SECTION 11: Biodiversity

11.1 Introduction

11.1.1 Background

This Section of the EIAR assesses the potential impacts (and resulting effects) likely to occur as a result of the Proposed Castletroy Wastewater Treatment Plant (WwTP) Upgrade Project on the receiving environment, in terms of biodiversity. Furthermore, it outlines the measures required to prevent significant impacts and considers achievement of No Net Loss of biodiversity with a view to Biodiversity Net Gain, in line with Irish Water biodiversity policy IW-AMT-POL-013 and guidance – *Biodiversity Guidance for Irish Water Developments.*

The Proposed Development involves upgrades to the existing Castletroy Wastewater Treatment Plant to increase treatment capacity from 45,000 PE (design capacity) to 77,500 PE, with provision made in the infrastructural development of the plant (i.e. tank sizing and pipework) for the 25-year growth projections of 81,100PE. The Proposed Development will include the addition of stormwater storage and improved treatment processes at the Plant. Further details on the elements of the Proposed Development are found in introductory chapters of this EIAR.

Castletroy WwTP is located in the suburb of Castletroy, County Limerick (Grid Ref: R 60761 58471), approximately 800m northwest of the University of Limerick and 4km east of Limerick City Centre. The site is located along the south bank of the Lower River Shannon which is a Special Area of Conservation as designated under the EU Habitats Directive. The Treatment Plant discharges via an outfall located within the main channel of the Lower River Shannon, approximately 75m from the site boundary.

The impact assessment includes an accurate description of all aspects of the proposed development during construction, operation and decommissioning (where relevant). It then provides a comprehensive description of the baseline ecological environment, which is based on an appropriate level of survey work that was carried out in accordance with the most appropriate guidelines and methodologies. The chapter then completes a thorough assessment of the impacts of the proposed development on biodiversity. Where likely ecologically significant effects are identified, measures are prescribed to avoid or minimise or compensate for such effects.

11.1.2 Statement of Authority

Baseline ecological surveys were undertaken on the 6th of April 2022 by Rachel Walsh (BSc. Env), on the 3rd of February 2022 by Neansaí O' Donovan (B.Sc., QCIEEM), on the 21st of January 2022 by Aran von der Geest Moroney (B.Sc., QCIEEM) and on the 23rd of July 2020 by Claire Stephens (BSc. Env.) of MKO. This report has been prepared by Rachel Walsh. The report has been reviewed by Pat Roberts (B.Sc., MCIEEM) who has over 16 years' experience in ecological assessment.

11.1.3 Relevant Guidance

The guidelines listed below were consulted in the preparation of this document to provide the scope, structure and content of the assessment:

- Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater, Coastal and Marine (CIEEM 2018, updated 2022).
- Guidelines on the information to be contained in Environmental Impact Statements (EPA, 2022).

- Environmental Impact Assessment of National Road Schemes –A Practical Guide (NRA, 2009).
- Guidelines for assessment of Ecological Impacts of National Road Schemes, (NRA, 2009).
- Environmental Assessment and Construction Guidelines (NRA, 2006).

11.2 Assessment Methodology

An Appropriate Assessment has been undertaken with regard to the European Sites in the Likely Zone of Impact and these have been assessed in a separate Natura Impact Statement report prepared by MKO (2022).

The following sections describe the methodologies followed to establish the baseline ecological condition of the proposed development site and surrounding area. Assessing the impacts of any project and associated activities requires an understanding of the ecological baseline conditions prior to and at the time of the project proceeding. Ecological Baseline conditions are those existing in the absence of proposed activities (CIEEM, 2018).

11.2.1 Desk Study

A comprehensive desk study was undertaken to inform this ecological impact assessment. This study includes a thorough review of available information that is relevant to the ecology of the site of the proposed development. This information provides valuable existing data and also helps in the assessing the requirement for additional ecological surveys.

The following list describes the sources of data consulted:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), Environmental Protection Agency (EPA);
- Review of the publicly available National Biodiversity Data Centre web-mapper;
- Review of specially requested records from the NPWS Rare and Protected Species Database; for the hectad in which the Proposed Development is located; and
- Review of NPWS Article 17 Metadata and GIS Database Files.

11.2.2 Multi-disciplinary Ecological Walkover Surveys

Habitat and Invasive Species Surveys

Habitat and Invasive Species surveys were conducted on the 6th of April 2022 and the 23rd of July 2020 in line with NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes) by MKO. The ecological surveys were undertaken within the optimal time of year to undertake a habitat and flora survey (Smith *et al.* 2011). The proposed construction works are restricted to within the boundary of the existing wastewater treatment plant site. No works are proposed at the existing discharge point from the Plant which consists of three outfall pipes extending 75m into the main channel of the Lower River Shannon .

All habitats within and adjacent to the works area were readily identifiable during the site visit. A dedicated invasive species survey was also undertaken during the site visit. During the survey, the site was searched for species listed on the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations (S.I. 477 of 2011).

Habitats were identified in accordance with the Heritage Council's *'Guide to Habitats in Ireland'* (Fossitt, 2000). Habitat mapping was undertaken with regard to guidance set out in *'Best Practice Guidance for Habitat Survey and Mapping'* (Smith *et al.*, 2011). Plant nomenclature for

vascular plants follows *'New Flora of the British Isles'* (Stace, 2019), while mosses and liverworts nomenclature follows *'Mosses and Liverworts of Britain and Ireland - a field guide'* (British Bryological Society, 2010).

The walkover survey was designed to detect the presence, or likely presence, of a range of protected species. Habitats considered to be of ecological significance and having the potential to correspond to those listed in Annex I of the EU Habitats Directive 92/43/EEC were not identified during the walkover survey. The multidisciplinary walkover survey comprehensively covered the entire study area of the wastewater treatment plant facility and adjacent habitats.

Otter Survey

A dedicated otter survey was carried out by Rachel Walsh (BSc. Env) on the 6th of April 2022. The survey was carried out in accordance with NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes) and NRA (2009) Guidelines for the Treatment of Otter During Construction of National Road Schemes. A search was carried out along drain ditches adjacent to the development site, as well as the nearby mill race channel, wooded areas, and both 150m upstream and downstream of the development site, along the banks of the Lower River Shannon . The survey included a search for holts, couches, slides, spraints, prints and feeding remains.

Badger Survey

Badger surveys were carried out at the site on the 21st of January 2022 by Aran von der Geest Moroney (B.Sc., QCIEEM) of MKO, and the 3rd of February 2022 by Neansaí O' Donovan (B.Sc., QCIEEM) of MKO.

The surveys adhered to the guidance as set out in Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Roads Schemes (NRA 2009) and Guidelines for the Treatment of Badgers prior to the Construction of National Road Schemes (NRA 2006).

The survey included a search of the wastewater treatment plant site and the perimeter of the University of Limerick carpark on the opposite side of the WwTP boundary, and focused on signs of Badger activity, including identification of potential habitat areas likely to be of significance to badger.

The Badger survey involved a search for all potential Badger signs as per NRA 2009 (latrines, badger paths and setts) and Scottish Natural Heritage (SNH) (2003):

- Faeces: Badgers usually deposit faeces in characteristic excavated pits, concentrations of which (latrine sites) are typically found at home range boundaries.
- Setts, comprising either single isolated holes or a series of holes, likely to be interconnected underground.
- Paths between setts or leading to feeding areas.
- Scratching posts at the base of tree trunks.
- Snuffle holes (small scrapes where Badgers have searched for insects, earthworms and plant tubers).
- Day nests (bundles of grass and other vegetation where Badgers may sleep above ground).
- Hair traces.
- Prints

Three trail cameras were deployed at the sett entrances between 21st January and 3rd of February 2022.

Bat Habitat Appraisal

During the multidisciplinary walkover survey, the trees within the proposed development site and in woodland areas adjacent to the site boundary were assessed for their suitability for bats according to *Collins, J. (ed.) (2016) Bat Surveys for professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London,* which provides a grading protocol for roosting habitats and for commuting and foraging areas. Suitability categories are divided into *High, Moderate, Low* and *Negligible*.

11.2.3 Survey Limitations

The ecological surveys were undertaken within the optimal time of year to undertake a habitat and flora survey (Smith et al. 2011). The proposed works are restricted to the existing water treatment plant site and all habitats within and adjacent to the works area were readily identifiable during the site visits. A full and comprehensive survey was achieved.

11.2.4 Methodology for Assessment of Impacts and effects

Determining Importance of Ecological Receptors

The importance of the ecological features identified within the study area was determined with reference to a defined geographical context. This was undertaken following a methodology that is set out in Chapter 3 of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular receptor is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The Guidelines clearly set out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significance and of any importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna. Specific criteria for assigning each of the other levels of importance are set out in the guidelines and have been followed in this assessment. Where appropriate, the geographic frame of reference set out above was adapted to suit local circumstances. In addition, and where appropriate, the conservation status of habitats and species is considered when determining the significance of ecological receptors.

Any ecological receptors that are determined to be of Local Importance (Higher Value), County, National or International importance following the criteria set out in NRA (2009) are considered to be Key Ecological Receptors (KERs) for the purposes of ecological impact assessment if there is a pathway for effects thereon. Any receptors that are determined to be of Local Importance (Lower Value) are not considered to be Key Ecological Receptors.

Characterisation of Impacts and Effects

The proposed development will result in a number of impacts. The ecological effects of these impacts are characterised as per the CIEEM 'Guidelines for Ecological Impact Assessment in the UK and Ireland (2018). The headings under which the impacts are characterised follow

those listed in the guidance document and are applied where relevant. A summary of the impact characteristics considered in the assessment is provided below:

- **Positive or Negative.** Assessment of whether the proposed development result in a positive or negative effect on the ecological receptor.
- **Extent.** Description of the spatial area over which the effect has the potential to occur.
- **Magnitude** to size, amount, intensity and volume. It should be quantified if possible and expressed in absolute or relative terms e.g. the amount of habitat lost, percentage change to habitat area, percentage decline in a species population.
- **Duration** is defined in relation to ecological characteristics (such as the lifecycle of a species) as well as human timeframes. For example, five years, which might seem short-term in the human context or that of other long-lived species, would span at least five generations of some invertebrate species.
- **Frequency and Timing.** This relates to the number of times that an impact occurs and its frequency. A small-scale impact can have a significant effect if it is repeated on numerous occasions over a long period.
- **Reversibility.** This is a consideration of whether an effect is reversible within a 'reasonable' timescale. What is considered to be a reasonable timescale can vary between receptors and is justified where appropriate in the impact assessment section of this report.

Determining the Significance of Effects

The ecological significance of the effects of the proposed development are determined following the precautionary principle and in accordance with the methodology set out in Section 5 of CIEEM (2018).

For the purpose of EcIA, 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national/local nature conservation policy) or more wide-ranging (enhancement of biodiversity). Effects can be considered significant at a wide range of scales from international to local (CIEEM, 2018).

When determining significance, consideration is given to whether:

- Any processes or key characteristics of key ecological receptors will be removed or changed;
- There will be an effect on the nature, extent, structure and function of important ecological features;
- There is an effect on the average population size and viability of ecologically important species; and/or
- There is an effect on the conservation status of important ecological habitats and species.

The EPA draft guidelines on information to be included in Environmental Impact Statements (EPA, 2017) and the *Guidelines for assessment of Ecological Impacts of National Road Schemes*, (NRA, 2009) were also considered when determining significance and the assessment is in accordance with those guidelines.

The terminology used in the determination of significance follows the suggested language set out in the Draft EPA Guidelines (2017) as shown in Table 11.1 below.

Table 11.1: Criteria for determining significance of effect, based on (EPA, 2017) guidelines.

Effect Magnitude	Definition
No change	No discernible change in the ecology of the affected feature.
Imperceptible effect	An effect capable of measurement but without noticeable consequences.
Not Significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
Slight effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities.
Moderate effect	An effect that alters the character of the environment that is consistent with existing and emerging trends.
Significant effect	An effect which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment.
Very Significant	An effect which, by its character, magnitude, duration or intensity significantly alters most of a sensitive aspect of the environment.
Profound effect	An effect which obliterates sensitive characteristics.

As per TII (NRA, 2009) and CIEEM (2019, updated 2021) best practice guidelines the following key elements should also be examined when determining the significance of effects:

1. The likely effects on 'integrity' should be used as a measure to determine whether an impact on a site is likely to be significant (NRA, 2009)

2. A 'significant effect' is an effect that either supports or undermines biodiversity conservation objectives (CIEEM, 2019)

Integrity

According to *Guidelines for Assessment of Ecological Impacts of National Road Schemes* (NRA 2009), in the context of EcIA, 'integrity' refers to the coherence of the ecological structure and function, across the entirety of a site, that enables it to sustain all of the ecological resources for which it has been valued. Impacts resulting in significant changes to the nature, extent, structure and function of component habitats and effects on the average population size and viability of component species, would affect the integrity of a site, if it changes the condition of the ecosystem to unfavourable.

Conservation status

An impact on the conservation status of a habitat or species is considered to be significant if it will result in a change in conservation status. According to CIEEM (2019) guidelines the definition for conservation status in relation to habitats and species are as follows:

- Habitats – conservation status is determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area

- Species – conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area.

As defined in the EU Habitats Directive 92/43/EEC, the conservation of a habitat is favourable when:

- Its natural range, and areas it covers within that range, are stable or increasing;
- The specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and/or
- The conservation status of its typical species is favourable.

The conservation of a species is favourable when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- The natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and/or
- There is and will probably continue to be, a sufficiently large habitat to maintain its population on a long-term basis.

According to the NRA/CIEEM methodology, if it is determined that the integrity and/or conservation status of an ecological feature will be impacted on, then the level of significance of that impact is related to the geographical scale at which the impact will occur (i.e. local, county, national, international).

11.3 Baseline Conditions

11.3.1 Desk Study

Designated Sites

Special Areas of Conservation (SACs) and Special Protection Areas for Birds (SPAs) are sites preserved for nature conservation as designated under the European Habitats Directive and are collectively known as 'Natura 2000 or European Sites'. The potential for effects on European Sites is fully considered in the AA Screening Report and Natura Impact Statement that accompanies this application. The European Sites that are within the Zone of Likely Impact are considered under the Appropriate Assessment process and are listed in the AASR and NIS which accompany this application. The Article 6(3) Appropriate Assessment Screening report identified the potential for the proposed development to result in significant effects on the following European Sites:

- Lower River Shannon SAC [002165]
- Lower River Shannon and River Fergus Estuaries SPA [00407]

The EPA Guidance (2022) states *"A biodiversity section of an EIAR, for example, should not repeat the detailed assessment of potential effects on European sites contained in documentation prepared as part of the Appropriate Assessment process, but it should refer to the findings of that separate assessment in the context of likely significant effects on the environment, as required by the EIA Directive."*

Therefore, the assessment of impacts on European Sites is not repeated here. However, Section 11.4.4 provides a summary of the key assessment findings with regard to European Designated Sites.

The potential for impacts on Nationally Designated Sites is considered in this chapter. Natural Heritage Areas (NHAs) are designated under the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in this EcIA.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in this EcIA.

The following methodology was used to establish which nationally designated sites have the potential to be impacted by the proposed development:

- Initially the most up to date GIS spatial datasets for all nationally designated sites and water catchments were downloaded from the NPWS website (www.npws.ie) and the EPA website (www.epa.ie) on the 06/05/2022. The datasets were utilized to identify Designated Sites which could feasibly be affected by the proposed development.
- All Nationally Designated Sites that could potentially be affected were identified using a source-pathway - receptor model and a map of all the Nationally Designated Sites around the Development Site is provided in 11.1.
- Catchment mapping was used to establish or discount potential hydrological connectivity between the site of the proposed development and any Nationally Designated Sites. The hydrological catchments are also shown in Figure 11.1.Table **11.2** provides details of all relevant Nationally Designated Sites as identified in the preceding steps and assesses which, if any, are within the likely Zone of Impact.
- The site synopses for these sites, as per the NPWS website (www.npws.ie), were consulted and reviewed at the time of preparing this report.

