary of the mitigation measures for the Flood Defences West as contained within chapters 5 – 18 of the Environmental Impact Assessment Report (EIAR). This is a summarised version stating only the mitigation measures to be provided and does not discuss the requirement for the measure to be applied or the residual impacts. This chapter also deals only with mitigation measures to be applied to the Flood Defences West and does not address the avoidance or reduction mitigation which has been applied through the design development.

19.2 General Mitigation and Monitoring Measures

Table 19.1 General Mitigation and Monitoring Measures

No.	Description
4.1	**Piling** • The following general procedure will be followed for installation of both riverside and landside sheet pile walls: • Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling, and shall not exceed 10 strikes in any one piling event • No more than two piling rigs shall operate simultaneously at any time. • The duration of any one piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes. • Following every piling event, there shall be a quiet period of at least 30 minutes. • The above specifications apply to all piling activity for the proposed development, riverside and landside, daytime and night-time.
4.2	**Cladding** The section of the riverside sheet piles within the intertidal zone of the River Suir (the area between the low- and high-water mark) will be fitted with cladding in a form of an eco-seawall to enhance marine biodiversity.
4.3	**Utilities** Prior to excavation works, a segment of the ground will be surveyed via CAT scan and shallow slit trenches excavated in order to confirm the position of utilities.
4.4	**Drainage – construction of Surface Water Outfall Structures** • A dry works area will be created by placing sheet piling or similar into the river from the bank outwards to construct a cofferdam. • Prior to the commencement of any de-watering operations within the cofferdam, adequate and appropriate facilities for the treatment of silt laden water will be designed prior to discharge to ground or back to the River Suir. • Clean, debris free stone will be utilised for the creation of the stone mattress.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>The dry works area will remain in place until all in-stream works have been completed and all concrete material has had sufficient time to cure.</td></tr>
<tr><td>4.5</td><td>Quarries
Only those quarries that conform to all necessary statutory consents may be used in the construction phase by the appointed Contractor.
For whatever quarry source, or sources, utilised for the fill material to be imported to the proposed road development, all will require suitable access routes for HGV traffic from their sites to the suitable main road network, in accordance with their planning approvals.</td></tr>
<tr><td>4.6</td><td>Construction Traffic
No construction traffic will be permitted to enter the site via Waterford City Centre.
The access route to the main and the ancillary construction compound is the R448 Regional Road which has a direct connection to the N25 National Road.</td></tr>
<tr><td>4.7</td><td>Environmental Operating Plan
The Environmental Operating Plan (EOP) shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.
The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.
Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:
All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
Any requirements of statutory bodies such as the NPWS and IFI, including adherence to Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
A detailed Biosecurity Protocol.
A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.
To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.</td></tr>
</table>

No.	Description
	The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor: **Appendix A:** Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase. It will be a condition of the Contract for the construction of the proposed development that the successful Contractor fully implement the EOP throughout the works. To oversee the implementation of the EOP, the Contractor will be required to appoint a responsible Site Environmental Manager (SEM) to ensure that the environmental commitments (as described above) and the EOP are fully executed for the duration of works, and to monitor whether the mitigation measures employed are functioning properly (i.e. are effectively addressing the environmental impact(s) which they were prescribed for).

19.3 Mitigation and Monitoring Measures for Traffic Analysis

Table 19.2 Mitigation and Monitoring Measures for Traffic Analysis

No.	Description
	There are no mitigation measures proposed for Chapter 5 Traffic Analysis as part of the Flood Defences West.

19.4 Mitigation and Monitoring Measures for Population and Human Health

Table 19.3 Mitigation and Monitoring Measures for Population and Human Health

No.	Description
6.1	Develop and implement all mitigation measures detailed in Chapter 4 (Description of the Proposed Development) this is to include development of Construction Environmental Management Plan (CEMP) and associated traffic management proposals to address all modes of transport including the navigational channel and will be required to be agreed with WCCC prior to construction stage. • The CEMP will be required to maximise the safety of the workforce and the public and minimise traffic delays, disruption and maintain access to properties. • The CEMP will also address temporary disruption to traffic signals, footpath access and the management of pedestrian crossing points. • The contractor shall provide an appropriate information campaign for the duration of the construction works. • The CEMP should minimise disruption to economic, marine users and residential amenities to be agreed by WCCC prior to construction and ensure access is maintained along the R448 & R680 for vehicles, pedestrians, cyclists, and economic operators at all times and ensure marine navigation is maintained. The contractor will be required to develop and implement Stakeholder Management and Communication Plan and will be required to be agreed with WCCC prior to construction stage. • All stakeholders will be required to be agreed with WCCC prior to construction commencing.

No.	Description
	Details of the general construction process/phasing will be communicated to the relevant stakeholders prior to implementation to ensure local residents and businesses are fully informed on the nature and duration of construction works.
6.2	Noise and Vibration mitigation will be provided for during construction of the development. Measures to mitigate noise and vibration impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities including the application of binding noise limits, hours of operation, along with implementation of appropriate noise and vibration control measures.
6.3	In order to minimise dust emissions during construction, a series of mitigation measures have been prepared as part of Chapter 13 Air Quality and Climate. Provided the dust minimisation measures are adhered to, the air quality impacts during the construction phase will not be significant. No further mitigation measures are required.
6.4	Emissions from the construction activities such as dust and risk of accidents were found to be potential short-term, negative impacts. It was found that noise emissions from construction activities, plant and machinery on site is likely to have a significant noise impact within the immediate area during distinct construction phases (i.e. piling activities) of the development.
6.5	Nightworks will also have a significant impact during the short duration they are required. All construction stage impacts will be temporary in nature and reduced and managed by CEMP and associated EOP and CDWMP and the range of mitigation measures of this EIAR.
6.6	All construction works will be temporary in nature and will be carried out in line with best practice thereby minimising the likely significant impacts to the community and human health impacts. The contractor will work within stringent construction limits and guidelines to protect surrounding populations and amenities.

19.5 Mitigation and Monitoring Measures for Biodiversity

Table 19.4 Mitigation and Monitoring Measures for Biodiversity

No.	Description
General Mitigation	
7.1	**Mitigation by Avoidance** The proposed development minimises land-take from ecologically sensitive areas and has been constraints-led from the initial phase, through an iterative design process, and into the final proposed development. The design of the flood defences has followed the basic principles outlined below to eliminate the potential for impacts on Key Ecological Receptors where possible, and to minimise such impacts where total elimination is not possible. The proposed development has been designed to minimise direct or indirect impacts on any habitats or species or other ecological features that were classified as being of Local Importance (Higher Value) or above. The alignment of the proposed flood wall has been designed to avoid, as far as possible, direct, indirect or secondary adverse effects on European sites and other designated sites for nature conservation.
7.2	**Mitigation by Design** The proposed development has been developed having regard to European and national legislation and all relevant guidelines and engineering best practice for the planning and construction of developments. These guidelines and best practice

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>provide practical measures that can be incorporated into the design to minimise the impact and protect the receiving environment.</td></tr>
<tr><td colspan="2">Specific Mitigation Measures – KER 1 River Suir, including Annex I 'Estuaries'
This subsection describes the mitigation proposed for general impacts on biodiversity in and immediately adjacent to the River Suir. Mitigation specific to other individual Key Ecological Receptors is described separately in relation to each Receptor.</td></tr>
<tr><td>7.3</td><td>Habitat Loss, Fragmentation and Degradation
The principal impact of the proposed development on the River Suir relates to the direct and indirect loss, fragmentation and degradation of intertidal and shoreline habitats. The direct loss of c. 800 m^2 of intertidal habitat cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the ecological enhancement of the riverside sections of the new sheet pile flood defence wall.
This enhancement will be provided by the attachment of highly structured or bio-active pre-cast concrete cladding ("eco-cladding") to the intertidal river face of the riverside sheet pile section of the new flood defence wall (see photomontages in Figures 11.1 and 11.2 in Volume 3 of this EIAR). The physical structure of this cladding will mitigate these impacts as follows:
• Any indirect loss of intertidal mudflats which might result from erosion associated with increased flow velocities immediately adjacent to the riverside sheet pile wall will be mitigated by the "rough" surface of the cladding, which will reduce flow velocities immediately adjacent to the wall. This will safeguard the remaining mudflats and fringing habitats from the effects of erosion.
• The highly structured surface of the cladding will maximise the opportunity for biological communities of hard intertidal substrates to colonise the new wall. The structure and composition of these communities will depend on the structure of the wall and the communities already present in the River Suir, which will act as a source to "seed" the cladding with encrusting organisms, including macroalgae ("seaweeds") and bivalve molluscs. The physical structure will also provide shelter/habitat for mobile species such as crabs and small fish.
• As the biological communities develop, particularly the seaweed, e.g. Fucus spp., the flow velocity moderation provided by the cladding will be enhanced, providing further protection against erosion for mudflats and shoreline habitats. Depending on the magnitude of this effect, over time, this may lead to an indirect recovery of a small portion of the mudflat habitat lost and, consequently, a slight increase in the area of saltmarsh (though this is unlikely to be significant).
• Once fully developed, the biological communities on the cladding would act as a source of food for a wide range of aquatic fauna in the River Suir and also as a reservoir of larvae or "seed" for the colonisation of other hard intertidal substrates elsewhere in the Suir Estuary.
• The flow velocity moderation provided by the cladding would also benefit fish and other mobile species, as discussed under KER 4 Fish Species, including Annex II migratory species. This addresses the habitat fragmentation impact.
The quantum of each benefit will depend on the final specification, e.g. the roughness of the surface and whether or not the cladding incorporates ledges or "shelves" to encourage shoreline vegetation at the top and/or accumulation of narrow strips of intertidal mudflats in the upper and mid-littoral zones. Incorporation of such features would further enhance the biodiversity value of the new flood defence wall through the provision of greater habitat zonation, heterogeneity and connectivity.
Assuming the specification of an appropriate cladding for the new riverside sheet pile wall, the replacement of intertidal mudflats (of high biodiversity value) and existing quay wall (of moderate biodiversity value) with a new sheet pile wall (of very low biodiversity value) would be mitigated as the cladding would increase the biodiversity of the new riverside flood defence wall to moderate-high (the as the overall value of the habitats being lost). While the loss of mudflat habitat is permanent and</td></tr>
</table>

No.	Description
	unmitigable, there would be No Net Loss of Biodiversity within the River Suir. Similarly, there would be no adverse effect on the conservation status of Annex I 'Estuaries'. This mitigation would also contribute to the achievement of the policies and objectives set out in the National Biodiversity Action Plan, the RSES for the Southern Region and the Waterford City Development Plan with regard to the protection and enhancement of the biodiversity value of ecological features and the provision of green infrastructure (and blue infrastructure), particularly in urbanised environments.
7.4	**Artificial Lighting** Artificial lighting associated with the construction of the proposed development poses a risk of potential negative impacts on habitats and species in and adjacent to the River Suir. Therefore, the following limits on construction lighting is proposed: • Subject to any Health & Safety and/or navigational requirements, construction lighting over the river channel shall be turned off outside of working hours. • Construction lighting shall be limited to the minimum area required to be lit and minimise light spill to areas not required for construction. • In order to further limit any light spill, solid hoarding shall be erected around areas which will be subject to night-time construction activities. Given the implementation of the above measures and the short duration of night-time construction activities (6-8 weeks), these works are unlikely to give rise to significant impacts beyond the duration of the works and, therefore, no additional mitigation is proposed in relation to these works. As there will be no new artificial lighting associated with the operation of the proposed development, no mitigation is proposed in relation to lighting for the operational phase.
7.5	**Water Quality** As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan have been prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4A, respectively. These will be updated and finalised by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts. The following will be implemented as part of this plan: • An Incident Response Plan (see Appendix 4.1 C) detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks. • All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction. • Inform and consult with Inland Fisheries Ireland. During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water. • Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016) • Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers • CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors • CIRIA C648 Control of Water Pollution from Constructional Sites • Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (NRA, 2006)

No.	Description
	Based on the above guidance documents, the following principal mitigation measures will be adhered to for the construction phase: *General Mitigation Measures* • Site works will be limited to the minimum required to construct the necessary elements of the proposed development; • Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches; • Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding; • Protection of waterbodies from silt load will be carried out through use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of run-off to watercourses; • Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap; • The anticipated site compound/storage facility will be fenced off at a minimum distance of 5 m from the top of the edge of the quay wall/river edge. Any works within the 10 m buffer zone will require measures to be implemented to ensure that silt-laden or contaminated surface water run-off from the compound does not discharge directly to the watercourse. See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail. • Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with NRA (2008d). All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20 m from watercourses. • Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution; and, • The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses. *Specific Mitigation Measures - Concrete Works* Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed: • Sandbags or an aqua-dam will be in place for the duration of remedial works to the existing quay wall to effectively isolate the area beneath these works from the River Suir and thereby control the risk of pollutants entering the river. This mitigation shall be removed once the remedial works are complete. • Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water. • When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used; • Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters; • Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW); • The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if wet weather is forecast such that precipitation may make it difficult to maintain a dry working area.

No.	Description
	• There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and any run-off shall be prevented from entering the watercourse; • Concrete waste and wash-down water shall be contained and managed on site to prevent pollution of all surface watercourses; • On-site concrete batching and mixing activities shall only be permitted within the identified construction compounds; • Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer); • Chute washout shall be carried out at designated locations only. These locations will be signposted. The concrete plant and all delivery drivers will be informed of their location with the order information and on arrival to site; and, Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Construction and Demolition Waste Management Plan.
7.6	**Operational Phase** The only potential water quality impacts associated with the operational phase relate to accidental spillage of paint which will be used in the periodic (approximately every 10 years) repainting of the exposed sections of the new sheet pile flood defence wall. In order to control this risk, the paint specified for this purpose shall not contain lead or tributyltin (TBT) or shall be otherwise approved for use near water.
7.7	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to Biodiversity in the River Suir in terms of the introduction or spread of invasive alien species.
Specific Mitigation Measures - KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide'	
7.8	**Habitat Loss, Fragmentation and Degradation** The direct loss of c. 800 m^2 of intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', cannot be avoided through design. However, indirect loss can be avoided and fragmentation and degradation mitigated through the provision of a highly structured or bio-active cladding, such as that described in relation to KER 1, to the outside of the riverside sheet pile wall. While the loss of mudflat habitat is permanent and unmitigable, there would be No Nett Loss of Biodiversity with regard to the intertidal habitats at this location and the effect on the conservation status of Annex I 'Mudflats and sandflats not covered by seawater at low tide' would be imperceptible at the National level.
7.9	**Water Quality** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on intertidal habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats.
7.10	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*.

No.	Description
	Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to intertidal habitats in terms of the introduction or spread of invasive alien species.
Specific Mitigation Measures - KER 3 Fringing Habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)'	
7.11	**Habitat Loss** A number of small areas of rough grassland habitats between the railway line and the River Suir will be lost as a result of the proposed development. Given the isolation of these habitats from the River Suir by the new flood defence wall and other habitats to the north by the railway line, it was not deemed appropriate to reinstate or improve these habitats as there is a risk to fauna, e.g. Otter, crossing the railway line to access them. Thus, the impact of the loss of these habitats is permanent, but is of low magnitude given the low biodiversity value of these habitats and their small extents. Any direct losses of saltmarshes and other shoreline habitats of high biodiversity value, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', have been largely avoided through the iterative design process. In particular, direct impacts on the area of 106 m^2 of Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' has been avoided entirely through moving the western tie-in point of the new flood defence wall, which was originally to transition back behind the existing quay wall at Ch. 0+950 (within this habitat), to its new position at Ch. 900, which is 25m further east than the most westerly point of the Annex I saltmarsh. Furthermore, the proposed eco-cladding described under *KER 1 River Suir, including Annex I 'Estuaries'*, will further safeguard saltmarsh habitats from future erosion be reducing flow velocities along the shoreline. There are no other areas of Annex I saltmarsh within the extents of the proposed development. Other shoreline habitats include extremely narrow strips of ruderal vegetation on the existing quay wall and at the bottom of the same in places. This vegetation will be lost, but can be fully replaced through specification of an appropriate "eco-cladding" as described under *KER 1 River Suir, including Annex I 'Estuaries'*.
7.12	**Disturbance** In order to provide further protection for 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)' from disturbance during the construction stage, the areas of confirmed or potential Annex I saltmarsh habitats identified in this EIAR shall not be included within the lands made available to the Contractor and it shall be made clear on all contract drawings that these areas contain sensitive habitats and shall not be disturbed. The Site Environmental Manager (SEM) and Ecological Clerk of Works (ECoW) shall also highlight the sensitivity of these habitats (and need to avoid disturbance of the same) during tool-box talks and other relevant communications with site personnel.
7.13	**Water Quality** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fringing habitats, including Annex I 'Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)', arising from accidental pollution associated with the proposed development would not give rise to significant effects on those habitats in terms of habitat degradation.
7.14	**Invasive Alien Species** Mitigation relating to biosecurity and the management of the risks associated with the spread of invasive alien species described under *KER 7 Invasive Alien Species*. Given the full and proper implementation of that mitigation, the proposed development does not pose a significant risk to shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', in terms of the introduction or spread of invasive alien species, especially Common Cordgrass (*Spartina anglica*).

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td colspan="2">Specific Mitigation Measures - KER 4 Fish Species
Mitigation measures prescribed for fish species below are relevant for nocturnal and diurnal fish species, fish of small body size and hearing specialists (fish with highly specialised auditory organs). The rationale for this mitigation is fully detailed in the NIS for the proposed development (included as part of this Planning Application).</td></tr>
<tr><td>7.15</td><td>Habitat Loss
The only fish habitat will be lost is the c. 800 m² of intertidal habitats on the left (north) bank of the River Suir where these are being reclaimed by the new flood defence wall. The mitigation which is being provided for the loss of these habitats include the provision of eco-cladding, which is described in detail above in relation to KER 1 River Suir, including Annex I 'Estuaries'. The positive effects of the eco-cladding are relevant to fish species as follows:
• It will provide the physical habitat conditions for quick establishment of biological communities of hard intertidal substrates, supporting macroalgae ("seaweeds"), crustaceans and fish. The establishment of such communities and consequent production of planktonic larvae will provide food for fish, including species of conservation importance, e.g. Twaite Shad.
It will mitigate against increased flow velocities at the channel edge resulting from the presence of the new sheet pile wall, which will facilitate movement against the tide by fish, especially small fish such as juvenile Twaite Shad.</td></tr>
<tr><td>7.16</td><td>Hydraulic Impacts
Predictions made from the hydrodynamic model for the proposed flood defences show that there would be a slight increase in flow velocity immediately adjacent to a sheet piled wall. While this will not lead to significant effects in the form or erosion of habitats within or on the banks of the River Suir, the rate of deposition will be slightly decreased. The measures described under KER 2 Intertidal Habitats, including Annex I 'Mudflats and sandflats not covered by seawater at low tide' relating to installation of eco-cladding will ensure that the impact on shoreline habitats, including Annex I 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', is further reduced/made positive.</td></tr>
<tr><td>7.17</td><td>Hydroacoustic Impacts
The mitigation for hydroacoustic impacts is as follows ("piling event" means any period of continuous piling by one or two rigs; "quiet period" means any period in which there is no piling by any rig):
• Night-time piling shall be limited to the minimum number of shifts possible and shall only be permitted for landside piling.
• In-stream (riverside) piling shall be restricted to daytime shifts only.
• Vibratory piling shall be the standard method for the installation of all piles. Impact piling shall only be employed where the required depth below ground cannot be achieved by vibratory piling.
• No more than two piling rigs shall operate simultaneously at any time.
• The duration of any vibratory piling event shall not exceed 55 piling minutes, i.e. the duration of piling by one rig or the sum of the duration of piling by two rigs shall not exceed 55 minutes.
• The length of any impact piling event shall not exceed 200 strikes from one piling rig (or 200 strikes from each of two piling rigs, if piling simultaneously).
• Following every piling event, there shall be a quiet period of at least 30 minutes. Only following 30 minutes of no piling whatsoever can the cumulation of piling minutes be re-zeroed.
• The above limitations apply to all piling activity for the proposed development, riverside and landside, daytime and night-time, permanent and temporary.</td></tr>
</table>

No.	Description
	Based on the expected time required for the installation of each pile (including ancillary processes), as described in Section 4.2.4, the limits prescribed above will not prolong the proposed programme for riverside or landside piling. Therefore, they are feasible within the proposed construction methodology and do not give rise to any additional effects on fish through extension of the total duration of impacts. Based on the detailed hydroacoustic impact assessment presented in the NIS, there is no necessity for daily/nightly or seasonal restrictions on piling activities or the use of soft-start/ramp-up procedures.
7.18	**Artificial Lighting** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the artificial lighting during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from artificial lighting from with the proposed development will not give rise to significant effects on the populations of those species. There are no lighting impacts associated with the operational phase.
7.19	**Water Quality** The measures described under KER 1 River Suir, including Annex I 'Estuaries' relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish species, including Annex II migratory species, arising from accidental pollution associated with the proposed development will not give rise to significant effects on the populations of those species.
7.20	**Fish Rescue** During de-watering of temporary cofferdams for the construction of drainage outfalls, any fish remaining within the cofferdams will be collected (by netting) and released into the River Suir outside the cofferdams. These fish rescue operations shall be carried out under the supervision of IFI. Given the Health and Safety implications of working within a stell cofferdam in a partially saline environment, the use of electrofishing is not considered to be appropriate in this case.
Specific Mitigation Measures - KER 5 Otter	
7.21	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct and indirect disturbance of otters during the construction of the proposed development. There are no sources of disturbance to otters arising from the operational phase.
7.22	**Prey Biomass Availability** The measures described under *KER 1 River Suir, including Annex I 'Estuaries'* relating to the protection of water quality during the construction of the proposed development will ensure that the impact on fish and other prey species for otters which might arise from accidental pollution associated with the proposed development will not lead to any reduction in the prey biomass available for otters. Furthermore, the implementation of the general mitigation of impacts on the River Suir and intertidal habitats, i.e. the proposed "eco-cladding" for the riverside flood defence wall, will likely lead to a slight increase in the total biomass available to otters in the long term.
Specific Mitigation Measures - KER 6 Bats	
7.23	**Disturbance (Lighting and Noise)** The mitigation proposed under *KER 1 River Suir, including Annex I 'Estuaries'*, for lighting impacts, and under *KER 4 Fish Species, including Annex II migratory species*, for noise impacts, are considered sufficient to eliminate any risk of significant direct

No.	Description
	and indirect disturbance of bats during the construction of the proposed development. There are no sources of disturbance to bats arising from the operational phase.
Specific Mitigation Measures - KER 7 Invasive Alien Species	
7.24	**Terrestrial Plant Species** In order to minimise the risk of the introduction or spread of invasive alien plant species (IAPS) during construction, all land-based works shall be executed in accordance with best practice for biosecurity in construction. In particular, prior to commencement, the Contractor shall prepare a detailed Biosecurity Protocol describing his/her proposed approach to ensuring that IAPS are not imported or spread during the construction of the proposed development. The Contractor's Biosecurity Protocol shall be in accordance with The Management of Invasive Alien Plant Species on National Roads – Technical Guidance (TII, 2020) and subject to approval by the Ecological Clerk of Works (ECoW) prior to its acceptance and implementation. The Biosecurity Protocol shall include, as a minimum, the following measures to prevent the spread of invasive species: • Good construction site hygiene will be employed to prevent the introduction and spread of problematic IAPS (especially Japanese Knotweed) by thoroughly washing vehicles prior to leaving any site. • All plant and equipment employed on the construction site (e.g. excavators, piling equipment etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of IAPS. • All washing must be undertaken in areas with no potential to result in the spread of IAPS, as detailed in the Construction Environmental Management Plan. • Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any IAPS and where it is confirmed that none are present. If possible, the known stand of Japanese Knotweed at the location of the proposed main construction compound should be eradicated prior to commencement of construction. Given the proximity of this stand to habitats of conservation importance, i.e. habitats within the Lower River Suir SAC, preference should be given to physical removal rather than chemical control. If for programme or other reasons the known stand of Japanese Knotweed cannot be eradicated prior to construction, it should be fenced off (at a distance of 7 m from all visible parts of the plant) at the outset and the access prohibited except for monitoring por treatment purposes. All site staff shall be made aware of the Contractor's Biosecurity Protocol and receive training in the importance of good site biosecurity.
7.25	**Pioneer Species** The invasive pioneer species Common Cordgrass (*Spartina anglica*) was previously recorded on intertidal mudflats in the River Suir within 500 m of the construction site (in the vicinity of the North Quays Development site and Sustainable Transport Bridge). According to the Saltmarsh Monitoring Project 2007-2008 (McCorry & Ryle, 2009): *"A general policy of active Common Cordgrass control in Irish saltmarshes is not recommended. […] It is recommended that instead of attempting to control or manage established populations of Common Cordgrass in Ireland, the primary policy should be that any available resources should be used to prevent the spread of this species to new sites."* In addition to the measures detailed below in relation to aquatic species, the following shall apply to all works on and adjacent to the mudflats: • Vehicles, vessels, plant, equipment, PPE, construction materials or excavated material shall not be moved directly from areas known to contain Common Cordgrass, e.g. the mudflats in the vicinity of the approved Sustainable Transport Bridge and North Quays Development site, without first having been inspected

No.	Description
	by the Ecological Clerk of Works (ECoW) and authorised by the Site Environmental Manager (SEM). Any material excavated from the mudflats, e.g. for the construction of drainage outfalls, shall be stored in a location where it is not at risk of colonisation by Common Cordgrass and shall be reinstated as quickly as possible.
7.26	**Aquatic Species** The use of barges during the construction of the proposed development poses the risk of the introduction of invasive alien species to the aquatic environment both in the vicinity of the works and in the wider Suir-Barrow-Nore Estuary. This has the potential to significantly affect the integrity of aquatic and intertidal habitats in the Zone of Influence. In order to minimise the risk of either the introduction or spread of aquatic IAS and thereby avoid negative impacts on these habitats, the owner or operator of the barge or barges shall: • Provide documentary evidence (in the form of a completed and signed Marine Institute "Cleaning and Disinfection Declaration Form") that the vessel was fully de-fouled within the 6 months immediately preceding its engagement in the construction of the proposed development; and, • Submit travel records relating to the vessel's movements during, at a minimum, the 6 months immediately preceding its engagement in the construction of the proposed development. In order to ensure full compliance with the above, authorisation to move the vessel to the construction area shall only be granted once the Ecological Clerk of Works (ECoW) has satisfied him/herself that the vessel does not pose a significant risk of importing aquatic IAS to the Suir-Barrow-Nore Estuary. He/she shall do so by: • Boarding the vessel; • Speaking with the skipper; • Inspecting the relevant documents; and, • Carrying out a final inspection of the vessel. In relation to other construction activities, including pre-construction surveys and any other site inspections, the principles and appropriate measures in the IFI guidance document Biosecurity Protocol for Field Survey Work (IFI, 2010) shall be followed and shall form part of the Contractor's Biosecurity protocol.
Specific Mitigation Measures - KER 8 Nationally Designated Sites	
7.27	As explained in the assessment of impact above, due to the distances between the proposed development and the pNHAs in the Zone of Influence, the only complete source-pathway-receptor chains are those relating to water quality impacts, invasive alien species (IAS) and migratory or highly mobile species, i.e. fish species and Otter. The mitigation measures proposed in relation to each of those is already described in detail under KERs 1, 4, 5 and 7 above and are deemed sufficient to eliminate any risk of such impacts on these sites.
Monitoring	
7.28	**Hydroacoustic Impacts** In order to allow for greater accuracy in the assessment of future plans and projects, it is recommended that hydroacoustic monitoring be undertaken for the full duration of the proposed development's construction. This monitoring should establish the ambient underwater noise levels in the estuary (and the rate of sound attenuation) and more accurately characterise the sound outputs in terms of both peak and root-mean-squared sound pressure level, as well as sound exposure level, at different frequencies arising from the different methods of pile driving and different types and sizes of piles. This monitoring shall be carried out by specialist underwater noise surveyors and the results will be frequently reviewed (at least fortnightly) by the Ecological Clerk of Works (ECoW).

No.	Description
7.29	**Record of Habitats** In order to maintain an accurate and precise record of changes to intertidal and fringing habitats, particularly mudflats and saltmarshes, a photographic record shall be made of these habitats. This record shall cover both sides of the river from 150m upstream of the new flood defence wall to 300m downstream. All photographs shall be taken at low tide, every 2 months, beginning 6 months prior to commencement of construction and finishing 12 months after completion. In addition, in order to accurately and precisely record any change in the structure and composition of biological communities of hard and soft intertidal substrates, sampling and analysis of these habitats shall be carried out at 6 months, 1 year, 2 years and 5 years post-construction. To facilitate meaningful comparative analysis and evaluation of the impacts of the proposed development, the sampling and analysis should follow the methodology employed by BEC Consultants Ltd in carrying out the pre-planning benthic surveys on 15th March 2021 (see Brophy (2021) in Appendix 7.1).
7.30	**Water Quality** Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager (SEM). The results of the water quality monitoring programme will be reviewed by the SEM and the ECoW on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where this is deemed to be associated with the proposed development.
Implementation	

7.31	In order to give effect to the mitigation prescribed in this EIAR, it should be a condition of any consent granted in respect of the proposed development that all of the mitigation, including monitoring and enforcement, prescribed in this EIAR be binding, during the construction phase, on the Contractor and, during operational phase, on WCCC. Accordingly, all of the mitigation prescribed herein shall be transposed into the Contract Documents for the construction of the proposed development.
	During construction, all works must comply with relevant legislation and guidelines in order to reduce and minimise environmental impacts and to protect all ecological receptors. In particular, there must be full compliance with the following:
	• The Schedule of Commitments.
	• The mitigation prescribed in Chapter 7 of the EIAR and in the NIS.
	• Any conditions which might be attached to the proposed development's planning consent.
	• Any requirements of stakeholders and statutory bodies, e.g. the NPWS and IFI, including:
	  o Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
	• All applicable legislative requirements in relation to environmental protection.
	• All relevant construction industry guidelines, including:
	  o C532 Control of water pollution from construction sites: guidance for consultants and contractors (CIRIA, 2001).
	• Any biosecurity requirements arising from the preceding points.
	• The Transport Infrastructure Ireland (TII) and National Roads Authority (NRA) Environmental Assessment and Construction Guidelines, specifically:
	  o Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes.
	  o Guidelines for the Testing and Mitigation of the Wetland Archaeological Heritage for National Road Schemes.

<table>
<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>

Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes.
Guidelines on the Management of Noxious Weeds on National Roads.
Guidelines for the Treatment of Noise and Vibration in National Road Schemes.
Guidelines for the Treatment of Otters Prior to the Construction of National Road Schemes.
Management of Waste from National Road Construction Projects.
Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan.

This list is non-exhaustive. All environmental commitments/requirements and relevant legislation and guidelines which are current at the time of construction will be followed.</td></tr>
<tr><td colspan="2">Environmental Management Plans</td></tr>
<tr><td>7.32</td><td>Environmental Operating Plan
Appendix 4.1 of this EIAR contains the Environmental Operating Plan (EOP) which shall be finalised by the Contractor, in agreement with Waterford City and County Council, prior to the commencement of the construction phase.
The EOP is a document that outlines procedures for the delivery of environmental mitigation measures and for addressing general day-to-day environmental issues that can arise during the construction phase of developments. Essentially the EOP is a project management tool. It is prepared, developed and updated by the Contractor during the construction stage and will be limited to setting out the detailed procedures by which the mitigation measures proposed as part of the EIAR and NIS and arising out of the Board's decision (if approving the proposed development) will be achieved. The EOP will not give rise to any reduction of mitigation measures or measures to protect the environment.
Before any works commence on site, the Contractor will be required to prepare an Environmental Operating Plan (EOP) in accordance with the TII/NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan. The EOP will set out the Contractors approach to managing environmental issues associated with the construction of the road and provide a documented account to the implementation of the environmental commitments set out in the EIAR and measures stipulated in the planning conditions. Details within the plan will include, as a minimum:

All environmental commitments and mitigation stipulated in the planning documentation in respect of the proposed development, including sediment controls and other measures to ensure that water quality in the River Suir and Waterford Harbour is not degraded.
Any requirements of statutory bodies such as the NPWS and IFI, including adherence to Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters (IFI, 2016).
A detailed Biosecurity Protocol.
A list of all applicable legislative requirements in relation to environmental protection and a method of documenting compliance with these requirements.
Outline methods by which construction activities will be managed in such a manner as to avoid, reduce or remedy potential negative impacts on the environment.

To oversee the implementation of the EOP, the Contractors will be required to appoint a person to ensure that the mitigation measures included in the EIAR, the EOP and the statutory approvals are executed in the construction of the works and to monitor that those mitigation measures employed are functioning properly.
The EOP has been appended (Appendix 4.1). This is a preliminary document, which will be updated and finalised by the successful Contractor. Appended to the EOP are the following constituent plans, also to be finalised by the Contractor:</td></tr>
</table>

No.	Description
	Appendix A: Construction Environmental Management Plan (CEMP) **Appendix B:** Construction and Demolition Waste Management Plan (CDWMP) **Appendix C:** Incident Response Plan (IRP) Each of these plans is discussed in the following sections. The obligation to develop, maintain and implement the EOP and all of the above-listed plans will form part of the contract documents for the construction phase.
7.33	**Construction Environmental Management Plan** Prior to any demolition, excavation or construction a Construction Environmental Management Plan (CEMP) will be produced by the successful contractors for each element of the proposed development. The CEMP will set out the Contractor's overall management and administration of the construction project. A Construction Environmental Management Plan has also been prepared as part of this EIAR, see Appendix A of Appendix 4.1. The CEMP will be developed by the Contractors during the pre-construction phase, to ensure commitments included in the statutory approvals are adhered to, and that it integrates the requirements of the Environmental Operating Plan (EOP). The CEMP will contain the following information of general importance: • An overview of the proposed development. • An organisational chart illustrating the structure of the Contractor's project team and the duties and responsibilities of the various members. • The Contractor's communications strategy. • The contact details of relevant persons/entities, e.g. the Safety Officer, the Site Environmental Manager and the emergency services. • A list of the documents which will have informed the CEMP, including all relevant legislation and construction/environmental guidelines. In relation to environmental management, the CEMP will provide and full list of the Contractor's environmental commitments and will detail the Contractor's approach to the following: • Details of working hours and days. • Details of emergency plan - in the event of fire, chemical spillage, cement spillage, collapse of structures or failure of equipment or road traffic incident within an area of traffic management. The plan must include contact names and telephone numbers for: Local Authority (all sections/departments); Ambulance; Gardaí and Fire Services. • Details of chemical/fuel storage areas (including location and bunding to contain runoff of spillages and leakages). • Details of construction plant storage, temporary offices. • Traffic management plan (to be developed in conjunction with the Local Authority – Roads Section) including details of routing of network traffic; temporary road closures; temporary signal strategy; routing of construction traffic; programme of vehicular arrivals; on-site parking for vehicles and workers; road cleaning; other traffic management requirements; • Truck wheel wash details (including measures to reduce and treat runoff). • Dust management to prevent nuisance (demolition & construction). • Control of sediment, run-off, erosion and pollution. • Noise and vibration management to prevent nuisance (demolition & construction). • Landscape management. • Management of contaminated land and assessment of risk for same by suitably qualified, trained and licenced personnel. • Management of waste arising from construction and demolition.

No.	Description

	• Minimisation of artificial lighting and shading.
	• Management of risk from invasive alien species
	• Stockpiles.
	• Project procedures & method statements for:
	  o Site clearance, site investigations, excavations
	  o Diversion of services.
	  o Excavation and blasting (through peat, soils & bedrock).
	  o Piling.
	  o Temporary hoarding & lighting.
	  o Borrow Pits & location of crushing plant.
	  o Storage and Treatment of peat and soft soils.
	  o Disposal of surplus geological material (peat, soils, rock etc.).
	  o Earthworks material improvement.
	  o Protection of watercourses from contamination and silting during construction.
	  o Works from a barge, including protection of watercourses from contamination when working in-river
	• Site Compounds.
	• Monitoring, inspection and auditing of the Contractor's compliance with his/her environmental commitments.
	The production of the CEMP will also detail areas of concern with regard to Health and Safety and any environmental issues that require attention during the construction phase. Adoption of good management practices on site during the construction and operation phases will also contribute to reducing environmental impacts.

7.34	**Construction and Demolition Waste Management Plan**
	The CDWMP sets out the Contractor's strategy (and measures required) to ensure that waste arising during the construction and demolition phase of the proposed development will be managed and disposed of in a way that ensures the provisions of European and Irish waste legislation (particularly the Waste Management Acts 1996 – 2011) are complied with, and to ensure that waste is managed in accordance with waste hierarchy insofar as possible.
	The finalised CDWMP will contain the following information:
	• Material transport routes;
	• Methods by which construction works shall be managed in accordance with the relevant legislative instruments, including but not limited to:
	  o An analysis of the different waste streams expected to be generated;
	  o A demolition plan, with the purpose of ensuring that demolition occurs in an orderly fashion so that the re-use and recycling of the resultant materials is given due priority;
	  o Details of waste storage (e.g. skips, bins, containers) to be provided for different waste streams and collection times;
	  o Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
	  o Details of storage areas for waste materials and containers;
	  o Details of how unsuitable excess materials will be disposed of, where necessary; and
	  o Details of how and where hazardous wastes, such as contaminated land, hydrocarbons and other hazardous substances, are to be stored and disposed of in a suitable manner;

No.	Description
	• Estimates of waste management costs; • Specific waste management objectives for the project; • Identification of the roles and responsibilities of the relevant personnel regarding waste management; • Procedures for communication and training in relation to on-site waste management; • Record keeping procedures; and • Details of an audit system to monitor implementation of the CDWMP. The CDWMP is appended to the EOP (i.e. Appendix B of Appendix 4.1). The plan shall be finalised by the successful Contractor, in agreement with WCCC, and in accordance with TII's guidelines on *The Management of Waste from National Road Construction Projects* (2017), the TII *Guidelines for the Creation, Implementation and Maintenance of an Environmental Operating Plan* (2007) and the Department of the Environment, Housing and Local Government's *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects* (2006). This will be a live document, which will be amended and updated to reflect the policy context, as well as conditions on site, as the construction of the proposed development progresses.
7.35	**Incident Response Plan** The Incident Response Plan (IRP) describes the procedures, lines of authority and processes that will be followed to ensure that incident response efforts during the construction stage of the proposed development are prompt, efficient, and appropriate to particular circumstances. The Contractor will finalise the IRP prior to the commencement of the proposed works to include the following information, at a minimum: • Contact names and telephone numbers for the local authority, i.e. WCCC (all sections and departments), An Garda Síochána and ambulance and fire services; and, • Method statements for weather forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The plan must outline how the Contractor will respond to forecasted flood events, including but not limited to, details of removal of site materials, fuels, tools, vehicles and persons from flood zones. • The measures to be taken to avoid or reduce the incident risk potential; • Reference to the method statement and management plans for construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents; • Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident; • Persons responsible for dealing with incidents and their contact details; • Procedures for alerting key staff, appropriate emergency services, authorities, the Employer's Representative and clean-up companies, where required, and contact details of same; • Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required, and contact details of same; • Standby / rota systems; and • The types and location of emergency response equipment available and appropriate personal protective equipment to be worn.

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<tr><th>No.</th><th>Description</th></tr>
<tr><td></td><td>An IRP has been appended to the EOP (i.e., Appendix C of Appendix 4.1). The document in its current form will be finalised by the successful Contractor prior to the commencement of the construction phase of the proposed development.</td></tr>
<tr><td>7.36</td><td>Site Environmental Manager
To ensure the successful development, implementation and maintenance of the EOP, the Contractor will appoint an independent Site Environmental Manager (SEM). He/she must possess training, experience and knowledge appropriate to the role, including a National Framework of Qualifications (NFQ) Level 8 qualification (or equivalent) or other acceptable qualification in environmental science, environmental management, hydrology or engineering. The principal functions of the SEM will be to ensure that the mitigation prescribed in this NIS, the EIAR, the CEMP, the EOP and the CDWMP, is fully and properly implemented and to monitor the construction stage from an environmental perspective. The SEM will also provide independently verifiable audit reports.
Separate from the on-going and detailed monitoring carried out by the Contractor as part of the EOP, the SEM will carry out the inspection and monitoring described below on behalf of WCCC. The results will be stored in the SEM's monitoring file and will be available for inspection or audit by WCCC, the NPWS or IFI.
• Daily reporting on weather and flood forecasting and daily reporting on the monitoring of water levels in the Lower River Suir.
• Weekly inspections of the principal control measures described in the CEMP and reporting of findings to the Contractor.
• Daily inspections of surface water treatment measures.
• Daily inspections of all outfalls to watercourses.
• Daily visual inspections of watercourse to which there are discharges from the works and those in the vicinity of construction works.
• Weekly inspections of wheel-wash facilities.
• Daily monitoring of any stockpiles.
Auditing at least six times per quarter of the Contractor's EOP monitoring results.</td></tr>
<tr><td>7.37</td><td>Ecological Clerk of Works
In order to ensure the successful development and implementation of the CEMP, an independent Ecological Clerk of Works (ECoW) will be appointed. The ECoW must possess training, experience and knowledge appropriate to the role, including:
• An NFQ Level 8 qualification or equivalent or other acceptable qualification in ecology or environmental biology; and,
• Demonstrable experience in the protection of European sites.
The principal functions of the ECoW are:
• To provide ecological supervision of the construction of the proposed development and thereby ensure the full and proper implementation of the mitigation prescribed in Chapter 7 Biodiversity of the EIAR and in the NIS;
• To highlight the sensitivity of 'Atlantic salt meadows (Glauco-Puccinellietalia maritimae)', and the need to avoid disturbance of the same, during tool-box talks and other relevant communications with site personnel.
• To regularly review the outcome of the ongoing monitoring during construction (as described in Section 5.2.7 of the NIS)
• To carry out inspections of all vehicles, vessels, plant, equipment, PPE, construction materials or excavated materials prior to their movement from areas known to contain invasive alien species; and,
• To carry out weekly inspections and reporting on the implementation of the Contractor's Biosecurity Protocol.
During the preparation of the Contractor's EOP, the SEM may, as appropriate, assign other duties and responsibilities to the ECoW. In exercising his/her functions, the ECoW will be required to keep a monitoring file and this will be made available for inspection or audit by WCCC, the NPWS or IFI at any time.</td></tr>
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19.6 Mitigation and Monitoring Measures for Soils and Geology

Table 19.5 Mitigation and Monitoring Measures for Soils and Geology

No.	Description
Mitigation by Design	
8.1	The construction works will be carried out with the least feasible disturbance of soils. The main flood defence elements, sheet pile wall and remedial works to the existing quay wall, directly avoid any requirement for excavation of in-situ ground and creation of waste.
8.2	The quantity of imported backfill for the gap between the sheet piles and the existing quay wall (where sheet piles are installed on the riverside), is minimised by design, as the alignment of the sheet pile wall was carefully selected as close as possible to the existing wall without compromising wall stability. Sheet piles were designed to be constructed on the landside of the existing wall wherever the width of cess allowed for safe day-time works without impact to rail operations, thus further minimising the backfill quantity.
8.3	The amount of waste from the excavations required for constructing the drainage system is minimised by reusing approximately a half of this material as a non-structural fill to even out the ground level across the site, wherever possible.
8.4	The potential impacts (ground displacement/settlement) on the Dublin to Waterford railway line have been mitigated by design, whereby the works are designed at a sufficient distance from the line, and are such that no temporary or permanent excavation in immediate proximity to the rail line is required, with the exception of shallow trenching for the construction of the drainage system. The potential impacts to the mudflats and riverbed from further deterioration of the existing masonry quay wall are also mitigated by design through the construction of the sheet pile wall and backfill in front of the quay wall at the most critical locations.
Specific Mitigation Measures	
8.5	The construction works will be carried out with the least feasible disturbance of the soils, minimising the amount of excavated soil with the inert excavated soil will be re-used on site insofar as possible.
8.6	Approximately 1,650m^3 of excavated ground material will be exported from the site. In addition to this, approximately 720 m^3 of construction and demolition waste will be generated during the demolition of the handrails and the upper parts of the existing quay wall which will be exported from site. The quantity is very small given the scale of the project, and will be disposed of by the Contractor who will ensure that all subsurface materials excavated during the construction phase of the proposed development are managed in accordance with the relevant waste management legislation. The successful Contractor will ensure that all subsurface materials are removed from the site and sent to authorised waste management facilities (i.e. which hold all relevant, valid permits / licences) which accept the corresponding types of waste. The contractor will be required to submit a Construction and Demolition Waste Management Plan (CDWMP) to the local authority for approval, which should address all types of material to be disposed of. The contractor will undertake the environmental testing of the material to be disposed of in order to determine the waste acceptability characteristics.
8.7	All imported material will be sourced from the nearest possible locations. A number of suitable active quarries with all necessary statutory consents exist across County Waterford and southwest County Wexford, such as Oaklands Quarry in Ballykelly, New Ross, Co. Wexford and Cappagh Quarry in Cappagh, Dungarvan, Co. Waterford. Both quarries are accessible from the N25 which links to the site of proposed development via the R448 Terminus Street.

No.	Description
8.8	A project-specific Construction Environmental Operating Plan (CEMP) will be prepared for the development by the Contractor for approval by WCCC. It will be maintained by the Contractor for the duration of the construction phase. The CEMP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the CEMP for the proposed development will be formulated in consideration of the standard best practice. The CEMP will include a range of site-specific measures which include: • Safety measures for working from barges in-river, including but not limited to risk of pollutants from the machinery stationed on the barge and operating with bulk materials such as backfill gravel on the barge; • Runoff will be controlled and treated to minimise impacts to groundwater and River Suir. • Temporary storage of any contaminated material on-site shall be carefully managed so as to limit any risk of contaminated surface water runoff leaving the site or infiltrating to groundwater. Runoff from the material shall be directed to a lined pond or temporary sewer/tank and the water shall be disposed of off-site for treatment at an appropriate licenced facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination. • All hazardous materials will be stored within secondary containment, designed to retain at least 110% of the storage contents. Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase. • The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment. • The successful Contractor will ensure that silt and sediment barriers are installed (and maintained in proper working order) at the perimeter of earthworks areas to limit transport of erodible soils to watercourses. • Where soils are being excavated and removed from site, the successful Contractor will ensure that dust generation will be avoided, by damping down material during excavation and loading onto trucks for off-site removal, if necessary. • Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction, including the usage of appropriate PPE. The successful Contractor will prepare an Incident Response Plan (IRP) which outlines measures to be implemented to prevent and address spillages of hazardous substances.

19.7 Mitigation and Monitoring Measures for Hydrogeology

Table 19.6 Mitigation and Monitoring Measures for Hydrogeology

No.	Description
9.1	A project-specific Environmental Operating Plan (EOP) and a Construction Environmental Management Plan (OCEMP) have been prepared and appended to Chapter 4 of this EIAR (see Appendix 4.1 and 4.1A respectively). They will be maintained by the Contractor for the duration of the construction phase. The EOP will cover all potentially polluting activities and include an emergency response procedure. All personnel working on the site will be trained in the implementation of the procedures. As a minimum, the EOP for the proposed development will be

No.	Description
	formulated in consideration of the standard best practice. The EOP will include a range of site -specific measures that include: • The successful Contractor will ensure that spill kits and hydrocarbon absorbent packs are stored in the site compound, and that operators will be fully trained in the use of this equipment. • Earthworks shall be carried out such that surfaces promote runoff and prevent ponding and flooding. • Runoff will be controlled and treated to minimise impacts to surface and groundwater. • Temporary pumping of groundwater, if required, shall be treated by means of a temporary sedimentation tanks prior to discharge • All hazardous materials will be stored within secondary containment designed to retain at least 110% of the storage contents. • Temporary bunds for oil/diesel storage tanks will be used on the site during the construction phase. • Contaminated material will be disposed of off-site for treatment at an appropriate licensed facility in accordance with the relevant waste management legislation. Alternatively, the material shall be covered while stored to remove the risk of surface water contamination. • Safe materials handling of all potentially hazardous materials will be emphasised to all construction personnel employed during construction. Mitigation measures during the construction phase will include implementing best practice during excavation works to avoid sediment entering the River Suir (refer to Chapter 10 'Hydrology' of this EIAR for details).

19.8 Mitigation and Monitoring Measures for Hydrology

Table 19.7 Mitigation and Monitoring Measures for Hydrology

No.	Description
Construction Mitigation	
10.1	As is normal practice with infrastructure projects, an Environmental Operating Plan (EOP) and Construction Environmental Management Plan will be prepared for the Flood Defences West and are included in Appendix 4.1 and Appendix 1.4 A, respectively. These will be developed by the selected contractor to suit the detailed construction methodology and allocate responsibilities to individuals in the construction team. In doing so, the measures detailed in the appended reports will be considered minimum requirements to be considered and improved upon. The level of detail provided within the current drafts of the Plans is sufficient to allow an assessment of the anticipated impacts including residual impacts. The following will be implemented as part of this plan: • An Incident Response Plan (see Appendix 4.1 C) will be finalised detailing the procedures to be undertaken in the event of spillage of chemical, fuel or other hazardous wastes, non-compliance with any permit or license, or other such risks that could lead to a pollution incident, including flood risks. • All necessary permits and licenses for in stream construction work for provision of the flood defences will be obtained prior to the commencement of construction. Inform and consult with Inland Fisheries Ireland and Waterways Ireland.
10.2	During construction, cognisance will have to be taken of the following guidance documents for construction work on, over or near water.

No.	Description
	• *Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites* (Eastern Regional Fisheries Board) • *Central Fisheries Board Channels and Challenges – The enhancement of Salmonid Rivers.* • *CIRIA C532 Control of Water Pollution from Construction Sites Guidance for Consultants and Contractors.* • *CIRIA C648 Control of Water Pollution from Constructional Sites.* • *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes (TII, 2006).* Based on the above guidance documents concerning the control of construction impacts on the water environment, the following outlines the principal mitigation measures that will be adhered to for the construction phase, in order to protect all catchment, watercourse and ecologically protected areas from direct and indirect impacts:
General Mitigation Measures	
10.3	Site works will be limited to the minimum required to undertake the necessary elements of the project.
10.4	Surface water flowing onto the construction area will be minimised through the provision of berms, diversion channels or cut-off ditches.
10.5	Management of excess material stockpiles to prevent siltation of watercourse systems through runoff during rainstorms will be undertaken. This may involve allowing the establishment of vegetation on the exposed soil and bunding.
10.6	Protection of waterbodies from silt load will be carried out through the use of gully silt/sediment filters and shallow berms in hardstanding areas to provide adequate treatment of runoff to watercourses.
10.7	Settlement tanks, silt traps/bags and bunds will be used. Where pumping of water is to be carried out, filters will be used at intake points and discharge will be through a sediment trap.
10.8	The anticipated site compound/storage facility will be fenced off at a minimum distance of 5m from the top of the edge of the quay wall/river edge. Any works within the 10m buffer zone will require measures to be implemented to ensure that silt laden or contaminated surface water runoff from the compound does not discharge directly to the watercourse. CEMP has been drafted and will need to be finalised by the appointed Contactor See the EOP and Construction Environmental Management Plan (CEMP) in Appendix 4.1 and 4.1 A of this EIAR for further detail.
10.9	Protection measures will be put in place to ensure that all hydrocarbons used during the construction phase are appropriately handled, stored and disposed of in accordance with the TII document "*Guidelines for the crossing of watercourses during the construction of National Road Schemes*". All chemical and fuel filling locations will be contained within bunded areas and set back a minimum of 20m from watercourses.
10.10	Foul drainage from all site offices and construction facilities will be contained and disposed of in an appropriate manner, off site, to prevent pollution.
10.11	The construction discharge will be treated such that it will not reduce the environmental quality standard of the receiving watercourses.
10.12	Water quality monitoring will be undertaken in the River Suir, with monthly samples being taken from at least 6 months prior to commencement of construction until at least 24 months post-completion. Water samples will be taken from at least two locations. The final number and location of sampling points will be determined by the Site Environmental Manager. The results of the water quality monitoring programme

No.	Description
	will be reviewed by the Site Environmental Manager and Ecological Clerk of Works on an ongoing basis during construction. In the event of any non-compliance with regulatory limits for any of the water quality parameters monitored, an investigation will be undertaken to identify the source of this non-compliance and corrective action will be taken where the this is deemed to be associated with the proposed development.
Specific Mitigation Measures – Concrete Works	
10.13	Remedial works to the existing masonry quay wall and increasing its height will require the use of in-situ concrete. The use and management of concrete in or close to watercourses must be carefully controlled to avoid spillage which has a deleterious effect on water chemistry and aquatic habitats and species. As the use of concrete cannot be avoided, the following control measures will be employed: • Hydrophilic grout and quick-setting mixes or rapid hardener additives shall be used to promote the early set of concrete surfaces exposed to water; • When working in or near the surface water and the application of in-situ materials cannot be avoided, the use of alternative materials such as biodegradable shutter oils shall be used; • Any plant operating close to the water will require special consideration on the transport of concrete from the point of discharge from the mixer to final discharge into the delivery pipe (tremie). Care will be exercised when slewing concrete skips or mobile concrete pumps over or near surface waters; • Placing of concrete in or near watercourses will be carried out only under the supervision of the Ecological Clerk of Works (ECoW); • The weather forecast will be consulted prior to commencing concrete pours. No such works will be undertaken if inclement weather is forecast such that precipitation may make it difficult to maintain a dry working area. • There will be no spills of concrete, cement, grout or similar materials hosed into surface water drains. Such spills shall be contained immediately and runoff prevented from entering the watercourse; • Concrete waste and wash-down water will be contained and managed on site to prevent pollution of all surface watercourses; • On-site concrete batching and mixing activities will only be allowed at the identified construction compound areas; • Washout from concrete lorries, with the exception of the chute, will not be permitted on site and will only take place at the construction compound (or other appropriate facility designated by the manufacturer); • Chute washout will be carried out at designated locations only. These locations will be signposted. The Concrete Plant and all Delivery Drivers will be informed of their location with the order information and on arrival to site; and Chute washout locations will be provided with an appropriate designated, contained impermeable area and treatment facilities including adequately sized settlement tanks. The clear water from the settlement tanks shall be pH corrected prior to discharge (which shall be by means of one of the construction stage settlement facilities) or alternatively disposed of as waste in accordance with the Contractor's Waste Management Plan.
Flooding	
10.14	The Contractor will provide method statements for weather and tide/storm surge forecasting and continuous monitoring of water levels in the River Suir and Waterford Harbour. The Contractor will also provide method statements for the removal of site materials, fuels, tools, vehicles and persons from flood zones in order to minimise the risk to persons working on the site as well as potential input of sediment or construction materials into the river during flood events.

19.9 Mitigation and Monitoring Measures for The Landscape

Table 19.8 Mitigation and Monitoring Measures for The Landscape

No.	Description
11.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.10 Mitigation and Monitoring Measures for Noise and Vibration

Table 19.9 Mitigation and Monitoring Measures for Noise and Vibration

No.	Description
12.1	With regard to construction activities, best practice control measures for noise and vibration from construction sites are found within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2*. Whilst day-time construction noise and vibration impacts are expected to be minimal and well within the criteria set out in this document, there are night-time works that have the potential to cause a temporary, significant impact. The contractor will ensure that all best practice noise and vibration control methods will be used, where practicable in order to minimise emissions to external noise sensitive locations. In this regard, various mitigation measures can be considered and applied during the construction of the proposed development, such as: • No plant used on site will be permitted to cause an ongoing public nuisance due to noise; • The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations; • Where practicable vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order; • Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers; • Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use; • All items of plant will be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures; Limiting the hours during which site activities which are likely to create high levels of noise or vibration are permitted
12.2	Furthermore, it is envisaged that a variety of practicable noise and vibration control measures will be employed. These may include: • Selection of plant with low inherent potential for generation of noise and/ or vibration; • Erection of good quality site hoarding on the landward side of the main works which will act as a noise barrier to general construction activity at ground level; • Situate any noisy plant as far away from sensitive properties as permitted by site constraints Erection of localised barriers as necessary or where practicable around noisy items of plant such as generators or high duty compressors, which is of particular importance during construction works that take place during the night-time.
12.3	Where practicable it is recommended that noise and vibration from construction activities to off-site residences be limited to the values set out in Table 12.2 and 12.8 of the Noise and Vibration EIAR Chapter.

No.	Description
	This may be achieved by undertaking noise and vibration monitoring at locations representative of the closest sensitive receptors. Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise. Vibration monitoring should be conducted in accordance with BS 6472 for human disturbance and BS ISO 4866:2010 for building damage.

19.11 Mitigation and Monitoring Measures for Air Quality and Climate

Table 19.10 Mitigation and Monitoring Measures for Air Quality and Climate

No.	Description
13.1	The proactive control of fugitive dust will ensure the prevention of significant emissions. The key aspects of controlling dust are listed below. These measures will be incorporated into the overall Construction Environmental Management Plan (CEMP) prepared in respect of the proposed development. In summary, the measures which will be implemented will include: • Hard surface roads will be swept to remove mud and aggregate materials from their surface while any un-surfaced roads will be restricted to essential site traffic. • Any road that has the potential to give rise to fugitive dust will be regularly watered, as appropriate, during dry and/or windy conditions. • Vehicles exiting the site shall make use of a wheel wash facility where appropriate, prior to entering onto public roads. • Vehicles using site roads will have their speed restricted, and this speed restriction must be enforced rigidly. On any un-surfaced site road, this will be 20 kph, and on hard surfaced roads as site management dictates. • Public roads outside the site will be regularly inspected for cleanliness and cleaned as necessary. • Material handling systems and site stockpiling of materials will be designed and laid out to minimise exposure to wind. Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods. • During movement of materials both on and off-site, trucks will be stringently covered with tarpaulin at all times. Before entrance onto public roads, trucks will be adequately inspected to ensure no potential for dust emissions. • During any demolition processes, water suppression should be used, preferably with a hand-held spray. Only the use of cutting, grinding or sawing equipment fitted or used in conjunction with a suitable dust suppression technique such as water sprays/local extraction should be used. • Drop heights from conveyors, loading shovels, hoppers and other loading equipment should be minimised, if necessary fine water sprays should be employed. At all times, these procedures will be strictly monitored and assessed. In the event of dust nuisance occurring outside the site boundary, movements of materials likely to raise dust would be curtailed and satisfactory procedures implemented to rectify the problem before the resumption of construction operations.

19.12 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

Table 19.11 Mitigation and Monitoring Measures for Archaeological and Cultural Heritage

No.	Description
Archaeology	
14.1	In order to ameliorate any negative impacts upon the archaeological resource, a full intertidal and wade/dive survey will be carried out along the sections of the existing quay wall to be directly impacted by the works and at the location of the upgraded and proposed outfalls. The survey will include a photogrammetry survey of the wall to be demolished (from Ch.350 to Ch.900), along with the mapping and recording of the former landing stages. All timber landing stages will be avoided during the course of works. The survey will also include a metal detecting survey and all works will be carried out by a suitably qualified underwater archaeologist, under licence to the National Monuments Service of the DoHLGH.
14.2	All ground disturbances associated with the works along the River Suir will be monitored by a suitably qualified underwater archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
14.3	All ground disturbances associated with excavations within the car park associated with the existing train station will be monitored by a suitably qualified archaeologist. If any features of archaeological potential are discovered during the course of the works further archaeological mitigation may be required, such as preservation in-situ or by record. Any further mitigation will require approval from the National Monuments Service of the Department of Housing, Local Government and Heritage (DoHLGH).
Cultural Heritage	
14.4	The section of the iron railway bridge that currently occupies the works compound will be left in-situ and undisturbed by contractors.

19.13 Mitigation and Monitoring Measures for Architectural Heritage

Table 19.12 Mitigation and Monitoring Measures for Architectural Heritage

No.	Description
12.1	There are no mitigation measures proposed for Chapter 11 The Landscape as part of the Flood Defences West.

19.14 Mitigation and Monitoring Measures for Material Assets and Land

Table 19.13 Mitigation and Monitoring Measures for Material Assets and Land

No.	Description
16.1	During construction, the following mitigation measures are proposed for the Waterford Flood Defences West: • Measures to control the production of dust will be put in place by the Contractor (refer to Chapter 13 Air Quality and Climate which presents a series of measures to control dust);

No.	Description
	• Noise mitigation will be provided during construction of the development. Measures to mitigate noise impacts on sensitive receptors are detailed within Chapter 12 Noise and Vibration. The Contractor will work within stringent construction limits and guidelines to protect residential and commercial amenities. • The upgrade works to the existing drainage system along the railway corridor west of Plunkett Station will be designed to ensure that the current drainage situation will not be impacted and there will be no increased risk of flooding as a consequence of the proposed development; • Prior to any excavation works, a segment of the ground will be surveyed via a CAT scan and a shallow slit trench will be excavated in order to confirm the position of utilities. • Any services that are interfered with as a result of the proposed development will be repaired / replaced without unreasonable delay. • A site plan will be prepared showing the location of all surface water drainage lines and proposed discharge points to surface water. This will also include the location of all existing and proposed surface water protection measures, including best practice measures such as monitoring points, sediment traps, settling basins, interceptors etc. All construction works will be temporary and will be carried out in line with best practice guidelines, thus minimising the impacts to the receiving communities. The Contractor will work within stringent construction limits and guidelines to protect surrounding amenities.

APPENDIX B

Construction and Demolition Waste Management Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Construction and Demolition Waste Management Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400050_[S3-P01] W Flood Def CDWMP

Client:
Waterford City & County Council
35 The Mall
Waterford

Waterford City Public Infrastructure Project

Flood Defences West

Construction and Demolition Waste Management Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

This Construction and Demolition Waste Management Plan (CDWMP) has been developed to ensure that waste arising on-site during the construction and demolition phase of the Waterford City Public Infrastructure Project - Flood Defences West will be managed and disposed of in a way that ensures the provisions of the Waste Management Acts, 1996-2011 and associated Regulations (1996-2011) are complied with and to ensure that optimum levels of reduction, re-use and recycling are achieved.

This CDWMP has been prepared for the provision of waste management for the construction phase of the Flood Defence West, taking into account the many guidance documents on the management and minimisation of construction and demolition waste, including:

- DEHLG (2006) *Best Practice Guidelines on the Preparation of Waste Management Plans for construction and Demolition Projects*. Department of Environment, Heritage and Local Government, Dublin;
- Provisions of the Waste Management Acts, 1996-2011 and associated Regulations;
- Construction Industry Research and Information Association (CIRIA) document 133 Waste Minimisation in Construction;
- TII (2014) *Guidelines for the Management of Waste from National Road Construction Projects*. Transport Infrastructure Ireland, Dublin; and,
- National Construction & Demolition Waste Council (NCDWC) 2006 *Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects.*

This plan is intended to be a working document and has been prepared to inform the Construction and Demolition Waste Management Plan which, in turn, will form an integral part of the Environmental Operating Plan (EOP) for the proposed development.

This document is preliminary in nature as it has been prepared at a stage when quantities are based on the design developed to a sufficient level of detail to inform the environmental impacts to be assessed in the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS). However, changes may occur during detailed design stages which may alter the volumes of waste.

All materials used during construction will be imported. Minimal quantities of soils will be excavated during construction.

Prior to the commencement of construction works, a Waste Management Co-ordinator (WMC) (who may also be the Site Environmental Manager) will be appointed by the Contractor to assume responsibility for the further development of the CDWMP and the management and treatment of all waste materials created during the construction of the Flood Defences West.

The Contractor's CDWMP must contain (but not be limited to) the following measures:

- Details of waste storage (e.g. skips, bins, containers) to be provided for different waste and collection times;

- Details of where and how materials are to be disposed of, i.e. landfill or other appropriately licensed waste management facility;
- Details of storage areas for waste materials and containers;
- Details of how unsuitable excess materials will be disposed of, where necessary;
- Details of how and where hazardous wastes such as oils, diesel and other hydrocarbon or other chemical waste are to be stored and disposed of in a suitable manner; and
- Details of locations.

Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects were published in 2006 by the National Construction & Demolition Waste Council (NCDWC). These Guidelines outline the issues that need to be addressed at the pre-planning stage of a development all the way through to its completion. These Guidelines have been followed in the preparation of this report.

2.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

2.1 Project Description

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City, refer to Figures 1.1 in Volume 3 of the EIAR. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD);
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

An overview of the structural elements of the proposed development is provided from east to west below:

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Construction of c.365m of underground flood defences (an impermeable shallow trench approx. 0.35m in width and up to 3m in depth) from Ch.0.0 to Ch.365 to cut off the potential groundwater seepage during high tide events It is possible that parts of these underground flood protection measures may be omitted during detailed design (see Figures 4.2 and 4.3 in Volume 3) or may be implemented on a phased basis depending on the ongoing groundwater monitoring results.
- Total of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
    - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
    - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m to conform with the design top-of-wall level of +4.30m OD.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090, with the top of wall at +4.30 mOD, to protect against overground flooding and underground groundwater seepage:
    - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material ("eco-seawall").
    - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
    - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works,

which will include a pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.

- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage and also to allow groundwater cut -off behind the sheet pile wall to drain to the River Suir with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900 where it is level with or above, the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level will be required in order to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.

Table 2.1 Overview of Proposed Flood Defences West

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

2.2 Construction Stage

It is anticipated that the construction of the proposed development will be progressed as a single construction contract with the construction phase lasting approximately 30 to 35 weeks.

2.3 Construction Procurement

It is envisaged that the construction of the proposed development will be tendered under a Public Works Contract for Civil Engineering Works Designed by the Employer.

3.0 WASTE MANAGEMENT STRAGETY

3.1 Scope

The Contractor will develop a CDWMP that will detail:

- Licensing of Waste Disposal;
- Site clearance;
- Excavations and disposal of materials;
- Measures to protect water quality;
- Importation, stockpiling and placing of fill;
- Management of drainage works to ensure no pollution of the River Suir;
- Construction vehicle management; and,
- Dust and noise abatement measures.

3.2 Waste and Recycling Management

The management of construction and demolition waste will reflect the waste management hierarchy, with waste prevention and minimisation being the first priority, followed by reuse and recycling. During site clearance and construction works, there are numerous opportunities for the beneficial reuse and recycling of materials. The subsequent use of recycled materials in reconstruction works also reduces the quantities of waste which ultimately needs to be consigned to landfill sites.

The Contractor will develop and implement a plan and manage all waste with a goal of achieving the waste hierarchy in accordance with the relevant statutory provisions as shown in Figure 3.1.

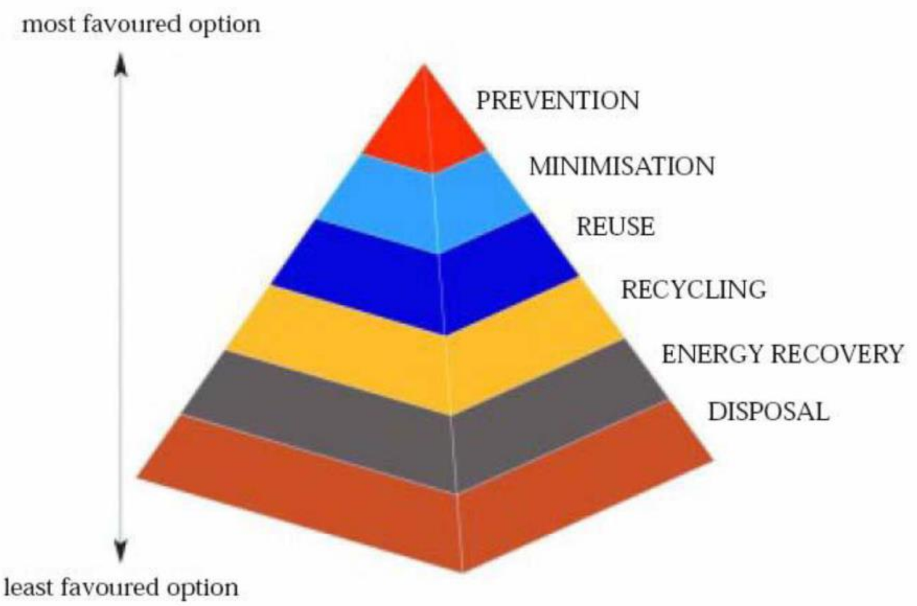

Figure 3.1 The Waste Management Hierarchy [DEHLG (1998) *Changing Our Ways*. Department of the Environment, Heritage and Local Government, Dublin]

Source Segregation

Wastes generated on the construction site will be identified and segregated according to their respective categories, as described by the European Waste Catalogue (EWC). Where possible, metal, timber, glass and other recyclable material will be segregated and removed off-site to a permitted/licensed facility for recycling.

In order to achieve this, designated waste storage areas will be created at the construction compound or other suitable locations for the storage of segregated wastes prior to transport for recovery/disposal at suitably licensed/permitted facilities. Suitably sized containers for each waste stream will be provided within the waste storage area and will be supervised by the WMC, who will be appointed by the Contractor. This will be the person responsible for the management of waste during the construction of the Flood Defences West. The number and sizing of containers will be agreed with Waste Contractors in advance of construction works commencing. Source segregation of waste will result in cost savings to the project as well as providing an environmentally sound route for the management of all construction and demolition wastes.

Re-use

Possibilities for re-use of clean, non-hazardous excavation material as fill on the site or in landscaping works will be considered following appropriate testing to ensure material is suitable for its proposed end use. During Ground Investigations (GI), samples were taken from exploratory holes and were tested at the Chemtest Accredited Laboratory in the UK. All samples have been classified as non-hazardous, falling within either inert WAC limits or increased inert WAC limits for non-hazardous landfills, except two samples which exceeded inert WAC limits and would classify for hazardous landfill. Some localised elevated levels of total organic carbon (TOC), chloride and heavy metals (Antimony, Mercury) were recorded, in specific locations close to rail tracks and the old landing stages. Asbestos was detected in a single sample with level detected <0.001% which is Non-Hazardous. Where excavated material is not to be reused within the works, the Contractor will endeavour to send material for recovery or recycling so far as is reasonably practicable. The Contractor will ensure that, if required, any off-site interim storage facilities for excavated material have the appropriate waste licences or waste facility permits in place.

Material Management

In order to prevent and minimise the generation of waste, the Contractor will be required to ensure that raw materials are ordered so that the timing of delivery, the quantity delivered, and the storage is not conducive to the creation of unnecessary waste. The Contractor, in conjunction with the material suppliers, will be required to develop a programme showing the estimated delivery dates and quantities for each specific material associated with each element of construction and demolition works. Following a "just-in-time" approach improves cash flow, better utilises storage space, reduces risk of environmental pollution events and reduces potential loss to theft and accidental damage as well as making the site safer.

It is essential that the planning, construction and demolition works are undertaken in close collaboration with waste management contractors, in order to determine the best techniques for managing waste and to ensure a high level of recovery of materials for recycling. The Contractor will be required to continuously seek to improve the waste management process on-site during all stages of construction and maximise opportunities for re-use and recycling where they exist. For example, in relation to waste packaging, the Contractor will seek to negotiate take-back of as much packaging waste as possible at source to ensure maximum recycling. The

CDWMP will be included as an agenda item at the weekly construction meetings. In addition, the plan will be communicated to the whole team (including the Client) at the monthly meetings. This will include any updates to earlier versions of the document.

Waste Auditing

The Contractor will record the quantity (in tonnes) and types of waste and materials leaving the site during the construction phase. The name, address and authorisation details of all facilities and locations to which waste and materials from the construction phase are delivered will be recorded along with the quantity of waste (in tonnes) delivered to each facility. Records will show all material recovered and disposed of.

The waste management strategy for the project will follow the accepted waste hierarchy and the Contract will implement the following types of measures to reduce waste and maximize opportunities for recycling:

- Wherever possible, materials for construction activities will be ordered as to require the minimum possible storage time;
- Materials will be ordered, where possible, in sizes to prevent wastage;
- Appointment of a WMC, who will be responsible for handling, storage and delivery of materials to the proposed development;
- Ensure that stored material is protected from damage from plant and environmental factors such as rain and wind;
- Secure storage areas to prevent unauthorised access;
- Establish a waste management compound to handle incoming waste from construction activities – this should facilitate the segregation of key waste streams to maximise the opportunity to re-use, recycle and return wastes generated on-site;
- Provide a separate secured area for dealing with hazardous waste; and,
- Provide separate facilities for the storage of fuels and chemicals.

3.3 Waste and Recycling Targets

The Contractor's CDWMP, waste handling and proposed construction methods should endeavour to achieve the following targets

- The re-use of all earthworks materials on site where possible;
- 100% recycling of surplus reinforcement and other metals, where possible; and,
- No contamination of skips.

3.4 Waste and Recycling Opportunities

The Contractor will seek opportunities, wherever possible, to reduce the amount of waste generated on site and maximize the potential for recycling materials in accordance with the waste hierarchy through the following:

- Storing materials in designated areas and separate from wastes to minimise damage;
- Returning packaging to the producer where possible;
- Segregating construction and demolition wastes into reusable, recyclable and non-recyclable materials;

- Reusing and recycling materials on site during construction where practicable;
- Recycling other recyclable materials through appropriately permitted/licensed contractors and facilities; and,
- Disposing of non-recyclable wastes to licensed landfills.

4.0 WASTE DISPOSAL LICENSING

4.1 Licensing Requirements

Under the Waste Management (Collection Permit) (amended) Regulations, 2016, a waste collection permit for appropriate EWC Code(s) and designations is required by a waste haulier to transport waste from one site to another. Compliance with the Waste Management (Shipments of Hazardous Waste in Ireland exclusively) Regulation, 2011 is also required for the transportation of hazardous waste by road. The export of waste from Ireland is subject to the requirements of the Waste Management (Shipment of Waste) Regulations, 2007. The Contractor will ensure that the transport and movement of all waste is carried out in compliance with these requirements.

Waste may only be treated or disposed of at facilities that are licensed to carry out that specific activity, *e.g.* chemical treatment, landfill or incineration, for a specific waste type. Records of all waste movements and associated documentation will also be held on-site. Generally, operators of waste management sites will facilitate a site visit and inspection of documentation if deemed necessary. Prior to any on-site recovery process, including the operation of mobile plant, an operator must apply to the governing local authority for a waste facility permit under the Waste Management (Facility Permit and Registration) Regulations, 2007. It is planned that waste activities at the site will comprise of source segregation, storage and collection and, therefore, it is highly unlikely that any waste licensable or waste permissible activity will be undertaken.

4.2 Exclusion from Legislation

The Directive on Waste contains a number of exclusions which make clear that certain materials are not subject to its requirements. A key exclusion affecting construction projects such as this development is set down in Article 2(1)(c). This states that the requirements of the EU legislation do not apply to:

"uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated"

This provision is repeated in the Waste Management Acts, as amended by the European Communities (Waste Directive) Regulations, 2011 (SI No. 126/2011). Should materials generated by construction activities fall within this provision, they are not then subject to the other requirements of the EU or national waste legislation. This means that, for example, such materials are not defined as "waste", do not need to be handled by duly authorised waste collectors and do not need to pass to disposal or recovery facilities that are subject to waste licences or other equivalent form of statutory authorisation. In addition, the requirements of the Waste Hierarchy do not apply.

5.0 PROPOSED CONSTRUCTION METHODOLOGY AND MATERIAL USAGE

5.1 Site Preparation

The construction of the Flood Defences West will require site clearance as part of the development, mostly for setting up the temporary compounds. Any site clearance works will however be minimal as the works area typically consist of levelled rail cess and built-up area (car parks). Also, a significant portion of works includes driving sheet piles in river/mudflats for which minimal site preparation is required. For the construction of impermeable trench at Plunkett station, the works may include minor diversion or protection works of services and utilities, such as public lighting, power services, watermains, rising main, storm water, electricity, telecommunications, gas mains and traffic light services. Due to the nature of works it is envisaged that it will only be possible during the main construction works.

The Contractor's CDWMP will take the following into account:

- The extent of the areas to be cleared and the potential types and volumes of arisings;
- Statutory requirements; and
- Specific environmental requirements and seasonal requirements, e.g. in respect of Shad, Salmon and Lamprey.

5.2 Site Offices, Construction Compounds and Security

A construction compound will be required in the vicinity of the proposed development and is proposed and assessed as being located in the widened rail cess area approximately 300m northwest of the flood defences' westernmost point, in vicinity of the rail level crossing. An ancillary compound is proposed at the Sally Park depot under ownership of Iarnród Éireann. The location, size and suitability of the compound will ultimately be at the discretion of the contractor once it is located within the project boundary and site access is approved by the Local Authority. For the purpose of the Environmental Impact Assessment Report (EIAR), it has been anticipated that the construction compound will be located in the widened rail cess area as described above. The location and layout of the construction compound selected by the contractor will however have to incorporate the protection and mitigation measures outlined in the EIAR and conform to the requirements outlined in the Natura Impact Statement (NIS) and planning conditions.

The compound will include stores, offices, material storage areas, plant storage and parking for site and staff vehicles. This site is proposed to remain in place for the duration of the contract but may be scaled up or down during particular activities on site.

The storage of fuels, other hydrocarbons and other chemicals within the construction compounds will not be permitted within 10m of the River Suir. All fuel storage areas will be bunded to 110% of storage capacity to prevent spills and provide sufficient additional capacity in the event of rainfall occurring simultaneously. The compounds will also have appropriate levels of security to limit potential vandalism, theft and unauthorised access within the compounds.

Following completion of construction, the compound will be cleared and reinstated in the original form. Temporary buildings and containers, parking areas and waste material such as rubble, aggregates and unused construction materials will not be permitted to remain exposed on these sites and will need to be removed and disposed of appropriately.

5.3 Material Quantities

Table 5.1 below provides the estimated material quantity requirements for the proposed Flood Defences West.

Table 5.1 Resources to be used During Construction

Element	Resources
Earthworks	Installation of a sheet pile wall will not require excavation of waste material. Imported material to fill the gap between the sheet pile wall and the existing quay wall will be clean granular material Class 6, totalling approximately 2000m^3. Approximately 2,500m^3 of clean imported granular fill material Class 6, will also be required for drainage works.
Structural Works	The project will require import of steel sheet piles for construction of new flood defence walls as well as material for in-situ concrete for remedial works on the existing quay wall. Total length of sheet pile wall will be approximately 770m, with height of piles between 10 and 21m. The total surface of the sheet piles is assumed to be approximately 11,000m^2 with the total tonnage of approximately 1,400 tonnes. Approximately 1,500 m^3 of precast concrete eco-seawall panels (with depth of approximately 13 cm) will be attached to the riverside sheet pile wall. Approximately 50 m^3 of concrete will be used for remedial works (raising) to the existing quay wall. Minor quantity of reinforcement steel will also be imported. Up to approximately 350m^3 of lean mix concrete / grout will be required to infill the impermeable trench.
Drainage	Drainage pipes (approx. 1,310m), valves, manholes, 2 No. precast pumping chambers, 3 No. precast headwalls, handrails, riprap, stone mattresses etc. 70m^3 fill of concrete surround for pump chambers of the proposed pumping stations will be required.
Construction and Demolition Waste	The removal of the upper section of the existing wall to the level of 800mm below existing ground level will generate approximately 600 m^3 of waste. Material excavated during demolition of a small section of the quay wall for the purpose of joining the riverside and landside sheet piles, will amount to approximately 50m^3. Another approximately 100 m^3 of wall will be demolished during the construction of a pumping station. Up to c.350m^3 of waste material will be generated during shallow excavations for the impermeable trench. Approximately 2,600m^3 of in-situ ground and ballast will be excavated during the drainage outlet remediation works and other drainage works such as installation of filter drains, with approximately half of it expected to be used again as a backfill across the site for ground levelling purposes. As such, approximately 1,300m^3 of surplus excavation will be generated.

5.4 General Construction and Demolition Works

Quantities of general construction and demolition wastes are made up of waste such as wood, packaging, metals, plastics, bricks, blocks, canteen waste, some hazardous waste, *e.g.* oils, paints and adhesives. Site clearance and residual waste will be generated during the construction phase, primarily from the construction of the proposed development. A detailed estimate of the anticipated quantities of these materials will be provided in the detailed CDWMP following appointment of the Contractor at construction stage. The majority of the waste material generated on site of proposed development, however, will be reused.

An overview of the methods to manage the primary waste streams expected is presented below. The main types of construction waste produced will be:

Excavated material

Where short-term temporary storage is unavoidable, the method of storage of material will be key to its potential use as certain types of materials mud are likely to degrade if left uncovered in wet weather due to its low plasticity and silty nature.

Concrete

Waste concrete is likely to arise during the construction phase of the Flood Defences West, primarily through the demolition of a section of an existing masonry flood defence wall. It is proposed that waste concrete generated will be returned to the supplier for re-use. For every tonne of concrete waste that is recycled for aggregate in new concrete, significant savings are made in energy and carbon dioxide emissions. It also saves money by avoiding disposal costs, which continue to increase. Residual concrete waste will be source segregated and stored in designated containers at the waste storage area for subsequent separation and recovery at a remote facility.

Metals

Metal waste has a significant scrap value. Although it is now common practice for sites to segregate metals for reuse and recycling, there are still sites where metal is thrown away with general rubbish. One of the primary sources of metal waste is steel reinforcement. Wastage of steel reinforcement will be reduced by ordering made to measure steel from the manufacturer and detailed scheduling of all reinforced concrete structural elements. Steel reinforcement requirements are likely to be limited for the proposed development.

Skip hire companies may provide free skips for the storage of scrap metal on sites and this will be investigated prior to construction commencing. When metal storage containers are full, they will be removed by the waste storage contractor and sent to a metals recycling facility.

Timber

Timber waste will be stored separately as it is readily contaminated by other wastes and if it is allowed to rot will reduce the recyclability of other stored wastes. Any pallets will be returned to the supplier for re-use. Off-cuts and trimmings will be used in formwork where possible. A container for waste wood will be covered where possible and will be placed in the waste storage area. The waste wood will be collected by a waste contractor who will forward it to a wood recycling facility for chipping.

Treatment of timber with chemicals and the overuse of nails will be minimised and avoided as this will make it difficult to reuse/recycle the timber afterwards. The utilisation of reclaimed timber products will also be investigated.