Figure 11-1: Nationally Designated Sites. (Full map in Appendix 11A, Fig 11-1)

Table 11.2: Nationally Designated Sites.

Designated Sites and distance from proposed development	Likely Zone of Impact Determination
Natural Heritage Areas (NHA)	
Woodcock Hill Bog NHA [002402] **Distance**: 8.2km	There will be no direct effects as the proposed development is located entirely outside of this designated site. There is no source-pathway-receptor chain for effect as the designated site is within a separate hydrological catchment to the development site. There is no potential for indirect effect. **No pathway for impact was identified and the site is not within the Likely Zone of Impact.**
Gortacullin Bog NHA [002401] **Distance:** 12.6km	There will be no direct effects as the proposed development is located entirely outside of this designated site. There is no source-pathway-receptor chain for effect as the designated site is located upgradient of the development site and is designated for terrestrial habitats. There is no potential for indirect effect. **No pathway for impact was identified and the site is not within the Likely Zone of Impact.**
Doon Lough NHA [000337] **Distance:** 14.7km	There will be no direct effects as the proposed development is located entirely outside of this designated site. There is no source-pathway-receptor chain for effect as the designated site is within a separate hydrological catchment to the development site. There is no potential for indirect effect. **No pathway for impact was identified and the site is not within the Likely Zone of Impact.**
Proposed Natural Heritage Areas (pNHA)	
Fergus Estuary and Inner Shannon, North Shore [002048] **Distance:** 3.0km	There will be no direct impact as the proposed development is located entirely outside the designated sites. Taking a precautionary approach, the Proposed Development works have the potential to cause deterioration of water quality of the designated site. The pNHA is located approximately 3km downstream of the proposed WwTP upgrade works via the Lower River Shannon . **The pNHA is considered to be within the Likely Zone of Impact and further assessment is required.**
Cloonlara House [000028] **Distance**: 3.5km	There will be no direct impact as the proposed development is located entirely outside the designated sites. This bat site is located in a three-storey domestic dwelling house and contains over l00 Leisler's Bats (*Nyctalus leisleri*) during the summer months. According to Bat Conservation Trust – *Bat Surveys for Professional Ecologists* (Collins 2016), Leisler's bats have a Core Sustenance Zone (CSZ) of 3km from the roost. Due to the intervening distance of 3.5km between the development site and the pNHA, the bat roost is unlikely to be affected by the proposed development. Moreover, Leisler's bats are known to fly higher than other Irish species. Due to the small scale and nature of the proposed development and the intervening distance between the pNHA and the development site, there is no potential for indirect effect. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**
Knockalisheen Marsh [002001] **Distance:** 3.5km	There will be no direct impact as the proposed development is located entirely outside the designated sites. There is no downstream hydrological connectivity from the development site to the pNHA. There is no source-pathway-

	receptor chain for impact, therefore the is no potential for indirect effect on the designated site. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**
Castleconnell (Domestic Dwelling, Occupied) [000433] **Distance**: 4.2km	There will be no direct impact as the proposed development is located entirely outside the designated sites. According to Bat Conservation Trust – *Bat Surveys for Professional Ecologists* (Collins 2016), Irish bat species Core Sustance Zone ranges between 1 and 4km from roost sites. Due to the intervening distance between the development site and the pNHA, the bat roost is unlikely to be affected by the proposed development. Due to the small scale and nature of the proposed development and the intervening distance between the pNHA and the development site, there is no potential for indirect effect. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**
Inner Shannon Estuary, South Shore [000435] **Distance**: 4.5km	There will be no direct impact as the proposed development is located entirely outside the designated sites. Taking a precautionary approach, the Proposed Development has the potential to cause deterioration of water quality of the site. The pNHA is located approximately 4.5km downstream of the proposed WwTP upgrade works via the Lower River Shannon. **The pNHA is considered to be within the Likely Zone of Impact and further assessment is required.**
Loughmore Common Turlough [000438] **Distance**: 8.2km	There will be no direct impact as the proposed development is located entirely outside the designated sites. There is no likely significant groundwater flow form the development site to the pNHA. There is no source-pathway-receptor chain for impact, therefore, there is no potential for indirect effect. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**
Glenomra Wood [001013] **Distance**: 8.3km	There will be no direct impact as the proposed development is located entirely outside the designated sites. Due to the terrestrial nature of the pNHAs, the intervening distance between the pNHAs and the development site, and a lack of a source-pathway-receptor chain for impact, there is no potential for indirect effects on these sites.. **No pathway for impacts was identified and these sites are not within the Likely Zone of Impact.**
Garrannon Wood [001012] **Distance**: 10.9km	
Clare Glen [000930] **Distance**: 12.2km	
Glenstal Wood [001432] **Distance**: 12.7km	
Skoolhill [001996] **Distance:** 13.3km	
Ballyvorheen Bog [001849] **Distance:** 13.6km	There will be no direct impact as the proposed development is located entirely outside the designated sites. Due to the lack of downstream surface water connectivity between the development and the pNHA and the intervening distance, there is no potential for indirect impacts of this site. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**
Castle Lake [000239] **Distance:** 14.9km	There will be no direct impact as the proposed development is located entirely outside the designated sites.

	Due to the lack of hydrological connectivity between the development and the pNHA and the intervening distance, there is no potential for indirect impacts of this site. **No pathway for impacts was identified and the site is not within the Likely Zone of Impact.**

New Flora Atlas

A search was made in the New Atlas of the British & Irish Flora (Preston et al., 2002) to investigate whether any rare or unusual plant species listed as Annex II of the Habitats Directive, which are listed as rare on the Red Data List (Curtis and McGough 1988), or protected under the Flora (Protection) Order 2022, had been recorded in the relevant 10km square in which the study site is situated (R65) (shown in Figure 11.2), during the 1987-1999 atlas survey. The results of the search are included in the Table below.

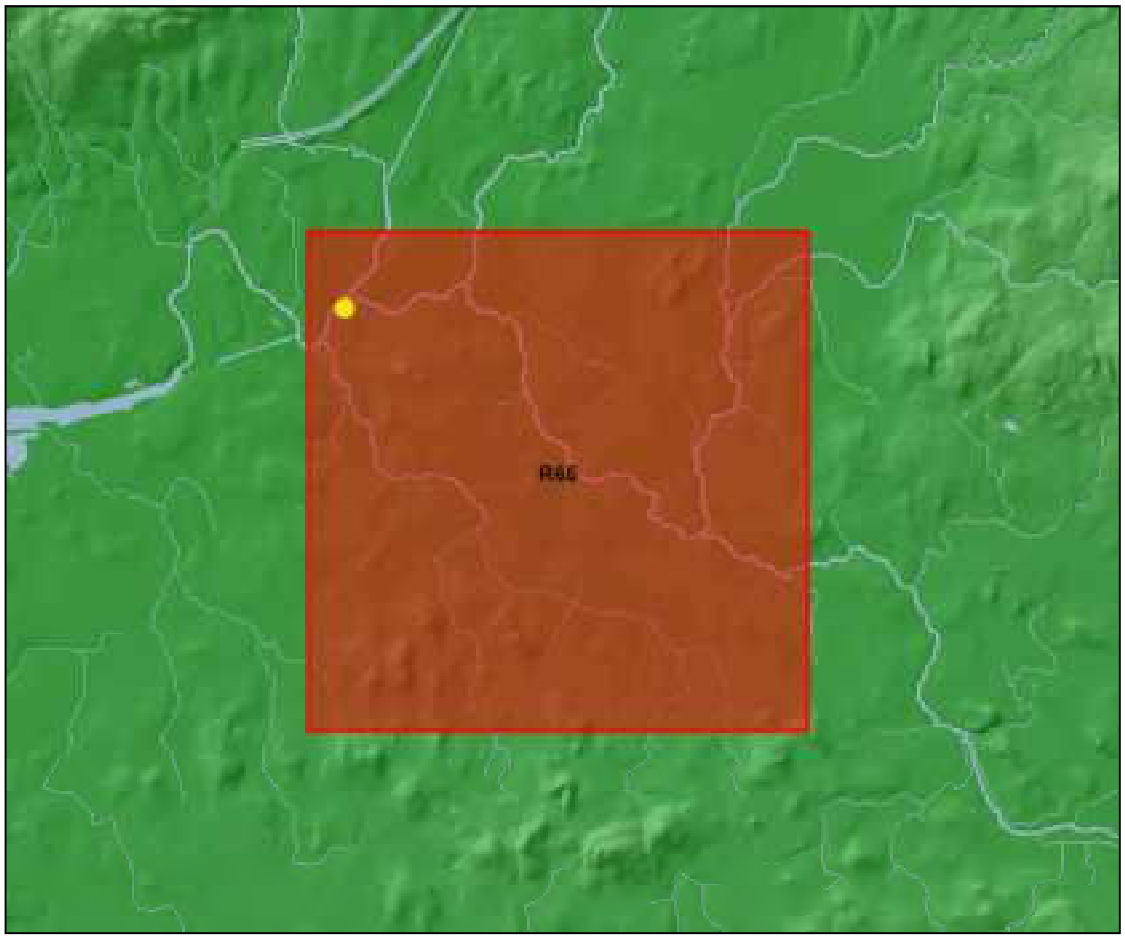

Figure 11-2: Grid Square R65 in relation to Castletroy WwTP (yellow dot). Source: https://maps.biodiversityireland.ie/Map

Table 11.3: Records of species listed under the Flora (Protection) Order 2022 or the Irish Red Data Book for Vascular Plants.

Common Name	Scientific Name	Status
Black Horehound	*Ballota nigra*	RL (NT)
Slender Thistle	*Carduus tenuiflorus*	RL (NT)
Slender Tufted Sedge	*Carex acuta*	RL (NT)
Spiked Sedge	*Carex spicata*	RL (NT)
Corn Marigold	*Chrysanthemum segetum*	RL (NT)

Opposite-Leaved Pondweed	*Groenlandia densa*	FPO; RL (NT)
Tubular Water-Dropwort	*Oenanthe fistulosa*	RL (NT)
Wood Clubrush	*Scirpus sylvaticus*	RL (NT)
Annual Knawel	*Scleranthus annuus*	FPO; RL (VU)

RL – Red Listed
NT – Near Threatened
VU – Vulnerable
FPO – Flora Protection Order

Biodiversity Ireland Database

The National Biodiversity Data centre database was accessed on 02/11/2022 and the following information was obtained. Table 11.4 lists the protected faunal species (excluding birds) recorded within the hectad which pertains to the current study area (R65) (Figure 11.1). The database was also searched for records of Third Schedule non-native invasive species within the hectad. Table 11.5 lists the non-native invasive species recorded within the hectad. Table 11.7 lists all the protected bird species recorded within the hectad which pertains to the current study area.

Table 11.4: NBDC records for protected flora/ fauna records (excl. birds) for hectad R65

Common Name	Scientific Name	Status
Marsh Fritillary	*Austropotamobius pallipes*	Annex IV, V; WA
Hedgehog	*Erinaceus europaeus*	WA
Smooth Newt	*Lissotriton vulgaris*	WA
Otter	*Lutra lutra*	Annex II, IV; WA
Pine Marten	*Martes martes*	Annex V; WA
Badger	*Meles meles*	WA
Daubenton's Bat	*Myotis daubentonii*	Annex IV; WA
Leisler's Bat	*Nyctalus leisleri*	Annex IV; WA
Common Pipistrelle Bat	*Pipistrellus pipistrellus*	Annex IV; WA
Soprano Pipistrelle Bat	*Pipistrellus pygmaeus*	Annex IV; WA
Brown Long-Eared Bat	*Plecotus auritus*	Annex IV; WA
Common Frog	*Rana temporaria*	Annex V; WA
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Annex II, IV; WA
Red Squirrel	*Sciurus vulgaris*	WA
Pygmy Shrew	*Sorex minutus*	WA
Common Lizard	*Zootoca vivipara*	WA
Freshwater White-clawed Crayfish	*Austropotamobius pallipes*	Annex II, Anex V, WA
Slender Tufted Sedge	*Carex acuta*	RL (NT)

Annex II, Annex IV, Annex V – Of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2021) FPO= Flora Protection Order.

Table 11.5: NBDC records for Invasive species for hectad R65.

Common Name	Scientific Name
Three Cornered Garlic	*Allium triquetrum*
Greylag Goose	*Anser answer*
Water Fern	*Azolla filiculoides*
Fallow Deer	*Dama dama*
Canadian Waterweed	*Elodea canadensis*
Nuttall's Waterweed	*Elodea nuttallii*
Japanese Knotweed	*Fallopia japonica*
Giant Knotweed	*Fallopia sachalinensis*
Giant Hogweed	*Heracleum mantegazzianum*
Indian Balsam	*Impatiens glandulifera*
Dace	*Leuciscus leuciscus*
Brown Rat	*Rattus norvegicus*
Grey Squirrel	*Sciurus carolinensis*

Table 11.6: NBDC Records for Birds for hectad R65

Common Name	Scientific Name	Status
Little Egret	*Egretta garzetta*	Annex I EU Birds Directive
Corn Crake	*Crex crex*	Annex I EU Birds Directive Red List
Golden Plover	*Pluvialis apricaria*	
Kingfisher	*Alcedo atthis*	Annex I, EU Birds Directive, Amber List
Whooper Swan	*Cygnus cygnus*	
Meadow Pipit	*Anthus pratensis*	Red List
Swift	*Apus apus*	
Tufted Duck	*Aythya fuligula*	
Stock Dove	*Columba oenas*	
Yellowhammer	*Emberiza citronella*	
Snipe	*Gallinago gallinago*	
Black-Headed Gull	*Larus ridibundus*	
Grey Wagtail	*Motacilla cinerea*	

Curlew	*Numenius arquata*	
Woodcock	*Scolopax rusticola*	
Barn Owl	*Tyto alba*	
Lapwing	*Vanellus vanellus*	
Common Sandpiper	*Actitis hypoleucos*	Amber List
Skylark	*Alauda arvensis*	
Teal	*Anas crecca*	
Greylag Goose	*Anser anser*	
Mute Swan	*Cygnus olor*	
House Martin	*Delichon urbicum*	
Robin	*Erithacus rubecula*	
Kestrel	*Falco tinnunculus*	
Coot	*Fulica atra*	
Swallow	*Hirundo rustica*	
Common Gull	*Larus canus*	
Lesser Black-Backed Gull	*Larus fuscus*	
Great Black-Backed Gull	*Larus marinus*	
Jack Snipe	*Lymnocryptes minimus*	
Spotted Flycatcher	*Muscicapa striata*	
Northern Wheateater	*Oenanthe oenanthe*	
House Sparrow	*Passer domesticus*	
Cormorant	*Phalacrocorax carbo*	
Goldcrest	*Regulus regulus*	
Sand Matin	*Riparia riparia*	
Starling	*Sturnus vulgaris*	
Little Grebe	*Tachybaptus ruficollis*	
Mistle Thrush	*Turdus viscivorus*	

Annex I – Of EU Birds Directive, Red List, Amber List – Birds of Conservation Concern in Ireland.

NPWS Data

A data request was sent to the NPWS and data received in relation to the grid square R65 (Figure 11.1) on the 07.12.2021. Table 11.7 lists the rare and protected species records obtained from the NPWS during this study. According to NPWS records, here are no records of Lesser Horseshoe bat roosts within 3km of the development site.

Table 11.7: Records for rare and protected species, NPWS.