Packaging and Plastic

Packaging waste can become a major problem on construction sites. Double handling will be avoided by segregating packaging wastes immediately after unwrapping. Many suppliers are now prepared to collect their own packaging for recycling, and this will also be investigated prior to works commencing. It is intended that, where possible, materials with recycled packaging will be purchased. Waste packaging will be segregated and stored in separate containers, preferably covered, in the waste storage area for collection by the waste management contractor and distribution to packaging recycling facilities.

Blocks, Bricks and Tiles

The careful storage of these raw materials will significantly reduce the volume of these wastes arising on site. The most likely wastes produced will be off-cuts, trimmings and waste arising from breakages. Every effort will be made to use broken bricks and off-cuts

Hazardous Wastes

All of the waste generated from construction phase of proposed development is likely to be of a non-hazardous origin, however there is potential to encounter hazardous waste on site due to the industrial history of the area. One area with potential for being characterised as hazardous is the excavated material below the car park, which will be excavated for the purpose of constructing the impermeable trench.

Prior to removal from the site, any hazardous waste identified will undergo a comprehensive waste assessment and classification by a suitably qualified person in accordance with the European Waste Catalogue and Hazardous Waste List. It should be noted that if non-hazardous waste becomes contaminated with hazardous waste the entire load will be considered hazardous. It is, therefore, critical to ensure that waste segregation areas are provided and are used properly to separate out hazardous, non-hazardous and inert waste arising. Hazardous wastes will be identified, removed and kept separate from other construction and demolition waste materials in order to avoid cross-contamination. Specific method statements detailing the necessary mitigation measures required during excavation, handling transportation and disposal of hazardous wastes encountered on the site will be prepared as required.

The likely disposal/treatment options for any hazardous wastes available to the Contractor will depend on the nature of the hazardous material and the concentration of parameters of concern. The costs associated with treatment and disposal will similarly vary depending on the concentration of parameters of concern and on the tonnage involved. There are several operators/facilities in operation within Ireland that could potentially accept the contaminated material depending upon the results of the Waste Acceptance Criteria testing or assist in the export of the material abroad for special treatment where required. Full details of the disposal route for hazardous wastes will be provided in the detailed CDWMP following the appointment of the contract and completion of the further investigations required.

Hazardous Liquids (Oils, Paints, Chemicals)

Hazardous liquid waste arising from the construction process will require careful handling. Oils, paints, bitumen, adhesives and chemicals will be kept in a separate contained storage area which will be locked when not in use. Hazardous liquids will be stored at least 10m from the River Suir. Lids will be kept on containers in order to avoid spillage or waste by evaporation. Waste oils, paints and chemicals, including the containers, will require careful handling and disposal. These will be stored in a containment tray with a capacity to contain 110% of the volume of the largest container.

Fuels and chemical will be stored in double-skinned containers or within a bund, i.e. an impervious structure with the capacity to contain 110% of the volume of the largest tank stored within it. All containers will be carefully labelled.

Food Wastes

Site staff generate food waste and packaging waste. Designated receptacles will be provided to allow for the segregation and storage of individual waste streams. These will include receptacles for food waste, *e.g*. brown bin for waste foods and peelings, dry recyclables, *e.g*. green bin for packaging, plastics, metals, wood, paper, cardboard and tetrapack, and residual bin, *e.g*. black bin for mixed food and packaging waste. Separate receptacles for the recyclable fractions may be provided such as plastics, metals, glass and this will be designed and detailed by the WMC in consultation with the selected waste management contractor.

Other Wastes (Residual)

Waste material other than those outlined above can constitute a significant proportion of the total waste generated by a construction site. This waste is normally made up of residual, non-recyclable waste such as soiled paper, cloth, cardboard or plastics, as well as food waste and general waste found on the site, including plastic bottles, bags, cans *etc*. Given the heterogeneous nature of this material, it is most important that residual waste is kept separate from the other waste streams to avoid contamination. This material will be stored in a dedicated container in the waste storage area. Container size and collection frequency will be assessed with waste management contractors as works proceed. All residual wastes will be dispatched to a suitably licensed facility for disposal. Other construction and demolition waste material will be collected in receptacles with mixed construction and demolition waste materials for subsequent separation and disposal at a segregation facility.

6.0 ASSIGNMENT OF RESPONSIBILITIES

A WMC will be appointed who will have overall responsibility for waste management on the site. The Employer (Waterford City and County Council) will receive summaries of any audit reports, which will be completed within three months of the end of each calendar year. The effectiveness and accuracy of the documentation may also be monitored on a regular basis via routine site visits. Following appointment of the preferred Contractor, the CDWMP will be updated in accordance with the final design and copies of the plan will be distributed to the Employer, the Site Manager and the site sub-contractors. The WMC appointed by the Contractor will be appropriately trained and experienced in all aspects of waste management. In addition he/she and the site crew must be in a position to:

- Distinguish reusable materials from material suitable for recycling;
- Ensure maximum segregation at source;
- Co-operate with site manager on best locations for stockpiling reusable material;
- Separate material or recovery; and,
- Identify and liaise with operators of recovery outlets.

The WMC will be responsible for educating all site staff, sub-contractors and suppliers about the available alternative to conventional waste disposal. Training will also be given to all site staff in materials management on sites. The WMC will continually identify waste minimisation actions on sites and this will be updated in the plan.

7.0 TRAINING

Copies of the CDWMP will be made available to all personnel on-site. All site personnel and sub-contractors will be instructed about the objectives of the plan and informed of the responsibilities that fall upon them as a consequence of its provisions. This is traditionally carried out during the induction process for new staff members. Where source segregation and material re-use techniques apply, each member of staff will be given instructions on how to comply with the CDWMP. Site notices will be designed to reinforce the key messages within the plan and will be displayed prominently for the benefit of staff.

8.0 WASTE RECORDS

When establishing the system for managing the details of all arisings, movement and treatment of construction and demolition waste in the CDWMP, the use of electronic tools should be considered to provide for convenient recording of information in a useful format such as “Smart – waste”.

The Contractor will be required to arrange for full details of all arisings, movements and construction and demolition waste to be recorded during all stages of the proposed development. Each consignment of construction and demolition waste removed from the site will be documented in the form of a Waste Movement Record form, which will ensure full traceability of the material to its final destination. Separate record forms will be completed in respect to each waste transfer that takes place. The Contractor will also receive printed documents/records from waste disposal companies employed, quantifying the exact amount of waste material removed from site. The sheet from the disposal company also identifies how much material went to landfill and how much went for recycling. All such records will be retained in a designated location and made available for auditing of the CDWMP.

9.0 SUMMARY OF THE CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

Waste will inevitably be generated during the construction and demolition phase of the Flood Defences West. It is intended that all steel and concrete will be imported for use within the project area. At this stage, it is anticipated that there will be excavated material for re-use on-site.

Other than spoil material from excavations, waste arisings during the construction phase will be minimised by the purchasing manager, who will time the ordering of materials so as to reduce the likelihood of over-purchase or damage during storage. Construction and demolition waste fractions will be segregated and stored on-site in designated areas or containers in the waste storage area prior to transport by licensed hauliers to facilities for segregation recycling and disposal.

A WMC will be appointed to ensure that the CDWMP is followed. Training will be given to all staff so that they are aware of the CDWMP and know their responsibilities.

Records will be kept to trace the inputs and outputs of the construction works at the site and this should allow the Employer to make informed decisions regarding waste management in the future. These records will be made available to the relevant local authorities and the EPA should it be required.

The design and implementation of the detailed CDWMP, in conjunction with the EOP for the Flood Defences West, will provide for the optimum planning/management and handling of waste generated by the project and will ensure that there will be no worse than a neutral or imperceptible impact from waste management practices during construction.

The contractor appointed to undertake the construction of the Flood Defences West will develop their own CDWMP based on their detailed plans, the requirements of this plan, the requirements of the EIAR, the requirements of the NIS and any commitments given as part of the project approval process and the Employer's requirements and specifications for executing the Flood Defences West.

APPENDIX C

Incident Response Plan

Prepared by
Roughan & O'Donovan
Arena House, Arena Road, Sandyford, Dublin 18
Tel: +353 1 2940800 Fax: +353 1 2940820
Email: info@rod.ie www.rod.ie

Comhairle Cathrach & Contae Phort Láirge
Waterford City & County Council

WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT

FLOOD DEFENCES WEST

Incident Response Plan

October 2021

WPIP-ROD-ENV-S1_AE-RP-EN-400055_[S3-P01] W Flood Def IRP

<u>Client:</u>
Waterford City & County Council
35 The Mall
Waterford

ROD
ROUGHAN & O'DONOVAN

Waterford City Public Infrastructure Project

Flood Defences West

Incident Response Plan

TABLE OF CONTENTS

1.0 INTRODUCTION

This Incident Response Plan (IRP) describes the guidelines for procedures, lines of authority and processes that should be followed to ensure that incident response efforts are prompt, efficient, and appropriate to particular circumstances. It has been developed to provide the information that each employee may need to respond to an emergency and to handle it effectively.

2.0 OBJECTIVE OF PLAN

The primary objective of this document is to:

- Ensure the health and safety of workers and visitors along the site;
- Minimise any impacts to the environment and to ensure protection of the water quality and the aquatic species dependant on it;
- Protect property and operations at the proposed site and to minimise the impact on the continuity of business; and,
- Establish procedures that enable personnel to respond to incidents with an integrated multi-departmental effort and in a manner that minimises the possibility of loss and reduces the potential for affecting health, property and the environment.

3.0 RESPONSIBILITY

It is the responsibility of the Environmental Manager to maintain and update this IRP as required.

This IRP will be reviewed on an ongoing basis and amended, as necessary, when one or more of the following occur:

- Applicable regulations are revised;
- The Plan fails in an emergency;
- The project changes in its design, construction, operation, maintenance, or other circumstance in a way that materially increases the potential for impacts on the environment, workers or visitors to the site; and/or,
- Amendments are required by a regulatory authority.

4.0 OTHER PLANS

In 2019, Health Service Executive (HSE) prepared an Emergency Plan for the South East Region in accordance with the Government’s Major Emergency Management Framework which include counties of Carlow, Kilkenny, Tipperary, Wexford and Waterford. This plan is available ONLINE at:

https://www.hse.ie/eng/services/list/3/emergencymanangement/area-mep/hse-emergency-management-area-5-emergency-plan.pdf

It details the initial contact that should be made in case of an emergency incident as well as those responsible for following up once an emergency event is declared. This plan may be referred to during both the construction and operation phases.

5.0 OUTLINE INCIDENT RESPONSE PLAN

Name and address of the Client:

Waterford City & County Council

35 The Mall

Waterford

The contact within the Client organisation is Peter Keane (tel. 0761 10 2788).

Site Location:

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City (see Appendix A Figure 1).

Overview of the activities on site:

The construction programme for the proposed development is 30 – 35 weeks.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.6 in EIAR Volume 3:

- Site Setup and establishment of construction compounds within IÉ lands;
- Relocation of underground utilities, where required.
- Construction of c.365m of underground flood defences from Ch.0.0 to Ch.365
- Construction of c.185m of overground flood defences from Ch.0.40 to Ch.210 consisting of:
  - c.170m of glass flood barrier on the river side of the road edge vehicular parapets on Rice Bridge roundabout and along the 3 roundabout arms (R680 Rice Bridge, R448 Terminus St. and R711 Dock Rd).
  - c.15m of demountable flood barriers on the R680 Rice Bridge for the section leading to the North Quays Strategic Development Zone.
- Remedial works to the existing quay wall from Ch.285 to Ch.360 by raising its height by 0.6m to 1.2m.
- Construction of a sheet pile flood defence wall from Ch.360 to Ch.1090:
  - From Ch.360 to Ch.900 the sheet pile wall will be installed within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the riverside sheet pile wall will be fitted with pre-cast concrete cladding material (“eco-seawall”).
  - From Ch.900 to Ch.1090, the sheet pile wall will be installed on land from the landside, 1m behind the existing quay wall.
  - The demolition of minor localised section of existing quay wall (max length of 3m) will be required in order to connect the in-river sheet piles with the landside sheet pile walls at Ch.900.
- Construction of c.20m of underground isolation structure at Ch.1090, consisting of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers (e.g. water filled inflatable flood barriers) should these be required to be implemented during a flood event.

Drainage works will be carried out for the entire extents of the proposed flood defence measures i.e., from Ch.0.0 to Ch.1090 as shown in Figure 4.7 to Figure 4.11 in EIAR Volume 3:

- Remedial measures to the existing drainage outfalls to the River Suir from Ch.0.0 to Ch.1090 by extending them to reach an outlet within the new sheet pile wall, or to be retrofitted to pass through the new sheet pile wall, into the River Suir.
- In the vicinity of Plunkett Station, from Ch.0.0 to Ch.470, new trackside drainage and groundwater drains are included in the upgraded drainage works, which will include a

pumping station (at approx. Ch.390) and a new surface water outfall structure in the River Suir at Ch.390.

- From Ch.370 to Ch.1090, new drainage system will be installed for trackside drainage with 2 No. new outfalls to the River Suir terminating at the front face of the proposed flood defence sheet pile wall (at Ch 550 and Ch.900). The works will also include the construction of pumping stations at Ch.390 and Ch.550 respectively.
- Existing surface water outfalls at Ch.470 and Ch.490 which extend into the riverbed will be demolished to allow installation of the new flood defence wall; these will be replaced by new surface water outfall structures in the River Suir.
- Demolition of the existing quay wall to approximately 800mm below the existing ground level and removal of handrails from Ch.360 to Ch.900. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station at Ch.380 (as shown in Figure 4.18 in EIAR Volume 3).
- All drainage outfalls (new and existing) will be fitted or retrofitted with non-return valves to prevent tidal water ingress.
- All ancillary works.

Description of the proposed development and surrounding area:

The proposed development is located within the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny along the north bank of the River Suir in Waterford City, Co. Waterford. The R680 Rice Memorial Bridge and the Waterford railway station, Plunkett Station are located at the easternmost extent of the site of proposed development, while the Iarnród Éireann (IÉ) rail corridor and the Sallypark industrial site bound the development to the north. The River Suir and the existing quay wall run along the south of the site.

The proposed development consists of flood defence measures for the protection of critical infrastructure including the existing Plunkett Train Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval. The design flood level of the proposed flood protection measures is +4.0m OD (metres above Ordnance Datum), with the top-of-the-wall flood protection measures of +4.30m OD.

An overview of the structural elements of the proposed development is provided from east to west below, and should be read in conjunction with Figures 4.1 to 4.11 in EIAR Volume 3.

Chainage	Proposed Works
Ch.0.0 to Ch.365	Construction of an impermeable trench
Ch.0.40 to Ch.210	Construction of overground flood defences at Rice Bridge Roundabout.
Ch.285 to Ch.360	Remediation of existing quay wall
Ch.360 to Ch.1090	Construction of sheet pile flood defence wall
Ch.0.0 to Ch.1090	Drainage works

Potential Incidents:

Potential incidents requiring emergency response procedures:

- Fuel and oil spills;
- Road traffic accidents involving chemical or biological spills;
- Rail accidents whilst carrying out landside sheet pile installations within the Waterford to Dublin rail corridor
- Earth slippages;
- Extreme rainfall events, causing swelling of the River Suir

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- Fires;
- Activities resulting in noise and vibration, air pollution, hazardous substances or impacts on water;
- Working within and in vicinity of River Suir
- Waste management; and,
- Discharge of effluent.

The Contractor will update the list of potential incidents based on their proposed construction methods and programme for the development of Flood Defences West and include, as a minimum, the following:

- The measures to be taken to reduce the risk potential;
- Procedures to be put in place to deal with the risk;
- Person responsible for dealing with incidents;
- Procedures for alerting key staff;
- Standby/rota systems;
- Clearly defined roles and responsibilities;
- Names of staff and contractors trained in incident response;
- The types and location of emergency response equipment available and appropriate personal protective equipment to be worn;
- A system of response coordination;
- Off-site support; and,
- Particular emergency service or persons to be notified in case of incident.

</td></tr>
<tr><td>Date and version of the plan:
April 2021</td><td colspan="2">Name or position of person responsible for compiling/approving the plan:
Barry Corrigan
Roughan & O’Donovan</td></tr>
<tr><td>Review Date:</td><td colspan="2">Date of next exercise:</td></tr>
<tr><td colspan="3">Objectives of the IRP:
To carry out the construction works in such a way as to avoid injury, health hazards or pollution incidents. However, should any such incident occur, procedures and measures will be implemented to contain, limit and mitigate the effects as far as reasonably practicable.</td></tr>
<tr><td colspan="3">List of external organisations consulted in the preparation of the IRP:
TBC by Contractor when preparing IRP</td></tr>
<tr><td colspan="3">Distribution of the IRP</td></tr>
<tr><th>Recipient</th><th>No. of copies</th><th>Version</th></tr>
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6.0 EXTERNAL CONTACTS

External Contacts		
Contact	**Office Hours**	**Out of Hours**
Waterford City Fire Station	(051) 849 982	(051) 849 982
Gardaí: Emergency	999 / 112	999 / 112

External Contacts		
Contact	**Office Hours**	**Out of Hours**
Gardaí: Waterford Divisional Headquarters Garda Station	(051) 305 300	(051) 305 300
University Hospital Waterford	(051) 848 000	(051) 848 000
EPA Regional Inspectorate Kilkenny	(056) 779 6700	-
Waterford City and County Council Emergency Planning Department	076 102020	0761 102020
ESB Networks	(021) 238 6555	1850 372 999
Bord Gáis	051 302 500 / 1850 20 50 50	1850 20 50 50
Waste Management Contractor	TBC	
Specialist Advice	TBC	
Specialist Clean up Contractor	TBC	
Waterford City and County Council	076 110 2020	0761 102020
Inland Fisheries Ireland		To be agreed with IFI
National Parks & Wildlife Service		To be agreed with NPWS

7.0 INTERNAL (CONTRACTORS) CONTACTS

Internal Contacts		
Contact	**Office Hours**	**Out of Hours**
Names and positions of staff authorised/trained to activate and coordinate the IRP	TBC	
Other Staff	TBC	
Managing Director	TBC	
Site Manager	TBC	
Health & Safety Manager	TBC	

8.0 CHEMICAL PRODUCT AND WASTE INVENTORY

Inventory of Chemical Products and Wastes						
Trade Name / Substance	**Solid / liquid / gas or powder**	**UN number**	**Maximum amount**	**Location marked on site plan**	**Type of containment**	**Relevant health and environmental problems**

Inventory of Chemical Products and Wastes						
Trade Name / Substance	**Solid / liquid / gas or powder**	**UN number**	**Maximum amount**	**Location marked on site plan**	**Type of containment**	**Relevant health and environmental problems**

9.0 POLLUTION PREVENTION EQUIPMENT INVENTORY

Inventory of Pollution Prevention Equipment (on- and off-site resources)			

10.0 DRAWINGS

Drawings of the proposed development are included in **Appendix A**.

Site Plan
Figure 4.1 - Location Plan

11.0 RESPONSE PLANNING

11.1 Incident Response Plan

The Contractor's Environmental Operating Plan (EOP) will include an Incident Response Plan, which will detail the controls to be adopted to manage the risk of pollution incidents and procedures to be followed in the event of any pollution incidents.

11.2 The Incident Response Plan will include the following, as appropriate:

- Reference to the Method Statements and Management Plans for other construction activities, insofar as they are relevant for the purposes of mitigating against health and safety and pollution incidents;
- Procedures to be adopted to contain, limit and mitigate any adverse effects, as far as reasonably practicable, in the event of a health and safety or pollution incident;
- Details of spill clean-up companies appropriate to deal with pollution incidents associated with the materials being used or stored on site.

- Procedures to be followed and appropriate information to be provided in the event of any incident, such as a spillage or release of a potentially hazardous material;
- Procedures for notifying appropriate emergency services, authorities, the Employer’s Representative and personnel on the construction site;
- Procedures for notifying relevant statutory bodies, environmental regulatory bodies, local authorities and local water and sewer providers of pollution incidents, where required;
- Maps showing the locations, together with address and contact details, of local emergency services facilities such as police stations, fire authorities, medical facilities and other relevant authorities; and,
- Contact details for the persons responsible on the construction site and within the Contractor’s organisation for pollution incident response.

11.3 Monitoring

The Contractor will investigate and provide reports on any health and safety or pollution incidents to the Employer’s Representative, including, as appropriate:

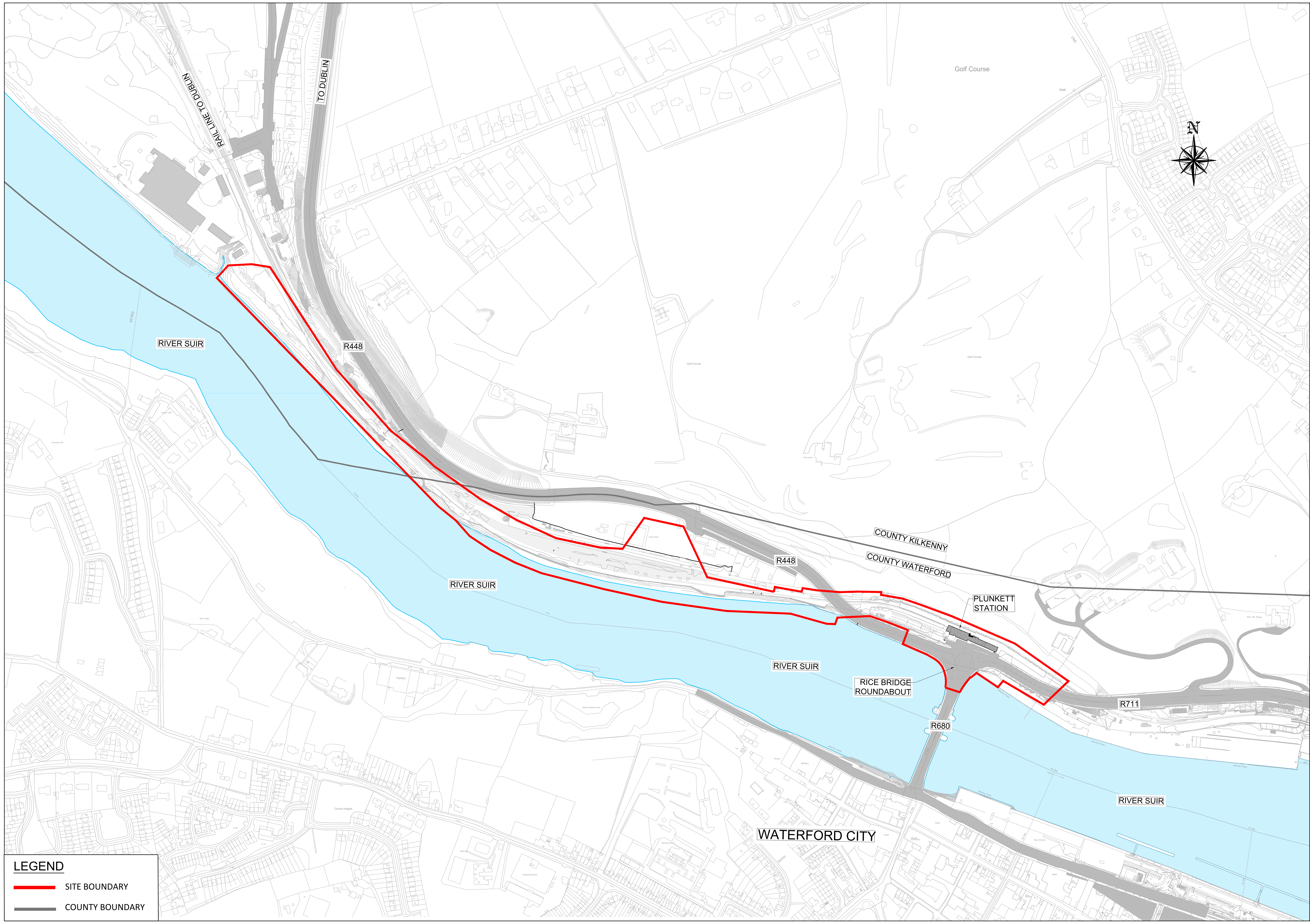
- A description of the incident;
- Contributory causes;
- Adverse effects;
- Measures implemented to mitigate adverse effects; and,
- Effectiveness of measures implemented to prevent pollution.

The Contractor will undertake appropriate monitoring of the procedures and measures set out in the management plans for construction activities required to prevent health and safety or pollution incidents to ensure they are being adequately implemented.

The Contractor will monitor the effectiveness of the procedures and measures implemented in the event of an incident and the effectiveness of the response procedures set out in the Incident Response Plan to identify any areas where improvement is required.

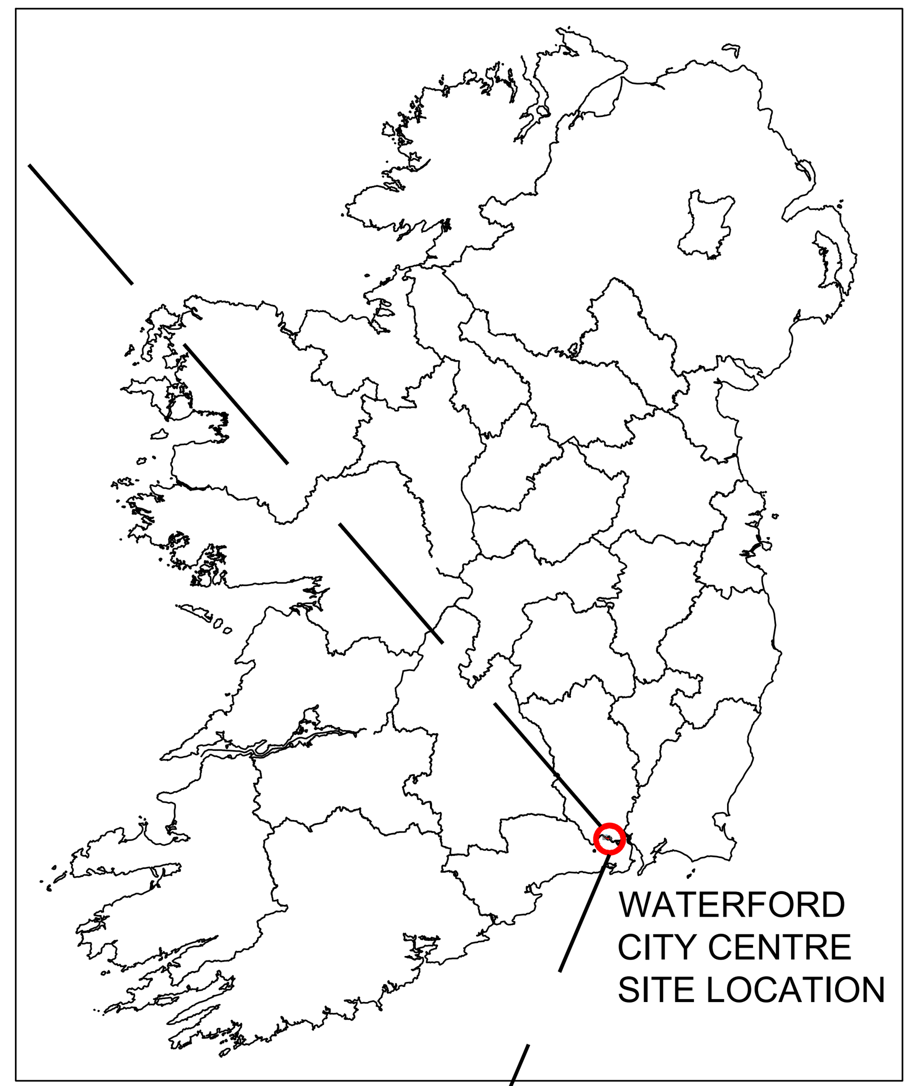
APPENDIX A

Figure 1



LOCATION PLAN

A1 SCALE 1:7000
A3 SCALE 1:3500



LOCATION MAP

N.T.S.

EIAR NOTE:

The design has been developed to a stage to permit a fully informed Environmental Impact Assessment to be carried out on the proposed development. Modifications may be made to avail of opportunities to improve the design at the detailed design stage in light of experience on the ground or other innovations, provided this has no significant adverse environmental impacts over and above those considered in the current Environmental Impact Assessment.

Project Ireland 2040 Building Ireland's Future

Comhairle Cathrach & Contae Phort Láirge Waterford City & County Council

NTA Údarás Náisiúnta Iompair National Transport Authority

Iarnród Éireann Irish Rail

ROD ROUGHAN & O'DONOVAN
Consulting Engineers
Civil - Structural - Transportation - Environmental

Arena House, Arena Road, Sandyford, Dublin 18, Ireland
t +353 (0) 1 294 0800
f +353 (0) 1 294 0820
www.rod.ie

Project Title: WATERFORD CITY PUBLIC INFRASTRUCTURE PROJECT FLOOD DEFENCES WEST

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Drawing Title: Location Plan of Proposed Development

Designed:	YB	File:		Status:	E.I.A.R.
Drawn:	IM	Job No:	18.141		
Checked:	BC	Scale:	AS SHOWN	Drawing No: FIG 1.1	Rev: -
Approved:	TD	Date:	OCTOBER 2021		

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

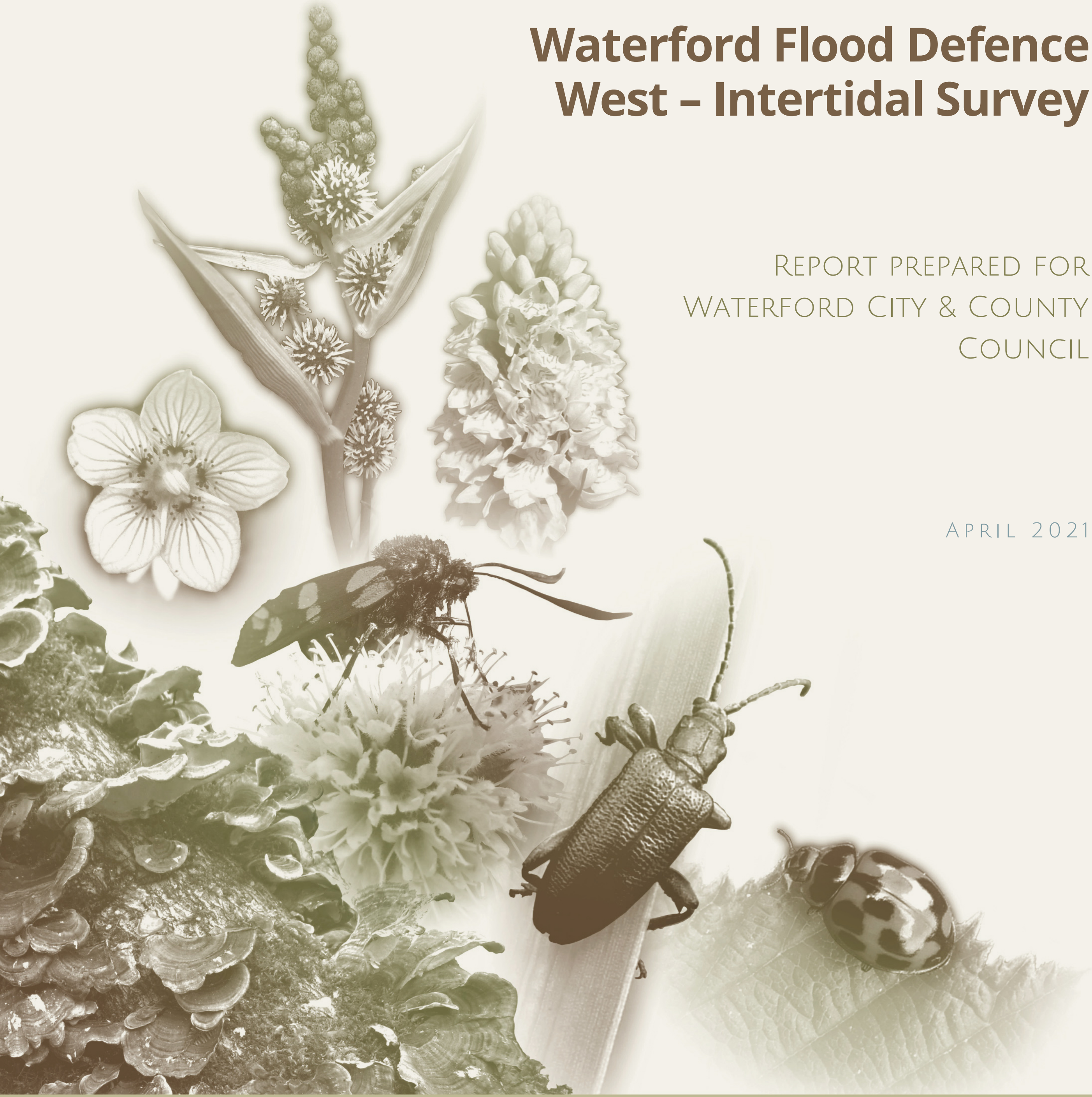
Appendix B
Intertidal Survey Report

CONSULTANTS

Waterford Flood Defence West – Intertidal Survey

Report prepared for Waterford City & County Council

April 2021



John T. Brophy

Waterford Flood Defence West – Intertidal Survey

April 2021

Botanical, Environmental & Conservation Consultants Ltd,
65 Holywell, Dundrum, Dublin 14, D14 P5W0.
Website: www.botanicalenvironmental.com
Email: info@botanicalenvironmental.com

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Author(s)	**Reviewed by**	**Approved by**	**Version**	**Issue date**
John T. Brophy B.A., M.Sc. MCIEEM, CEcol.	Simon Barron B.Sc., MCIEEM, CEnv.	James Martin B.Sc., Ph.D., MCIEEM	Draft	12/04/2021
JB	SB	JM	Final	12/04/2021

Table of Contents

1 Introduction

BEC Consultants Ltd was contracted by Roughan & O'Donovan on behalf of Waterford City & County Council to carry out an intertidal survey in relation to the Waterford Flood Defence West project.

2 Project description

The proposed development aims to develop flood defence measures for the protection of critical infrastructure including the existing Plunkett Train Station, the railway line east and west of Plunkett Station and the future SDZ Transportation Hub which will provide a connection to the North Quays SDZ site via the railway line. The project will involve the installation of sheet piles approximately 1 m in front of the existing quay wall along much of the study area, and the gap backfilled.

3 Study area

The study area was the northern bank of the River Suir estuary upstream of Rice Bridge, Waterford City, Co. Waterford. The survey area is within the Lower River Suir Special Area of Conservation (SAC) (Site code: 002137) (Figure 1).

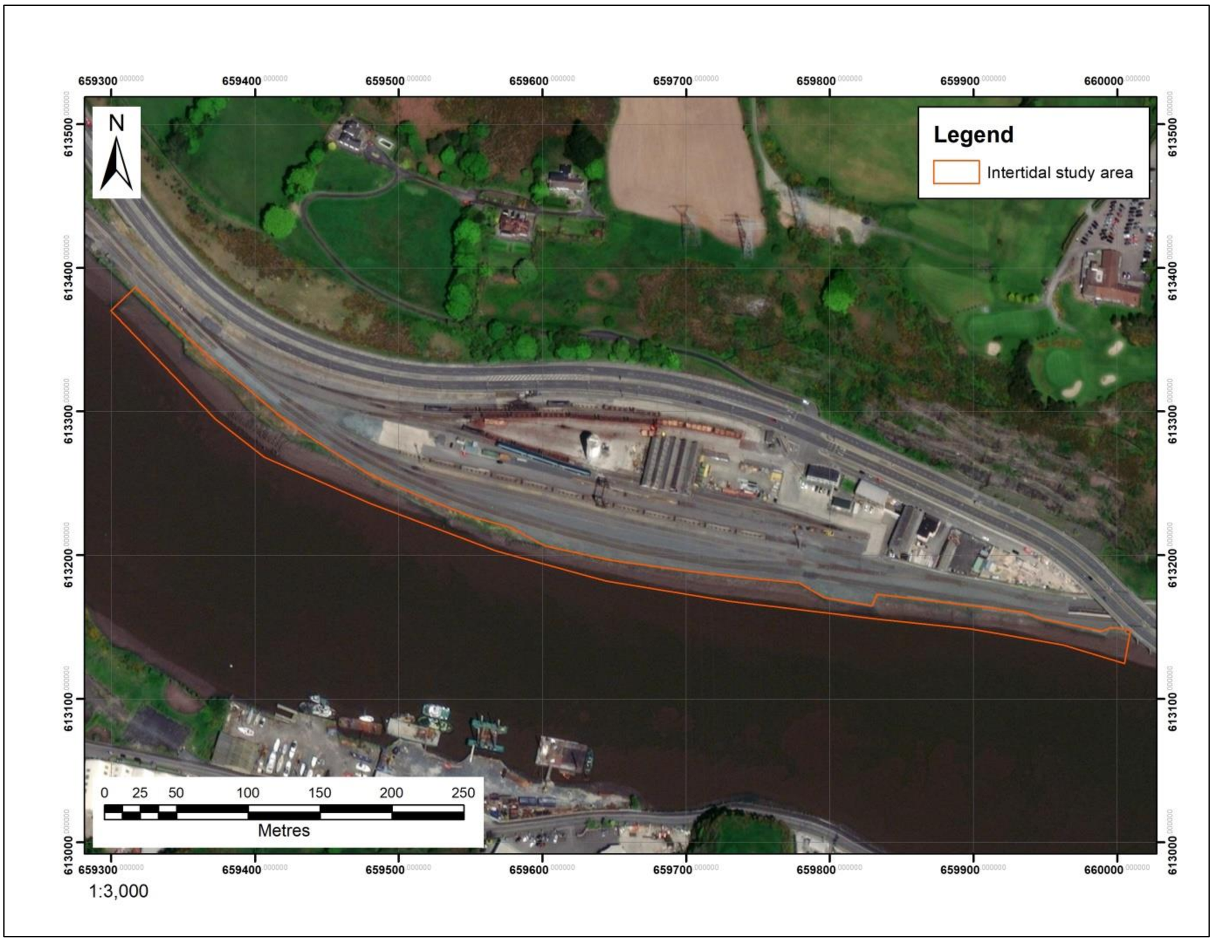

Figure 1. Waterford Flood Defence West intertidal survey study area within the River Suir Estuary

3.1 Lower River Suir SAC

The Lower River Suir SAC is one of the Natura 2000 sites designated to fulfil Ireland's obligations under the Habitats Directive (92/43/EEC) which is transposed into Irish legislation by the European

Communities (Birds and Natural Habitats) Regulations, 2011 (S.I. 477/2011). The site is designated for a number of terrestrial, freshwater and coastal habitats and species, which are listed in Table 1.

Table 1. Qualifying interests of the Lower River Suir SAC (NPWS, 2017)

EU habitat/species	**EU code**
Margaritifera margaritifera (Freshwater Pearl Mussel)	1029
Austropotamobius pallipes (White-clawed Crayfish)	1092
Petromyzon marinus (Sea Lamprey)	1095
Lampetra planeri (Brook Lamprey)	1096
Lampetra fluviatilis (River Lamprey)	1099
Alosa fallax fallax (Twaite Shad)	1103
Salmo salar (Salmon)	1106
Atlantic salt meadows (Glauco-Puccinellietalia maritimae)	1330
Lutra lutra (Otter)	1355
Mediterranean salt meadows (Juncetalia maritimi)	1410
Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	3260
Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels	6430
Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles	91A0
Taxus baccata woods of the British Isles	91J0
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae)	91E0

4 Methodology

An intertidal field survey was carried out on 15th March 2021 during low water spring tides by John Brophy and Simon Barron of BEC Consultants Ltd.

4.1 Intertidal mudflat survey

Intertidal core samples were taken in soft sediment using a 0.01 m^2 core to a depth of 25 cm at five locations. The methodology for the survey generally followed that of the Marine Monitoring Handbook (Davies *et al*., 2001). Sample stations were chosen to provide a spread of sites from the along the length of the project area across the upper and lower shore (Figure 2).

Three replicate cores were taken at each sample station. Each replicate was sieved through a 1 mm sieve and the residue retained for macroinvertebrate analysis. The samples were preserved in 70% industrial methylated spirits and placed in containers labelled inside and out, before being returned to the laboratory for sorting, identification and enumeration. One small core to a depth of 10 cm was taken for sediment analysis, placed in a labelled container and stored in a cooler box before being returned to the laboratory where the samples were frozen prior to analysis for Particle Size Analysis (PSA) and Total Organic Carbon (TOC).

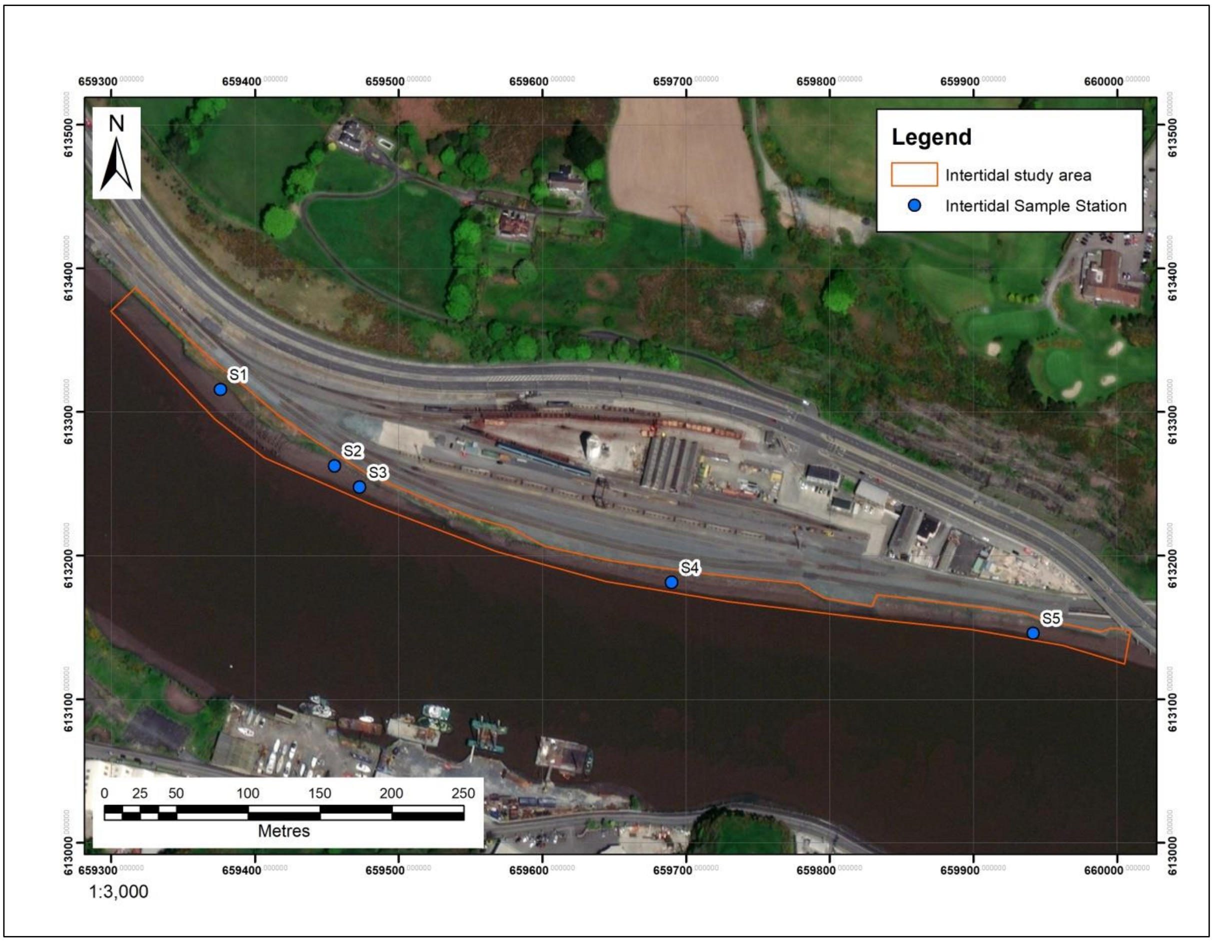

Figure 2. Map showing location of intertidal sample stations within the Waterford Flood Defence West study area.

The following data was recorded on standard field sheets at each sample station:

- Location
- Surveyors
- Sampler type
- Weather
- Date
- Time
- Station
- Irish Grid Reference
- Exposure
- Sieve size (mm)
- Core depth (cm)
- Sediment description
- Photo reference numbers

The mudflat biotope was assigned based on the fauna and sediment type recorded following the JNCC Marine Habitat Classification for Britain and Ireland (Connor *et al*., 2004).

4.2 Intertidal hard substratum survey

Intertidal hard substrata biotopes were recorded during a walkover survey following the JNCC Marine Habitat Classification for Britain and Ireland (Connor *et al*., 2004). The biotopes were mapped in the field onto recent satellite imagery and digitised using ArcGIS 10.0 on return to the office. A handheld GPS was used to locate features and record target note locations. Photographs were taken to provide a visual record of the existing habitats.

4.3 Saltmarsh survey

The survey area was walked and any areas conforming to Annex I saltmarsh habitat were mapped in the field onto recent satellite imagery and digitised using ArcGIS 10.0 on return to the office. A handheld GPS was used to locate features and record target note locations. Photographs were taken to provide a visual record of the existing habitats.

4.4 Macroinvertebrate analysis

Samples were sorted in a white tray, with macroinvertebrates being transferred to labelled containers and preserved with 70% IMS prior to identification. The species list was checked against the Pan-European Species directory Infrastructure (PESI, 2021).

Identification was carried out using stereoscopic and compound microscopes and appropriate keys.

4.5 Sediment sample analysis

Sediment analysis for PSA and TOC (by Loss on Ignition (LOI)) was carried out by Nautilus, Dublin.

5 Existing environment

5.1 Intertidal Mudflats

The intertidal mud of the study area is all classified as '*Tubificoides benedii* and other oligochaetes in littoral mud' (LS.LMu.UEst.Tben) under the JNCC Marine Biotope Classification (Appendix I, Figure A1-A3). This biotope is species-poor and found in upper estuarine locations where the salinity is reduced, with wave exposure ranging from sheltered to extremely sheltered (Connor *et al*., 2004). The substratum is one of fine sandy mud, and extends from the lower shore to the upper shore (Connor *et al*., 2004). Within the study area, the nature of the mudflat in the upper shore differed from lower down. The upper shore along much of the length comprised firm, anoxic mud, with rubble and debris dumped onto it from the land side, with quite a steep profile (Appendix II, Plate 1). Burrows were visible in this upper shore mud surface and Horned Wrack (*Fucus ceranoides*) was growing on rocks scattered along the shore. The lower shore was one of soft mud, with the anoxic layer often deeper than the 25 cm reached by the core and a flatter profile (Appendix II, Plate 2 & 3).

In the current survey, only four species were recorded across the five sampling locations (Appendix III, Table A1). The oligochaete worm *Baltidrilus costatus* was recorded at the uppermost sample station S1, which was located on the upper shore. The true fly (Diptera) larva of the Family Dolichopodidae was found at sample station S2, forming burrows in the upper shore. A single mayfly *Baetis rhodani* was recorded at sample station S3; this must have washed down from upstream as there is no suitable habitat present in the estuary for this species. Similarly, a larva of the water beetle *Esolus parallelepipedus* recorded at S5 must also have been washed down, as, again, no suitable habitat for this species is present within the estuary. No fauna were recorded from sample station S4. Sample station environmental data are presented in Appendix III, Table A2.

The granulometric analysis classified all stations as ‘Sandy Mud’, with the mud content ranging from 59.6% (S3) to 79.3% (S1) (Appendix III, Table A3). Total Organic Carbon ranged from 7.37% (S2) to 8.20% (S5) (Appendix III, Table A4).

5.2 Intertidal hard substrata

The hard substrata biotopes of the study area were limited to artificial surfaces in the form of the historical retaining wall separating the estuary from the rail line. The biotopes here were typical of the sheltered location in a reduced salinity environment on an artificial substratum. The eastern end of the study area showed the most developed zonation of intertidal hard substratum biotopes. From bottom to top, this area included a band of ‘*Ascophyllum nodosum* and *Fucus vesiculosus* on variable salinity mid eulittoral rock’ (LR.LLR.FVS.AscVS) up to 1.5 m wide (Appendix II. Plate 4), ‘*Fucus ceranoides* on reduced salinity eulittoral rock’ (LR.LLR.FVS.Fcer) approximately 30cm wide (Appendix II, Plate 5), sparse and intermittent ‘*Enteromorpha* spp. on freshwater-influenced and/or unstable upper eulittoral rock’ (LR.FLR.Eph.Ent) (Appendix II, Plate 5) and ‘Yellow and grey lichens on supralittoral rock’ (LR.FLR.Lic.YG) (Appendix II, Plate 5), which is similarly sparse and intermittent. Heading west, the LR.LLR.FVS.AscVS zone rapidly disappears, as the upper mud shore covers its potential substratum along the base of the retaining wall, leaving only the upper three biotopes. There is often a strip of bare stone between the LR.LLR.FVS.Fcer and the LR.FLR.Eph.Ent above it.

The barnacle *Austrominius modestus* was recorded on some of the wooden posts found emerging from the mudflat (Appendix II, Plate 6) and occasionally on rocks on the mud.

5.3 Saltmarsh habitat

A small area (approximately 100m^2) of saltmarsh habitat was recorded within the study area (Appendix I, Figure A1-A2. Appendix II, Plate 7). This saltmarsh formed in the shelter provided by an outward projection of the retaining wall. The saltmarsh was mainly lower saltmarsh, dominated by Common Saltmarsh-grass (*Puccinellia maritima*), with Sea Plantain (*Plantago maritima*), with the strip closest to the sea wall dominated by Creeping Bent (*Agrostis stolonifera*), making it more of an upper fringe saltmarsh. There were dead stems of what was most likely last year’s Sea Aster (*Aster tripolium*) present in both zones. Flood debris in the form of Common Reed (*Phragmites australis*) covered much of the saltmarsh. There was no *Spartina* spp. present.

Based on the species present, the area corresponds to the Annex I habitat Atlantic salt meadows (1330), which is a qualifying interest for the Lower River Suir SAC.

The remaining grassy areas within the study area, including along the area of collapsed retaining wall, were dominated by Couch Grass (*Elytrigia repens*), with occasional Butterfly-bush (*Buddleja davidii*), Gorse (*Ulex europaeus*) and Bramble (*Rubus fruticosus* agg.) (Appendix II, Plate 8).

6 Discussion

The biotopes and species of the study area are typical of upper estuarine areas around Ireland, and are indicative of a variable salinity environment, with a strong freshwater influence. The low species richness is the result of the challenges relating to life in the upper estuary, with salinity varying with tidal cycle and river flow conditions. The two infaunal species that were found to be living within the mudflat biotope of the study area (*Baltidrilus costatus* and Family Dolichopodidae), were found in the upper shore, where conditions are more stable. The remaining fauna recorded were single specimens washed down from true freshwater habitat upstream.

The more stable and firm sandy mud of the upper shore had been impacted by deposited waste in the form of stone and metal, scattered along the shore. The anoxic layer of the upper shore was very close to the surface, due to its stable nature preventing oxygen penetration. This contrasted with the soft sandy mud of the lower shore, where the anoxic layer began much deeper. This is likely due to the water currents stirring up the mud and the fact that it is covered by water for more of the tidal cycle.

The hard substratum biotopes found within the study area are common around the Irish coast, particularly in sheltered areas with a strong freshwater influence, where there is rock available for colonisation. They are also low in species richness.

A notable presence within the study area is the patch of Annex I saltmarsh habitat Atlantic salt meadows (1330). While this area is small in size (approximately 100m^2), the habitat is a qualifying interest for the Lower River Suir SAC. The establishment of this area of saltmarsh was facilitated by an outward turn in the existing retaining wall, which provided shelter from the river current. Due to its small size, the full development of saltmarsh zonation could not be achieved, and so it consists of a Creeping Bent-dominated upper saltmarsh community on the landward side of a Common Saltmarsh-grass-dominated lower saltmarsh community.

Brophy *et al.* (2019) recorded 19.34 hectares of Atlantic salt meadows within the Lower River Suir SAC. Based on this figure, the area of Atlantic salt meadows within the study area is 0.05% of the total area of the habitat within the SAC.

In summary, the study area has low species richness and contains biotopes common in upper estuarine areas around Ireland, which are indicative of a variable salinity environment, with a strong freshwater influence. The most notable feature is the small area of Annex I Atlantic salt meadow habitat along the retaining wall; a habitat that is a qualifying interest for the Lower River Suir SAC.

7 References

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Davies, J., Baxter, J., Bradley, M., Connor, D., Khan, J., Murray, E., Sanderson, W., Turnbull, C. and Vincent, M. (2001) Marine Monitoring Handbook. Joint Nature Conservation Committee, Peterborough, UK. http://archive.jncc.gov.uk/default.aspx?page=2430

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Appendix I – Map

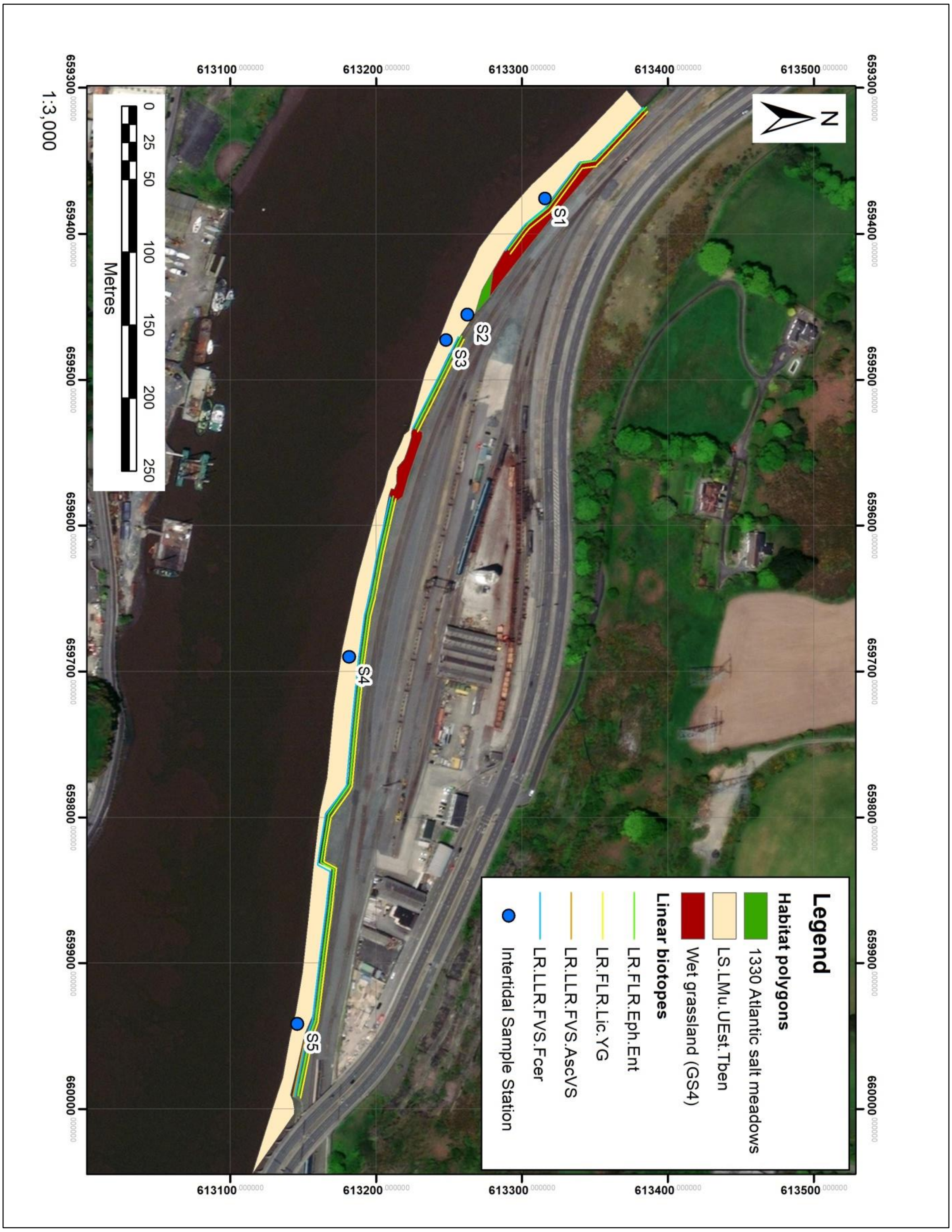

Figure A1 Overview biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

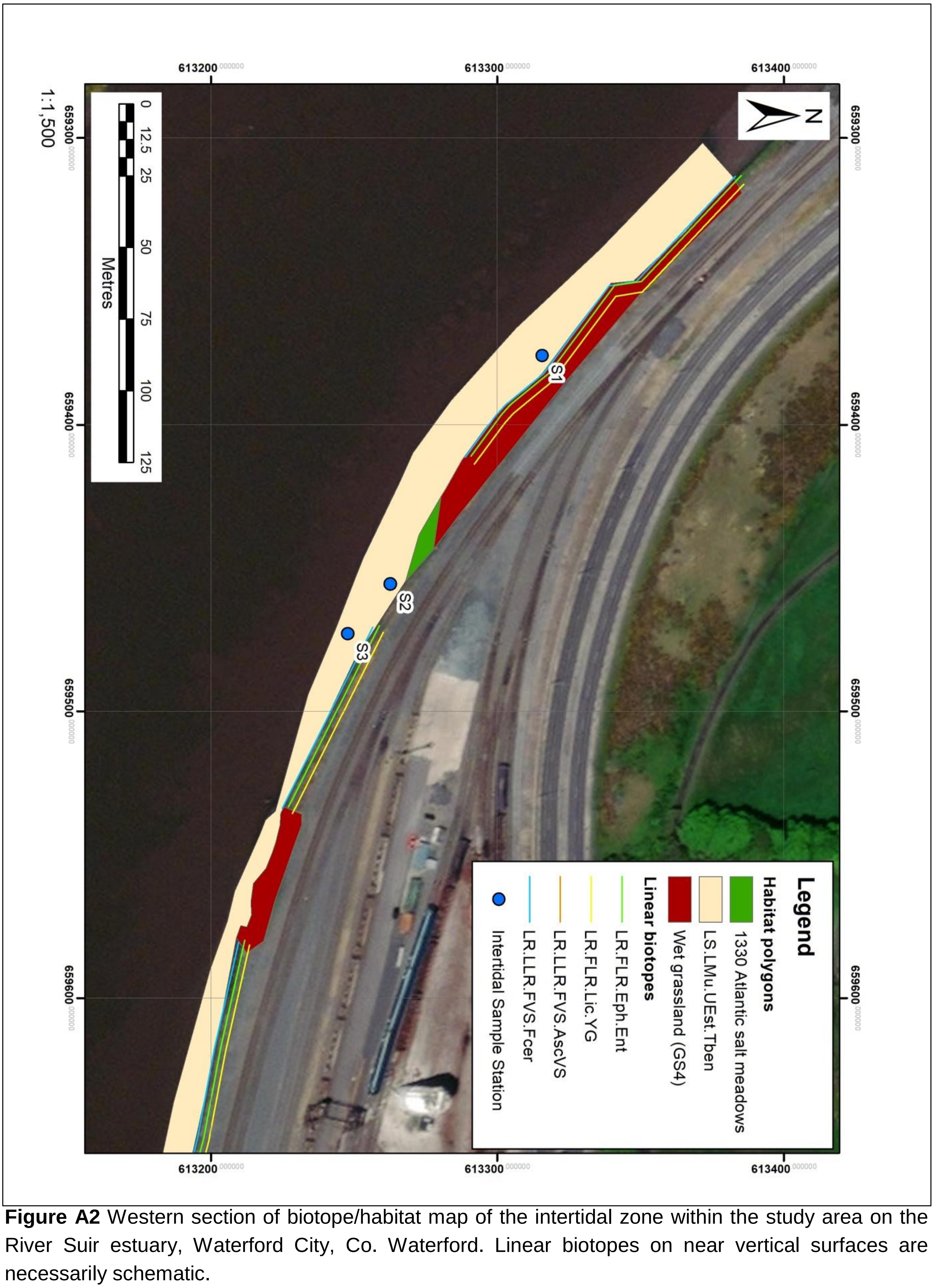

Figure A2 Western section of biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

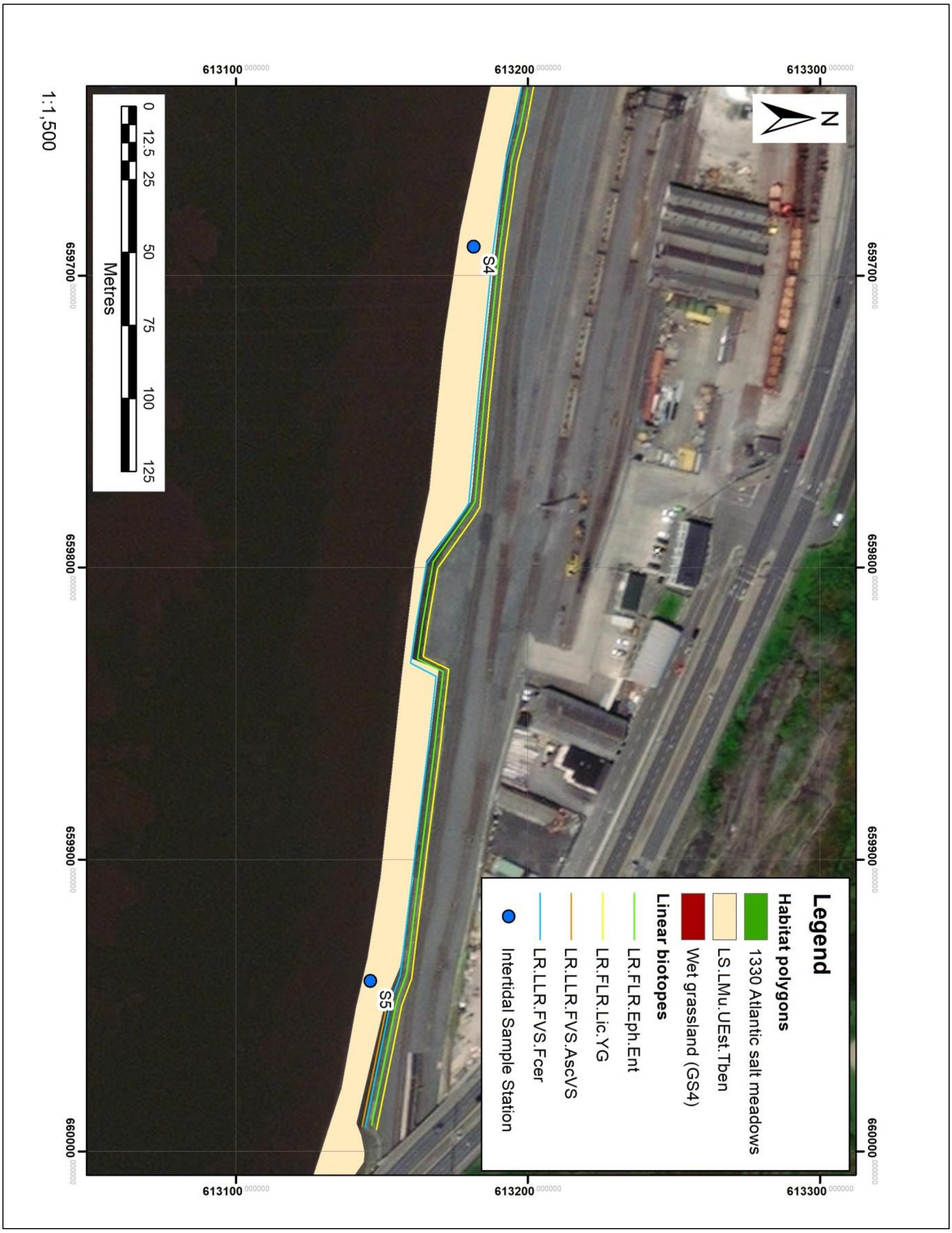

Figure A3 Eastern section of biotope/habitat map of the intertidal zone within the study area on the River Suir estuary, Waterford City, Co. Waterford. Linear biotopes on near vertical surfaces are necessarily schematic.

Appendix II – Plate

Plate 1.Upper shore of firm mud and rubble/ stone

Plate 2. Lower shore with soft mud

Plate 3. Soft mud surface at S5

Plate 4. The biotope LR.LLR.FVS.AscVS on the retaining wall at the southern end of the study area

Plate 5.The biotopes LR.LLR.FVS.Fcer, LR.FLR.Eph.Ent and LR.FLR.Lic.YG on the retaining wall

Plate 6. The barnacle *Austrominius modestus* on a wooden post, with *Fucus ceranoides*

	
Plate 7. Area of 1330 Atlantic salt meadows	**Plate 8**. Grassland areas above retaining wall alongside railway

Appendix III – Tables

Table A1. Results of intertidal core survey carried out in the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	S1			S2			S3			S4			S5			Total
Replicate	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	
ANNELIDA																
Oligochaeta																
Baltidrilus costatus	3	30	5	-	-	-	-	-	-	-	-	-	-	-	-	**38**
INSECTA																
Ephemeroptera																
Baetis rhodani	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	**1**
Diptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Dolichopodidae	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	**1**
Coleoptera	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0**
Esolus parallelepipedus (larva)	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	**1**
Total individuals	**3**	**30**	**5**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**41**
Total species	1	1	1	1	0	0	1	0	0	0	0	0	0	1	0	**4**

Table A2. Environmental data collected at sample stations on the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	Time	Sampler type	Core depth (cm)	Sieve size (mm)	Weather	ITM_X	ITM_Y	Exposure	Sediment description*
S1	15:52	Sediment core	25	1	Dry, bright	659328	613355	Sheltered	SM, 3, 5, 1, n/a, 5 burrows (upper shore)
S2	15:15	Sediment core	25	1	Dry, bright	659456	613263	Sheltered	SM, 5, 5, 1, n/a, 5 burrow (upper shore)
S3	14:52	Sediment core	25	1	Dry, bright	659473	613253	Sheltered	SM, 3, 4, 4, n/a, 3. No casts
S4	13:47	Sediment core	25	1	Dry, bright	659690	613189	Sheltered	SM, 3, 4, 4, n/a, 3 No casts
S5	13:03	Sediment core	25	1	Dry, bright	659941	613155	Sheltered	SM, 4, 4, 4, n/a, 1 No casts

*Sediment Type: Mud(M), Sandy Mud (SM), Muddy Sandy (MS), Sand (S), Gravelly Sand (GS), Sandy Gravel (SG), Gravel (G).

*Site features: (1-5 scale): Surface relief (even-uneven), firmness (firm-soft), stability (stable-mobile), sorting (well-poor), black layer (1 = not visible, 2 = >20 cm, 3 = 5-20 cm, 4 = 1-5 cm, 5 = <1 cm)

Table A3. Results of particle size analysis carried out on samples from the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	% Coarse sand	% Medium sand	% Fine sand	% Very fine sand	% Mud
S1	0.0	0.1	0.4	20.1	79.3
S2	0.1	0.1	0.4	21.2	78.3
S3	0.0	0.1	1.7	38.6	59.6
S4	0.0	0.1	1.7	28.6	69.6
S5	0.0	0.1	1	25.0	73.8

Table A4. Results of Loss On Ignition analysis carried out on samples from the River Suir Estuary, Waterford City, Co. Waterford on 15/03/2021

Station	% Loss on Ignition
S1	7.83
S2	7.37
S3	7.41
S4	7.91
S5	8.20

CONSULTANTS

BEC Consultants Ltd.
65 Holywell, Dundrum,
Dublin 14, D14 P5W0

Email: info@botanicalenvironmental.com
Web: www.botanicalenvironmental.com

Appendix C
Hydraulic Modelling Report

Report No. HEL212204 v1.2

Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall

Prepared for

Roughan O'Donovan Consulting Engineers

April 2021

FINAL

Hydro Environmental Ltd
No. 4 Caiseal Riada,
Clarinbridge,
Co. Galway.
Tel / Fax: 091 796734
email: info@HydroE.ie

Hydraulic Modelling of the Flood Defences West Scheme River Suir Flood Wall

Job No.:	212204
Report No.:	HEL212204 v1.2
Prepared by:	Anthony Cawley BE, MEngSc, CEng MIEI
Date:	30th April 2021
Issue	**Final**

DISCLAIMER

This hydraulic modelling report has been prepared for Roughan O'Donovan Consulting Engineers as input to the Flood Defences West Scheme Project. Hydro Environmental Ltd. accept no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned.

Contents

1. INTRODUCTION

1.1 Background

Hydro Environmental Ltd., was commissioned by Roughan O'Donovan Consulting Engineers to carry out hydrodynamic modelling study of a proposed Flood Defence Wall a long a 730m Section of the north bank of the River Suir northwest of the Waterford Plunkett Rail Station. This hydrodynamic model study supports the Hydrology chapter of the Environmental Impact Assessment Report (EIAR) and the Natura Impact Statement (NIS). The purpose of this study is to predict the potential local change in flow velocities within the Suir Estuary and to assess the impact of the proposed flood wall on bed morphology as a result of changes to the hydrodynamic regime.

1.2 Description of Proposed development

The proposed development comprises c.1.1km of flood protection measures in the townlands of Mountmisery and Newrath in Co. Waterford, the townland of Newrath in Co. Kilkenny located along the north bank and within the foreshore of the River Suir in Waterford City. The development extends for approximately 1km to the west and 100m to the east of the Waterford (Plunkett) Station, following the alignment of the existing quay wall and the Iarnród Éireann (IÉ) railway corridor located to the north of the proposed development.

The proposed flood defence measures are for the protection of critical infrastructure including the existing Plunkett Station, the railway line east and west of Plunkett Station and the Rice Bridge roundabout. The proposed development will also form a continuation of the flood protection measures, Flood Defences East proposed along the North Quays Strategic Development Zone (SDZ) as part of the Transport Hub Part 8 planning approval, eliminating the risk of flooding to the Transport Hub.

A design flood level of +4.0m OD (metres above Ordnance Datum Malin) is proposed for this development. The design flood level has been based on a flood with an annual exceedance probability of 0.5% and allowances for climate change and isostatic tilt as noted below.

The design (top-of-wall) level for the proposed flood protection measures is +4.30m OD (metres above Ordnance Datum Malin). The following allowances are integrated into the proposed height of the flood defence walls:

- 0.5% annual exceedance probability combined tidal-fluvial event (+3.45 m OD)
- An additional 0.55m to allow for climate change and isostatic tilt; and,
- 0.30m freeboard to the wall, including local wave wake effects.

The proposed flood protection measures will consist of:

- Construction of c.365m of impermeable shallow underground trench (0.35m wide and up to 3m deep) within Iarnród Éireann's Plunkett Station car park.

- Total of c.185m of overground flood defence measures consisting of:
    - o c.170m of glass flood barriers (each parapet is approx. 1.5m in length and 0.7m in height) fitted on the river side of the road edge vehicular parapets on R680 Rice Bridge roundabout and along the 3 roundabout arms; R448 Terminus St., R711 Dock Rd., and R680 Rice Bridge.
    - o c.15m of demountable flood barriers on the R680 Rice Bridge (leading to the North Quays Strategic Development Zone);
- Remedial works to c.75m section of existing quay wall in front of the Plunkett Station car parking area by raising its height to between 0.6m and 1.2m to conform with the top-of-wall flood protection measures of +4.30m OD.
- Construction of c.730m of sheet pile flood defence wall with the top-of-the wall level at +4.30mOD consisting of:
    - o c.540m of sheet pile wall within the foreshore from the riverside, 1m from the front face of the existing quay wall. The space between the sheet pile wall and the front face of the existing quay wall will be filled with clean imported granular fill. The intertidal zone of the sheet pile wall within the foreshore will be fitted with pre-cast concrete cladding material (“eco-seawall”).
    - o c.190m of sheet pile wall will be installed on Iarnród Eireann land, 1m behind the existing quay wall. Construction of c.20m underground isolation structure comprising of a sheet pile cut-off wall and a concrete capping beam. The concrete capping beam will facilitate the installation of temporary overground flood barriers to the structure should these be required to be implemented during a flood event.
    - o Demolition of up to 3m of existing quay wall at transition point between the landside and riverside sheet pile wall.
- Drainage works will consist of:
    - o Remedial works to the existing drainage outfalls to the River Suir by extending them to reach an outlet within the new sheet pile wall and/or be retrofitted to pass through the new sheet pile wall, and installation of non-return valves.
    - o Construction of new trackside drainage and groundwater drains to include 2 no. pumping stations and surface water outfalls to the River Suir.
    - o Demolition of c. 540m of existing quay wall south of the railway corridor to approximately 800mm below the existing ground level.
    - o Demolition of the existing quay wall to approximately 800mm below the existing ground level. The demolition of approx. 25m of the existing quay wall to a level of between 2 to 4m below existing ground level to facilitate the construction of a surface water pumping station.
- And all ancillary works.

The location of the proposed 730m length of sheet piled food defence wall upgrade located along the Suir channel bank within the North Quays area is presented here in Figure 1-1.

Figure 1-1 Location and Extent of the proposed Flood Defence Wall at the North Quays area

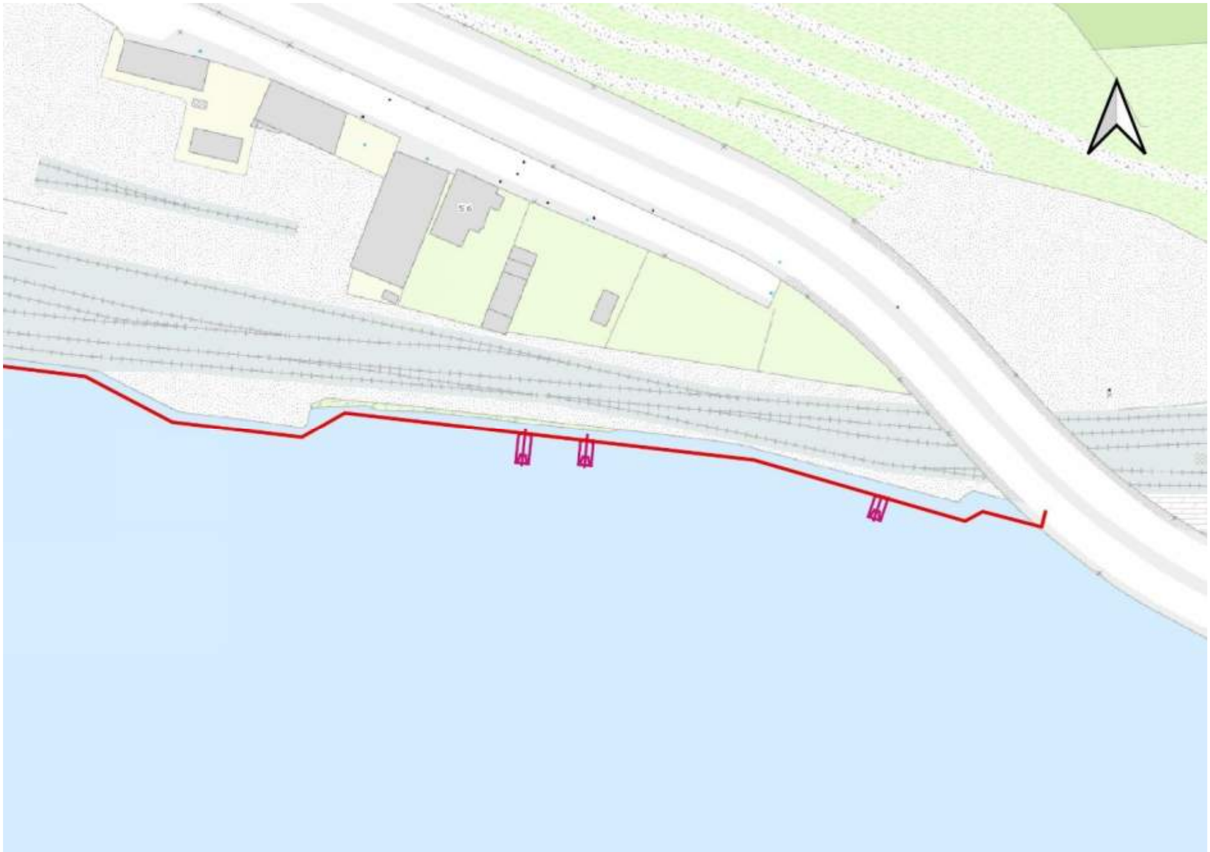

Figure 1-2 Location of storm drainage outfalls associated with the proposed Flood Defence Wall at the North Quays area

1.3 Existing Flood Defences on the North Quays

The existing flood protection measures along this section of north quays area consist of a quay wall along the banks of the River Suir. These existing flood protection measures are no longer effective in protecting the infrastructure on the North Quays from flood events. The existing quay wall is a masonry structure over most of its length built in the late 19th century and has been subject to numerous upgrades / repairs since including sections of mass concrete. Sections of this existing Quay Wall structure are damaged with structural cracks and damage to both foundations and wall and loss of masonry from the wall.

There has been a series of recent tidal flood events in the vicinity of Plunkett Station over the past two decades in which the estuary overtopped of sections of the existing flood wall at Ch 370, Ch 540, Ch 590 and between Ch. 900 and Ch.1050. The OPW CFRAM Flood inundation mapping of this area shows the lands behind the proposed floodwall to be inundated at both 200 (0.5% AEP) and 1000year (0.1% AEP) return period coastal flood events.

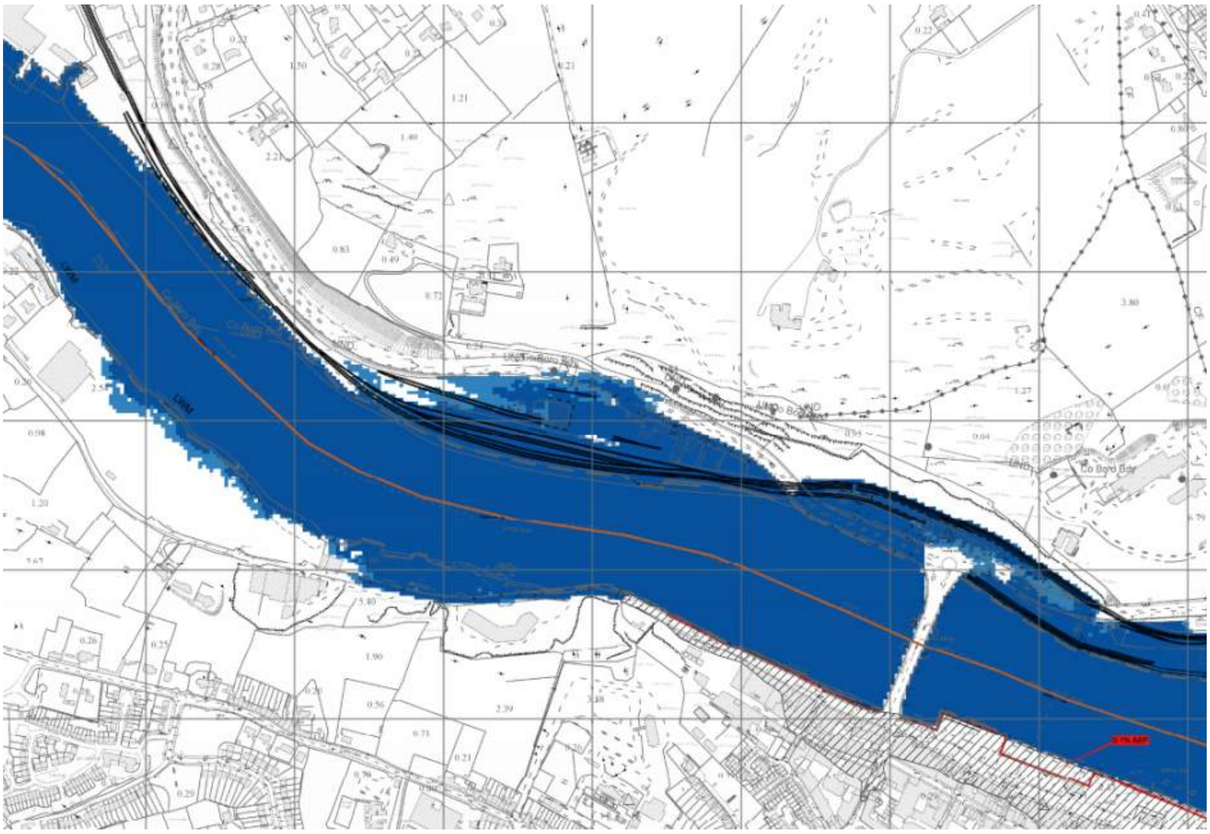

Figure 1-3 Extract from OPW River Suir CFRAM Map of 200year and 1000year coastal flooding

1.3 Sediment Sampling of channel bed

Aquafact Ltd. was commissioned to take a series of bed surface grab sediment samples for sediment distribution analysis across the width of the estuary channel and banks. They were unable to obtain any grab samples towards the middle of the River channel as no loose sediment was present with the bed sediment likely to be a compacted cohesive sandy Silt. The location where grab samples were obtained are shown in Figure 1-4 and the sediment distribution results are presented in Table 1.1.

The results show that where fresh unconsolidated sediment was captured it generally represented a silt and fine sand with little or no coarser sediments. It is likely given the generally high fines content that the sediment acts as a cohesive sediment that is consolidated over time and provides good resistance to erosion. With only the freshly laid silts mobile in the tidal flows.