Common Name	Scientific Name	Status
Kingfisher	*Alcedo atthis*	Annex I
River Lamprey	*Lampetra fluviatilis*	Annex II, IV
Smooth Newt	*Lissotriton vulgaris*	WA
Sea Lamprey	*Petromyzon marinus*	Annex II
Common Frog	*Rana temporaria*	Annex V; WA
Common Lizard	*Zootoca vivipara*	WA
Irish Hare	*Lepus timidus subsp. hibernicus*	Annex V; WA
European Otter	*Lutra lutra*	Annex II, IV; WA
Eurasian Badger	*Meles meles*	WA
Irish Stoat	*Mustela erminea subsp. hibernica*	WA
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	Annex II, IV; WA
Spiked Sedge	*Carex spicata*	RL (NT)
Opposite-leaved Pondweed	*Groenlandia densa*	RL (NT)
Darnel	*Lolium temulentum*	RL (EN)

Annex II, Annex IV, Annex V – Of EU Habitats Directive, WA – Irish Wildlife Acts (1976-2021), Red Data List (Curtis and McGough 1988), BoCCI Red List – Birds of Conservation Concern in Ireland (Population for which the species is red listed in brackets), AEWA -Agreement on the Conservation of African-Eurasian Migratory Waterbirds [1999].

Water Quality

The existing discharge point from the WwTP includes three outfall pipes which exit the final effluent inspection chamber. These outfall pipes extend approximately 75m into the main river channel and each is fitted with 2 no. diffuser heads. The diffuser heads have 4 no. legs to disperse discharge and enhance mixing with the river flow.

During normal weather conditions the final effluent consists of treated discharge from the WwTP process (SW-1). Due to the lack stormwater storage on site, screened stormwater from the inlet works (SW-4), and an upstream unscreened emergency overflow (EO), flow directly to the final effluent chamber, where they are mixed with treated effluent before discharging to the Lower River Shannon.

Water quality has been assessed as part of **Section 14**, Water. A summary of baseline findings is provided below.

WFD Waterbody Status

The EPA GIS Application (EPA Maps) and Catchments.ie were reviewed in order to establish a baseline on existing receiving water quality (accessed 21/10/2022). The outfall point for effluent discharge from Castletroy WwTP is located in the Shannon River (Lower), European Code IE_SH_25S012600. Table 14.10 below provides a summary of WFD Waterbody Status attributes for the Lower River Shannon (Lower) (EPA Code: 25S01) and main tributaries upstream of the Castletroy WwTP site.

Results from surveys carried out between 2013 and 2018, class the reach as 'moderate' WFD water quality status. It was also assigned a WFD risk score 1a in 2008, which indicates the waterbody is at risk of not achieving 'good' status.

Biological Q values upstream of the WwTP are also an indicator of receiving water quality. Most recent Q values were recorded 2021. Results for upstream monitoring points in the Shannon, Mulkear and Blackwater rivers range from 'poor' to 'good' ecological status.

Table 11.8: Lower River Shannon WFD Waterbody Status Attributes

WFD Waterbody Status	
River Waterbody Code	IE_SH_25S012600
Protected Area	Yes
WFD Risk (3rd cycle)	Under review
WFD Status (2016-2021)	Moderate
Sub catchment	Shannon [Lower]_SC_090
Pressures	No Significant Pressures identified
Q-Values	
9.4km u/s, Shannon (Lower), RS25S012500	Q3, Poor (2021)
4.9km u/s, Mulkear (Limerick), RS25M040590	Q4 Good (2021)
3.6km u/s, Blackwater (Clare), RS25B060250	Q3-4, Moderate(2021)

It has also been noted the Shannon Estuary (Limerick Dock) begins approximately 3km downstream of the outfall point where the river changes into a transitional waterbody with 'good' water quality status.

Water Quality Monitoring Data

Ambient Chemistry Monitoring data was obtained from catchments.ie (accessed 10/08/2022) for the following monitoring stations:

- Upstream of Castletroy WwTP - RS25S012561 'WDLE 21 Shannon BR in UL u/s Castletroy STP'
- Downstream of Castletroy WwTP - 'RS25S012570 'D/S Castletroy UWWTP WDLE22'

Results for the EQS parameters BOD, Ortho-P and Ammonia were analysed.

EQS Compliance

A preliminary assessment of sample results was carried out to establish the baseline water quality upstream (u/s), and downstream (d/s) of the WwTP. The assessment also considers the physiochemical status of the water with regard to corresponding EQS values. High status EQS values are listed for reference in Table 11.9.

Table 11.9: EQS Concentration Limitations (High Status)

Parameter	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
EQS (High/Mean)	1.3	0.025	0.04
EQS (High/95%ile)	2.2	0.045	0.09

Both mean and 95%ile concentrations of BOD, ammonia and ortho-phosphate were calculated for a three-year period , January 2019 to November 2021. U/s and d/s results for both categories are listed in Table 11.10. It can be seen that changes are insignificant between u/s and d/s concentrations for all parameters. The 95%ile results for ammonia show the greatest change, at .01 mg/l or an increase of 18% in the d/s concentration, but it is still safely within the 95%ile EQS range. As expected, the 95%ile ortho-phosphate concentration is higher u/s.

Table 11.10: Baseline Water Quality Monitoring Results (2019-2022)

Baseline Upstream	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
Mean Conc.	1.05	0.016	0.022
95%ile Conc.	1	0.039	0.043
Baseline Downstream			
Mean Conc.	1.06	0.018	0.023
95%ile Conc.	1	0.037	0.053

All sample results for measured concentrations are of WFD High Water Quality Status. This indicates the existing WwTP is not having any significant long-term effect on the receiving water quality and confirms the WwTP is operating safely within the allowable ELVs.

Baseline Waste Assimilative Capacity Assessment

The impact of the final effluent on the Lower River Shannon is dependent on its Waste Assimilative Capacity (WAC). WAC refers to the ability of the river to disperse wastes and pollution without exceeding EQS limits and/or causing harm to the aquatic environment. For the purpose of the baseline assessment, it has been calculated for both median and Q95 flow rates, with respective (high status) mean and 95%ile EQS limits.

U/s and d/s WAC figures have been calculated using measured monitoring data as listed in Table 11.11. The results are displayed as the percentage of total assimilative capacity remaining in the river after loads of the primary waste parameters (kg/day) have been deducted. U/s concentrations (converted to kg/day) reflect how much WAC is already taken up by background contributors to water pollution such as agriculture and urban run-off, and how much remains to accept WwTP effluent load. The rate of change in the d/s results indicates the impact on WAC from the WwTP.

Similar to the findings in measured concentrations, there are no significant differences between u/s and d/s values. The greatest deterioration in capacity appears in 95%ile ammonia results from 52 – 41%, but there is still sufficient remaining WAC d/s. Ortho-phosphate capacity improves downstream in the 95%ile results.

Table 11.11: U/s and d/s WAC Figures

Baseline Upstream	BOD	ortho-P	Ammonia
Mean & Median Flow	19%	36%	45%
95%ile & Q95 Flow	55%	13%	52%
Baseline Downstream			
Mean & Median Flow	18%	28%	42%
95%ile & Q95 Flow	54%	17%	41%

Conclusions from the baseline water quality assessment indicate that water quality in the vicinity of the discharge point is of good standard. Monitoring results for the primary wastewater parameters BOD ammonia and ortho-Phosphate were plotted for a 5-year period (2016-2021) with regard to their relevant Environmental Quality Standards (EQS). Concentrations were typically within the high quality EQS limits, but there were outlier results (spikes) at both upstream and downstream monitoring points, possibly due to high rainfall levels and stormwater runoff. Some of these results were in fact higher upstream than downstream, indicating that background activities such as agriculture and surface run off play a large role in water quality in the area.

Further inspection of 2019-2021 monitoring results confirmed that average concentrations of primary waste water parameters are within High EQS limits. The WwTP is not currently having any significant impact on receiving water quality in terms of increases in d/s concentrations or deterioration in the river's waste assimilative capacity (WAC). It was also observed that the WwTP is producing a final effluent with significantly lower emissions than the allowable ELVs.

Therefore, it can be deduced that there are currently no negative impacts on water quality and aquatic habitats and species as a result of the current discharges from the WwTP.

Inland Fisheries Ireland Data

Inland Fisheries Ireland carried out fish stock surveys of the Shannon Estuary, Fergus Estuary and Limerick Docks in 2014 (Kelly et al. 2014). The Limerick Docks sampling site is approx. 7.5km downstream of Castletroy WwTP. A total of six beach seines, six fyke nets and six beam trawls were deployed in Limerick Docks water body in October 2014.

Limerick Docks

A total of 13 fish species were recorded in Limerick Docks. Flounder was the most abundant species, followed by smelt. In a similar trend to many of the other transitional water surveys, flounder was widespread, being recorded using all three netting methods.

A number of species were newly recorded in the 2014 survey, including lamprey sp., plaice, sand goby, smelt, sprat and thick-lipped grey mullet. Dace, an invasive species to this country, was also newly recorded in 2014. Common goby, pike and salmon were previously caught in 2008 but not captured in the 2014 survey of the Limerick Docks. European eel was also recorded during this survey.

Fish were recorded in the following order of decreasing frequency: Flounder (*Platichthys flesus*), Smelt (*Osmerus eperlanus*), Three-spined stickleback *(Gasterosteus aculeatus),* Roach (*Rutilus rutilus)*, European eel (*Anguilla Anguilla*), Sprat (*Sprattus sprattus*), Dace (*Leuciscus leucisus)* Perch (*Perca fluvialtilis*), Sand goby (*Pomatoschistus minutus*), Brown trout (*Salmo trutta*), Lamprey sp., Plaice (*Pleuronectes Figuressa*), Thick-lipped grey mullet (*Chelon labrosus*).

Common goby (*Pomatoschistus microps*), Pike (*Esox lucius*) and Salmon (*Salmo salar)* were previously recorded in 2008 surveys of the Limerick Docks but were not recorded during 2014 surveys.

Upper Shannon Estuary

A total of 22 fish species were recorded in the Upper Shannon Estuary in October 2014. Flounder was the most abundant species, followed by sprat and sand goby. Flounder was widely distributed throughout the water body, being captured using all three netting methods, while other species such as sand goby were more localised, only recorded in the shallow marginal areas using beach seines. A number of species were newly recorded in 2014, including Atlantic horse mackerel/scad, bib, brill, coalfish/saithe, fifteen-spined stickleback, pogge and grey gurnard. Long-spined sea scorpion, perch, poor cod and short-spined sea scorpion were previously caught in 2008 but not captured in the 2014 survey. European eel was also recorded during this survey.

Lower Shannon Estuary

A total of 29 fish species were recorded in the Lower Shannon Estuary in October 2014. Sprat was the most abundant fish species, followed by sand goby, thick-lipped mullet and sand smelt. Flounder was well distributed throughout this water body, being captured using all three netting methods. A number of species were newly recorded in 2014, including bib, coalfish/saithe, grey gurnard, mackerel and sand sole. A number of species were previously caught in 2008 but not captured in the 2014 survey, including black goby, cod, European sea bass and European eel. This was the only water body surveyed during 2014 in which thornback ray was recorded.

The report concludes that plaice, smelt, flounder, sand goby, and sprat were among the most abundant and widespread species recorded between Limerick Docks and the Lower Shannon Estuary.

11.3.2 Field Study

Habitats

Assessing the impacts of any project and associated activities requires an understanding of the ecological baseline conditions prior to and at the time of the project proceeding. Ecological Baseline conditions are those existing in the absence of proposed activities (CIEEM 2018, updated 2022).

The existing WwTP infrastructure is classified as *buildings and artificial surfaces (BL3).* Associated hard standing areas are classified as *(BL3), spoil and bare ground (ED2)* and *recolonising bare ground (ED3)* (Figure 11.2). The WwTP site boundary is demarcated by palisade and post and wire fencing inside, outside of which is broadleaved woodland (WD1) consisting of ash *(Fraxinus excelsior),* willow *(Salix* spp.), alder (*Alnus glutinosa)*, sycamore (*Acer pseudoplatanus)* and cypress (*Cupressus* sp.). Within the boundary of the fence, the northern and eastern boundaries consist of treelines (WL2) with the southern and western boundaries consisting of broadleaved woodland (WD1). Species recorded within treelines and woodland include ash *(Fraxinus excelsior),* willow *(Salix* spp.), alder (*Alnus glutinosa)*, sycamore (*Acer pseudoplatanus),* cypress (*Cupressus* sp.), elder *(Sambucus nigra),* horse-chestnut (*Aesculus hippocastanum)* and hazel (*Corylus avellana).* Species recorded in the understory include hedge bindweed *(Calystegia sepium),* laurel (*Prunus spp.),* giant hogweed *(Heracleum mantegazzianum),* wild Angelica *(Angelica sylvestris*) cleavers *(Galium aparine),* hart's-tongue fern *(Asplenium scolopendrium),* pendulous sedge (*Carex pendula),* ivy *(Hedera hibernica),* Himalayan balsam *(Impatiens glandulifera)*, bramble (*Rubus fruticosus* agg.) and *Hydrangea.* Treelines and woodland within the site are at times infested with the invasive Giant

Hogweed. The treeline (WL2) along the northern boundary separates the site from a drain (FW4) and a public river walkway.

Areas of grassland within the WwTP boundary are classified as *amenity grassland (GA2)* with *scattered trees and parkland (WD5)* in places, there being individual ornamental trees planted within the grounds (Figure 11.3). Species present within the grassland and recolonising ground habitats include cock's foot (*Dactylis glomerata*), Yorkshire fog (*Holcus lanatus*), broad-leaved dock (*Rumex obtusifolius*), ribwort plantain (*Plantago lanceolata)*, creeping buttercup (*Ranunculus repens),* common daisy (*Bellis perennis*), dandelion (*Taraxacum officinale agg.*), red clover (*Trifolium pratense*), bush vetch (*Vicia sepium*), white clover (*Trifolium repens),* great willowherb *(Epilobium hirsutum)* and self-heal (*Prunella vulgaris*). The grassland area to the north of the site is slightly less managed and is transitioning to dry meadows and grassy verges (GS2). The species composition is similar to that of amenity grassland areas (GA2), with the addition of bird's foot trefoil (*Lotus corniculatus*), creeping thistle *(Cirsium arvense),* hoary willowherb *(Epilobium parviflorum),* common ragwort *(Jacobaea vulgaris),* redshank *(Persicaria maculosa),* perennial sowthistle *(Sonchus arvensis)* and occasional soft rush (*Juncus effusus).* Giant hogweed (*Heracleum sphondylium*) is found in large patches and as individual plants throughout grassland areas.

Tree species located on amenity grassland which are within the footprint of the proposed stormwater tank are categorised as scattered trees and parkland (WD5) and include: 7 no. semi-mature Norway Maple (*Acer platanoides)*, 5 no. immature silver birch (*Betula pendula)*, 1 no. semi-mature Scots pine (*Pinus sylvestris),* and 8 no. immature Rowan (*Sorbus aucuparia).*

A drainage ditch (FW4) surrounds the entire site, within the boundary fencing to the southern and western boundary and directly adjacent to the north and eastern boundary (Figure 11-4). The drains were dry during all site visits. No other watercourses occur within the site boundary. The Lower River Shannon, a lowland/depositing river (FW2), part of Lower River Shannon SAC, flows approximately 20m to the north of the site. Treated effluent from the wastewater treatment plant is discharged to the Lower River Shannon via the existing outfall approximately 75m north-west of the wastewater treatment site boundary, in the middle of the river channel.

The wider area consists of woodland, public river walkway (Figure 11.5) and a mill race channel to the east.

None of the habitats within or adjacent to the works areas correspond to those listed in Annex I of the EU Habitats Directive. No Annex II or Annex V species were recorded on site. No works will take place within any of the adjacent habitats as works will be confined to the existing wastewater treatment plant. No works are proposed at the outfall.