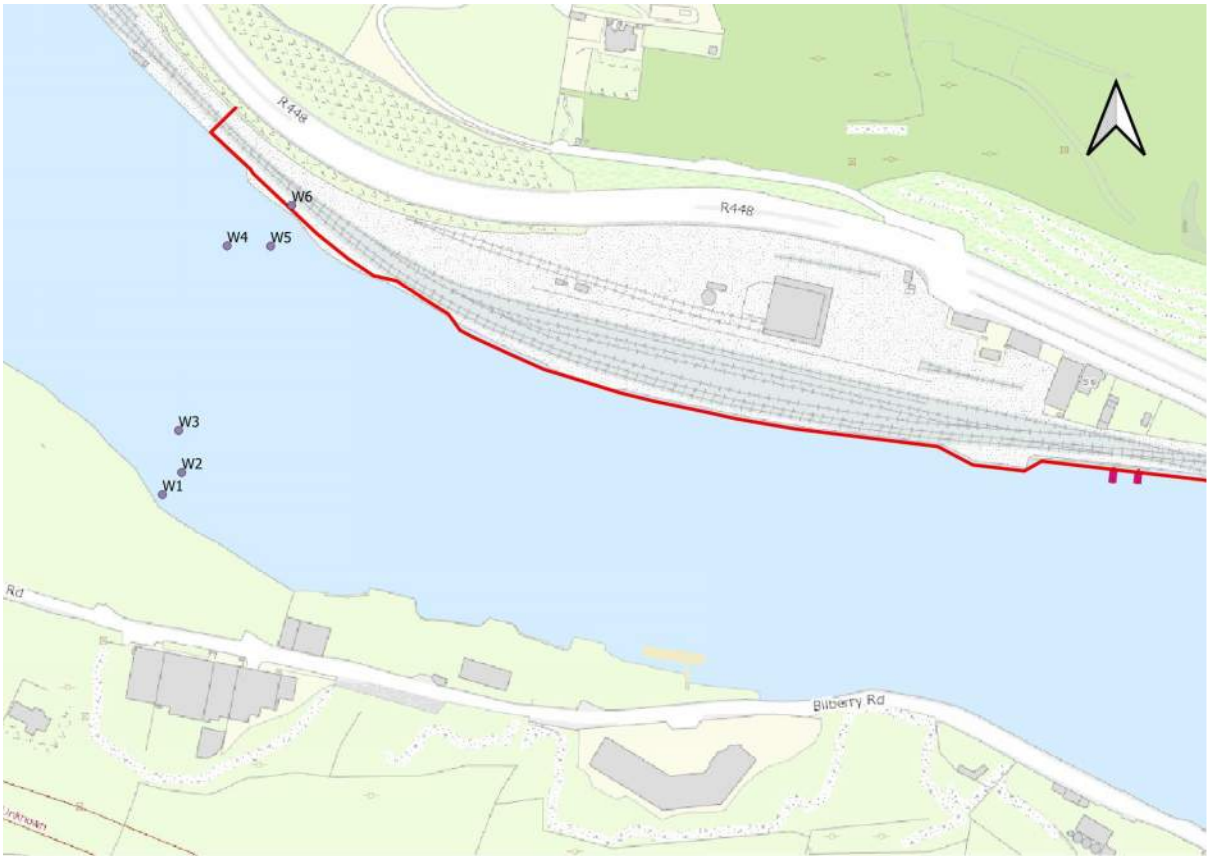

Figure 1-4 Bed Sediment sampling Locations

Table 1.1 Results from Sediment Sampling

Fraction Size (mm)	Description	W1 (%)	W2 (%)	W3 (%)	W4 (%)	W5 (%)	W6 (%)
< 0.063	Silt/clay	42.3	6.5	38.4	38.9	33.3	34.5
0.063 - 0.125	silt / v. fine Sand	30.6	40.9	32.6	36.5	34.6	38.2
0.125 - 0.250	fine Sand	7.9	27.7	9.5	8.9	14.4	8.7
0.250 - 0.500	medium sand	7.7	8.5	8	6.7	6.5	7.7
0.500 - 1.000	Coarse Sand	6.8	8.9	7.2	5.6	5.9	6.9
1.000 - 2.000	Very Coarse Sand	3.9	5.7	3.4	2.9	4	3.6
2.000 - 4.000	fine gravel	0.8	1.3	0.7	0.3	0.8	0.3
> 4.000	medium gravel	0.2	0.6	0.1	0.2	0.5	0.1

2. HYDRAULIC MODEL DESCRIPTION

2.1 General

In order to assess accurately the potential impact of the proposed 740m length of sheet piled flood wall on the hydrodynamics of the River Suir adjacent to the development a high resolution 2-D hydrodynamic model of the local reach was developed. Two-dimensional modelling was chosen in preference to 1-d modelling so as to evaluate spatially the tidal circulation and flood inundation of the estuary banks. To efficiently drive the high resolution 2-D model a 1D node-link river estuary model was developed, which extended from southern open sea upstream to the tidal extents on the Suir, Nore and Barrow Rivers, as presented in Figure 3. This enabled the large tidal flows generated within each of the estuaries to be computed under varying tides and fluvial inflow conditions and the relevant output from this model in terms of flow and water level hydrographs was specified as boundary conditions to drive the local 2-D model.

2.2 HEC-RAS 1-D model

A 1D river model using HEC-RAS hydraulic software system developed by the U.S. Army Corps of Engineers was used to model Waterford Harbour and its full estuarine reaches of the Suir, Barrow and Nore Rivers. HEC-RAS is the industry standard used internationally for hydraulic modelling of river and estuarine systems. HEC-RAS implements a 1-dimensional model of longitudinal channel flow (depth and width averaged) and solves for water elevation and average cross-sectional velocity under unsteady flows solving the full St. Venant equations that include the momentum and mass equations. HEC-RAS 1-D is ideal for modelling narrow elongated estuaries where the dominant flow is longitudinal with little variation in the energy slope in the transverse direction.

The unsteady model allows for tidal varying flow and elevation boundary conditions to be specified at the downstream Open Sea boundary and inflow hydrographs at the upstream fluvial boundaries. It also facilitates internal inflows at various nodes to allow for inclusion of lateral tributary inflows. The HEC-RAS model requires cross section survey data of bed and overbank levels versus Station distance from left overbank to right overbank and facilitates different channel roughness's and various structure types including bridges, culverts spillways and weirs.

2.3 TELEMAC Hydraulic Software System

The TELEMAC system is the software of choice for modelling the complicated hydrodynamics of the Suir Estuary at the bridge crossing, particularly given the very high computation refinement required to model the individual slender piles for the proposed bridge structure and the collision fender system. TELEMAC is a software system designed to study environmental processes in free surface transient flows. It is therefore applicable to seas and coastal domains, estuaries, rivers and lakes. Its main fields of application are in hydrodynamics, water quality, sedimentology and water waves.

TELEMAC is an integrated, user friendly software system for free surface waters. TELEMAC was originally developed by Laboratoire National d'Hydraulique of the French Electricity Board (EDF-LNHE), Paris. It is now under the directorship of a consortium of organisations including EDF-LNHE, HR Wallingford, SOGREAH, BAW and CETMEF. It is regarded as one of the leading software packages for free surface water hydraulic applications and with more than 1000 Telemac Installations Worldwide.

The TELEMAC system is a powerful integrated modelling tool for use in the field of free-surface flows. Having been used in the context of very many studies throughout the world (several thousand to date), it has become one of the major standards in its field. The various simulation modules use high-capacity algorithms based on the finite-element method. Space is discretised in the form of an unstructured grid of triangular elements, which means that it can be refined particularly in areas of special interest. This avoids the need for systematic use of embedded models, as is the case with the finite-difference method. Telemac-2D is a two-dimensional computational code describing the horizontal velocities, water depth and free surface over space and time. In addition it solves the transport of several tracers which can be grouped into two categories, active and passive, with salinity and temperature being the active tracers which alter density and thus the hydrodynamics.

The TELEMAC System is a set of finite element programs designed to solve free water surface problems. A series of modules are available for solution of hydrodynamics, transport and dispersion of pollutants, sediment transport and wave dynamics. These are:

- TELEMAC-2D: 2-dimensional depth averaged hydrodynamics and transport and dispersion of tracers

- TELEMAC-3D: 3-dimensional hydrodynamics, transport and dispersion and sediment movement

- TOMAWAC: A third generation spectral wave model representing the generation of waves due to winds or offshore climates and propagation into shallow waters.

- ARTEMIS: A harbor wave model that solves the mild slope equation in elliptical form and includes the processes of refraction by bed shoaling, wave breaking, diffraction and reflection of waves due to structures.

- SISYPHE: Sediment transport module solving bed and suspended load of cohesive and non-cohesive sediments and can be coupled with TELEMAC-2D, -3D and TOMAWAC for the hydrodynamic transport and bed shear stress calculations

Each TELEMAC Module uses a completely flexible unstructured mesh of triangular elements allowing it to efficiently model complex geometry problems such as harbours and estuaries.

2.4 Data Sources

A range of survey information was utilised in constructing the 1D and 2D models which are described below:

- OPW CFRAM river cross-section survey of the Suir, Nore and Barrow river channels
- Apex cross-sections River Survey of the Suir at Waterford
- Infomar Sea bed Survey of Waterford Harbour
- Admiralty Chart of Waterford Harbour
- Apex Topographical Survey of the SDZ site and adjacent lands
- 2m Lidar Survey of Waterford City
- High resolution bathymetric Survey of the river reach by Murphy Surveys in 2021.
- Bed sediment sampling by Aquafact at the bridge crossing
- ADCP (Acoustic Doppler Current Profiler) current metering over a 24day period at 1m vertical Bin depths by Aquafact.

2.5 1-D Model Development

River channel and overbanks were defined for approximately 115km of river reach along the main river/estuarine channels of the Suir, Nore and Barrow. The complete estuarine reaches which extend many kilometres upstream along the Suir, Barrow and Nore were included in the model so that the simulations accurately accounted for the large tidal exchange volume that generate significant ebbing and flooding flows at

Waterford Harbour. The model domain is presented in Figure 2-1 and the HEC-RAS model schematic in Figure 2-2.

The model domain extends from the open sea off Dunmore to 1km upstream of Carrick-On-Suir on the Suir, to 3km north of St. Mullin's Village on the River Barrow and to Inistoige on the Nore. A total of 249 river sections were included from the various surveys. Survey information was not available for a 19km upstream middle section of the Suir Estuary from Woodstown, Waterford to Piltown, southeast of Carrick-on-Suir. This unavailable (un-surveyed) reach was represented by simple liner interpolation between the nearest available upstream and downstream surveyed section so as to account for the tidal exchange volume.

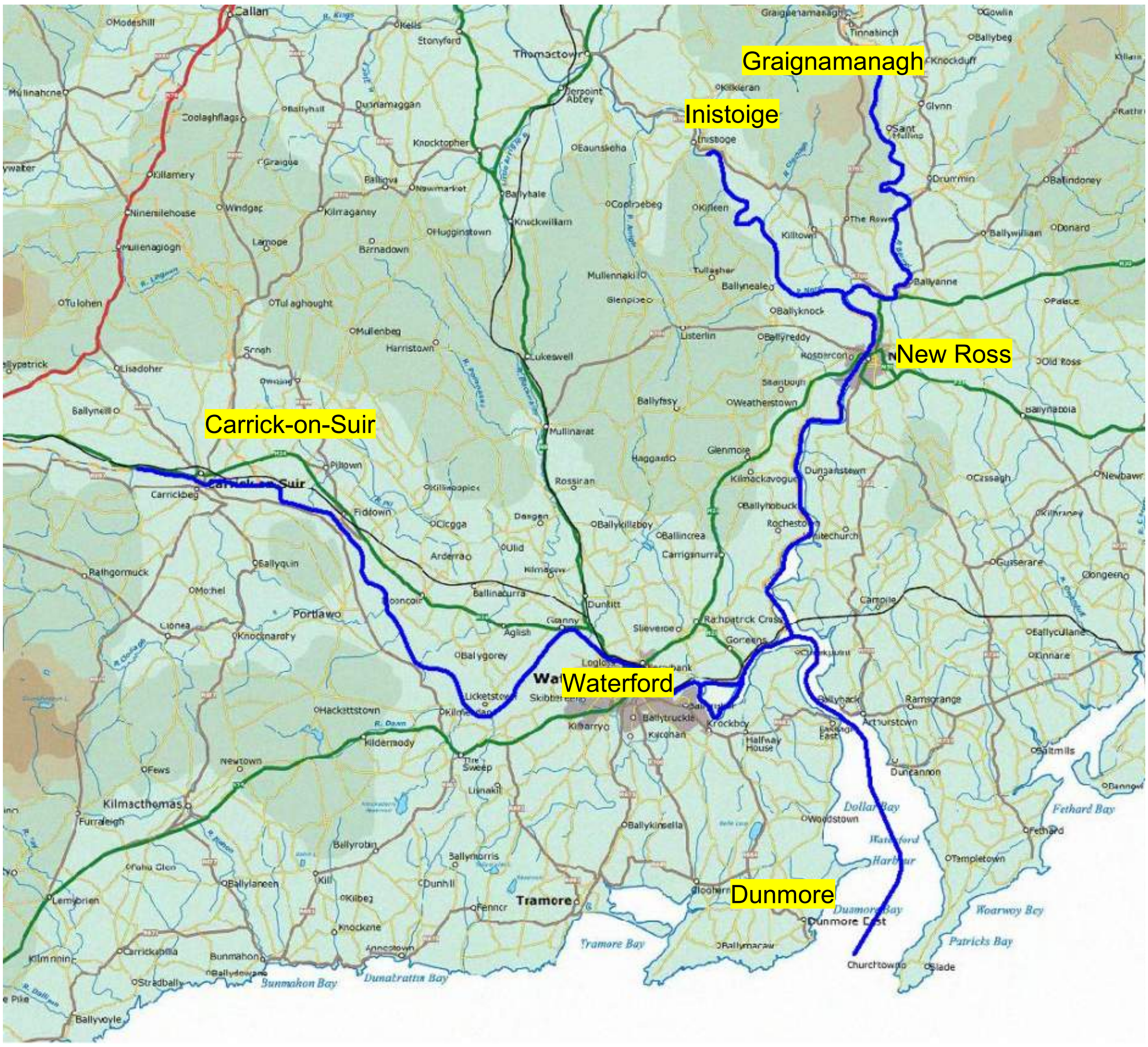

Figure 2-1 Extent of one-dimensional tidal model for the Waterford Flood Defences Project

A Manning's roughness coefficient (n) of 0.028 was used for the various estuarine reaches and a lower roughness coefficient of 0.024 for the wider and deeper Waterford Harbour reach. These roughness coefficients are considered to be appropriate for the wide deep estuarine reaches through Waterford. The HEC-RAS 1-D model set-up included the loop configuration around King's island in Waterford Harbour.

Figure 2-2 ***HEC-RAS Model Schematic***

2.6 2-D Model Development

The 2-D model domain area is presented in Figure 2-3 which represents the local estuarine reach at Waterford City, some 4km in length and 90ha in area. The existing model has a variable mesh set with a general mesh spacing of 10m remote from the flood wall reach section and a more refined mesh within the flood wall reach section of 5m and local refinement in the vicinity of the flood wall of 2m. The total number of computational nodes in the finite element model is 20,652 and 40,168 triangular finite elements. Tidal Flat wetting and drying option was included in the model to facilitate out of channel flow and the wetting and drying of the channel banks with the rising and falling of the tide. Computationally this can lead to some numerical oscillation in water surface elevation and computed flows in the vicinity of the drying element. The Mesh structure in the vicinity of the proposed flood wall is presented in Figure 2-7.

Figure 2-3 2-D Model Reach of Suir Estuary at Waterford City

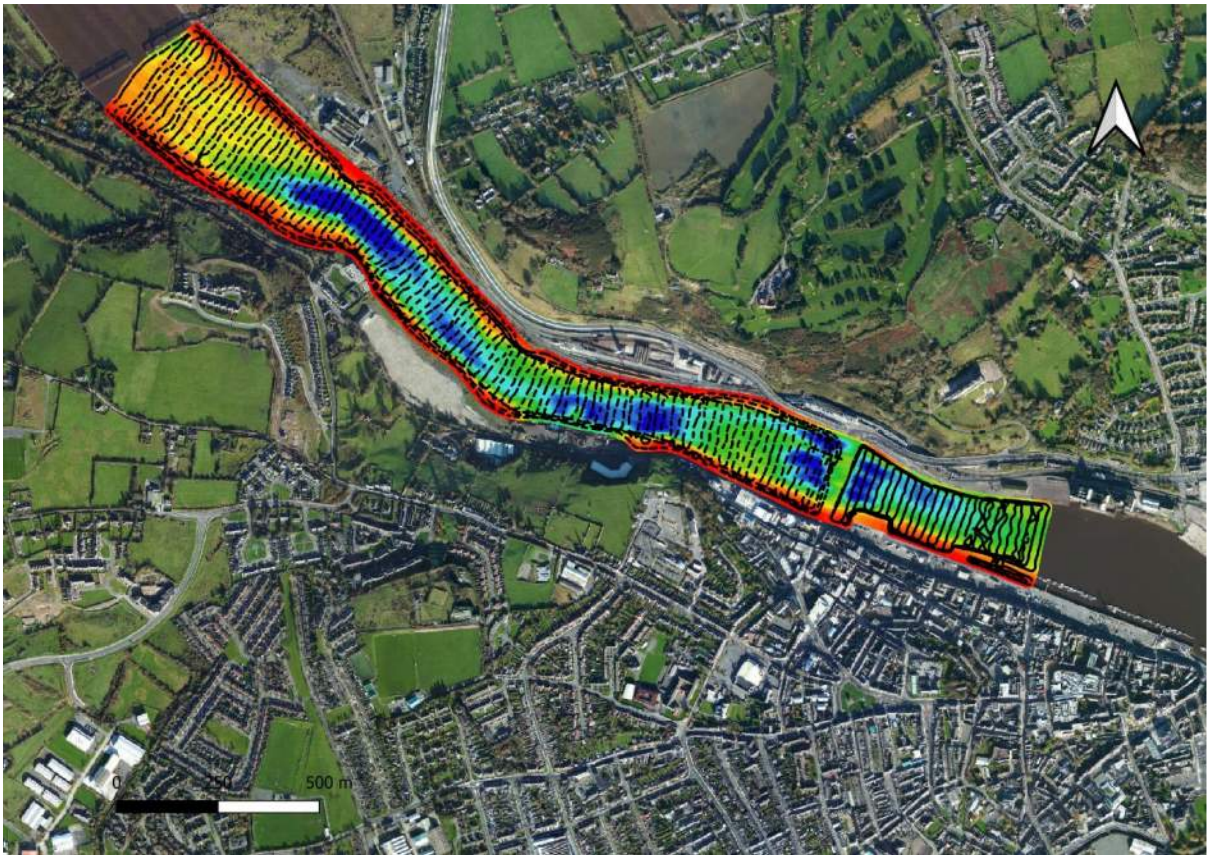

Figure 2-4 2-D Recent 2021 Murphy Survey's bathymetric coverage

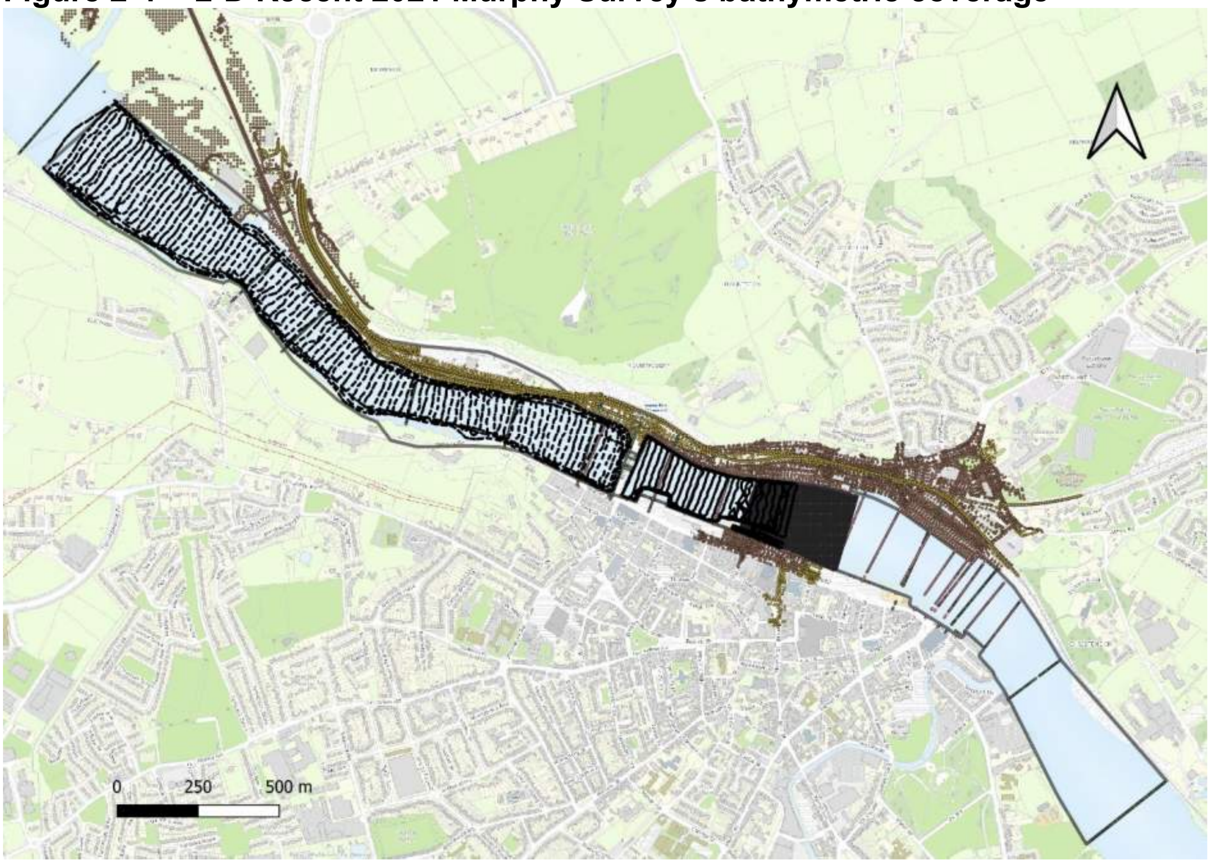

Figure 2-5 combined Bathymetric and topographic surveys including OPW CFRAM cross-section survey data (lidar data not included in figure)

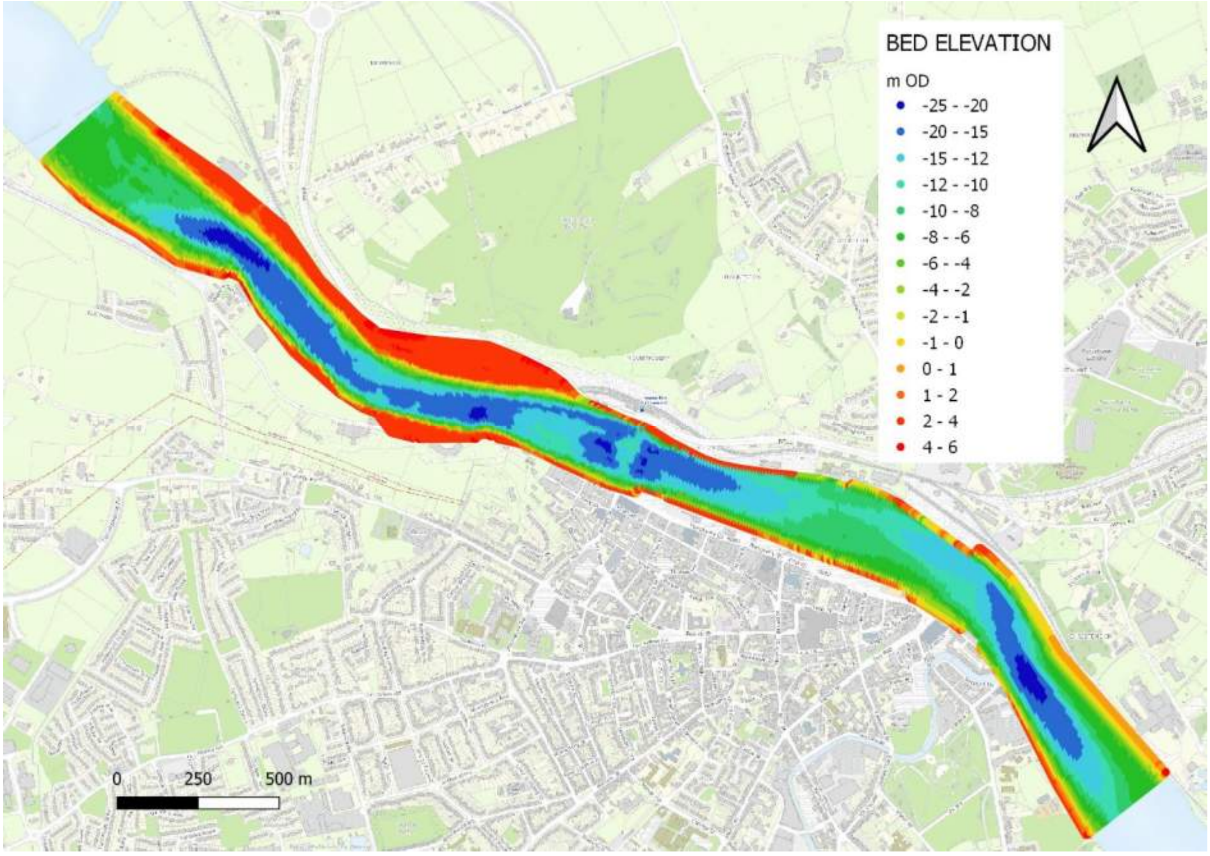

Figure 2-6 Modelled Bathymetry

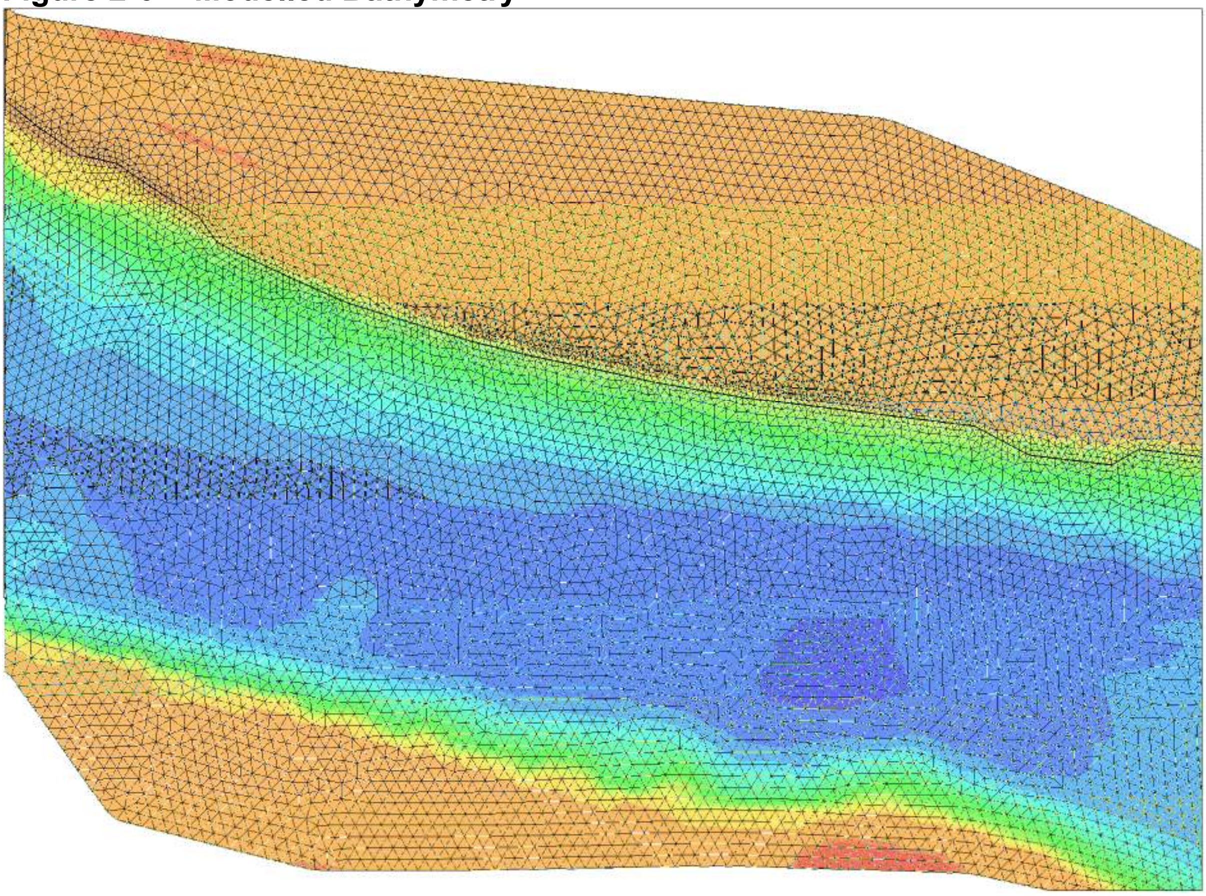

Figure 2-7 Finite Element Mesh for existing case in vicinity of the proposed Flood Wall alignment

2.7 Model Calibration

The hydrodynamic model was calibrated against the tidal velocity and elevation measurements obtained from a previous survey that was carried out in support of the hydrodynamic modelling for the Sustainable Transport Bridge planning application. This hydrographic survey was performed by Aquafact (2018) using an Acoustic Doppler Current meter for the period 25th June 2018 to 19th July 2018. The ADCP was deployed for 24 days near the proposed pedestrian bridge crossing section, located 42m out from the North Quay at National Grid Reference 260782, 112796 (refer to Figure 2-8).

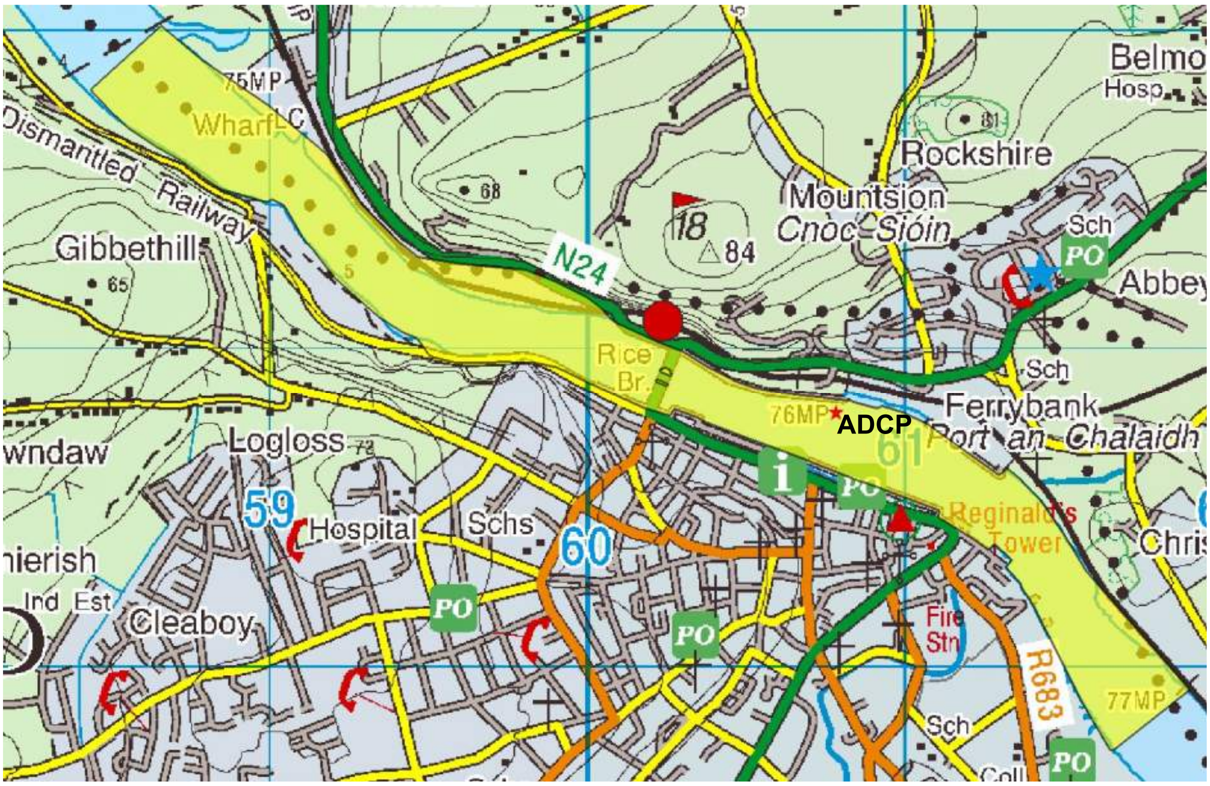

Figure 2-8 ***Location of ADCP current meter for model calibration.***

The tide elevation recorded at Dunmore East tidal gauge was input to the 1D HEC-RAS model and the model was run for the 24day simulation period so as to produce flow and elevation hydrographs at the upstream and downstream locations.

The hydrodynamic model was run for a start date of 25/06/2018 14:00 to the 19/07/2018 12:00 for a computational time step of 1second and simulation results were output every 10 minutes for the complete model domain and stored in a binary results database. Time series of tide elevation and depth averaged velocities were generated for the measurement point from this results database. A final calibrated

Manning's roughness of 0.028 was used with a full k-ε turbulence model to simulate eddy viscosity / turbulence and accurately produce the observed hydrodynamics.

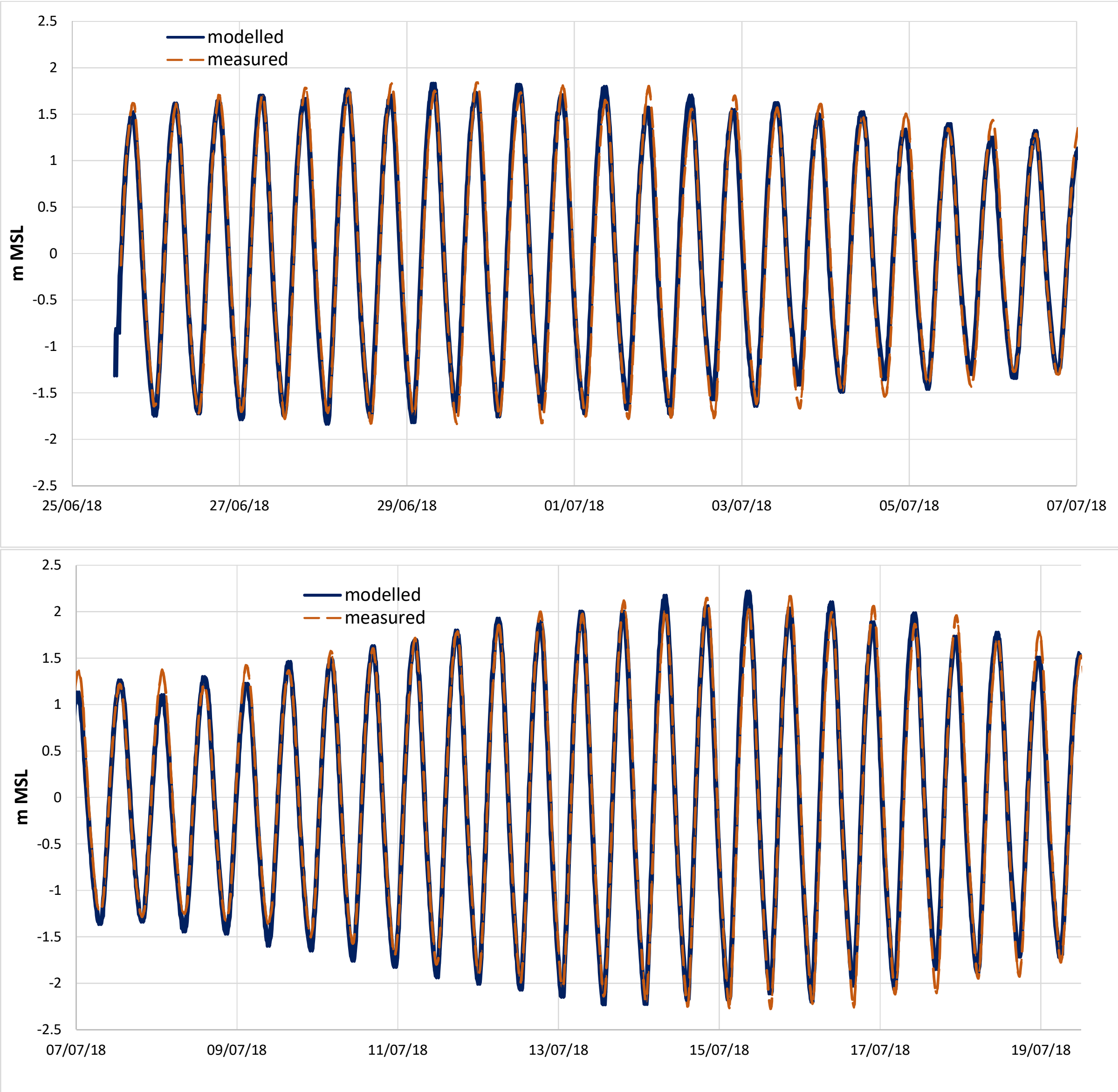

Figure 2-9 Measured and Predicted Tidal Elevation 25 June 2018 to 19 Jul 2018

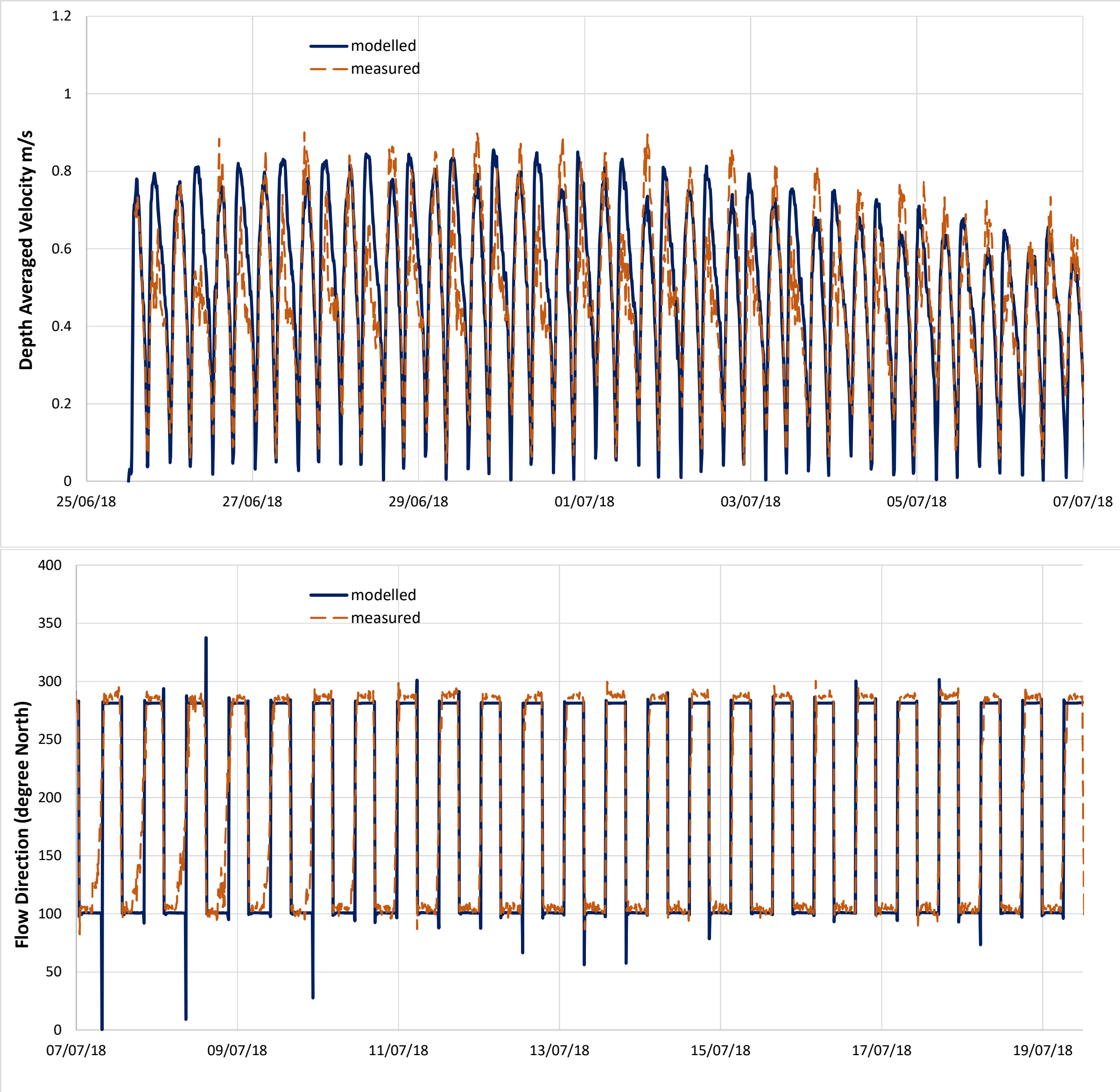

Figure 2-10 Measured and Modelled Depth Averaged Velocity Magnitude and Direction 26 June 2018 to 7 July 2018

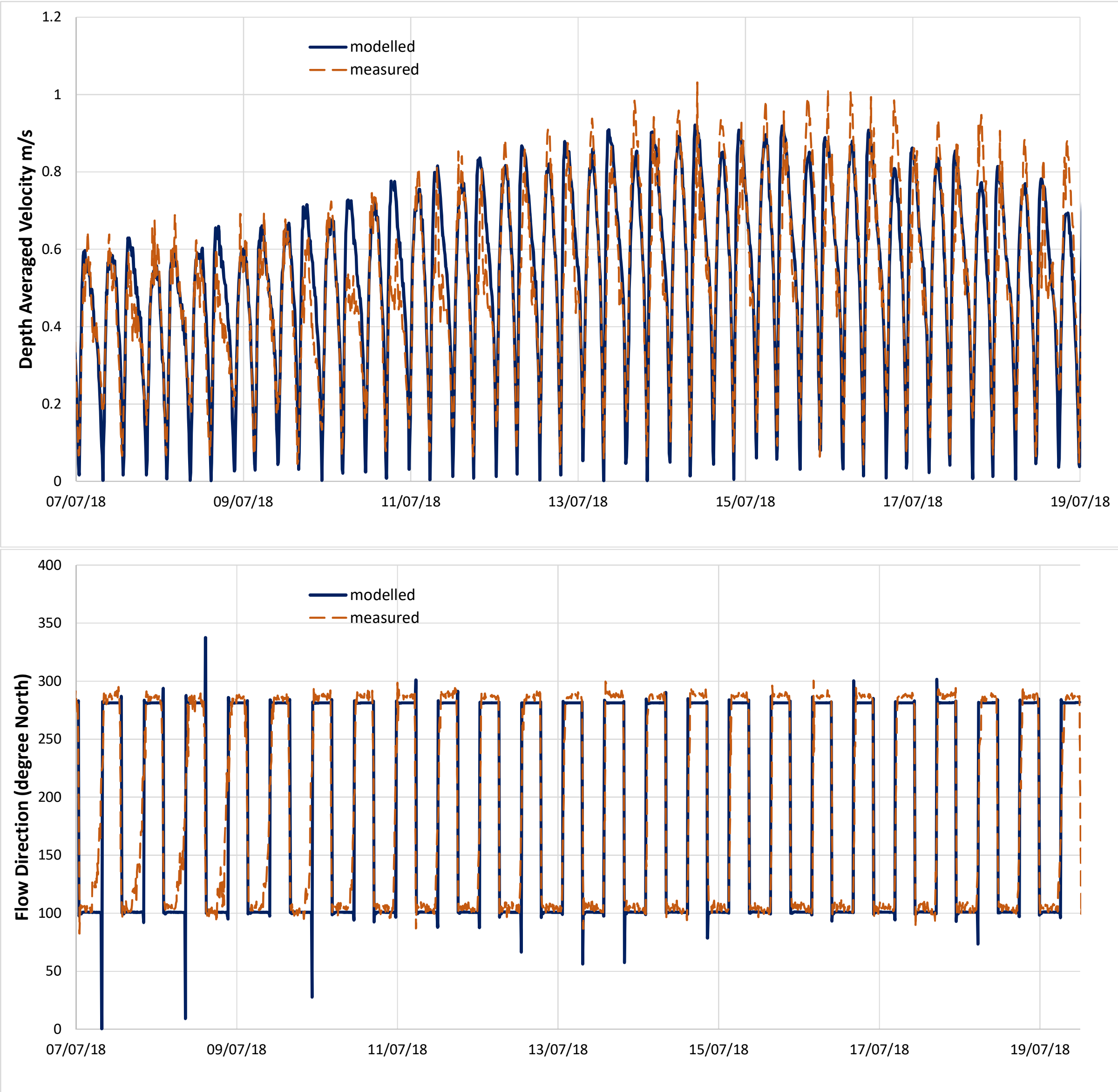

Figure 2-11 Measured and Modelled Depth Averaged Velocity Magnitude and Direction 7 July 2018 to 19 July 2018

2.8 Proposed Flood Wall Finite Element Model

The proposed case which includes the proposed 740m long sheet piled flood Wall and three no. proposed drainage outfalls was modelled using the same mesh structure as the existing case model but with the defended land behind the flood wall removed and a lateral model boundary included along the proposed flood wall alignment, refer Figure 2-12. This is the preferred method for modelling a vertical structure such as a flood wall. The avoidance of remeshing for the proposed case eliminates potential for additional numerical noise associated with the performance of two different finite element meshes which can generate differences that mask the impact of the physical changes being modelled.

An alternate to this approach is to raise the ground levels defended behind the flood wall to the defended level but this would model the flood wall as a sloped wall structure as opposed to a vertical wall which for 2m meshing represents a significant difference and likely to cause additional artificial roughening on the flow field in the vicinity of these elements. A regular vertical sheet piled wall is expected to produce a smoother effect with less resistance on the flow passing along the face of the wall.

The effect of the three proposed outfalls were modelled by locally rising the bathymetry at the model nodal points in the vicinity of the outfalls to the proposed top of outfall elevation.

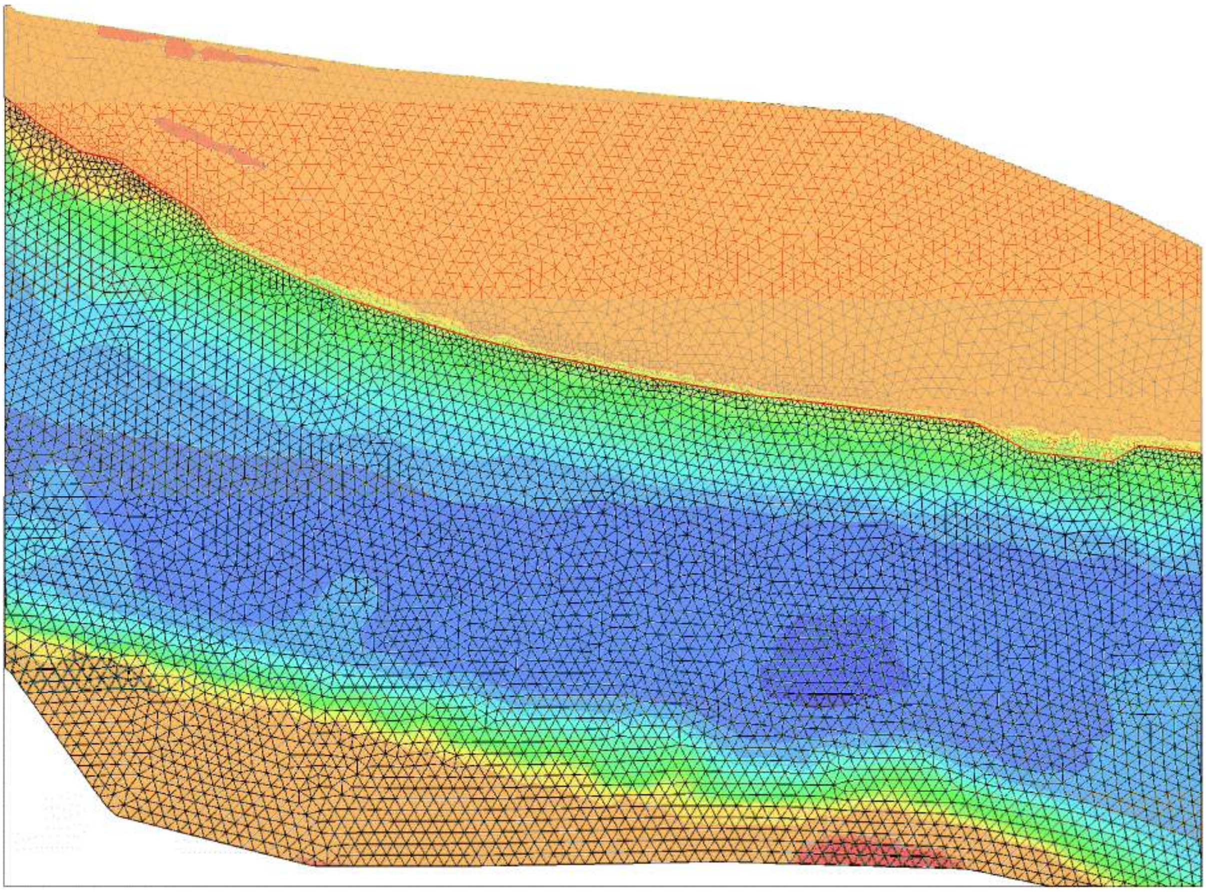

Figure 2-12 Proposed Case Model with model boundary set along the proposed flood wall alignment

3. HYDRODYNAMIC SIMULATIONS

3.1 Introduction

A 24day spring – neap – spring tide using the tidal observations recorded from the 25th June to the 19th July 2018 was simulated so as to assess the potential change in tidal velocities and bed shear stresses within the study reach under existing and proposed cases.

In addition to the normal lunar tide simulations a number of extreme flood simulations were also performed that included both tidal storm surge and fluvial flood events.

3.2 Predicted Hydrodynamic change

The computed neap and spring tide ebb and flood velocities for the existing (do nothing scenario) case are presented in Figure 3-1 to Figure 3-4. These simulation results show the strongest currents located in the middle of the channel where water depths are the largest. The plots show significant reduction in flow velocities in the shallow depths along the channel banks. The velocity plots show locally increased velocities around the existing piers at Edmund Rice Bridge. The flows are generally rectilinear with the longitudinal channel access and maximum flow velocities reaching 0.6 to 0.7m/s on the neap tides and 0.9 to 1.0m/s on spring tides towards the centre of the channel adjacent to the proposed Flood Defence Wall. Along the alignment of the Flood Wall the stronger currents along the bank and toe of the Flood Wall occur on the Flooding Tide whereas on the Ebbing tide the flow velocities slightly pull away from the bank as it navigates the slight NW to ESE bend in the river channel.

Velocity difference plots between proposed and existing cases are presented in Figure 3-5 to Figure 3-8 for neap and spring tides at mid-ebb and mid-flood respectively, These figures show the extent of the estuary area hydraulically impacted by the sheet pilled flood defence wall and associated storm outfalls. The simulations show an increase in velocity along the middle section of the flood wall alignment on both ebb and flood tidal flows and a reduction in velocity locally in the vicinity of the outfall structures with their slightly raised profile. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes and are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the far bank. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive.

To demonstrate the effect of the proposed flood defence wall on tidal velocities a series of 10 output reference locations were chosen, refer to Figure 3-9. The time series plots of existing velocity magnitude under the spring and neap tidal conditions for a 24day simulation period and computed change in velocity magnitude is presented in Figure 3-10 to Figure 3-19. Location 1 to 6 show generally an increase in velocity magnitude over the existing and sites 7 and 8 near the outfalls show a reduction. These changes in velocity magnitude is small relative to the existing velocities and will not represent a significant change to the hydrodynamics of the flow regime of the bed morphology and sediment transport within the reach. Reference site 1 upstream and 9 and 10 further off shore show minimal effect on velocity magnitudes. Only local changes to velocity along this northern bank are predicted with no impacts to flows in the main channel of on the adjacent riverbank.

3.3 Predicted Channel erosion

In order to access the potential impact on bed sediments the bed shear stress is computed using the Chezy equation for bed shear. This is then compared to the critical bed shear of a given sediment particle size for initiation of mobilisation. The Mobility Factor M is defined as the ratio of bed shear to critical bed shear, such that factors exceeding 1 represent mobilisation of the fresh unconsolidated silt/sediment and less than 1 represents immobility with the deposited sediment remaining in place on the bed.

$$\theta_{cr} = \frac{0.3}{1+1.2D_{gr}} + 0.055\left[1 - e^{-0.02D_{gr}}\right] \qquad (1)$$

$$D_{gr} = D\sqrt[3]{\frac{g(s-1)}{\vartheta^2}} \qquad (2)$$

$$\theta_{cr} = \frac{\tau_{cr}}{\rho(s-1)gD} \qquad (3)$$

$$\tau_{cr} = \theta_{cr}\rho(s-1)gD \qquad (4)$$

Where g = 9.81m/s2, s= 2.65 (specific density), D_{gr}= dimensionless grain size, θ_{cr} critical Shield's parameter, ϑ viscosity = 1.2 x $10^{-6}$$m^2$/s, ρ water density kg/m3, D is the sediment diameter and τ_{cr} is the critical shear stress for mobilisation.

Bed Shear Stress is calculated as follows

$$\tau = \frac{U^2\rho}{C'^2} \qquad (5)$$

Where

$$C' = \frac{H^{\frac{1}{6}}}{ng} \quad (6)$$

U depth averaged velocity, H is water depth, n is manning roughness.

The mobility Factor is expressed as

$$\mathrm{M} = \frac{\tau}{\tau_{cr}} \quad (7)$$

M=1	At some point, the fluid shear will just be in balance with the critical shear stress for erosion (M=1). As flow increases past this point, the grain will start to move along the bed: at first by 'saltating' or jumping along the bed (bed load). These jumps are caused by turbulence in the flow.
1<M<8	In this range, the size and mass of the grain is sufficient that it falls back to the bed quite quickly after each jump. As the amount of bed load increases, bedforms such as ripples and/or dunes develop. Bedform length of ripples is mainly a function of grain-size while the height of the bedform is dependent on flow intensity. For dunes, bedform length is mainly a function of flow depth.
8<M<14	As flow intensity increases, the bedforms start to reduce in height, the 'hang time' of the particles increases.
14<M<65	Sediment is now being swept higher into the flow field. The lift forces in this increasingly turbulent flow field are sufficient to keep the grain in suspension. The onset and characterisation of suspended load is, in large part, controlled by the ratio of sediment fall velocity to the total shear velocity, (w/u_*).

The sediment sampling indicates a silty sediment. This sediment forms over time a cohesive consolidated sediment which provides strong resistant to erosion. Only in the slacker waters towards the channel banks was unconsolidated silt encountered and retrieved by the grab sampling, which is likely to have been freshly laid and the underlying sediment is likely to be a consolidated cohesive clayey silt. Such consolidated cohesive material provides good resistance to erosion and can have a critical shear stresses that exceed a coarse sand in respect to bed erosion.

The computed maximum Bed Shear Stresses for the existing and proposed flood wall case is presented in Figure 3-20 to Figure 3-27 for neap and spring, flood and ebb flows respectively. These generally show relatively low shear stress magnitudes along the riverbank of less than 0.7Pa and typically below 0.5 Pa, which would be of insufficient shear force to erode a consolidated cohesive sediment but sufficient both under the existing and proposed cases, particularly on spring tides (ebb and flood) to mobilise unconsolidated silt and fine sand primarily on the flooding tide but also to a lesser extent on the ebbing tide. The computed mobility factors for fine silt is presented in Figure 3-28 to Figure 3-35 for the neap and spring tides and existing and proposed cases and shows local increases in the silt mobility factor in the vicinity of the bank area immediately adjacent to the flood wall encroachment into the riverbank from Chainage Ch.540 to Ch.900.

The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce shear stresses (i.e., generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments on the channel bed and banks in the vicinity of the affected area. Fresher unconsolidated silts will be mobile under ebb and flood conditions both for the proposed and existing cases.

3.4 Extreme Flood Conditions

The impact of the proposed flood defence wall on the hydrodynamics was also assessed under worse case scenarios in respect to a combined fluvial and coastal storm surge event. The extreme flood simulations considered were

- A 200year storm Surge Tide (over two highwater cycles coinciding with a 2year fluvial flood event in the Rivers
- A 100year Fluvial Flood event in the rivers coinciding with a high spring tide event.

The predicted impact on flow velocity magnitudes for these extreme flood events are presented in Figure 3-36 to Figure 3-39. These show the fluvial 100year flooding event to generate lower velocities and velocity change than the 200year tidal storm surge event. The 200 year storm surge event which limited to a very short period of a 12.5 hour tidal cycle produces slightly higher velocities and velocity change over the normal range of tidal events considered earlier in section 3.2 as to be a local impact with the maximum change occurring along the toe of the Sheet pile and no effect to the deeper channel sections. The conclusion reached given the low probability of such an event and the limited duration of the mid-flood and mid-ebb flows that insignificant morphological change is likely to occur along the impacted section adjacent to the sheet piled wall.

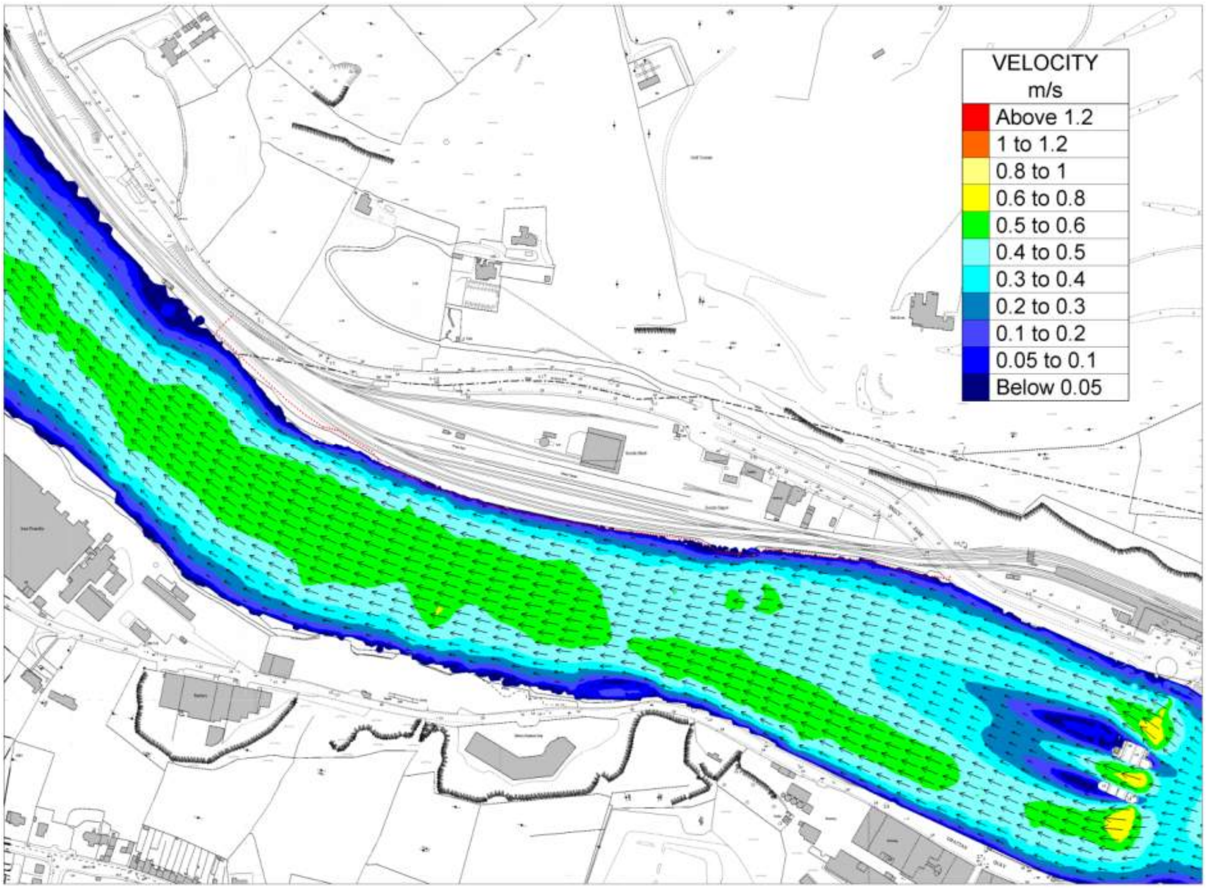

Figure 3-1 Mid-Flood velocities under existing conditions - Neap Tide

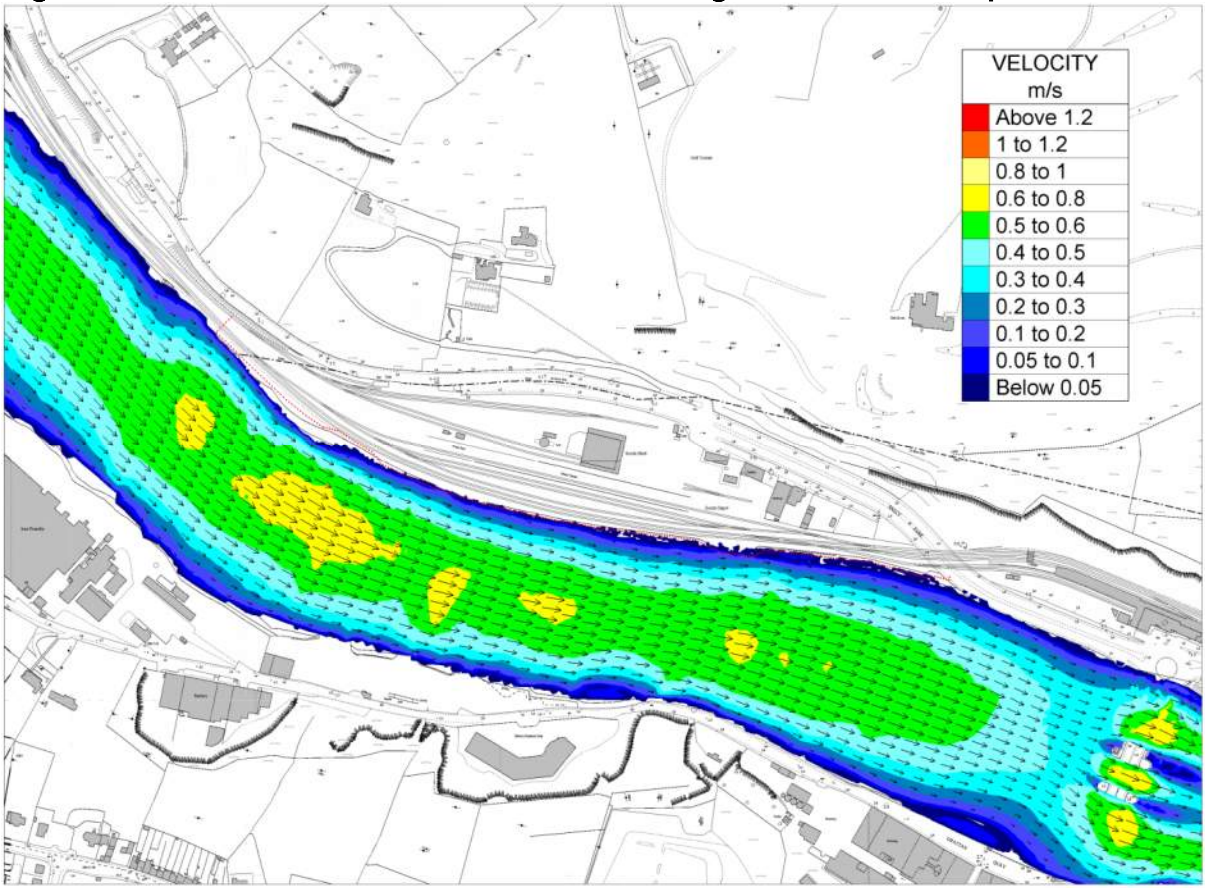

Figure 3-2 Mid-Ebb velocities under existing conditions - Neap Tide

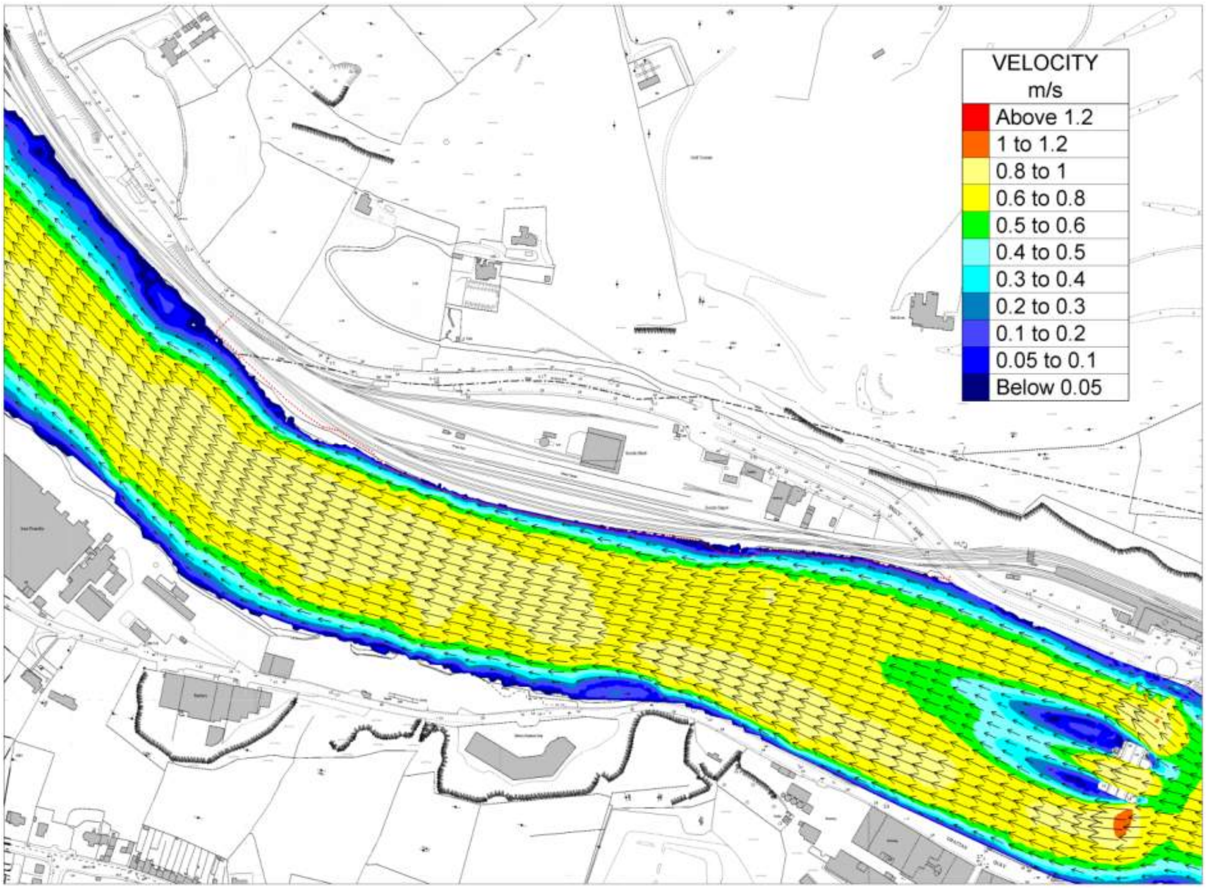

Figure 3-3 Mid-Flood velocities under existing conditions - Spring Tide

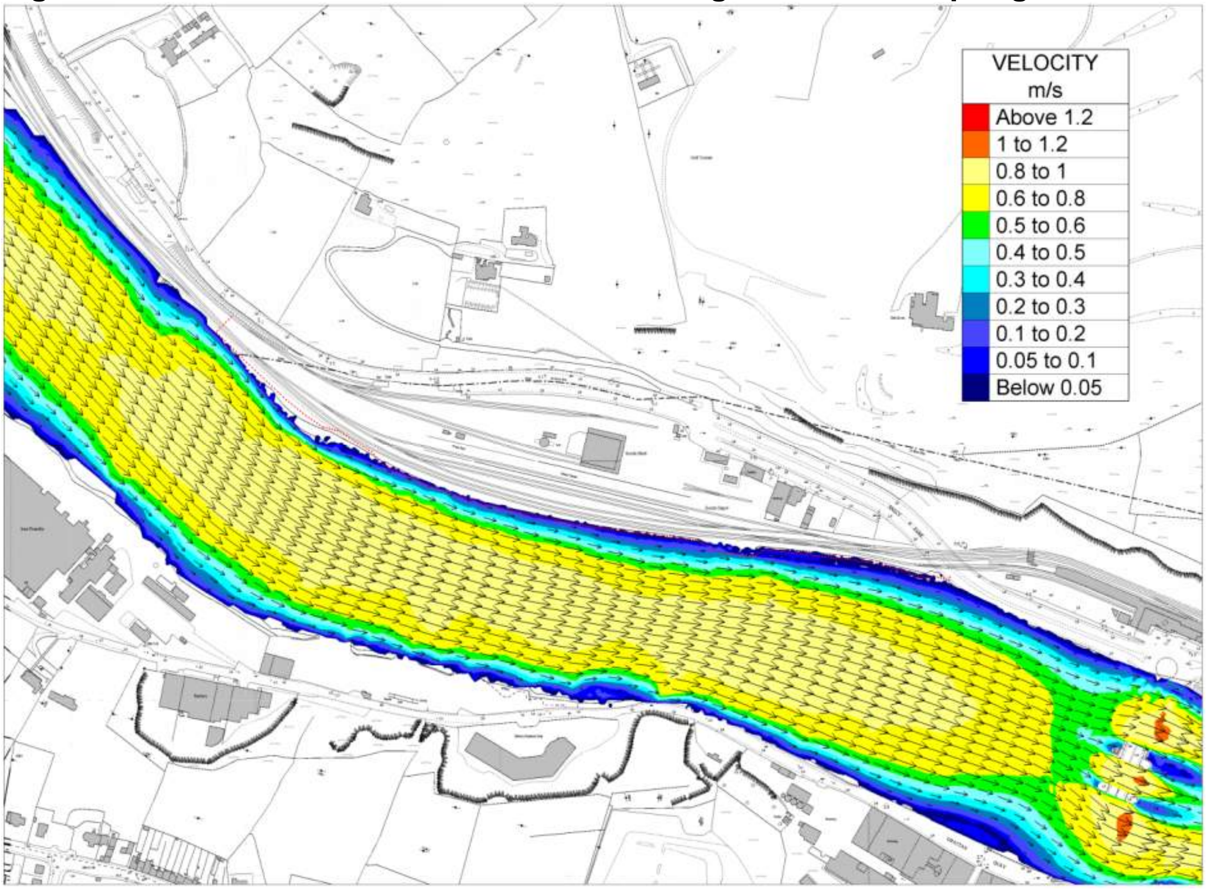

Figure 3-4 Mid-Ebb velocities under existing conditions - Spring Tide

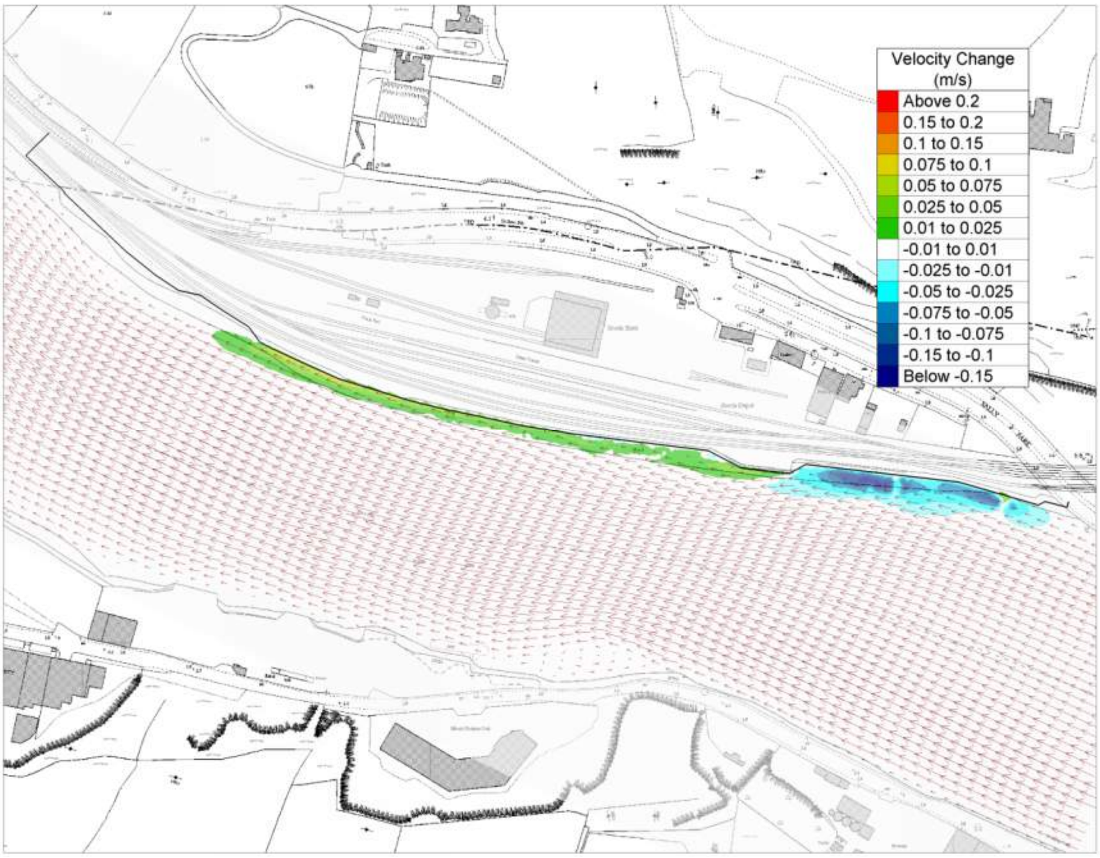

Figure 3-5 Computed change in velocity magnitude Neap Tide Mid-Flood

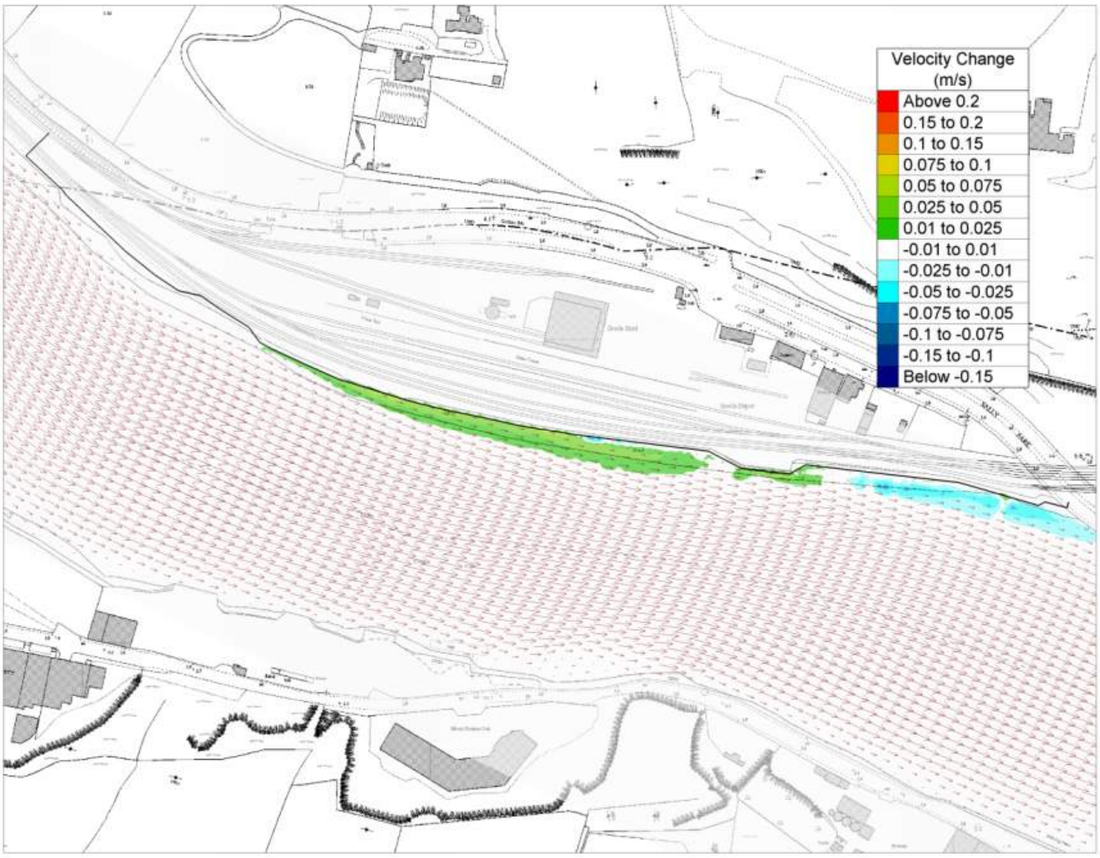

Figure 3-6 Computed change in velocity magnitude– Neap Tide Mid-Ebb

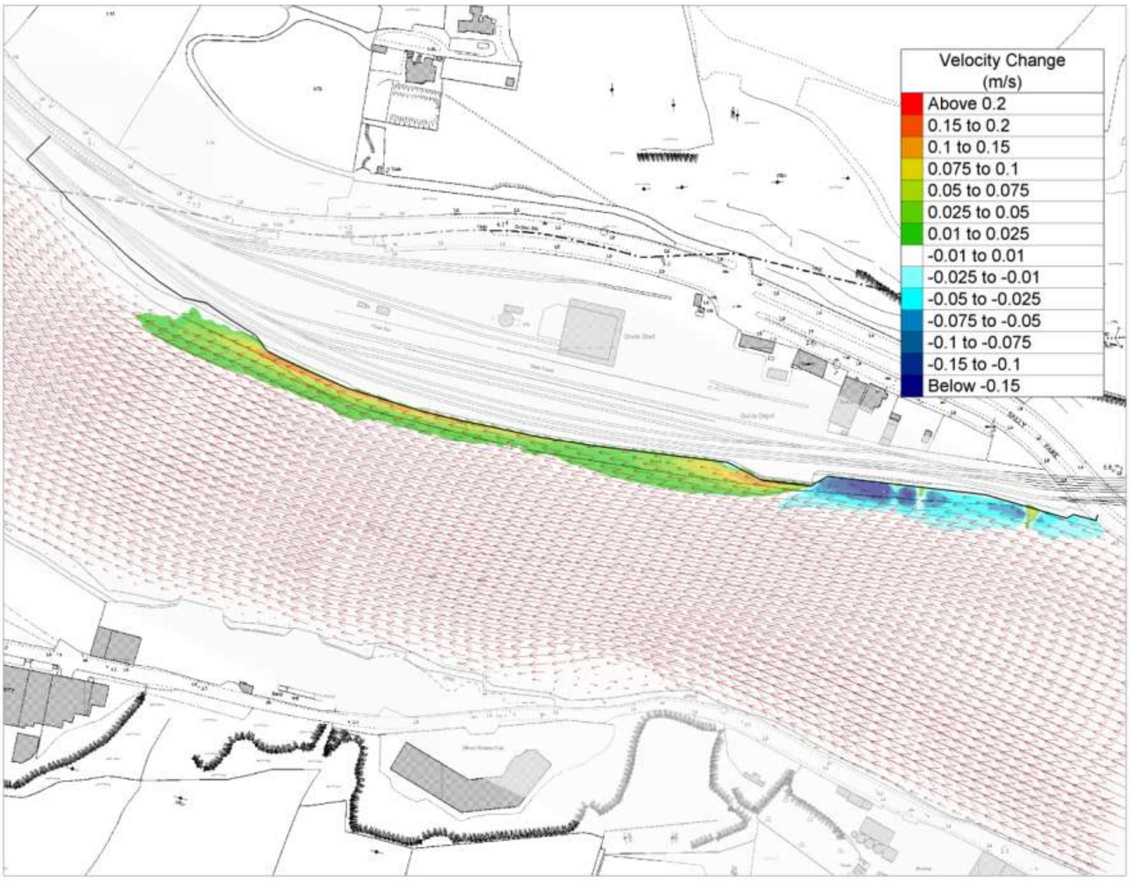

Figure 3-7 Computed change in velocity magnitude – Spring Tide Mid-Flood

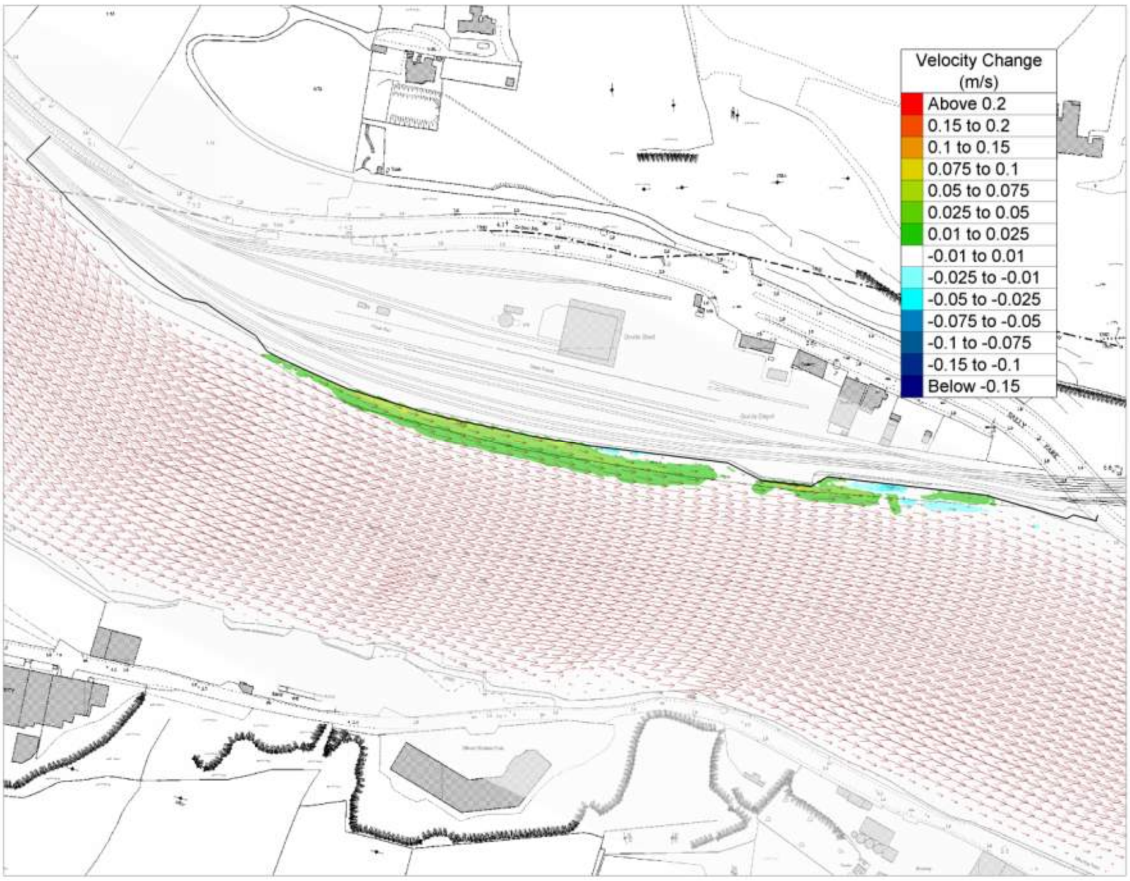

Figure 3-8 Computed change in velocity magnitude – Spring Tide Mid-Ebb

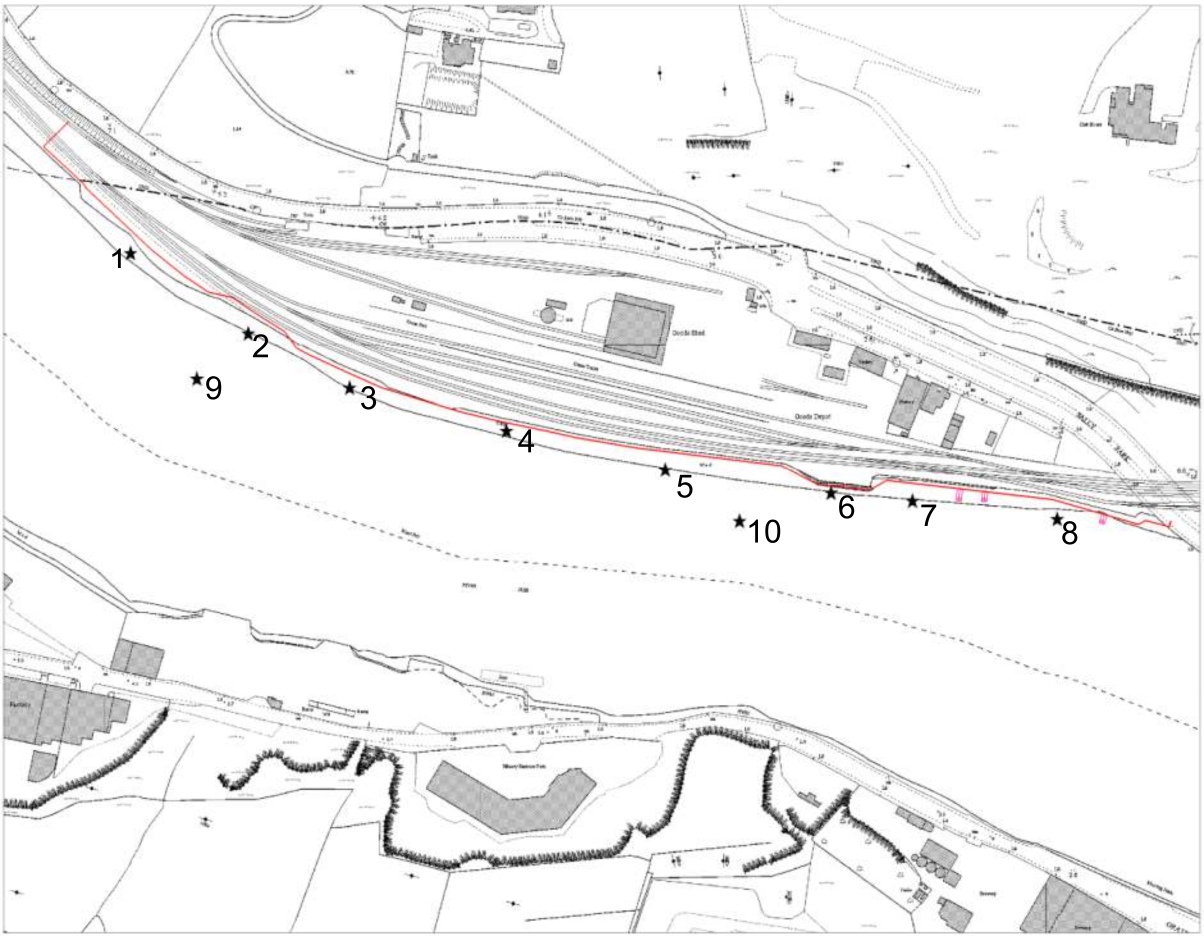

Figure 3-9 Reference Points for Time series output of existing Velocity and change in Velocity