The non-native invasive species, giant hogweed *(Heracleum mantegazzianum)* was recorded in a large proportion of the site boundary (Figure 11.6). The species within the grassland had been sprayed in March 2020, but re-growth was obvious in a number of areas. This species is listed on the 'Third Schedule' of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). Areas infested with Giant Hogweed within the site have been subject to ongoing treatment via spraying since 2020.

A number of stands of the non-native invasive species, Himalayan Balsam *(Impatiens glandulifera)* were recorded within the site boundary to the north, north-west and north-east (Figure 11-7) and in the wider area along the banks of the Lower River Shannon . This species is listed on the 'Third Schedule' of Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011).

No other invasive species listed under Regulations 49 and 50 of the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011) were recorded during the field survey. A habitat map of the proposed development site is provided in Figure 11.8 and full site overlay is available in **Appendix 11A, Fig 11-10 & 11-11.**

Figure 11-3: WwTP infrastructure classified as buildings and artificial surfaces (BL3) and associated hard stand areas of (BL3)/spoil and bare ground (ED2)/recolonising bare ground (ED3). Grassland classified as amenity grassland (GA2).

Figure 11-4: Scattered trees and parkland (WD5) in the centre of the site.

Figure 11-5: Drainage ditch (FW4), dry at the time of the surveys, outside of the eastern boundary.

Figure 11-6: Public river walkway separating the WwTP from the Lower River Shannon and associated woodland.

Figure 11-7: Infestation of Giant Hogweed along the north-western boundary

Figure 11-8: Infestation to the northwest of the site adjacent to the existing final effluent and storm outfall chamber.

Figure 11-9: Habitat Map. (See Appendix 11A, Figure 11-10 for full diagram)

11.3.3 Fauna

Otter

An otter survey was carried out on the 6th of April 2022 by Rachel Walsh (BSc.) of MKO. The otter survey area is depicted in Figure 11.9, with full map in **Appendix 11A, Fig 11-14**. The otter survey was conducted 150m upstream and downstream of the WwTP boundary as well as along the millrace and woodland to the east of the WwTP. No signs of otter, including holts, slides, couches, prints, spraints or feeding remains, were found during the survey. However, otter are likely to use the section of the Lower River Shannon adjacent to the WwTP for commuting and foraging. Otter also potentially use nearby drains and the mill race channel to the east of the site boundary.

Figure 11-10: Otter survey extent. Full map in Appendix 11A, Figure 11-14

Aquatic Fauna

The Lower River Shannon in the vicinity of the development site is a wide, deep, slow-flowing lowland/depositing river. Inland Fisheries Ireland reported the following fish species in order of frequency at Limerick Docks in 2014 (Kelly et al. 2014): Flounder (*Platichthys flesus*), Smelt (*Osmerus eperlanus*), Three-spined stickleback *(Gasterosteus aculeatus),* Roach (*Rutilus rutilus)*, European eel (*Anguilla Anguilla*), Sprat (*Sprattus sprattus*), Dace (*Leuciscus leucisus)* Perch (*Perca fluvialtilis*), Sand goby (*Pomatoschistus minutus*), Brown trout (*Salmo trutta*), Lamprey sp., Plaice (*Pleuronectes Figuressa*), Thick-lipped grey mullet (*Chelon labrosus*). Common goby (*Pomatoschistus microps*), Pike (*Esox lucius*) and Salmon (*Salmo salar)* were previously recorded in 2008 surveys of the Limerick Docks but were not recorded during 2014 surveys.

The Lower River Shannon is a priority Freshwater Pearl Mussel river listed under S.I. No. 296/2009 - The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009. According to the Site-Specific conservation objectives for the Lower Shannon SAC, Freshwater pearl mussel is found within a separate catchment to that which is downstream of the development, namely, the Cloon catchment. There are no records of Freshwater Pearl Mussel downstream of the development site.

Bottlenose Dolphin are known to frequent the Lower River Shannon but according to the site-specific conservation objectives, their range extends only to an area over 12km downstream of the Plant.

Badger

Badger surveys were carried out at the site on the 21st of January 2022 by Aran von der Geest Moroney (B.Sc., QCIEEM) of MKO, and the 3rd of February 2022 by Neansaí O' Donovan (B.Sc., QCIEEM) of MKO.

Three trail cameras were deployed at the sett entrances between 21st January and 3rd of February 2022.

An active badger sett is present along the south-eastern boundary of the site. Four entrances are present: two entrances are present within the perimeter fence with two entrances present on the other side. The trail cameras revealed that at least two badgers were present at the sett during the survey time period and demonstrated a degree of aggressive behaviour, indicating potential breeding behaviour. A full badger survey report is shown in **Appendix 11C.**

Evidence of snuffle holes (foraging behaviour) and trails/commuting routes are present along the southern and eastern boundaries of the WwTP. The trails enter under the fence at various points and continue into the adjacent woodland to the east of the WwTP. A figure depicting the location of the sett entrances and commuting/foraging routes is shown in Figure 11.10 and full map in **Appendix 11A, Fig 11-15**. No evidence of badger trails or foraging was found within central or western parts of the site.

Figure 11-11: Badger commuting routes. Full map in Appendix 11A, Fig 11-15

Bats

Habitats within the WwTP boundary were appraised for their suitability for bats as per Collins (2016).

The woodland edges around the perimeter of the WwTP are of *Moderate* suitability for commuting and foraging bats. Some trees around the perimeter of the site are of *Low* suitability for roosting bats, as although no potential roost features were seen from ground level, some trees had a degree of ivy cover which offers potential shelter for bats.

Throughout adjacent woodland areas, several trees were assessed as having *Low* to *Moderate* bat roosting potential due to ivy cover and size of trees. However, no direct evidence of roosting bats within trees was observed.

One Scot's pine tree with ivy cover within the site (which will be retained) is assessed as having *Low* suitability for roosting bats. Other features across the rest of the development site are of *Negligible* suitability for roosting bats. The ornamental trees across the site are scattered and are not of a sufficient age or with ivy cover to support potential roost features. Therefore, trees proposed to be removed are of *Negligible* suitability for roosting bats. They are of *Low* suitability for commuting and foraging due to their being isolated and not well connected to surrounding woodland. In addition, the site is currently well lit up at night with external lighting on throughout the night, as shown in Figure 11.11.

Figure 11-12: Current lighting situation at Castletroy WwTP

Birds

Bird species observed within the site were of an assemblage of common garden/passerine species and used trees around the perimeter of the site. Species observed include Blackbird (*Turdus merula*), Robin (*Erithacus rubecula*) and Wood Pigeon (*Columba palumbus*).

No bird species listed as an SCI of any European Site, listed under Annex I of the Birds Directive, or on the Amber List or Red List of the Birds of Conservation Ireland, were observed during the surveys. However, ornamental trees within the site, adjacent treelines within the site and adjacent woodland provide suitable nesting habitat for common bird species.

Other Faunal Taxa

No evidence of any other protected faunal taxa was recorded within the site of the proposed development. The habitats within the site are typical of highly managed wastewater treatment facility.

11.3.4 Flood Risk Assessment

A review of the potential for the site to flood was undertaken due to the potential for deterioration of river water quality as a result of flooding during construction, which would have potential to impact aquatic habitats and species.

A Flood Risk Assessment was carried out by JB Barry & Partners Consultant Engineers. CFRAM mapping has revealed that a portion of the site to the centre and south are within Flood Zone C. A portion of the site around the perimeter of the WwTP is within Flood Zones A and B (Figure 11.12). The CFRAM map indicates that the 1% AEP fluvial flood level (Flood Zone A) is +6.37mOD and the 0.1% AEP fluvial flood level is +6.93mOD.

From a site visit it was noted that recent flood events recorded levels up to the door entrance of the main control building and it was reported that flooding occurred through a channel/ditch which runs along the Western boundary of the site. Water ingress also occurred through the site entrance. Recent flooding was not reported to have occurred in the green area which will be the primary proposed area for new infrastructure.

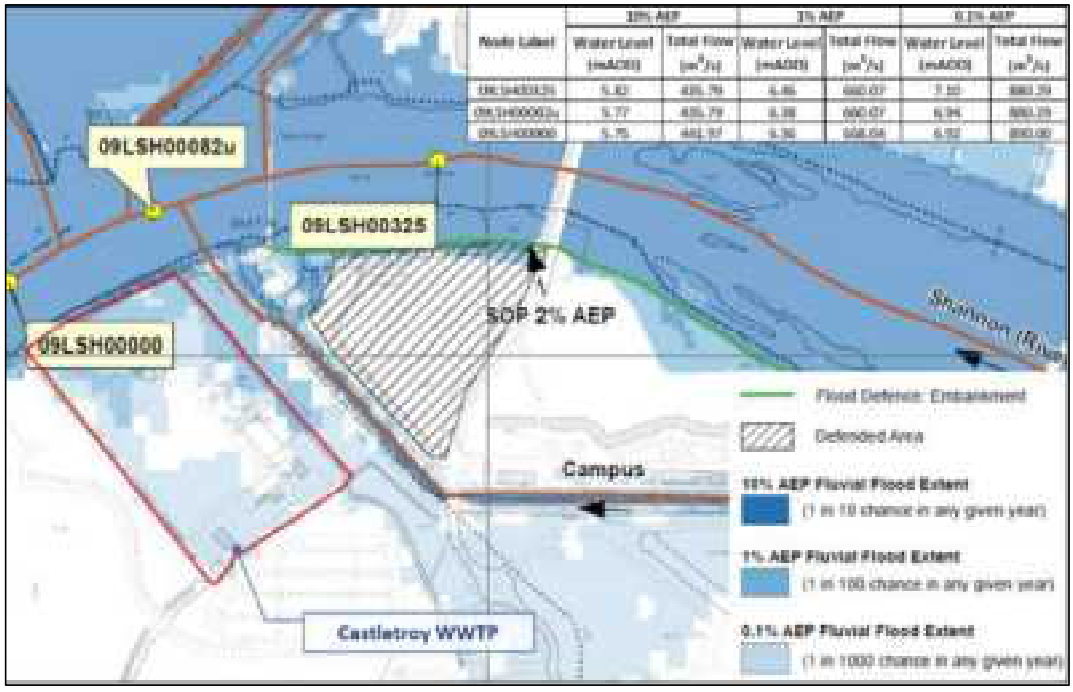

Figure 11-13: CFRAM map indicating AEP fluvial flood levels

11.3.5 Ground Investigations

A review of site investigation results of the study site was undertaken due to the potential for groundwater contamination during construction resulting in impacts on aquatic habitats and species. The anticipated excavation level for the installation of the proposed storm tank structure and forward feed pump station are in the order of 2m OD or approximately 5m below existing ground surface. Three exploratory boreholes were conducted as part of investigations and revealed water-table levels to be between 4.3m bgl to 6.8m bgl (2.75m OD to 0.2m OD).

After 20 minutes, levels rose to between 3.7m bgl to 6m bgl. The soil type is granular glacial till and soft silt and clay.

11.4 Likely Significant Effects

11.4.1 Do nothing Impact

If the proposed development were not to go ahead, the existing WwTP would continue according to existing operations and the habitats within the site would continue under their current management regime. Short-sward grassland areas of the site (Amenity grassland GA2) are mowed regularly throughout the year. Areas infested with Giant Hogweed are subject to spraying with herbicide.

The existing Plant would continue to discharge to the Lower River Shannon, which currently is not having an observably negative impact on water quality, however, the Plant as it currently operates will not be able to treat effluent to a sufficient standard for expected future loading increases if the upgrades do not go ahead.

11.4.2 Impacts during construction

Habitats

The proposed development will result in the loss of approx. 3290 m^2 of amenity grassland and dry meadow/grassy verge, and 25 ornamental trees, most of which are young.

In the absence of mitigation, the loss of these habitats is considered to be a permanent, slight negative effect at the local scale.

Fauna

Loss of faunal habitat

The loss of small areas of Amenity grassland/grassy verge (GA2/GS2) and artificial surfaces (BL3) is not considered significant in the context of faunal habitat. The trees within the footprint of the development were assessed as being of *Negligible* suitability for roosting bats. There will be no loss of linear vegetation features, including any treelines or adjacent woodland edge, as a result of the development.

The badger sett which was found within the development site boundary is completely outside of the footprint of the development. As detailed in **Section 11.3.3** and the attached Badger Survey Report, evidence of foraging and badger commuting is restricted to the southern and eastern boundaries of the site. There will be no loss of these commuting routes as a result of the development. Impacts with regard to construction phase disturbance of the sett are considered below.

There are no works proposed at the discharge point, therefore no instream works are required. However, the potential for indirect impacts on the aquatic environment as a habitat for aquatic species is addressed under 'Deterioration of Water Quality' below.

There will be a loss of approx. 25 ornamental trees to accommodate works. In the absence of mitigation, the loss of these trees in the context of faunal habitat is considered to be a permanent, slight negative effect at the local scale.

Disturbance and Displacement

The potential for disturbance of otter was considered. During the dedicated otter survey undertaken on the 6th of April 2022, no signs of otter or their resting or breeding places were found within 150m of the development site, including along the Lower River Shannon and mill race channel to the east of the site. However, otter are known to use the Lower River Shannon for foraging and commuting. A potential for disturbance was identified on commuting otter as a result of noise from construction, and due to the potential for establishment of a holt in the interim between baseline otter surveys and commencement of construction. This is considered a temporary, significant negative effect. A further indirect potential for impact was identified as a result of reduction in fish biomass due to deterioration of water quality (discussed further below).

An active, potentially breeding badger sett exists at the southern boundary of the development site. A potential for impact on the sett during construction was identified due to disturbance as a result of noise and vibration from pile driving (for construction of stormwater tank) and machinery and loss of commuting/foraging links as a result of construction infrastructure. This is considered a temporary, significant negative effect. The potential for impact via direct tunnel collapse and mortality due to machinery movement was also identified which would be a permanent, profound negative effect.

Due to the removal of trees to accommodate the development footprint, a potential for disturbance of nesting birds exists, considered to be a permanent negative significant effect.

One Scot's pine tree with ivy cover within the site (which will be retained), as well as several ivy-covered ash trees along the perimeter of the site were identified as having *Low* potential to support roosting bats. Further trees within the adjacent woodland were assessed as having *Low* to *Moderate* bat roosting potential. A potential for disturbance to roosting bats during construction was identified as a result of construction phase lighting and pile driving/noise. This impact is considered a temporary, slight negative impact.

There will be no instream works as part of the development. All works will be within the WwTP boundary which are buffered from the Lower River Shannon by a treeline, ditch and public river walkway. The WwTP is approx. 75m from the river. No potential for impacts on aquatic species as result of construction phase noise or lighting is predicted. However, the potential for impact as a result of deterioration of water quality is discussed below.

Water Quality

The construction of the proposed development carries a risk of silt/sediment and hydrocarbons run-off to adjacent drains within the WwTP site, which in turn potentially act as surface water conduits to the Lower River Shannon. There is also a risk of run-off of other pollutant materials such as cement.

Deep excavations are required for the proposed stormwater tank and as such there is also a risk of groundwater contamination, which can also result in infiltration to surface water bodies.

Peripheral areas of the site are within Flood Zone B with part of the north of the site in Flood Zone A, which also offers a risk of surface water contamination should a flood event occur during construction activities. Contamination may occur due to the inappropriate storage of pollutant materials, stockpiles and sediments within floodable areas.