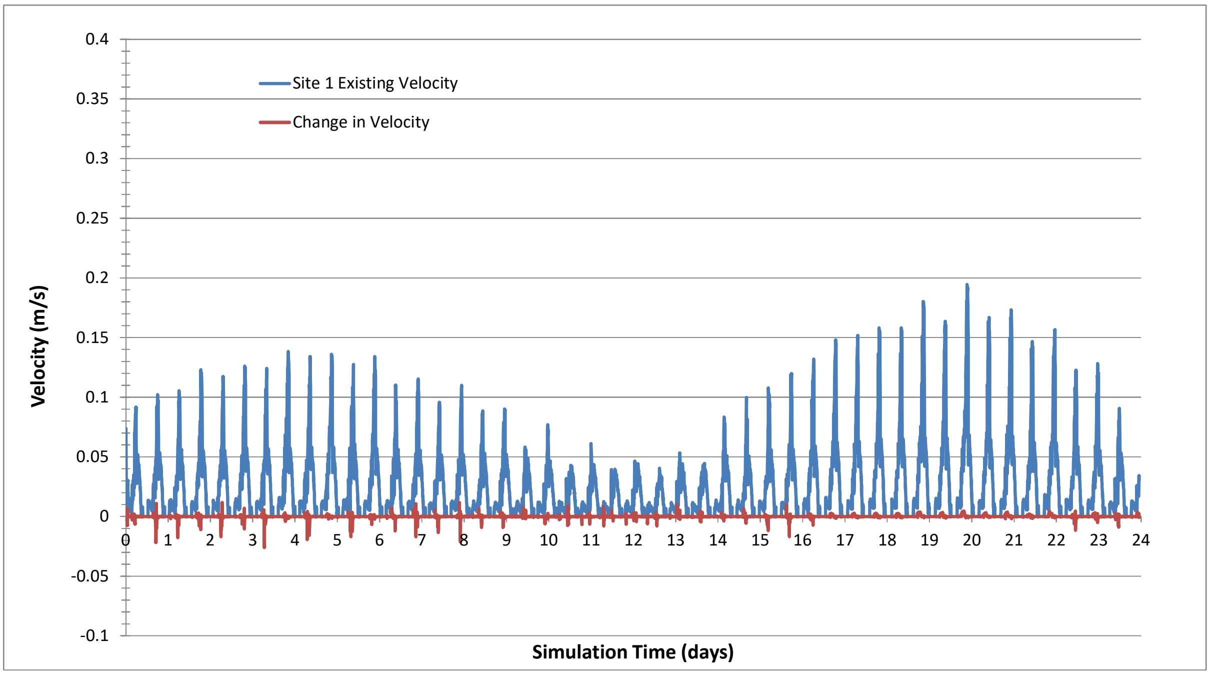

Figure 3-10 Time Series of existing velocity magnitude and computed change at Site 1

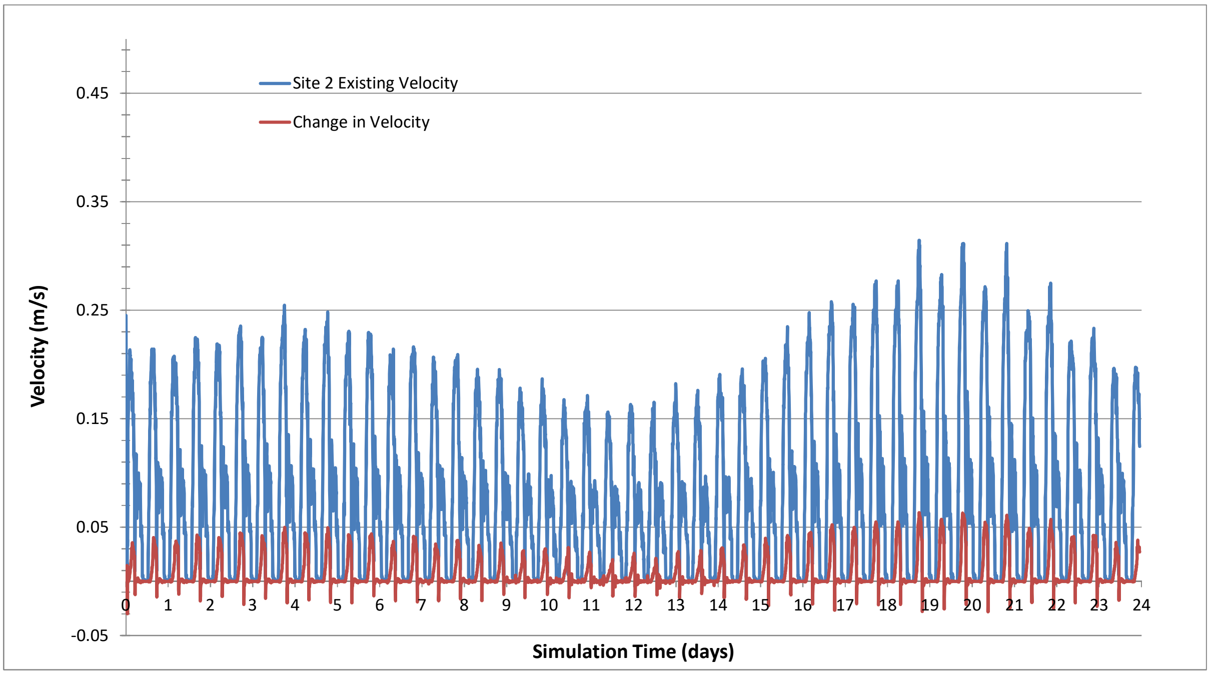

Figure 3-11 Time Series of existing velocity magnitude and computed change at Site 2

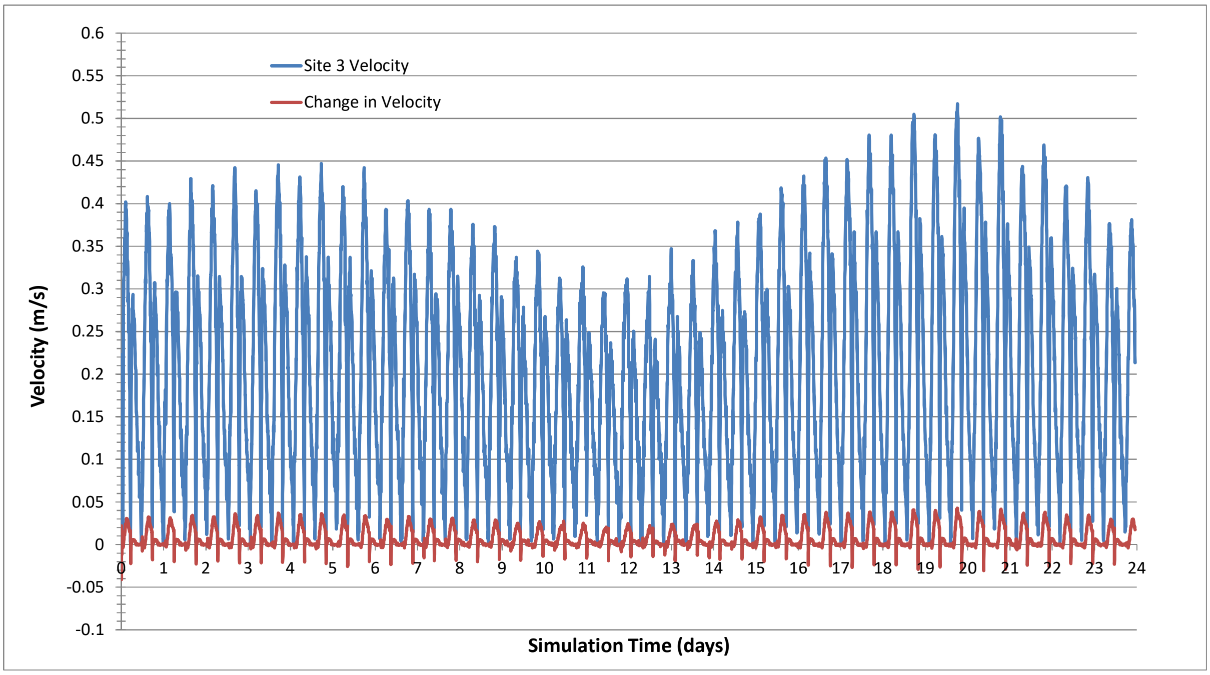

Figure 3-12 Time Series of existing velocity magnitude and computed change at Site 3

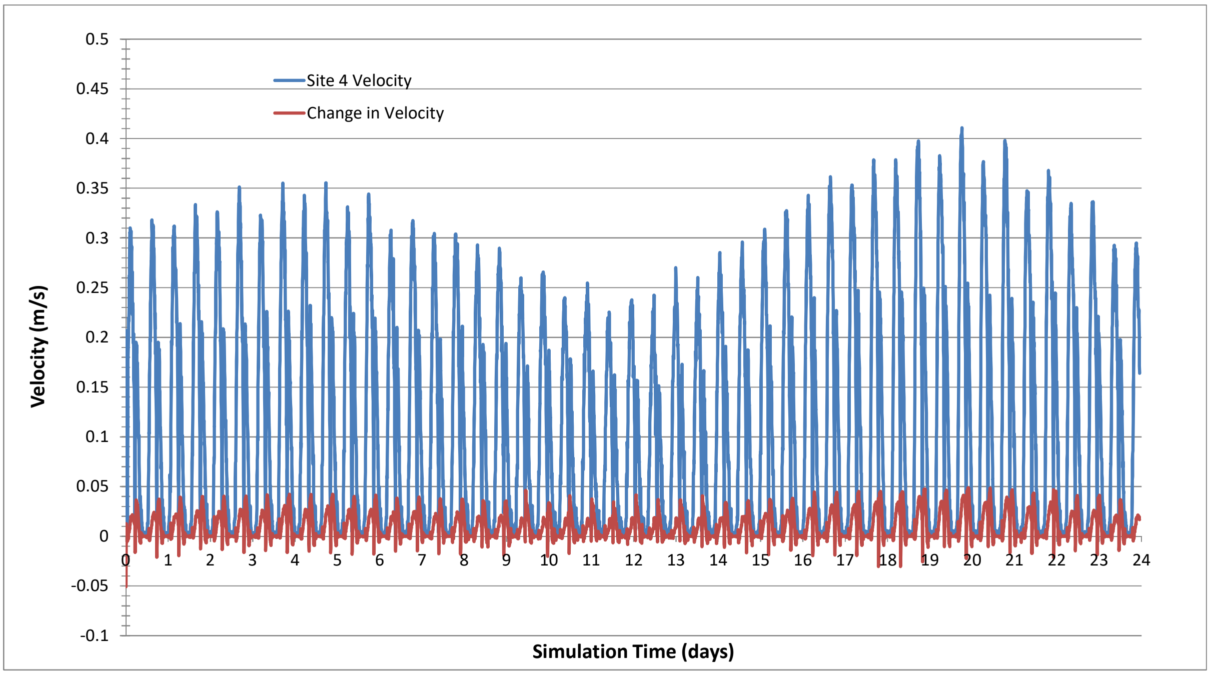

Figure 3-13 Time Series of existing velocity magnitude and computed change at Site 4

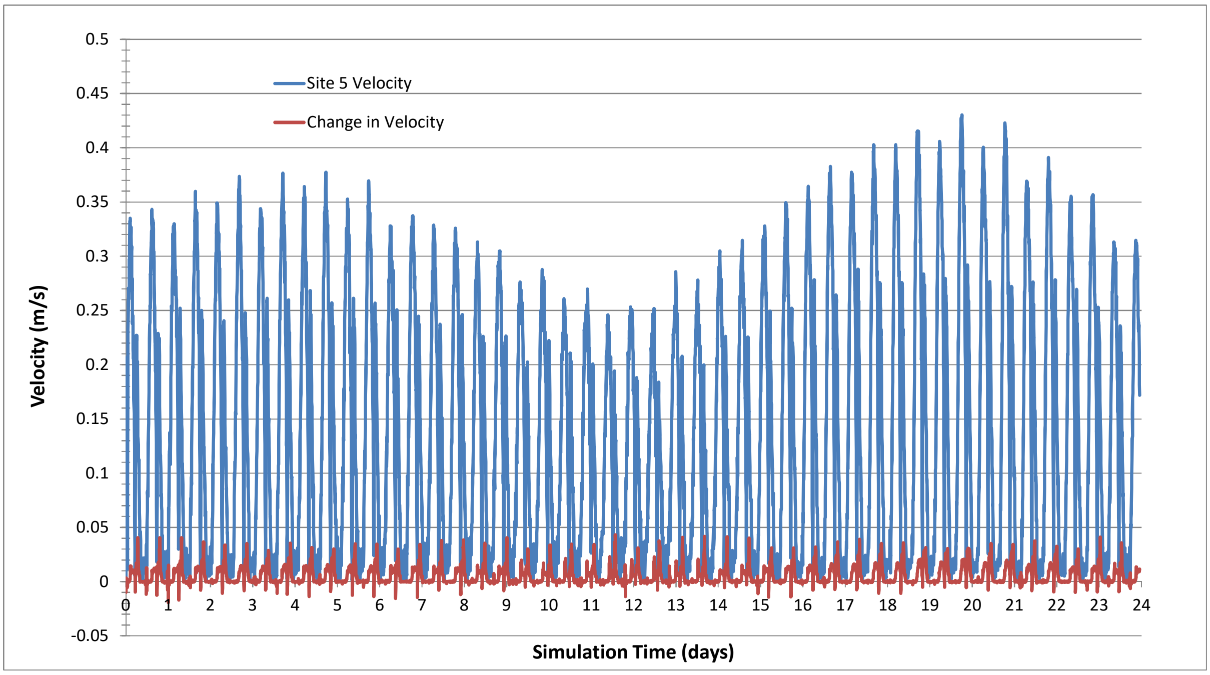

Figure 3-14 Time Series of existing velocity magnitude and computed change at Site 5

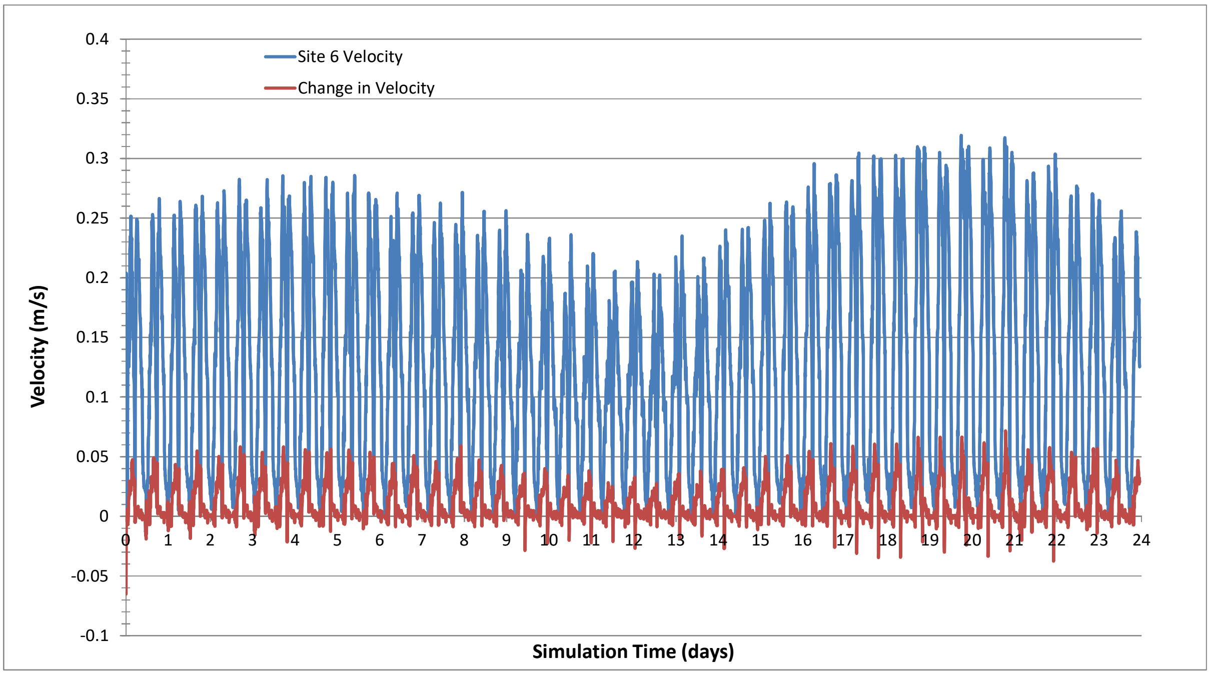

Figure 3-15 Time Series of existing velocity magnitude and computed change at Site 6

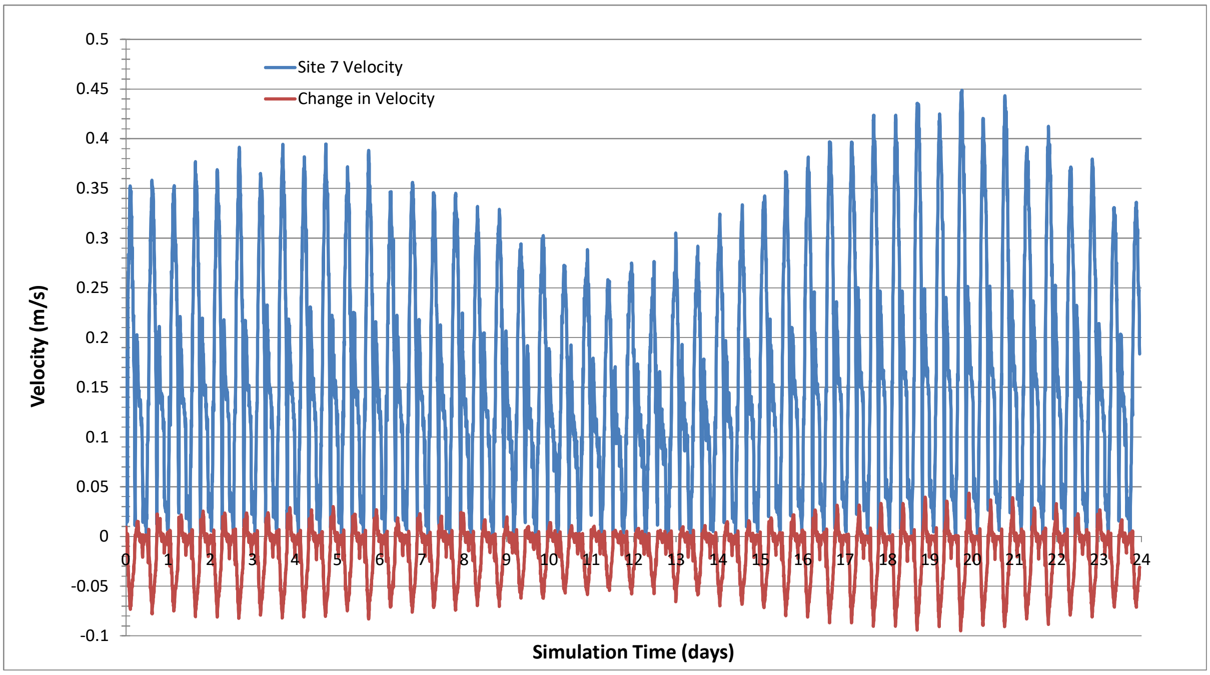

Figure 3-16 Time Series of existing velocity magnitude and computed change at Site 7

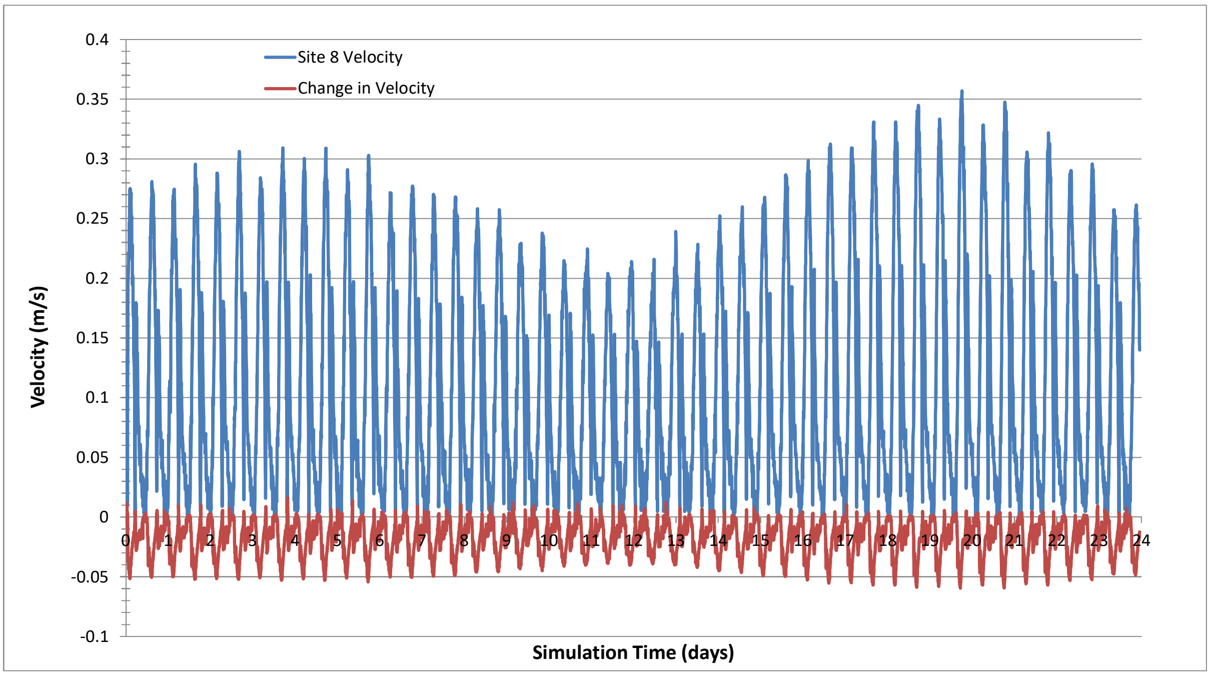

Figure 3-17 Time Series of existing velocity magnitude and computed change at Site 8

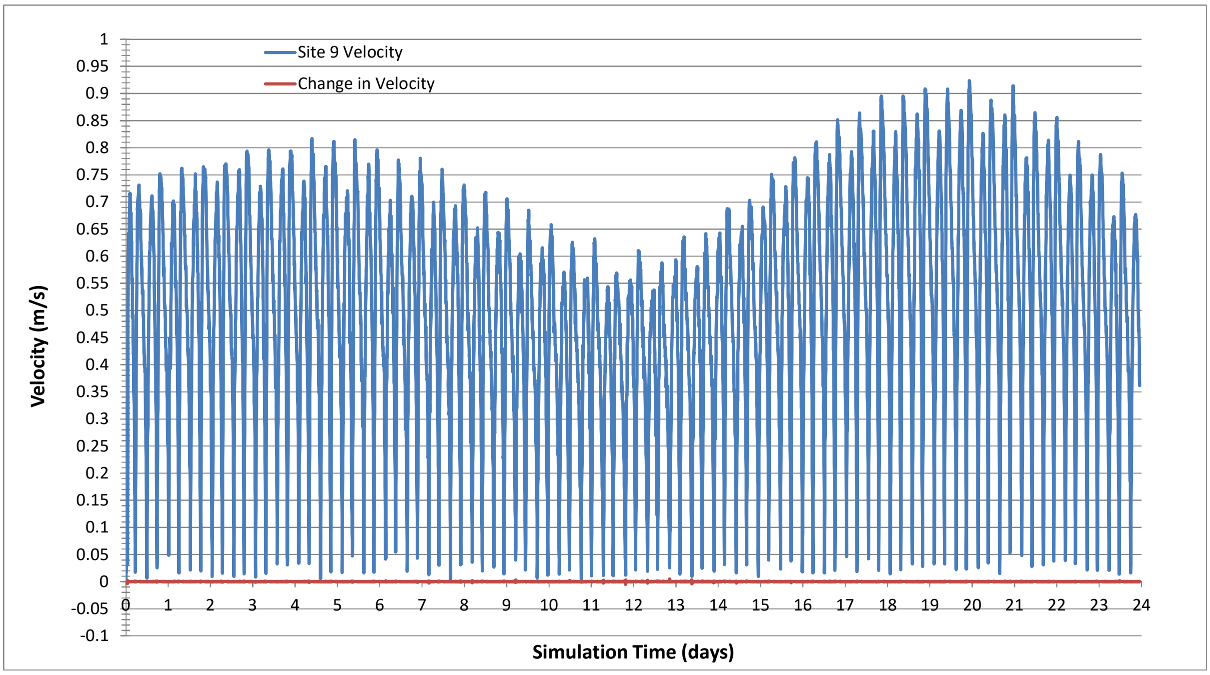

Figure 3-18 Time Series of existing velocity magnitude and computed change at Site 9

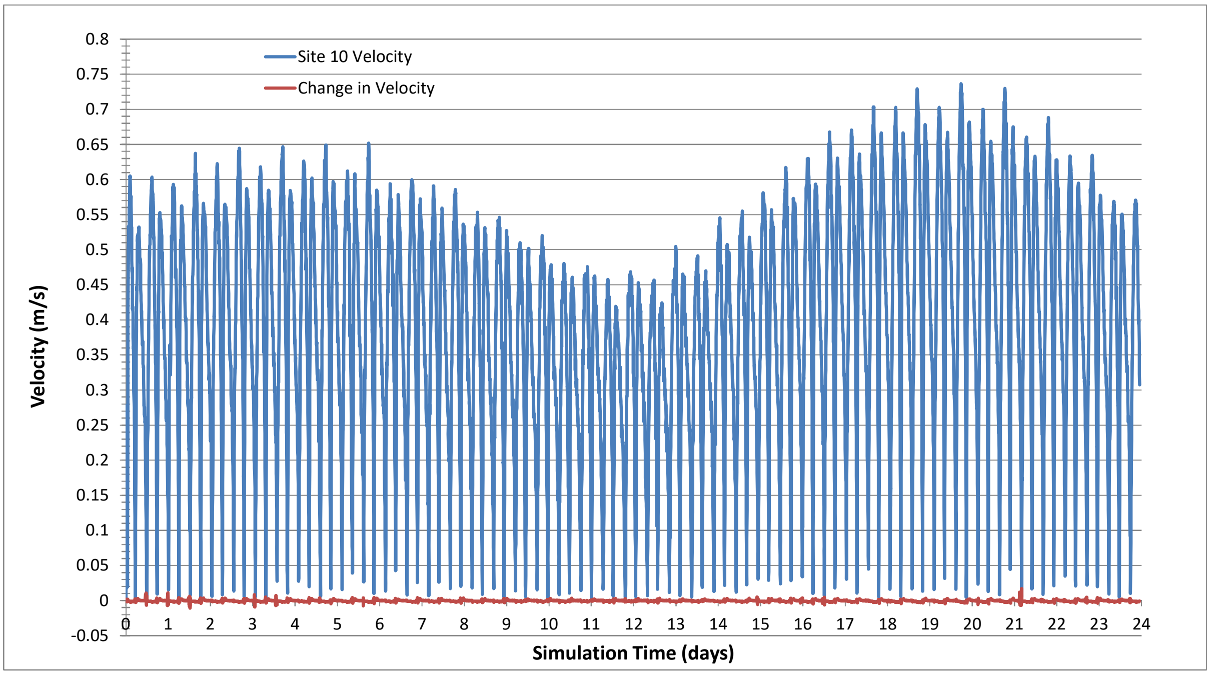

Figure 3-19 Time Series of existing velocity magnitude and computed change at Site 10