The Lower River Shannon in the vicinity of the development site is a wide, deep, depositing/lowland river (FW2) with a slow flow in glides. Previous IFI surveys (**Section 11.3.1)** have identified that the Lower River Shannon, from Limerick Docks to the lower estuary, is

dominated by coarse fish species such as plaice, smelt, flounder, sand goby, and sprat. Salmon were not recorded at the Limerick Docks in 2014. The deterioration of the aquatic environment has a potential to affect aquatic species which use it, as significant sedimentation can result in smothering or oxygen starvation for species. Increased sedimentation can impact on fish species by clogging gills, reducing visibility when foraging, and clogging spawning gravels for salmonids and lamprey. The release of certain materials, such as hydrocarbons or cement products, would be toxic to fish life. In turn, as mentioned above, potential fish-kills would result in indirect impacts to otter via reduced fish biomass for foraging.

Further assessment with regard to potential impacts on water quality are provided in **Section 14** of this EIAR. A Short term, Significant Negative impact on surface water quality of the Lower River Shannon, deterioration in groundwater quality and deterioration in riverine habitats thus affecting aquatic fauna as a result of the construction phase of the development was identified. Mitigation measures will be in place and are detailed in Section **11.5.4** of this report.

Biosecurity

The Third Schedule Invasive Species Himalayan Balsam (*Impatiens glandulifera)* and Giant Hogweed (*Heracleum mantegazzianum)* are present within the development site, around the boundaries of the site, on grassland areas and within the proposed development footprint. Infestations are also present outside of the site on adjacent properties. There is potential for the construction works and excavations to cause further spread of the plants to other sites. A site-specific Invasive Species Management Plan has been prepared which details measures to eradicate the plants in advance of construction as much as possible, avoid infestations within the site where possible, appropriate biosecurity protocol to prevent the spread of the plants outside of the site, and recommendations for their continued treatment during operation. The Invasive Species Management Plan is attached as **Appendix 11B.** The potential for spread of invasive species outside of the site is considered a significant negative effect. The mitigation measures provided in the Invasive Species Management Plan are also provided in **Section 11.5.6**.

11.4.3 Impacts during operation

Impacts on habitats

There will be no additional loss of habitat or other impacts to habitats as a result of the operational phase.

Impacts on fauna

Increased Human Activity

The site is an existing wastewater treatment facility which is subject to ongoing human disturbance and operations of the plant. Fauna which are or may be in the vicinity of the site, such as badger and otter, are likely to be accustomed to a degree of disturbance due to existing activities at the site. There is likely to be a slight increase in activity at the site if there is a requirement for more personnel or more vehicles entering the site. However, these activities will be mainly during normal daylight hours and no significant increase in activity relative to operations in place currently is expected.

Badger

During badger surveys of the site, no signs of commuting or foraging were found to the centre of the site. There will be no loss of commuting routes as a result of the stormwater tank or any other proposed infrastructure.

Otter

There are no otter breeding places within or adjacent to the WwTP site, although they are likely to commute along the Lower River Shannon . Otter are predominantly crepuscular in nature and activity at the site is predominantly confined to daytime hours, thus minimizing potential disturbance related impacts to the species. In addition, activities are confined to the existing wastewater treatment plant. Otter are anticipated to have habituated to the ongoing anthropogenic activities associated with the operation of the plant.

Irish Wildlife Manual No 76 (*National Otter Survey of Ireland 2010/2012*) notes that the occurrence of Otter was unaffected by perceived levels of disturbance at the survey sites. It also notes that there is little published evidence demonstrating any consistent relationship between Otter occurrence and human disturbance (Mason & Macdonald 1986, Delibes et al. 1991; Bailey &Rochford, 2006). Irish Wildlife Manual No 23 (*National Otter Survey of Ireland 2004/2005*) found no significant relationship between disturbance and otter occurrence. It also states "the lowest percentage occurrence was found at the sites with the lowest recorded disturbance".

Channin P (2003) [4] provides a literary review with regard to anthropogenic disturbance and refers to several reports which have found that disturbance is not detrimental to Otters (Jefferies (1987), (Durbin 1993). (Green & Green 1997). The report also describes successful breeding in towns, under ferry terminals and under the jetties of one of Europe's largest oil and gas terminals at Sullom Voe in North Scotland.

Lighting

Due to the ecological sensitivities present within the site including the badger sett and peripheral woodland areas with suitability for roosting and foraging bats, a potential for a permanent significant effect as a result of external lighting proposed for the development was identified.

Impacts on Water Quality and Aquatic Biodiversity

The operation phase of the wastewater treatment process and higher loadings at Castletroy have the potential to negatively impact water quality of the Lower River Shannon and result in higher nutrient inputs, resulting in reduced oxygen availability and oxygen starvation of fish species including Lamprey, Salmonids, European Eel and coarse fish. The Lower River Shannon in the vicinity of the development site is a wide, deep, depositing/lowland river (FW2) with a slow flow in glides. Previous IFI surveys (**Section 11.3.1**) have identified that the Lower River Shannon , from Limerick Docks to the lower estuary, is dominated by coarse fish species such as plaice, smelt, flounder, sand goby, and sprat. Salmon were not recorded at the Limerick Docks in 2014.

[4] Chanin P (2003). Ecology of the European Otter. Conserving Natura 2000 Rivers Ecology Series No. 10. English Nature, Peterborough.

The current operations at Castletroy WwTP are not having an observably negative impact on water quality of the Lower River Shannon as described in **section 11.3**.

Future Impacts on Water Quality due to Discharge

The following summarises the assessment on operational water quality as detailed in **Section 14.**

EQS Compliance

The assessment of the changes in the final effluent discharge focuses on the environmental impact of the discharge on the local receiving waters with reference to the relevant European and Irish legislation. Calculated predictions were carried out to assess (worst case) future impacts of the final effluent on water quality in the Lower River Shannon according to high status mean EQS concentration limits.

Table 11.12: High Status EQS Concentration Limits

Parameter	BOD (mg/l)	Ortho-P (mg/l)	Ammonia (mg/l)
EQS (High/Mean)	1.3	0.025	0.04

Table 14.20 displays projected downstream concentrations calculated for each loading scenario, and on the basis of median river flow, future hydraulic loading rates (ADF) at the WwTP and relative effluent concentrations when max. ELVs are utilised. It can be seen that d/s ammonia will exceed the EQS under all cases and ortho-phosphorus is on the borderline for both the 10- and 25-year scenarios. BOD comes close to the limit in long range 25-year scenario, but still remains within the allowable EQS.

Table 11.13: Predicted D/s Concentrations using Existing ELVs

Parameter	BOD (25mg/l)	Orth-P (1mg/l)	Ammonia (5mg/l)
EQS (High/Mean)	**1.3**	**0.025**	**0.04**
45,000PE (Design PE)	1.19	0.022	0.051
77,500PE (+10 year)	1.25	0.024	0.062
81,100PE (+25 year)	1.27	0.025	0.065

Following the initial assessment, calculations for the future scenario were altered to consider the d/s effects if the ELVs were reduced, subject to a WWDL review. It has been considered that demands on the WwTP will increase, but improvements in treatment capacity have been designed to meet future requirements. There should be no reduction in WwTP performance compared to the current situation with regard to quality of the final effluent. And therefore, meeting more stringent ELVs will be achievable. Again, future ELVs will be subject to licence review, but for the purposed of this assessment the following limits have been applied; BOD 20mg/l, Orth-P .75mg/l and Ammonia 2mg/l. Results in Table 11.14 indicate that by reducing the ELVs d/s water quality will remain within high status mean EQS values.

Table 11.14: Predicted D/s Concentrations using Proposed ELVs

Parameter	BOD (20 mg/l)	Orth-P (.75mg/l)	Ammonia (2mg/l)
EQS (High/Mean)	**1.3**	**0.025**	**0.04**
45,000PE (Design PE)	1.16	0.020	0.033

77,500PE (+10 year)	1.21	0.022	0.038
81,100PE (+25 year)	1.22	0.023	0.039

WAC Assessment

A similar assessment was carried out for future effects on d/s WAC in the Lower River Shannon. Projections listed in Table 11.15 were calculated using high quality EQS standards, maximum emissions from the WwTP at future hydraulic loading rates (ADF) and median river flow in the river. In line with the concentration results in the previous section, ammonia WAC is exceeded at current full design capacity and becomes increasingly deficient in the future loading scenarios.

Table 11.15: Predicted WAC using Existing ELVs

Loading Scenario	BOD	Ortho-P	Ammonia
45,000PE (Design PE)	8%	13%	-27%
77,500PE (+10 year)	4%	3%	-57%
81,100PE (+25 year)	2%	1%	-65%

Again, calculations for the future scenario were altered to consider the d/s effects if the ELVs were reduced, subject to a WWDL review. Using the same method of calculation as above with the reduced emission limits, it can be seen that there will be sufficient WAC in the Lower River Shannon for all parameters and future loading scenarios, Table 11.16.

Table 11.16: Predicted WAC using proposed ELV's

Loading Scenario	BOD	Ortho-P	Ammonia
45,000PE (Design PE)	10%	19%	16%
77,500PE (+10 year)	7%	20%	14%
81,100PE (+25 year)	6%	18%	12%

In summary, there will be a % reduction in WAC as the WwTP discharge rate increases, but it is not expected to breech high status environmental constraints if more stringent ELVs are put in place (subject to an WWDL review). There will also be significant improvements in the rate of stormwater overflows due to the addition of stormwater storage.

Stormwater Storage Tank

A new 4,500m^3 stormwater storage tank will be constructed on-site that will reduce storm spills to the Lower River Shannon. It has been designed to cater for 25-year growth projections, and in accordance with Uisce Éireann (formerly Irish Water) Document No. UÉ-TEC-700-99-02 “Inlet works & stormwater treatment (wastewater)”.

The new stormwater tank will significantly reduce spills and will help to meet Recreational Water Standards. Modelling of existing spills from the outfall at the WwTP, under current conditions, estimated the average annual spill volume to be 48,312m^3. As summarized in **Section 11.3**, the discharge from the WwTP is currently within EQS’s and in line with the WFD. The proposed new stormwater tank will result in significant reductions in yearly stormwater spills and therefore an improvement in treatment of effluent.

As summarized in **Chapter 14** ‘Water’, flows in excess of 3DWF and emergency overflows will be redirected to the new stormwater storage tank. The wastewater will be screened and held until such a time that incoming flows to the WwTP subside, then it will be returned to the main process stream for full treatment. In the event that the storm intensity causes the tank to reach

capacity, the (screened) spills will be directed to the final effluent chamber, as per the current situation.

The DAP model (as discussed in **Section 14**) was run using baseline flow survey data with stormwater storage introduced. Model outputs for the current baseline versus future spill frequency, following the Proposed Development works, can be seen in Table 11.17. It is predicted that there will be an average of less than 7 spills per annum.

Table 11.17: DAP Model Outputs - Current Vs. Future Scenario (Spill≥1m3)

Year	Model Output	Avg. Annual Spills	Avg. Bathing Season Spills	Avg. Annual Spill Vol. (total m^3)	Avg. Bathing Season Spill Vol. (total m^3)
2018 - 2028	Current Baseline	123	33	48,312	16,767
	Future Scenario	7	3	4,839	290

Surface Water Run-off

Increased hardstanding areas and infrastructure will increase surface water run-off from the site during operation. However, surface water created will be directed through to a surface water attenuation storm cell, measuring 22.4m x 13m in surface area, in the north of the site via a hydrocarbon interceptor. The proposed planting of woodland in the north of the site will also help to intercept run-off from leaving the site. A flood compensation storage area measuring 28m^3 will also be provided within the site.

Flood Risk

Due to the site being predominantly situated within Flood Zone A, the design has been designed in line with flood risk management guidelines so that contamination or change in flood regime is avoided in case of flood events during operation of the development. These include the following measures:

- The project has been designed so that the majority of proposed infrastructure is located within the Flood Zone C area to the centre of the site, including the new stormwater holding tank.
- All new infrastructure will be at an elevation higher than the 1% Annual Exceedance Probability (AEP) flood level with a suitable freeboard and an allowance for the effects of climate change.

Summary of operational impacts on water quality and aquatic biodiversity:

Based on the water quality operational impacts assessment, there will be a slight reduction in WAC as the WwTP discharge rate increases, but it is not expected to breach high status environmental constraints if more stringent ELVs are put in place (subject to an WWDL review) i.e., creating a long term, slight negative impact on receiving water in the Lower River Shannon.

Conversely, there will be significant improvements in the rate of stormwater overflows due to the addition of stormwater storage, which will have a long term, significant positive impact on receiving water quality.

Therefore, a conservative conclusion has been reached as follows; (as per EPA Guidelines, 2002) the proposed development is considered to have a long term, imperceptible/neutral impact on water quality, i.e. an effect which alters the character of the environment without affecting its sensitivities.

11.4.4 Impacts on European Designated Sites

A separate Appropriate Assessment Screening Report and Natura Impact Statement has been prepared by MKO as part of the application in which the potential for impacts on European Sites is assessed.

The EPA Guidance (2022) states,

"A biodiversity section of an EIAR, for example, should not repeat the detailed assessment of potential effects on European sites contained in documentation prepared as part of the Appropriate Assessment process, but it should refer to the findings of that separate assessment in the context of likely significant effects on the environment, as required by the EIA Directive"

This section provides a summary of the key assessment findings with regard to Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Two European Sites were found to be within the Zone of Likely Impact:

Lower River Shannon Sac (002165)
Lower River Shannon and River Fergus Estuaries SPA (004077)

The potential indirect effects were identified within the AASR while the Natura Impact Statement concluded that:

'This NIS has provided an assessment of all potential direct or indirect adverse effects on European Sites.

Where the potential for any adverse effect on any European Site has been identified, the pathway by which any such effect may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its appendices. The measures ensure that the construction and operation of the proposed development does not adversely affect the integrity of European sites.

Therefore, it can be objectively concluded that the Proposed Development, individually or in combination with other plans or projects, will not adversely affect the integrity of any European Sites.'

11.4.5 Impacts on Nationally Designated Sites

Impacts on Nationally Designated Sites are considered in this section of the report. Where such sites are also designated as SACs or SPAs (European Sites), they have also been assessed and considered under that designation. The following Nationally Designated Sites are located downstream of the development site:

- Fergus Estuary and Inner Shannon, North Shore [002048]
- Inner Shannon Estuary, South Shore [000435]

The potential for temporary significant negative effect on these downstream Designated Sites via deterioration in water quality as a result of construction, through degradation in surface water quality and groundwater quality was identified.

As described in **Section 11.4.3**, there will be a long-term, neutral impact on operational water quality. No potential for indirect effect on any other Nationally Designated Site was identified.

11.5 Mitigation Measures and Monitoring

11.5.1 Mitigations for habitat loss

The proposed development will result in the loss of 3290 m^2 of amenity grassland and dry meadow/grassy verge, and 25 ornamental trees, most of which are young.

A landscaping plan has been prepared for the proposed development and is provided in **Appendix 12B**.

It is proposed to create a wet woodland to the north of the site. Presently, this area is encroached with the invasive, Giant Hogweed. However, treatment is ongoing and it is expected that once construction is complete and it is time to implement landscaping measures, the area will be free of invasive plants. Planting a wet woodland in this area will provide new habitat and competition against re-encroachment of invasive species. The woodland will also potentially slow surface water run-off rates from the site. The following species are proposed for the woodland, which is based on species that are present in the local area and typical species found in Wet pedunculate oak-ash woodland (WN4) (Fossitt 2000).

- Pedunculate oak (*Quercus robur)* – 30%
- Alder (*Alnus glutinosa)* – 20%
- Grey willow (*Salix cinerea)*, Goat willow (*Salix caprea),* Hawthorn (*Crataegus monogyna),* holly (*Ilex aquifolium)* and Hazel (*Corylus avellana)* – 50%.

Additional understory and ground-flora species include the following native wetland species will be planted to include:

- Flag iris (Iris pseudacorus)
- Great wood-rush (Luzula sylvatica)
- Pendulous sedge (Carex pendula)
- Water mint (Mentha aquatica)
- Meadowsweet (Filipendula ulmaria)

Planting of a treeline along the proposed new access track. Species will include:

- Rowan (Sorbus aucuparia)
- Wild Cherry (Prunus avium)
- Silver Birch (Betula pendula)
- Scots pine (Pinus sylvestris)
- Elder (Sambucus nigra)
- Pedunculate oak (Quercus robur)

A quantitative Biodiversity Metric has been applied to calculate a biodiversity score for the development site for both the baseline habitats and proposed post-construction habitats. The biodiversity metric has been applied according to Irish Water's *Biodiversity Guidance for Irish Water Developments* (IW-AMT-GL-021). The workings for calculation of the baseline biodiversity score at the site are shown in Table 11.18.

Full workings are provided in **Appendix 11E**.

Table 11.18: Biodiversity Units Calculation - Pre-Development

Baseline/Pre-development Score			
Habitat	**Score**	**Area (m^2)/Length (m)**	**Biodiversity Units**
Non-linear			
BL3 Buildings and artificial surfaces	0	11901	0
GA2 Amenity grassland (improved)	2	8688	17376
GS2 Dry meadows and grassy verges	2	5676	11352
WD5 Scattered trees and parkland	5	449	2245
WD1 (Mixed) broadleaved woodland	6	3335	20010
Total Non-linear			**50983**
Linear			
FW4 Drainage ditches	5	313	1565
WL2 Treelines	6	348	2088
Total Linear			**3653**

A calculation has been carried out for the biodiversity score of the site post-development, to include all proposed new infrastructure, operations and proposed biodiversity enhancement measures. The results are shown in 1.19 below.

Table 11.19: Biodiversity Units Calculation - Post-Development

Post-development Score			
Habitat	**Score**	**Area (m^2)/Length (m)**	**Biodiversity Units**
Non-linear			
BL3 Buildings and artificial surfaces	0	15197	0
GA2 Amenity grassland (improved)	2	5877	11754
GS2 Dry meadows and grassy verges	2	3104	6208
WD5 Scattered trees and parkland	5	292	1460
WD1 (Mixed) broadleaved woodland	6	3335	20010
WN4 Wet pedunculate oak-ash woodland	6	2307	13842
Total Non-linear			**53274**
Linear			
FW4 Drainage ditches	5	313	1565
WL2 Treelines	6	348	2088
WL2 Treelines (access track)	5	80	400
Total Linear			**4053**

Table 11.20 below also considers the qualitative benefits of the biodiversity enhancement measures applied at the site.

Table 11.20: Qualitative Assessment of Biodiversity Measures

Biodiversity Measure	Benefit Delivered
Design measures	At design layout stage, it was decided to place as much of the infrastructure as possible, such as the stormwater storage tank, outside of floodable areas in order to prevent loss of flood storage capacity within the site. In addition, these areas were also chosen to avoid areas infested by Giant Hogweed and Himalayan Balsam.
Habitat metric	The habitats to be lost for the Proposed Development works include amenity grassland, dry meadows/grassy verges and 25 ornamental trees. The remaining amenity grassland areas and northern grassland area, which is currently less managed (mown twice a year) and infested with Giant Hogweed, were identified as areas that could be treated for eradication of invasive species in advance of construction. It is envisaged that ongoing treatment of Giant Hogweed to the north of the site will result in areas of bare soil which are proposed to be planted with flood-tolerant tree species to create a wet woodland, which should also slow down run-off from the site. Replanting in this area will provide competition against re-encroachment of invasive species. Replanting will be carried out in accordance with best practice guidelines in relation to herbicides use for invasive species eradication and it will be ensured that such chemicals have leached from the soil before replanting by leaving an appropriate amount of time after application according to the manufacturer's guidelines. In addition, treelines will be planted along the proposed new access track for trucks. The metric indicates the following net gains in terms of provision of habitat: Non-linear habitat: 2291 Biodiversity Units (approximately a 4.5% increase) Linear habitat: 400 Biodiversity Units (approximately a 10.9% increase) It is estimated that the wet woodland and treelines will take approximately 20 years to reach full maturity. However, an immediate benefit to biodiversity will be achieved through providing a buffer for surface water and flooding to the north of the site as well as competition against invasive species.
Habitat connectivity	Creation of woodland and additional treelines within the site will provide 'steppingstones' for wildlife across the site.
Strategic relevance	Grassland areas within the site will be mown less regularly at a maximum of twice per year in accordance with the All-Ireland Pollinator Plan, and pollinator friendly/native tree planting also aligns with the Plan. Designing the landscape in order to reduce biodiversity loss is in keeping with the objectives of the Limerick City Development Plan 2022-2028. This Plan contains objectives related to provision of bat boxes and swift boxes as part of development, to prevent the creation of barriers to wildlife, and to create new habitats and plant native trees as part of new development.

Habitat creation	As well as the creation of wet woodland to the north of the site, bat boxes will be placed on suitable trees along the eastern and western perimeters of the site. It is also proposed to install a swift box on the sludge building in the north of the site.
Carbon offset	Tree planting, woodland creation and less intensive grass management delivers a benefit in terms of carbon sequestration.

Residual Effect

No significant effects on habitats are predicted once the prescribed measures are implemented. Once the prescribed measures are implemented, there will be a Biodiversity Net Gain as a result of the development.

11.5.2 Mitigations for Loss of Faunal Habitat

As described above, the loss of potential faunal habitat as a result of the loss of trees will be mitigated through replanting as part of the landscaping plan. In addition, it is proposed to create faunal habitat through the following measures:

- At least 4 bat boxes will be placed on suitable trees along the eastern and western boundaries of the site, in agreement with a qualified ecologist. It is proposed to use bottom-less bat boxes in order that bat droppings will fall out, reducing the need for cleaning. However, these will be checked by site operators to ensure they do not become clogged. If the boxes require cleaning, this will be carried out by a qualified Ecologist with a roost disturbance licence, outside of bat maternity season (May to August).
- It is proposed to place a swift box on the external façade of the northern building within the site, underneath an overhang, approximately 5m from the ground, under supervision of a suitably qualified ecologist.
- Dead wood piles will be created in suitable areas of the site from the trees being felled.

Residual Effect

No significant effect on faunal habitat is predicted once the prescribed measures are implemented.

11.5.3 Mitigations for Disturbance/Displacement Of Fauna

Mitigation Measures for Construction Works

- All plant and equipment for use will comply with Statutory Instrument No 359 of 1996 “European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1996”. Plant will be chosen to avoid significant low-frequency noise emissions which increase nuisance potential.
- Operating machinery will be restricted to the proposed development site boundary.
- The methodology of British Standard WS 5228-1:2009+A1:2014 “Code of Practice for Noise and Vibration Control on Construction and Open Sites” Part I, will be employed during works, where required, to minimise emission of any noise.
- Work will be completed during daylight hours. However, if lighting is needed for construction during certain periods over winter months, this lighting will be limited and will face downwards, with no lighting focussed onto surrounding woodland.

- A pre-commencement survey for Otter will be carried out prior to any works commencing. Should Otter holts be recorded within 150m of the proposed works, a derogation license will be obtained from NPWS and works carried out in accordance with NRA (2006) *Guidelines for the Treatment of Otters prior to the Construction of National Road Schemes*. The otter survey will be carried out no more than 10 months in advance of commencement. The survey will be supplemented with an additional inspection immediately prior to commencement.
- Regular maintenance of plant will be carried out in order to minimise noise emissions. Particular attention will be paid to the lubrication of bearings and the integrity of silencers.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the works.
- Compressors will be of the "sound reduced" 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.
- Machines, which are used intermittently, will be shut down during those periods when they are not in use.
- Noisier plant will be positioned to optimise screening by other plant.
- Any requirement for removal of vegetation will be carried out in line with the provisions of the Wildlife Act. Therefore, the necessary removal of trees within the site will not be carried out between 1st of March and 31st of August inclusive, unless a breeding bird survey is carried out by a qualified ecologist 2 weeks before scheduled felling and a second survey no more than 48 hours before the felling.

Mitigation Measures for Badger

In relation to the badger sett, as described in the attached Badger Survey Report, all construction works will be carried out in line with *NRA (2006) Guidelines for the Treatment of Badger Prior to the Construction of National Road Schemes. National Roads Authority, Dublin, Ireland.*

At the time of writing, the NPWS do not issue disturbance licences for works in the vicinity of badger setts, however, they require consultation for such works.

Consultation was carried out with the NPWS with regard to the badger sett within the sett and the prescribed mitigation below. An account of the email correspondence is provided as **Appendix 11F**.

The majority of the works are located outside of the 30m buffer from the sett. The proposed site compound is located outside of the 50m buffer from the sett, therefore the compound and associated construction site traffic is not likely to cause significant disturbance of the sett.

The following measures will be in place to prevent disturbance or infringement on the sett:

- A pre-construction badger survey should be carried out no more than 10-12 months in advance of construction in order to ascertain if there are any additional sett entrances.
- No construction works will take place within 30 meters of the badger sett unless in consultation with the NPWS.
- No heavy machinery will be used within 30m of badger setts (unless carried out in consultation with NPWS); lighter machinery (generally wheeled vehicles) will not be used within 20m of a sett entrance; light work, such as digging by hand or scrub clearance will not take place within 10m of sett entrances.
- Any works within the badger breeding season (December to June inclusive) will require an exclusion zone of 50m around the setts.

- During the breeding season, no blasting or pile driving will be carried out within 150m of active setts. This will apply to works related to the construction of the storm tank. This buffer zone is shown in Figure 11-15 **Appendix 11A, Figure 11-20**.
- As the proposed works associated with the inlet works are located in proximity to the badger sett, they will be carried out in consultation with the NPWS. A solid barrier will be erected along the south of the paved area adjacent to the sett in order screen off the works from the sett and prevent any entry of machinery to the south of the paved area, as depicted in yellow in Figure 11.13.
- The fence will be constructed in consultation with a qualified ecologist. It will not obstruct badger movement along existing commuting routes.
- Construction works will be carried out during normal working hours and all construction lighting and machinery will be switched off outside of these hours.
- Any works with potential to result in high levels of noise or vibration will be appropriately sequenced in order to avoid potential for cumulative increases in noise or vibration.

The sett is located on a slightly elevated bank at the perimeter of the site. Given the topography of site and the barrier of the existing paved road between the sett and the proposed excavations associated with the proposed works, it is highly unlikely that the sett will be affected by these works. No works are proposed to the south of the existing tarmac road. The layout of the Proposed Development works in relation to the badger sett buffer zones shown in Figure 11-14, see full drawing in **Appendix 11A, Figure 11-15**.

None of the works or mitigation measures, during construction or operation of the development, will impact on badger commuting or foraging areas, which are restricted to the eastern and southern boundaries of the WwTP and the adjacent woodland.

Figure 11-14: Badger Protective Barrier

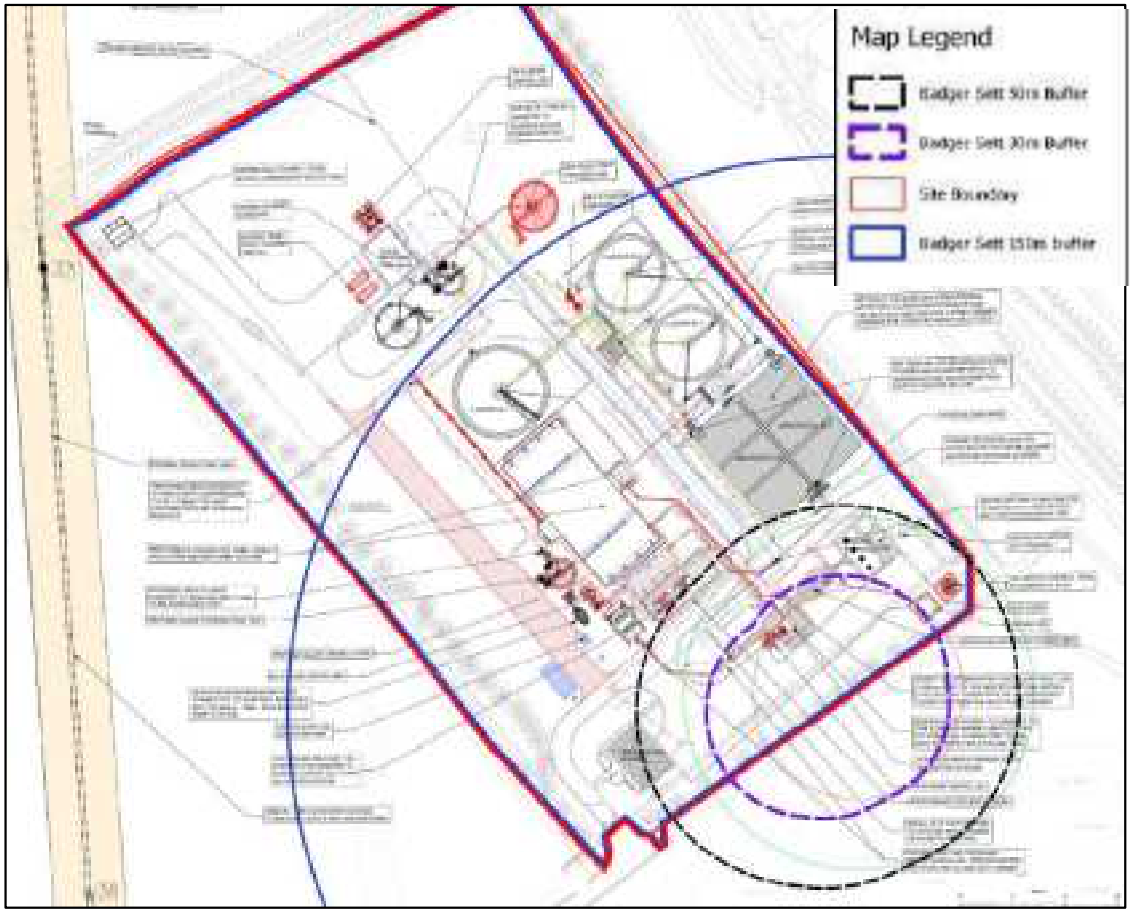

Figure 11-15: Badger Sett Buffer Zones Overlay (See full diagram in Appendix 11A, Figure 11-20)

Lighting

The proposed external lighting design for the proposed development has been provided by Thorlux Lighting and is shown in Figure 11.15, full lighting specifications are available in **Appendix 11D**.

The site is already subject to external lighting on surfaced areas and infrastructure. The existing lights are on constantly throughout the night and are resulting in large amounts of light spillage, as shown in Figures 11.16, 11.17 and 11.18 below.

Consideration was given to ecological sensitivities on the site in the design of the lighting layout, including the badger sett on the site and peripheral woodland areas with suitability for bat roosting and foraging. Therefore, the proposed new lighting layout, which will replace the existing lights, has been designed with the following mitigations in place, in line with Bat Conservation Trust - Guidance Note 08/18 *Bats and artificial lighting in the UK* and 2022 NPWS guidance (Marnell et al., 2022)*:*

- All lights will be of warm colour temperature 3000K.
- External lights will contain motion sensor systems, therefore, there will be the option for all lights to be off, or dimmed, when not needed.
- Lighting levels around the perimeter of the site/wooded areas will be kept to 1lux or lower.
- Lighting will be directional and will be focused onto roads and infrastructure and away from adjacent habitats.

Figure 11-16 : Proposed Lighting Layout Plan

Figure 11-17: Existing Lighting on Buildings

Figure 11-18: Existing Lighting Around Site

Figure 11-19: Existing Lighting Around Infrastructure

Residual Effect

No significant effects via disturbance of fauna is predicted once the above mitigation measures have been implemented.