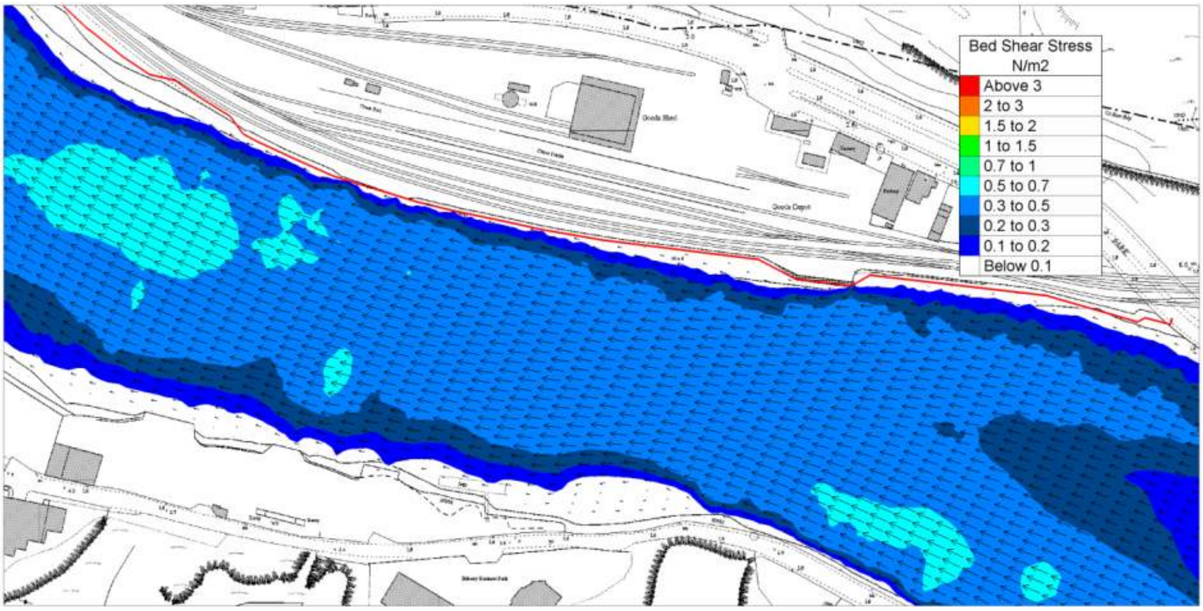

Figure 3-20 Mid-Flood Bed Shear Stress - existing case Neap Tide

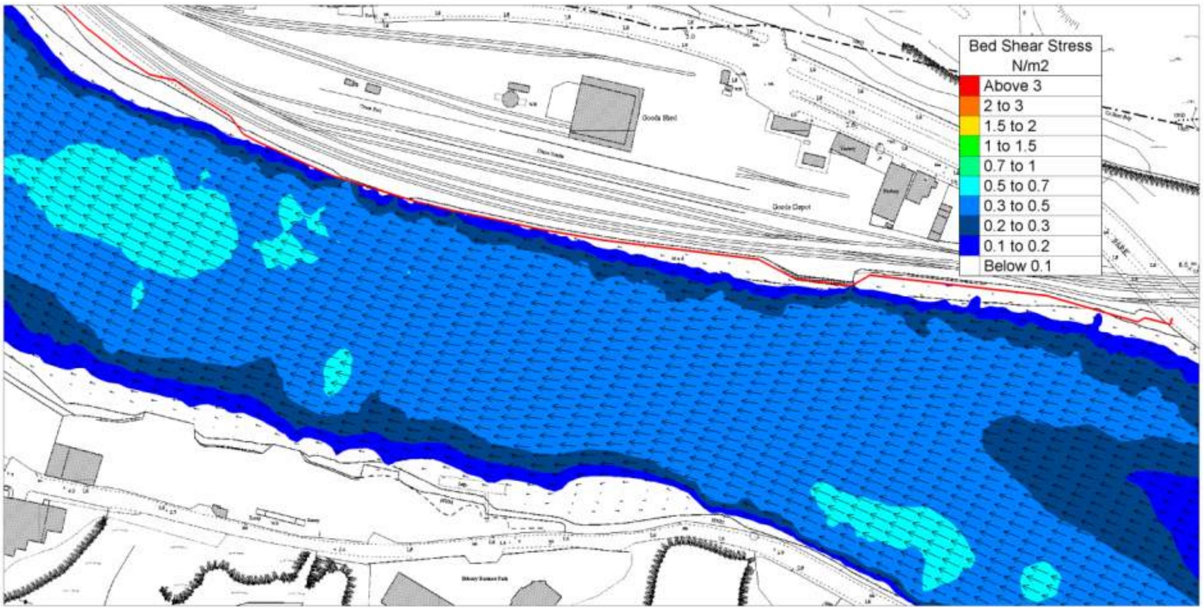

Figure 3-21 Mid-Flood Bed Shear Stress – proposed case Neap Tide

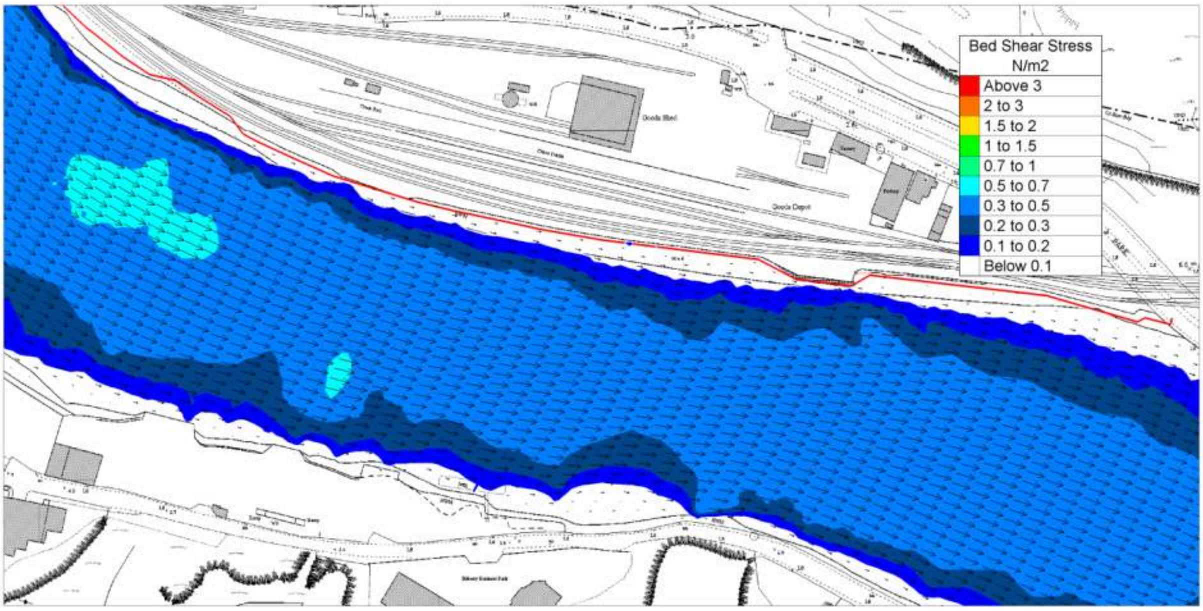

Figure 3-22 Mid-Ebb Bed Shear Stress - existing case Neap Tide

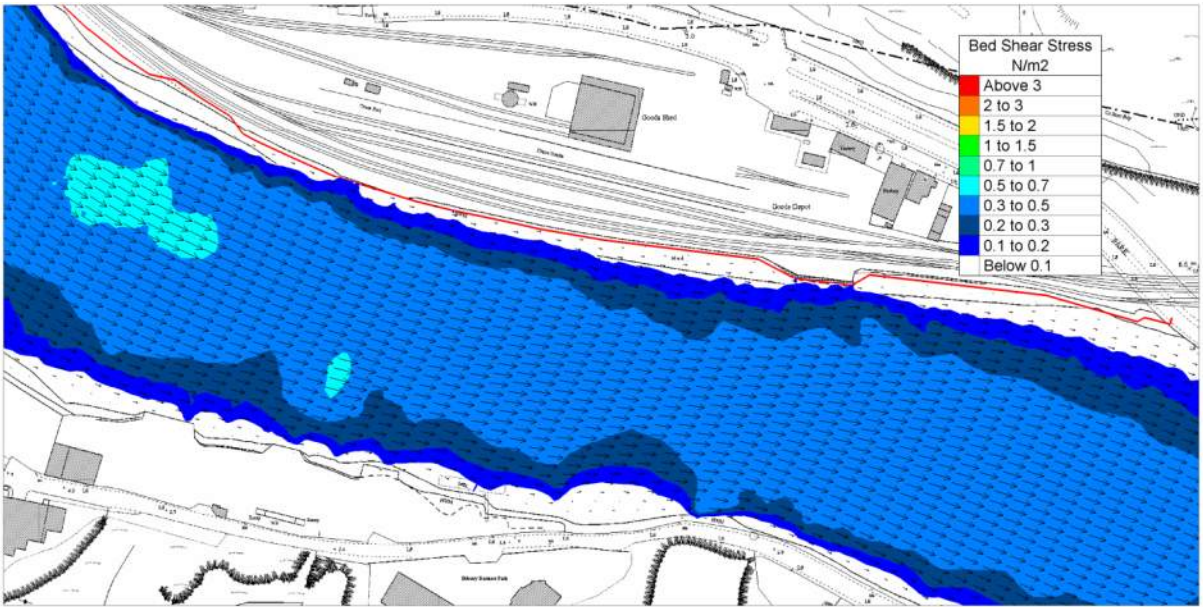

Figure 3-23 Mid-Ebb Bed Shear Stress – proposed case Neap Tide

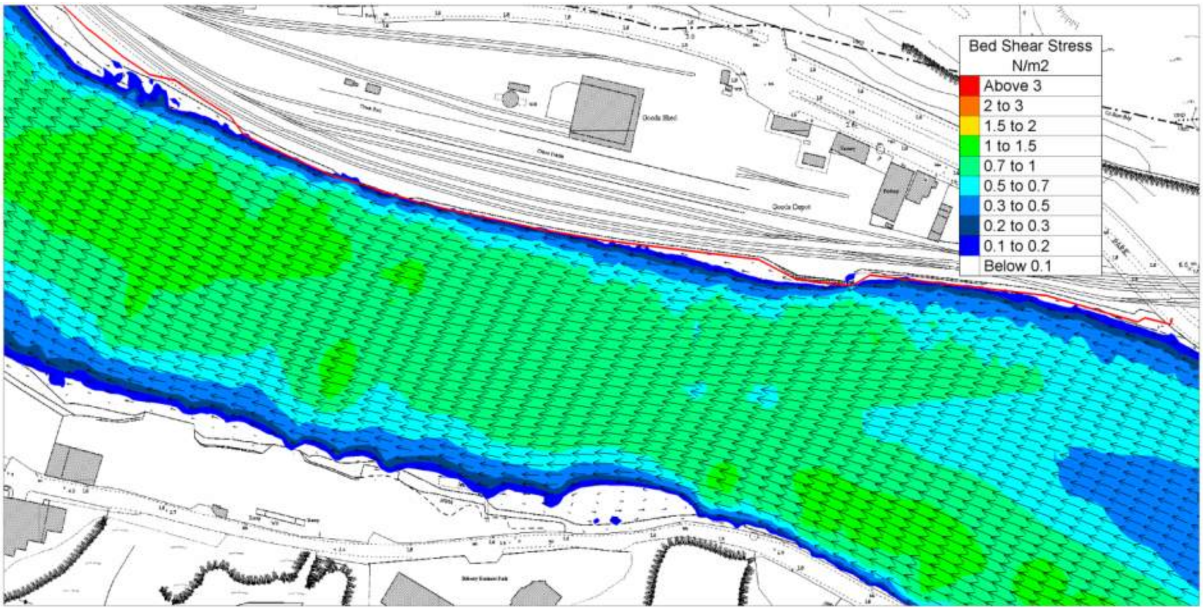

Figure 3-24 Mid-Flood Bed Shear Stress - existing case Spring Tide

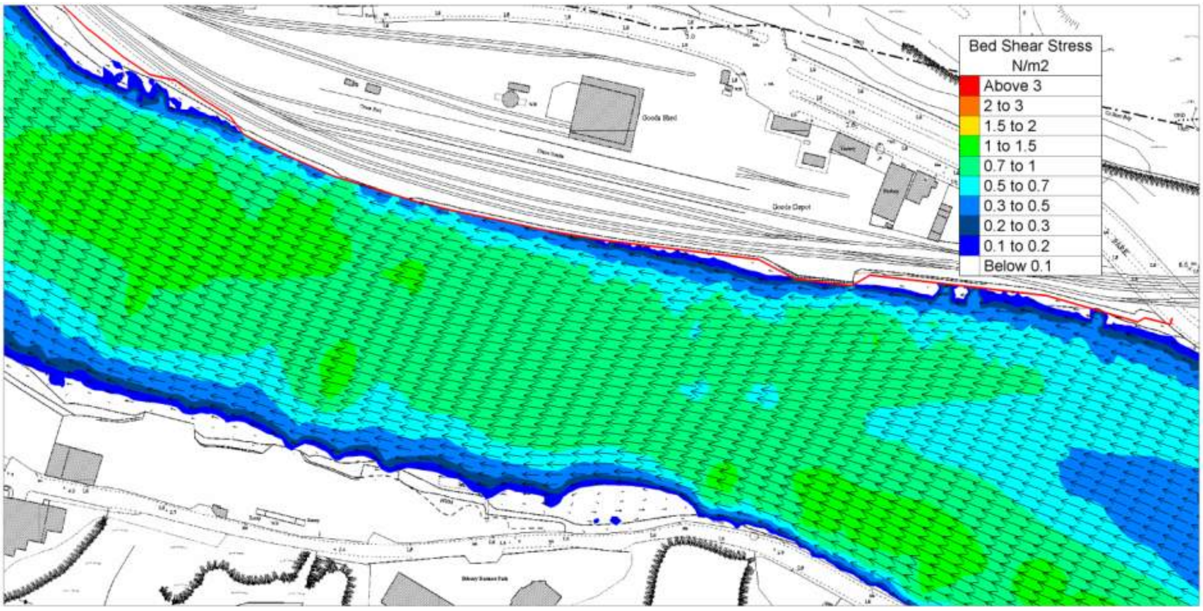

Figure 3-25 Mid-Flood Bed Shear Stress – proposed case Spring Tide

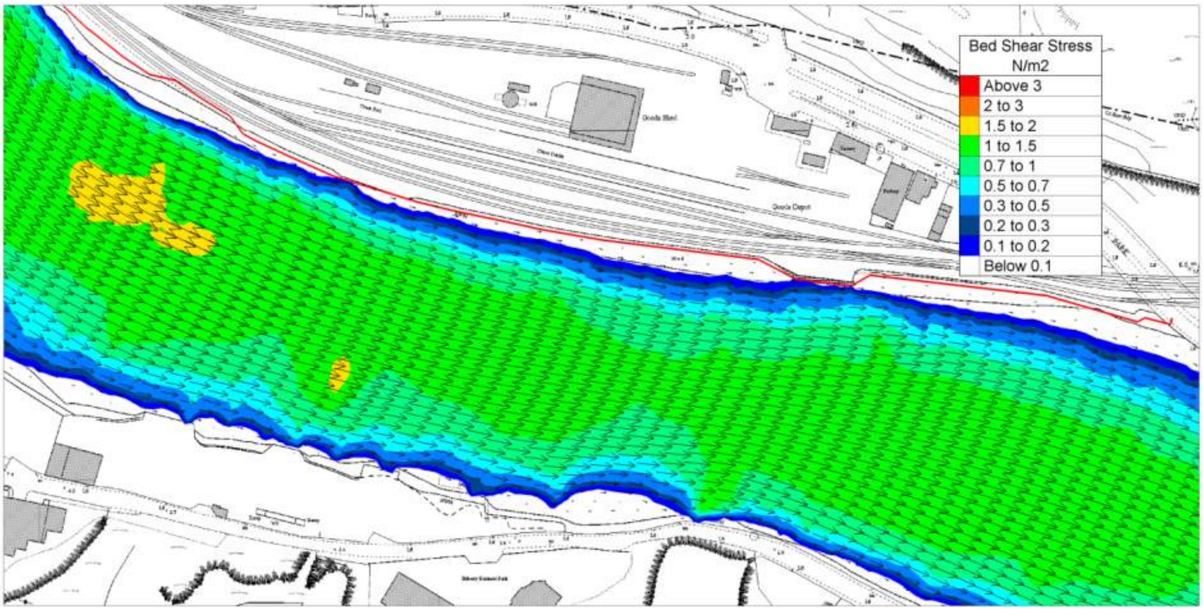

Figure 3-26 Mid-Ebb Bed Shear Stress - existing case Spring Tide

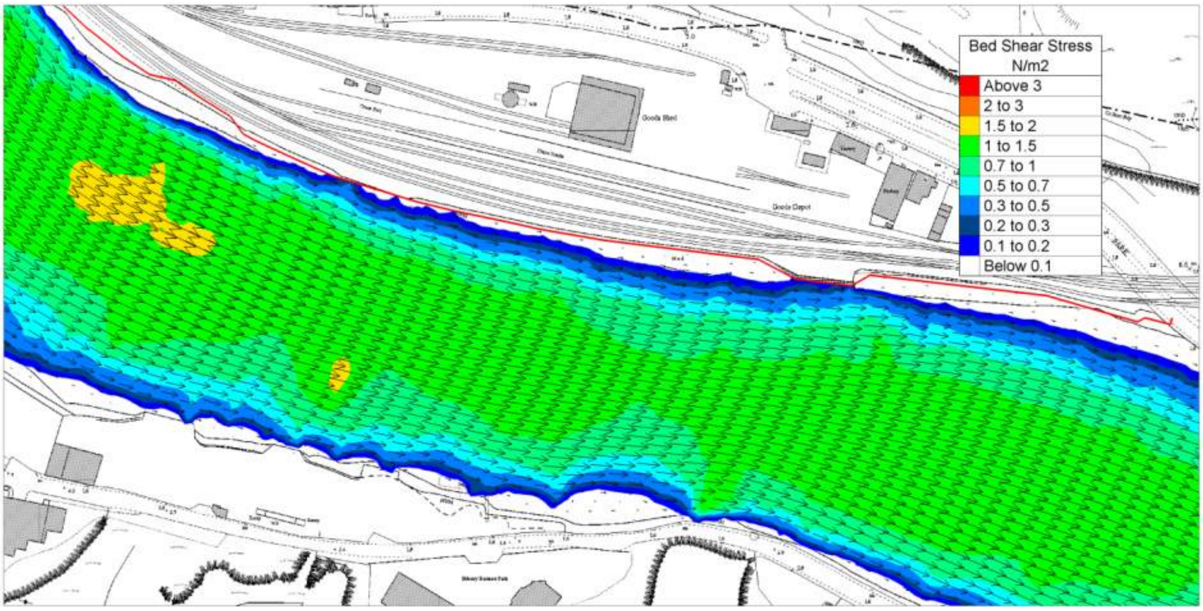

Figure 3-27 Mid-Ebb Bed Shear Stress – proposed case Spring Tide

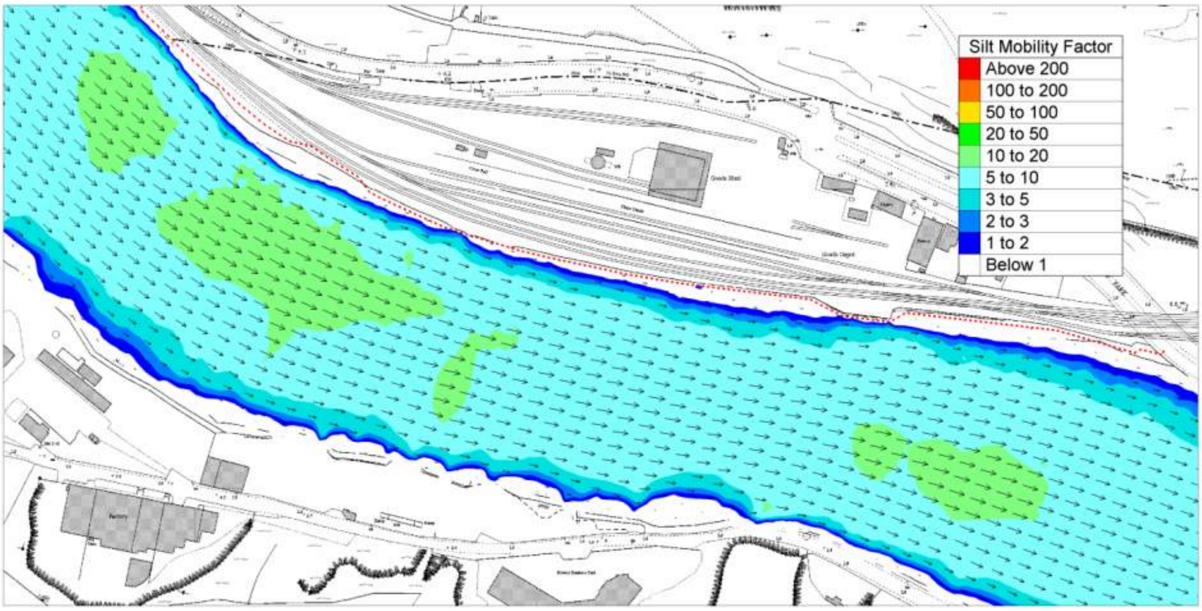

Figure 3-28 Fine Silt Mobility Factor at Mid-Ebb Neap Tide – existing case

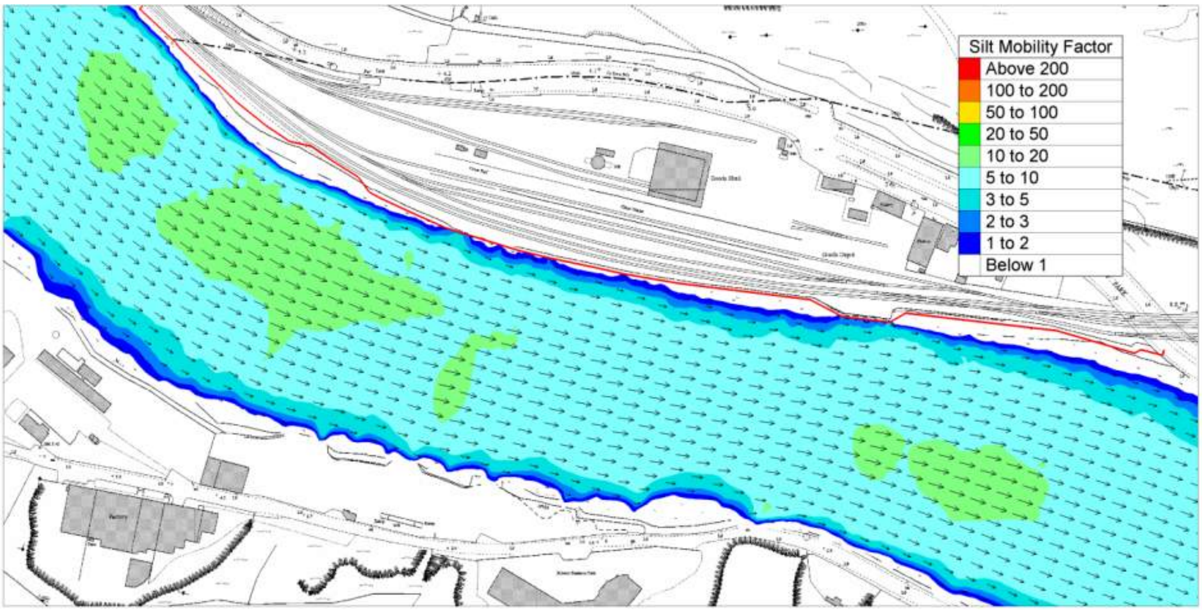

Figure 3-29 Fine Silt Mobility Factor at Mid-Ebb Neap Tide– proposed case

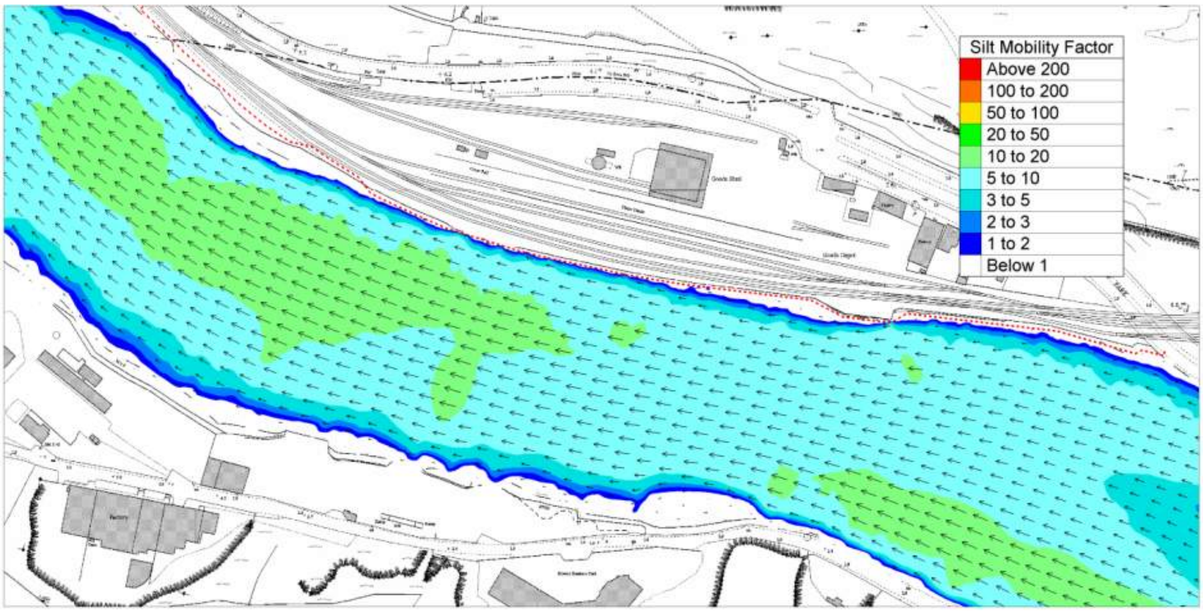

Figure 3-30 Fine Silt Mobility Factor at Mid-Flood Neap Tide– existing case

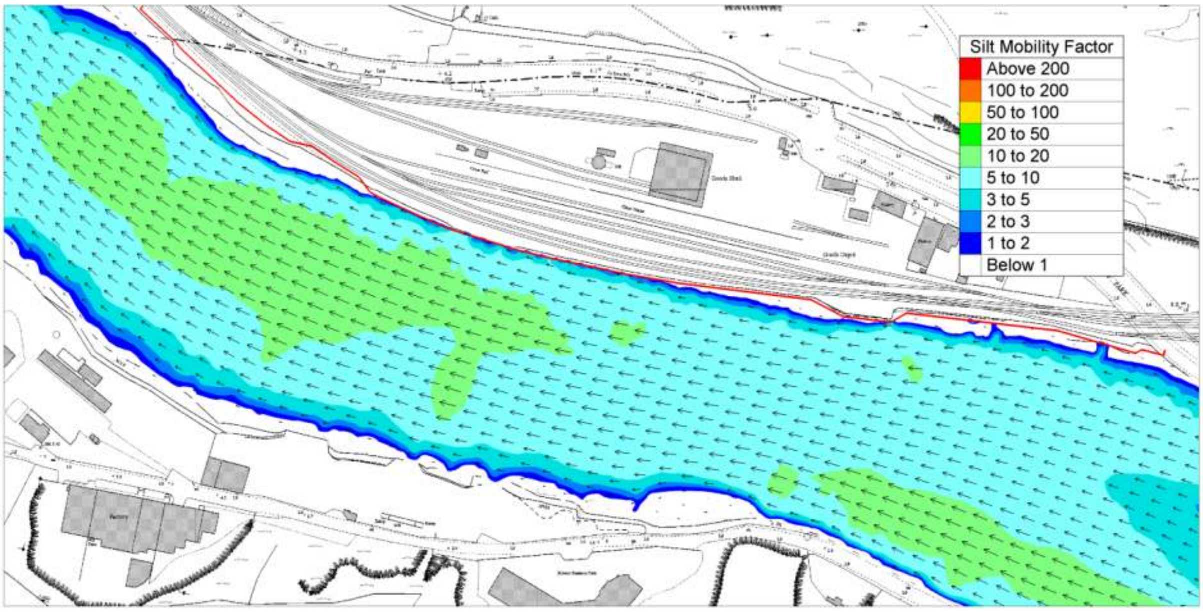

Figure 3-31 Fine Silt Mobility Factor at Mid-Flood Neap Tide– proposed case

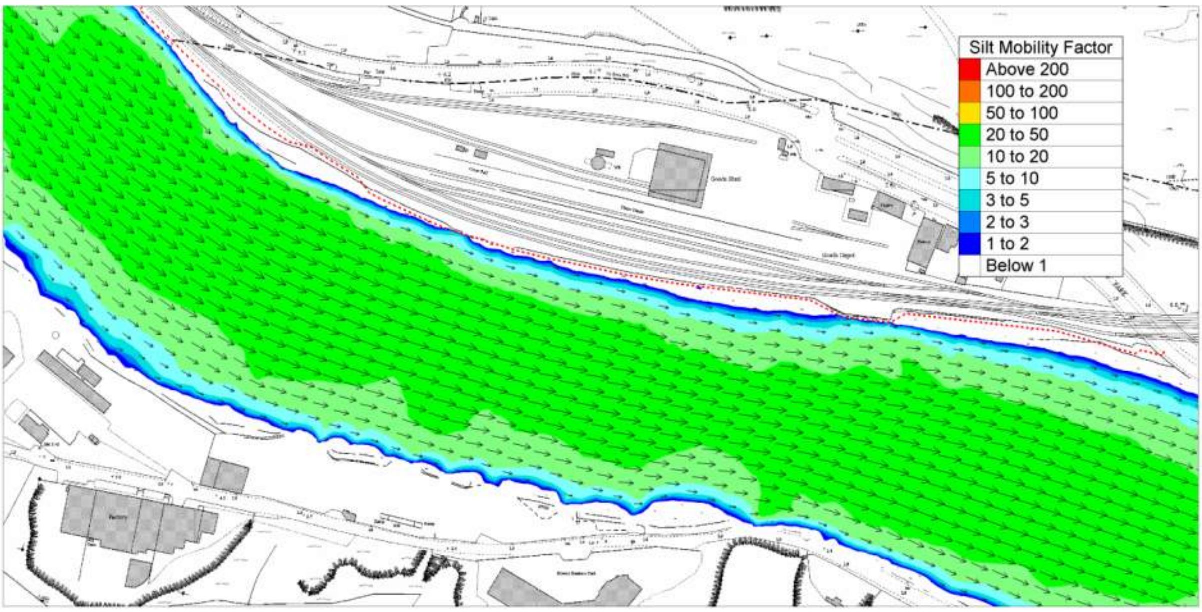

Figure 3-32 Fine Silt Mobility Factor at Mid-Ebb Spring Tide – existing case

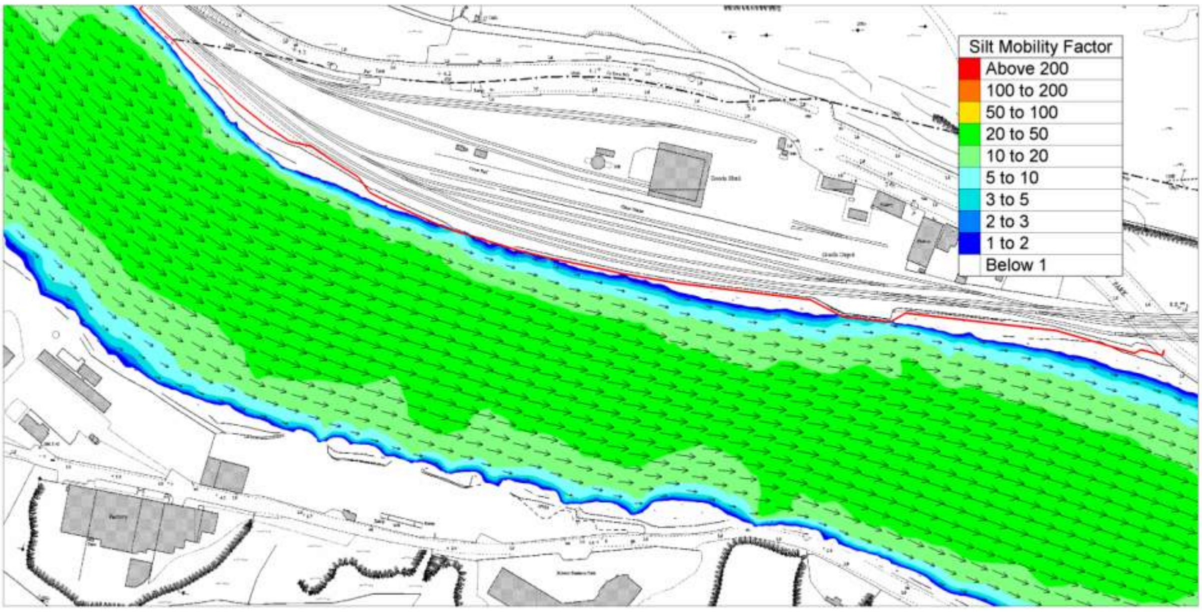

Figure 3-33 Fine Silt Mobility Factor at Mid-Ebb Spring Tide– proposed case

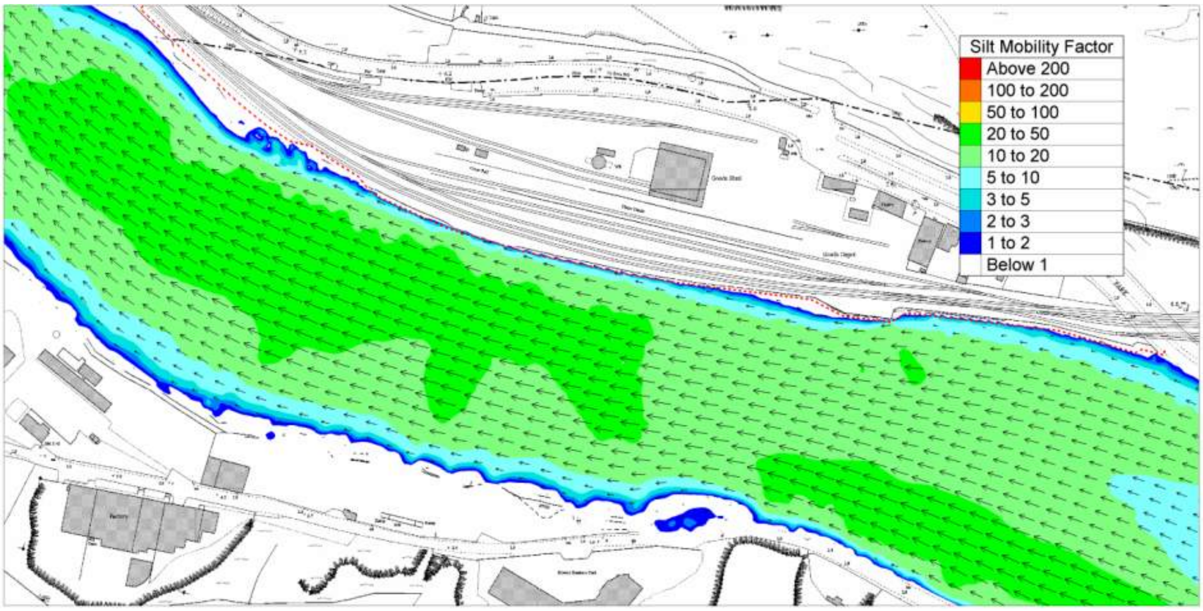

Figure 3-34 Fine Silt Mobility Factor at Mid-Flood Spring Tide – existing case

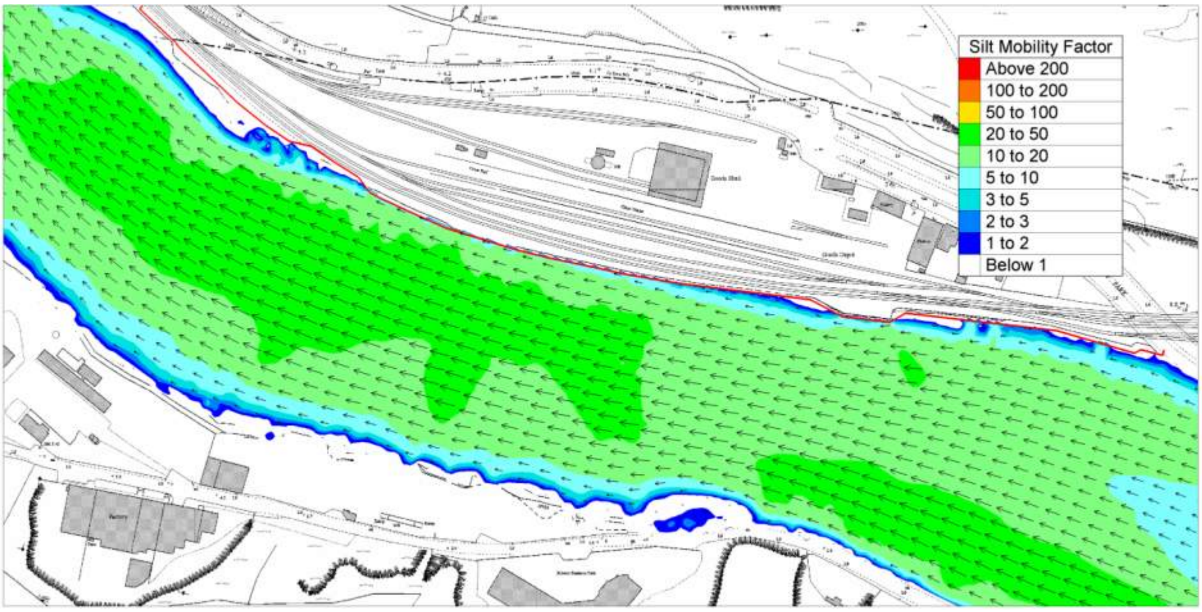

Figure 3-35 Fine Silt Mobility Factor at Mid-Flood Spring Tide– proposed case

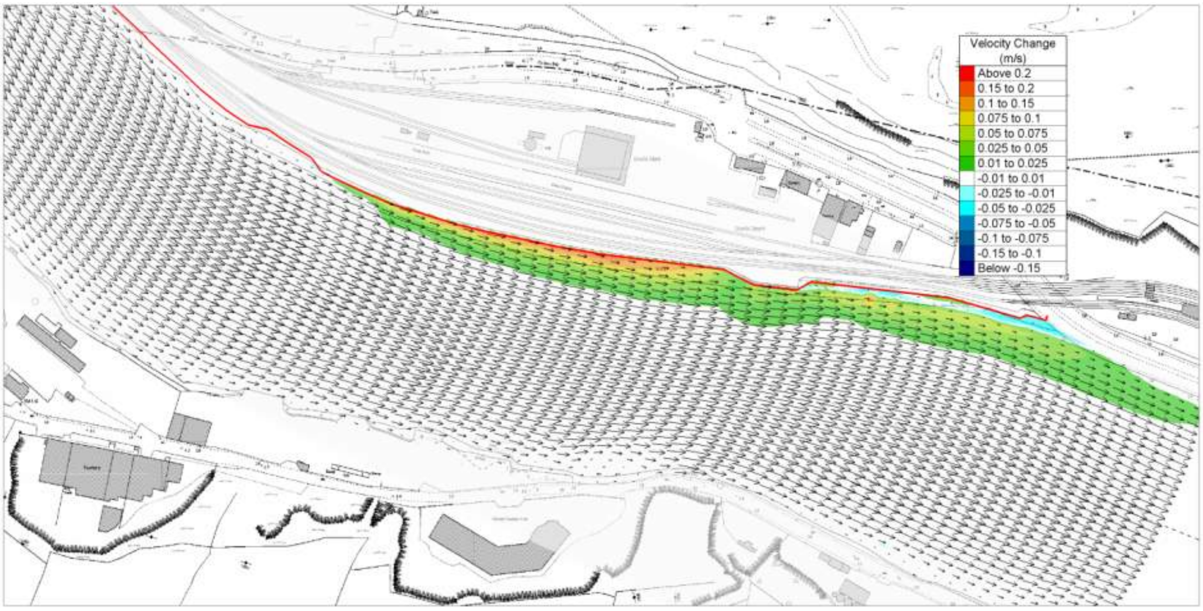

Figure 3-36 Computed change in velocity magnitude ebbing tide for a 200year return period storm surge event

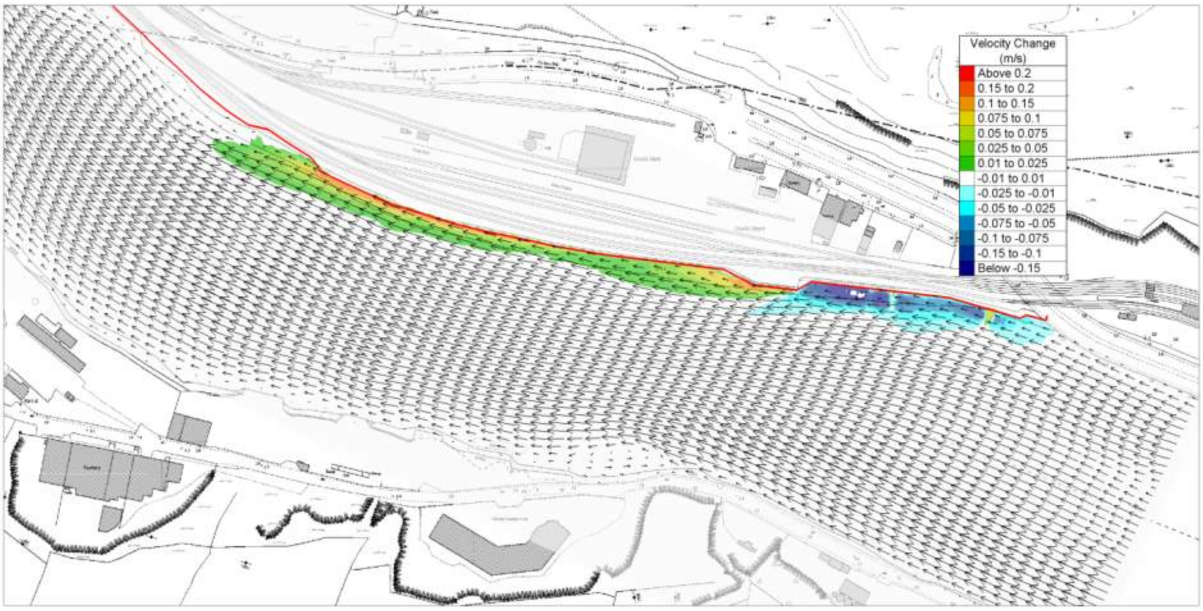

Figure 3-37 Computed change in velocity magnitude flooding tide for a 200year return period storm surge event

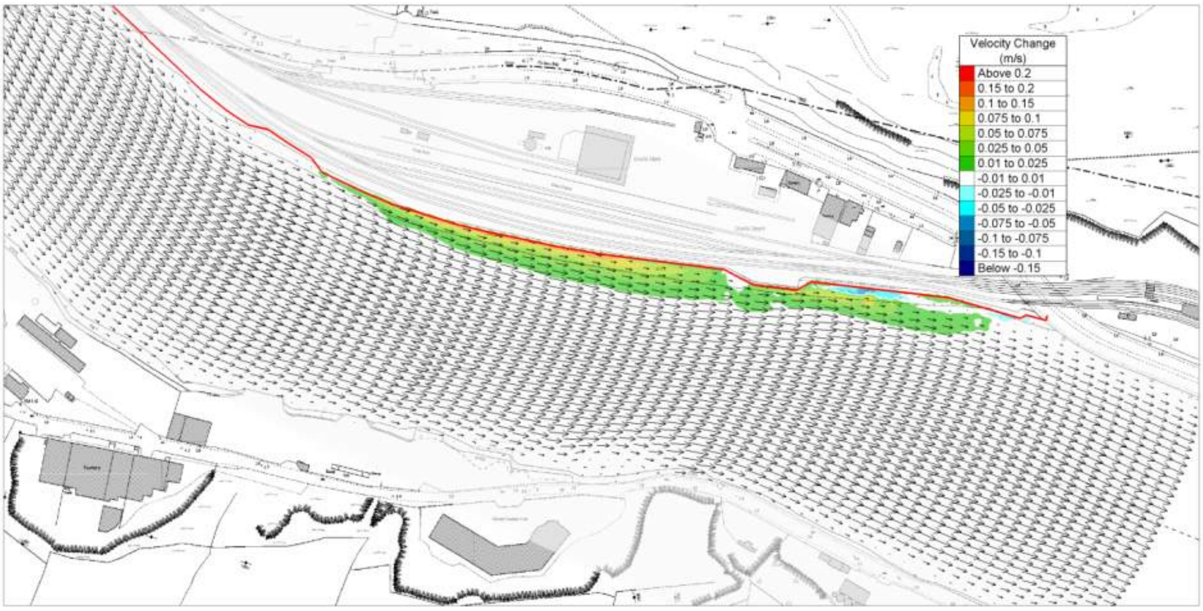

Figure 3-38 Computed change in velocity magnitude ebbing tide for a 100year return period river flood event coinciding with a high spring tide

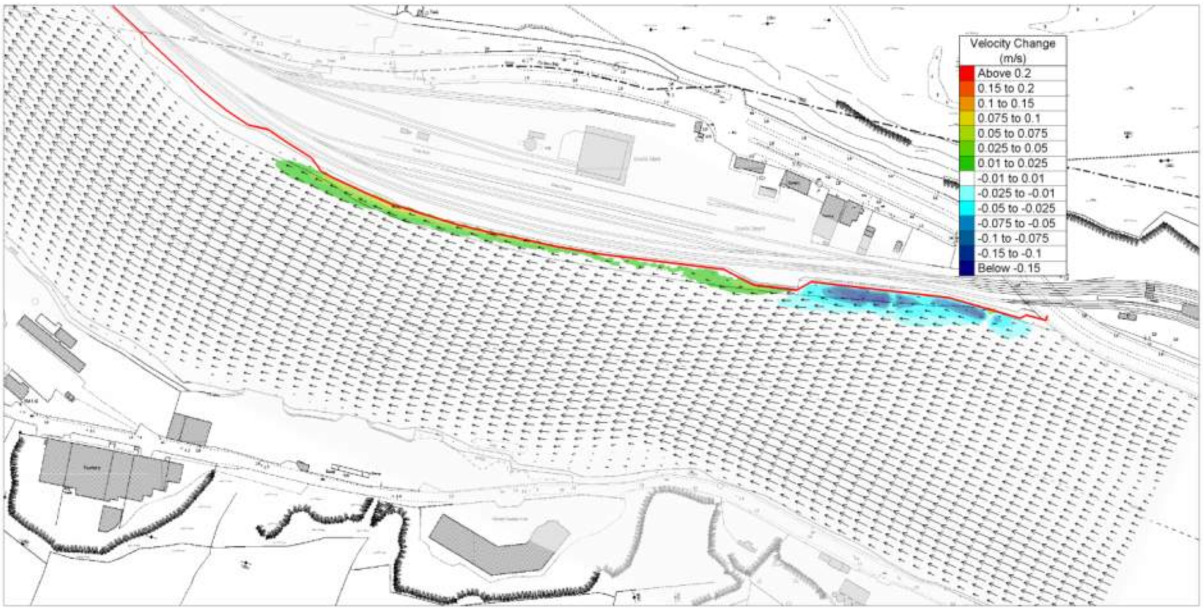

Figure 3-39 Computed change in velocity magnitude flooding tide for a 100year return period river flood event coinciding with a high spring tide

4. CONCLUSIONS

A hydrodynamic assessment was performed on the proposed sheet piled flood wall associated with the proposed Waterford City and County Council Flood Defences West Scheme to assessment the potential implications on scouring within the River Suir Estuarine channel. A local Telemac2d model was developed for this purpose with a high-resolution variable mesh. Pre-development and post -development models were developed using the same mesh structure to minimise numerical error in comparing hydrodynamic results.

A high-resolution bathymetric survey of the estuarine channel was conducted by Murphy Surveys Ltd. to provide recent bed elevations for input to the hydrodynamic model. The two-dimensional local model was driven by a 1-dimensional model that covered the entire tidal zone from Open Sea at Waterford Harbour Mouth and extending up the full Barrow, Nore and Suir tidal reaches so as to ensure correct tidal flows and elevations are computed for driving the local 2-d model.

The hydrodynamic model examined normal river flow and tidal conditions, both spring and neap tides and also the more extreme flood events associated with tidal storm surges and fluvial flood events in the River. The effect of the proposed flood defence wall and associate storm outfall structures (3 No. storm outfall) will generally increase flows along the bank in the vicinity of the vertical Flood Wall over the existing case.

The hydrodynamic simulations both normal tidal conditions and extreme flood events show an increase in velocity magnitude along the middle section of the flood wall alignment on both ebb and flood flows and a reduction in velocity locally in the vicinity of the outfall structures. The higher increases in velocity between existing and proposed cases occur on the spring tides and on the flooding tide with a general local increase of 0.05m/s and larger increases along the toe of the Flood wall of 0.075 to 0.1m/s. These local changes are not significant in comparison to the computed baseline velocity magnitudes under the present existing situation. There is no perceptible change in flow velocities in the main, deeper channel section or at the opposite far bankside. The predicted upstream and downstream changes to the flow velocity magnitude at the near bank is local and not very extensive or significant.

The sediment mobility assessment shows that under both existing and proposed cases sufficient velocities are generated on both flooding and particularly ebbing spring tides to mobilise only the fresher unconsolidated fine silts that might at slack tides temporarily deposit along the channel bank in the vicinity of the proposed flood wall. The conclusion reached from this analysis is that the computed velocity increases from the proposed vertical sheet piled wall are relatively small and of insufficient magnitude to produce sufficient shear stresses (i.e. generally <0.7Pa) that would result in any potential significant erosion of the permanent consolidated sediments /muds on the channel bed and banks in the vicinity of the affected area.

The proposed storm outfalls and extension towards the channel bank edge associated with the proposed defences are shown due to their raised bed elevation at their soffit and outfall wing walls and apron to reduce the tidal velocities on the ebbing and flooding tides at the bank immediately local to the outfalls. These works do not result in any noticeable increases in flow velocities elsewhere. The construction of these outfalls will involve temporary sheet piling cofferdams to protect construction activities at each outfall. The effect of these cofferdams will be to result in a similar pattern as the permanent outfalls in respect to local reduction in velocities but over the complete tidal cycle. Such localised sheltering is likely to give rise to a local increase in the deposition rate of silt at the channel bank immediately in the wake of the outfalls.

CONTACT

ROUGHAN & O'DONOVAN CONSULTING ENGINEERS

Arena House
Arena Road
Sandyford
Dublin 18
D18 V8P6
Ireland

Phone +353 1 294 0800