The proposed lighting regime will result in improved suitability for fauna across the site, given that the proposed lighting, as detailed above, is designed in line with relevant guidance for bats. This will replace the existing lighting at the site, which as shown in the photos below, is of a cold colour with high levels of spillage and is therefore unsuitable for fauna. Furthermore, the existing lighting at the site stays on throughout the night. The proposed scheme ensures that there is an option for external lights to be motion-sensored, therefore rendering the site in darkness throughout the night when vacant.

11.5.4 Construction Phase Water Quality

Surface/Groundwater Mitigation Measures

- Prior to the outset of works, a double silt fence will be erected along the drains present to the west, north and east of the WwTP boundary. This will comprise wooden posts and geotextile membrane buried in an 'L' shape to a minimum depth of 250mm. The silt fence will filter any potential surface water run-off from the site generated during the proposed works. All surface water will thus be intercepted in this way before potentially entering any of the perimeter drainage ditches. An indicative layout of the double silt fences is provided in Figure 11.19, **Appendix 11A, Figure, 11-20**.
- Access routes will be clearly marked / identified. Access during construction to any working areas will be restricted to land within the outlined works area.
- Plant will travel slowly across bare ground at a maximum of 5 kilometres per hour (km/hr).
- Excavations will be carried out using a suitably sized excavator and, in all circumstances, excavation depths and volumes will be minimised.
- Stockpiling of excavated material will be temporary and located in a clearly defined and demarcated area, away from any watercourse. Stockpiles will be removed on a regular basis to avoid potential sediment-laden run-off escaping the site, or will be surrounded with silt fencing to prevent pathways to sensitive receptors.
- Earthworks will not take place during periods of high rainfall to reduce run-off and potential siltation of watercourses. Details on rain levels provided in 'Environmental Monitoring' section below.
- Good construction practices such as dust suppression on site roads, and regular plant maintenance will ensure minimal risk.
- Works may be required to be carried out within the water-table. Any ingress of groundwater into excavations will be pumped out to ground via a silt bag which will filter remaining sediment from the pumped water. The entire discharge area from silt bags will be enclosed by a perimeter of silt fencing. Alternatively, it will be pumped to a sealed clean tanker and removed from the site for appropriate treatment and discharge. Indicative areas for the discharge over grassland, surrounded by silt fencing, is shown on. In addition, silt traps or straw bales will be provided within the drain closest to this area to provide another level of interception. Water monitoring will be carried out while this measure is being used. This will include monitoring two points as indicated for turbidity. If downstream NTU levels are 10% higher than those upstream, works will pause until the issue has been addressed or further silt prevention measures are implemented. Water quality mitigation plan drawing is available in Figure 11.19, **Appendix 11A, Figure, 11-20**.

Earth Works

- Excavation depths will be kept to a minimum.
- Material (excluding soils contaminated with invasive species, see biosecurity mitigation measures in **Section 11.5.6**) that cannot be re-used will be transported off site to a designated waste facility.

- Soil excavation will be completed during dry periods and will be undertaken with excavators and dump trucks. No excavation works will take place during periods of heavy rainfall. Details on rain levels provided in 'Environmental Monitoring' section below.
- A silt fence will be erected around any stockpiling of material associated with earthworks.

Cement-based Products Control Measures

- No batching of wet-cement products will occur on site.
- Ready-mixed supply of wet concrete products will be used where needed.
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site.
- Where concrete is delivered on site, only chute cleaning will be permitted, using the smallest volume of water possible, in an area within the compound at least 30m away from any drain within the site. No discharge of cement contaminated waters to any drain or watercourse will be allowed. This will be contained within the site compound area which will be bunded to ensure that there is no escape of cement-laden water from works areas. The compound will be buffered from nearby drains on the site with sandbags and a double silt fence. If this is not practicable, chute cleaning will be avoided on the site.
- The weather forecast will be checked prior to the pouring of concrete and no such works will be undertaken when heavy rain is forecast. Concrete will not be poured at times when rain is predicted as this may lead to run off and over spillage of the formwork.
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

Refuelling, Fuel and Hazardous Materials Storage

- All plant will be inspected prior to use. Defective plant shall not be used until the defect is satisfactorily fixed. All major repair and maintenance operations will take place off site.
- Minimal refuelling or maintenance of vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station.
- Vehicles will never be left unattended during refuelling. Only dedicated, trained, and competent personnel will carry out refuelling operations. Plant refuelling procedures, which will include the below listed measures, shall be detailed in the contractor's method statements.
- Fuels, lubricants and hydraulic fluids for equipment used will be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment.
- Refuelling will be completed in a controlled manner using drip trays at all times.
- Fuels volumes stored on site will be minimised. Any fuel storage areas will be bunded appropriately for the fuel storage volume for the time period of the works and fitted with a storm drainage system and an appropriate oil interceptor.
- Mobile storage tanks such as fuel bowsers will be bunded to 110% capacity to prevent spills. Tanks for bowsers and generators shall be double skinned. When not in use, all valves and fuel trigger guns from fuel storage containers will be locked.
- All pipework from containers to pump nozzles will have anti siphon valves fitted.
- The plant refuelling procedures shall be detailed in the contractor's method statements.
- The plant used will be regularly inspected for leaks and fitness for purpose.

- An Emergency Response Procedure to deal with accidental spillages has been devised as detailed below. Spill kits, oil soakage pads and oil booms will be available to deal with and accidental spillage in and outside the refuelling area and will be kept within the site compound.

Dust Control

- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions.
- Public roads outside the site and along the main access route to the site will be regularly inspected by the Site Manager for cleanliness, most notably before and after plant and machinery deliveries to site.
- Material handling systems and material storage areas 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.
- Water misting or bowsers will operate on-site as required to mitigate dust in dry weather conditions.
- If transport of soils or other material off site is required, which has significant potential to generate dust, this will be undertaken in tarpaulin-covered vehicles where necessary.
- Daily inspection of site to examine dust measures and their effectiveness.

Environmental Monitoring

- The contractor will assign a member of the site staff as the Environmental Manager with the responsibility for ensuring the environmental measures prescribed in this document are adhered to. Any environmental incidents or non-compliance issues will immediately be reported to the project team.
- An ECoW will be employed by the contractor for the duration of the project. The ECoW will be present during site set up and will inspect the silt fence and other mitigations as described prior to commencement of the proposed works and will ensure efficiency is maintained throughout the construction phase. ECoW visits will be conducted at least twice per month to ensure that all mitigations are in place.
- Daily general visual inspections of site operations and inspections of all watercourses within the site and in the surrounding area will also be carried out by the Environmental Manager.
- Inspection to include silt fences and all monitoring. Inspections required to ensure that mitigation measures are operating correctly and to identify any maintenance that is required. Daily inspections checks will be completed on plant and equipment, and whether materials such as silt fencing, or oil absorbent materials need replacement.
- Silt fences will be checked and repaired as necessary in the case of a flood event.

- Water monitoring will be carried out by the ECoW at agreed intervals during works that have potential to result in sediment-laden water entering the mill race channel to the east of the site boundary and subsequently to the Lower River Shannon. A point upstream and downstream of the confluence of the drain network with the mill race channel to the east of the site boundary, as shown in drawing in Figure 11.19, **Appendix 11A, Figure, 11-20**, will be monitored for turbidity. If the downstream turbidity (NTU) is 10% higher than the upstream turbidity within the mill race channel, works will be paused and silt prevention measures will be inspected and improved where necessary.
- A written record will be maintained or available on-site of all monitoring undertaken.

- Event based inspections by the Site Manager as follows:
  - Rainfall >10 mm/hr (i.e. high intensity localised rainfall event)
  - Rainfall >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
  - Rainfall total greater than monthly average recorded in 7 consecutive days (prolonged heavy rainfall over a week).

Flood Risk

- As a portion of the site is within Flood Zone A, strict long-range and short-range weather forecasting will be used for works which carry a pollution risk such as excavations.
- Works will be postponed if heavy rain is forecast.
- The contractor will devise an appropriate construction-phase flood defence around works areas, such as a defined area bunded with sandbags. Indicative areas for bunding can be seen in drawing in Figure 11.19, **Appendix 11A, Figure, 11-20**.
- If a flood is forecast, potentially pollutant materials will be removed from the site and will not be stored within the floodable areas around the peripheries of the site.
- An indicative area for a raised and bunded site compound is shown on drawing in Figure 11.19, **Appendix 11A, Figure, 11-20**.

Emergency Response Procedure

Emergency incidents are those occurrences that give rise to significant negative environmental effects including but not limited to the following:

- Any malfunction of any mitigation measure and/or environmental protection system;
- Any emission that does not comply with the requirements of the contract and relevant licences;
- Any circumstance with the potential for environmental pollution; or
- Any emergency that may give rise to environmental effects (e.g. significant spillages or fire outbreak).

Every effort will be made to prevent pollution incidents associated with spills during the construction of the Proposed Development. The risk of oil/fuel spillages will exist on the site and any such incidents requires an emergency response procedure. The following steps provide the procedure to be followed in the event of an oil/fuel spill occurring on site:

- Identify and stop the source of the spill and alert people working in the vicinity;
- Notify the Environmental Manager immediately giving information on the location, type and extent of the spill so that they can take appropriate action;
- If applicable, eliminate any sources of ignition in the immediate vicinity of the incident;
- Contain the spill using the spill control materials, track mats or other material as required. Do not spread or flush away the spill;
- If possible, cover or bund off any vulnerable areas where appropriate such as drains, watercourses and/or sensitive habitats;
- If possible, clean up as much as possible using the spill control materials;
- Contain any used spill control material and dispose of used materials appropriately using a fully licensed waste contractor with the appropriate permits so that further contamination is limited;
- The Environmental Manager shall inspect the site as soon as practicable and ensure the necessary measures are in place to contain and clean up the spill and prevent further spillage from occurring; and

- The Environmental Manager will notify the appropriate stakeholders such as Limerick City and County Council,, National Parks and Wildlife Service, Department of Communications, Climate Action and Environment and Department of Housing, Planning and Local Government and/or the EPA.
- Environmental incidents are not limited to just fuel spillages. Therefore, any environmental incident must be reported, recorded, and investigated.
- In the event of an emergency incident occurring, the contractor will be required to investigate and provide a report including the following, as a minimum:

  - A description of the incident, including location, the type and quantity of contaminant and the likely receptor(s);
  - Contributory causes;
  - Negative impacts;
  - Measures implemented to mitigate impacts; and
  - Any recommendations to reduce the risk of similar incidents occurring.

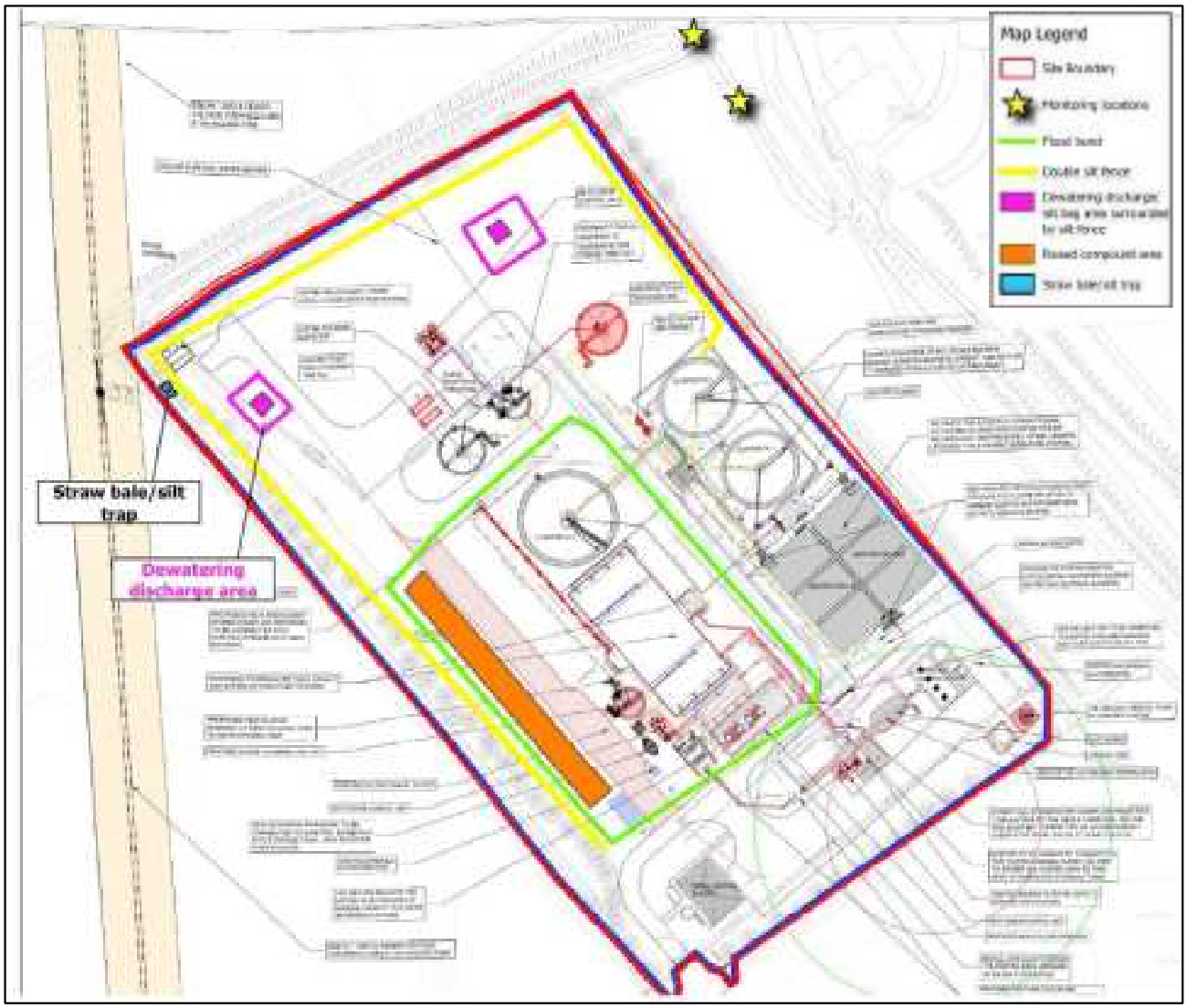

Figure 11-20: Indicative Water Pollution Mitigation Measures (Full drawing available in Appendix 11A, Figure, 11-20)

11.5.5 Operational Phase Water Quality

As described in Section 11.4.3, the operational phase of the development will have a neutral/imperceptible effect on water quality of the aquatic environment of the River Shannon as a result of the wastewater treatment plant upgrade works. The upgrade works will accommodate future loadings to the Plant and will ensure that the resulting effluent will remain within EQS's for the Lower River Shannon. Improved stormwater storage will be provided such that untreated spills to the River Shannon will be reduced annually. In addition, a procedure will be in place for a Wastewater Discharge Licence review for the Plant. Once planning permission for the development is received, the EPA will determine whether a review is required. It is likely that ELVs for the Plant will be reduced to account for additional loading to the plant. Given the improved operational performance of the Plant, more stringent ELVs will be achievable.

Where feasible, new development will be constructed within Flood Zone C of the current site, and all highly essential infrastructure be constructed at an elevation higher than the 1% AEP flood level with a suitable freeboard and an allowance for the effects of climate change. This will protect the proposed development against flooding and to preserve the existing flood plain as to avoid flooding elsewhere. Where it is not possible to locate new infrastructure in Flood Zone C due to physical or hydraulic constraints, compensatory storage will be provided so as not to increase flood risk elsewhere. As per the Flood Risk Management Guidelines, the volume of compensatory storage will equal the volume of flood plain lost to the proposed development, 28m^3. It will also be situated in an area where flood flow routes are protected.

Therefore, there is no requirement for mitigation with regard to water quality during operation of the development.

11.5.6 Biosecurity Mitigation

A site-specific Invasive Species Management Plan has been provided in respect of the proposed works and the presence of Giant Hogweed and Himalayan Balsam at the site. The Invasive Species Management Plan is attached as an **Appendix 11B**. Mitigation measures are also provided below.

Himalayan Balsam (Impatiens glandulifera)

Due to the nature of the proposed works, it will be necessary to achieve immediate eradication of the plant within proposed works areas in order to reduce the extent of infestation in advance of construction works. Hand-pulling the plant from proposed works areas is identified as the most appropriate control option for Himalayan Balsam at the site. The material will be kept within the site and left to dry out and die. Uprooted plants will be stockpiled and covered with jute material in order to block out light and degrade, since uprooted plants can potentially re-root form nodes in moist conditions. Infested areas within the site will be fenced off with a buffer of 7 meters and avoided where possible during construction works.

The following sections outline the steps that will be followed in order to achieve removal of the plant within the works areas and prevent any potentially contaminated material being removed off site.

Interim Before Construction Phase

Hand-pulling the plant from infested areas within the site in advance of construction phase is identified as the most appropriate control option for this species at the site.

- Himalayan Balsam hand-pulling will be supervised by a qualified ecologist and will be undertaken between the end of April to May 2023, when plants are visible but before seed pods have developed.

- To manually remove, stems will be gripped about 0.5m above the ground and carefully pulled.
- The uprooted material will be stockpiled within the site and covered with jute material in order to block out light and degrade. The stockpile will be located within an area of the site where it will be undisturbed. Indicative stockpile areas are shown in the Invasive Species Management Plan **Appendix 11B.**
- Post control monitoring will be carried out four weeks after the control operations to assess the need for further control in advance of construction.
- Any hand-pulling which needs to take place from June onwards will be carried out by a qualified ecologist using a plastic bag to carefully cover the seed heads.

Construction Phase

Pre-commencement:

- A pre-commencement invasive species survey will be undertaken in advance of construction.
- Any persistent plants within works areas will first be removed by hand under supervision of the ecologist prior to works commencing and/or machinery and personnel accessing the area. This will avoid unnecessary disturbance to seed pods and potential dispersal of seed. Balsam plants will be removed by placing a plastic bag over the head of the plant to create a seal and pulling. Pulled plants will be stockpiled under jute material within the site in an area unlikely to be disturbed.
- Any current or previously mapped infested areas which can be avoided by the works will be fenced off to a 7-meter buffer.
- Throughout much of the site, it will not be possible to avoid areas that are contaminated with Himalayan Balsam. All works within 7m of Himalayan Balsam will be supervised by a suitably qualified ecologist.
- A Toolbox Talk will be given by the ecologist in relation to the management of Himalayan Balsam within the site.
- The entire site will be treated as a contaminated zone. A bio-secure zone will be set up at the entrance to the site. The bio-secure zone will comprise heras panels and/or posts and geotextile membrane in order to form a contained area for brush down of personnel and machinery to take place. Warning signage will be erected to direct personnel through the bio-secure zone prior to leaving the contaminated construction site. Clothes and shoes will be brushed down within the bio-secure area to prevent any seed being carried off site. Any material gathered here will be collected and kept within the site. The biosecure zone is shown in the Invasive Species Management Plan (**Appendix 11B).**
- As well as personnel, any machinery will be fully brushed down prior to moving away from the works. Power washing may also be carried out, however, all washings generated during clean down will need to be fully contained and discarded within the site away from any watercourse. It is recommended that power washing be avoided due to proximity to watercourses and potential for contaminated material to escape.
- On completion of the works biosecurity measures will be removed under the supervision of the Ecologist.
- Excavations:
- Contaminated areas where pipework is to be laid can be excavated and back-filled using the original excavated soil, resulting in this soil being left in-situ.
- Any other excavated soil to be isolated and contained within the site, either within the compound area or as a bunded stockpile such as indicated in the ISMP and re-used in landscaping and infilling.

- It is envisaged that no soil is to be removed from the site but is to be reinstated within the site, thus negating the need for transport off-site, further risk of spread, and licencing requirements. Should potentially contaminated spoil be required to be removed from the site, it will be transported to a suitably licenced waste facility and will require a licence from the NPWS prior to its transportation.

Excavations

- Contaminated areas where pipework is to be laid to be excavated and back-filled using the original excavated soil, resulting in this soil being left in-situ.
- Any other excavated soil to be isolated and contained within the site, within the compound or within bunded stockpiles, and re-used in landscaping and infilling. Stockpile locations and associated bunding are shown in the ISMP.
- It is envisaged that no soil is to be removed from the site but is to be reinstated within the site, thus negating the need for transport off-site, further risk of spread, and licencing requirements. Should potentially contaminated spoil be required to be removed from the site, it will be transported to a suitably licenced waste facility and will require a licence from the NPWS prior to its transportation.

Post-Construction

Post control monitoring will be carried out four weeks after the control operations to assess the need for further control and additionally on at least an annual basis, since seeds can persist in soil for up to 3 years, and since the infestation extends beyond the boundary of the WwTP.

Uprooted areas and areas of bare soil post-construction will be re-seeded with native seed or replanted with extirpated native species, for habitat enhancement and in order to increase native competition and reduce the potential for re-establishment of Himalayan Balsam in these areas.

Giant Hogweed (Heracleum mantegazzianum)

Due to the nature of the proposed works, it will be necessary to achieve immediate eradication of the plant within proposed works areas via spraying in order to reduce above-ground plant biomass in advance of construction works.

Soil within 4m of plants which have flowered and set seed is likely to contain vast quantities of seed and disturbance to these areas will be avoided unless required as part of a treatment/control measure. Seeds are typically concentrated in the top 50cm of soil. Infested areas within the site which can be avoided by the construction works will be fenced off with a buffer of 4 meters.

Everyone operating in areas infested with Giant Hogweed will be made aware of the health risks associated with this plant. Infestations will be fenced off including a 4m buffer zone and a warning notice erected. All parts of the plant must be avoided. Any person involved in control or treatment is at risk from direct contact or contact with small fragments of plant or sap released into the works area. Workers must wear protective synthetic water-resistant clothing. Gloves with long sleeves and protective goggles must also be worn. Care must be taken not to touch any exposed skin with gloves covered in sap. If skin is accidentally exposed then the affected area should be carefully washed with soap and water, then covered to prevent UV light reaching the area and medical advice sought.

A professional specialist contractor must be employed for treating any Giant Hogweed infestations and must carry out a detailed risk assessment prior to undertaking any survey/treatment/control measures.

The following sections outline the steps that will be followed in order to achieve removal of the plant within the works areas and prevent any potentially contaminated material being removed off site.

Interim Before Construction Phase

Immediate commencement of in-situ spraying of Giant Hogweed is identified as the most appropriate control option for this species at the site. Due to the proximity of watercourses around the site and the SAC, a suitable herbicide which is approved for use near watercourses will be required.

- An invasive species specialist with experience in Giant Hogweed and the appropriate PPE will be employed for eradication of the plant from within the WwTP.
- Herbicide treatment will only be carried out by suitably qualified personnel/contractors with strict reference to the product label, local land use, health and safety considerations, compliance with relevant legislation and adherence to Irish Water's Biocide Strategy and Policy.
- A Risk Assessment with regard to the hazards of working with and in proximity to the plant will be provided by contractors.
- Treatment has been carried out in 2022. Follow-up treatment will be carried out in May 2023 in order to treat any seedlings which may have germinated after first treatment.

Construction Phase:

Pre-commencement:

- A pre-commencement invasive species survey will be undertaken in advance of construction.
- Do not allow vehicle/machinery/personnel access to the infested area until the infestation has been treated by a Giant Hogweed Specialist and deemed not to present a health risk.
- Any current or previously mapped infested areas which can be avoided by the works will be fenced off to a 4-meter buffer, as per the ISMP where possible.
- Where works within 4m of Giant Hogweed are unavoidable - these will be supervised by a suitably qualified ecologist.
- A Toolbox Talk will be given by the ecologist in relation to the management of Giant Hogweed within the site.
- The entire site will be treated as a contaminated zone. A bio-secure zone will be set up at the entrance to the site. The bio-secure zone will comprise heras panels and/or posts and geotextile membrane in order to form a contained area for brush down of personnel and machinery to take place. Warning signage will be erected to direct personnel through the bio-secure zone prior to leaving the contaminated construction site. Clothes and shoes will be brushed down within the bio-secure area to prevent any seed being carried off site. Any material gathered here will be collected and kept within the site. The location of the biosecure zone is shown in the ISMP.
- As well as personnel, any machinery will be fully brushed down prior to moving away from the works. Power washing may also be carried out, however, all washings generated during clean down will need to be fully contained and discarded within the site away from any watercourse. It is recommended that power washing be avoided due to proximity to watercourses and potential for contaminated material to escape.

- On completion of the works biosecurity measures will be removed under the supervision of the Ecologist.

Excavations

- Contaminated areas where pipework is to be laid to be excavated and back-filled using the original excavated soil, resulting in this soil being left in-situ.
- Any other excavated soil to be isolated and contained within the site, within the compound or within bunded stockpiles, and re-used in landscaping and infilling. Stockpile locations and associated bunding are shown in the ISMP.
- It is envisaged that no soil is to be removed from the site but is to be reinstated within the site, thus negating the need for transport off-site, further risk of spread, and licencing requirements. Should potentially contaminated spoil be required to be removed from the site, it will be transported to a suitably licenced waste facility and will require a licence from the NPWS prior to its transportation.

Post-Construction

- Ongoing monitoring for Giant Hogweed with follow-up spraying will be necessary in order to control Giant Hogweed within the site, particularly as it is pervasive in areas outside of the site.
- Uprooted areas and areas of bare soil post-construction will be re-seeded with native seed or replanted with extirpated native species, for habitat enhancement and in order to increase native competition and reduce the potential for re-establishment of Giant Hogweed in these areas.

It is not envisaged that excavated material will require removal from the site. However, if this is required it will be completed under licence from the NPWS.

11.6 Residual Effects

Based on the above, in view of best scientific knowledge, on the basis of objective information, the Proposed Development will not adversely affect surface or ground water in the area during either construction or operation of the proposed project. The operational phase of the development will result in a neutral impact on water quality and therefore will result in a neutral impact on aquatic habitats and species.

In addition, there is no potential for significant negative impacts on fauna as a result of disturbance. No otter breeding or resting habitats were identified during ecological surveys, and disturbance measures have been included to ensure there is no potential for effect via disturbance on otter, the badger sett within the site, and bats.

There will be no net loss of ecologically valuable habitats within the site. A landscape plan and additional biodiversity measures are in place such that the proposed development will result in a Biodiversity Net Gain.

All identified pathways for significant impact on biodiversity have been robustly blocked through measures to avoid impacts and the incorporation of best practice and mitigation measures into the project design.

After implementation of the mitigation measures outlined in this report, no potential for significant effect on any ecological receptors, their integrity or conservation status, remain.

11.6.1 Cumulative impact assessment

A search and review in relation to plans and projects that may have the potential to result in cumulative and/or in-combination impacts on biodiversity was conducted. This included a review of online Planning Registers, development plans and other available information and served to identify past and future plans and projects, their activities and their predicted environmental effects.

The following Plans were also reviewed:

- Limerick Development Plan 2022-2028
- Limerick City Council Biodiversity Action Plan
- National Biodiversity Action Plan 2017-2021
- Regional Spatial and Economic Strategy 2020 – 2032

Other Projects

The potential for the proposed works to contribute to a cumulative impact on local biodiversity, biodiversity in the wider area, and European Sites was considered. The online planning system for Limerick County Council was consulted on the 17/05/2022. Projects in the area included small-scale single house extensions. Additional projects identified within the area in the last 5 years include:

- Extension of Duration for pl. ref: 15/697: the construction of a new single storey, PGA Accredited Golf Academy Building incorporating 19 covered driving range bays, two teaching bays, two manufacturing bays, a ball management area, toilets, reception, a shop and ancillary spaces. The associated site works include an outfield area 150m wide and 300m long, a putting green, a pitching area, a chipping green and a chipping area, with perimeter call catch nets and associated landscaping. The site works will also include the relocation underground of the existing overhead 38kv power cables and includes the removal of two existing pylons and the erection of two new steel pylons at the extremities of the diverted cables (A Natura Impact Statement will be submitted with the application. The site is located 235 metres from Plassey Mill and Headrace (a protected structure) and 790 metres from Plassey House (a protected structure). The site is located to the southeast of the existing University Boat House, to the west of the main campus and to the east of the Lower River Shannon Candidate Special Area of Conservation (cSAC, site code 002165) and within the Architectural Conservation Area (ACA) - extended under 21/7002 until 28/02/2026.
- Extension of Duration for 06/4024 for construction of 240 dwellings in three areas/lots: Area 1 consists of 152 no. two storey dwellings, types A-G . Areas 2 & 3 consist of 88 dwellings - three storey duplex dwellings with 34 two bed apartments at ground floor with 34 three bed duplex houses on first and second floor and 20 two storey dwellings and creche. Site entrance to area 1 to be widened and improved. Site entrance to area 2 & 3 is via the existing Woodhaven estate. The proposed development includes all ancillary site works, parking landscape and drainage (pl ref: 217036)
- Permission for construction of 23 no. two-storey residential units and associated infrastructure on lands situated adjacent to the 'Carrowkeel' and 'Woodhaven' residential estates and the Castletroy Urban Greenway. The proposed development includes 17 no. terrace and 6 no. semi-detached style residential units, associated landscaping including connection with the Castletroy Urban Greenway, public lighting, surface water attenuation tank, petrol interceptor, connection to public water and foul water infrastructure and vehicular access from Kilmurry Road via existing estate roads (pl ref: 211475)

- Permission for a residential development comprising 96 no. residential units, (16 no. semi-detached houses, 6 no. terrace houses, 2 detached units along with 2 no. 5 storey apartment blocks over basement, comprised of 72 no. apartments and basement parking), bin & bike stores, demolition of existing farm buildings, additional parallel parking along the Castletroy College road, accessed via a new entrance onto the Castletroy College road and all ancillary development works. Ancillary site development works include a new connection to the public water main, foul and surface water drainage, access roads, footpaths, vehicle parking, landscaping, boundary treatments and site development works above and below ground. The planning application is accompanied by a NIS (Natura Impact Statement). (pl ref: 211400)
- Permission for construction of a single storey pre-school building, new site entrance, boundary walls and connection to services with all associated site works (pl ref: 211241)
- Permission was sought for the erection of illuminated signage on the eastern elevation of the existing boat house. The site is located circa 832m from Plassey House (protected structure) and circa 247m from Plassey Mill and Headrace (protected structure). The University of Limerick campus falls within an architectural conservation area. [Pl. Ref. 18440]
- Permission was sought for the demolition of an existing concrete canopy and alterations to the existing East elevation of the Glucksman Library and Information Services Building along with providing a new external sign approx. size 3.2m X 3.2m, to facilitate the relocation of current main entrance located North to further South along the East elevation. The works involve the addition of internal entrance glazed screens and doors with internal alterations to the existing ground floor level at 11.500m OD, of c. 200m^2 gross floor area to facilitate the new main entrance relocation and to provide an new media area. Works also to involve the addition of a new single storey extension at 11.500m OD for a new exhibition and meeting area along with a new café entrance of c. 112m^2 gross floor area at an overall height of 16.275m OD (Ground Level at 11.500m OD) adjacent to the existing main entrance area, along with some existing internal room alterations at 11.500m OD of c. 100m^2 in this area to extend the existing café. The construction of a new three storey infill extension of c.88m^2 gross floor area at an overall maximum height of c. 12.975m and at an overall height of 24.475m OD (Ground Level at 11.500m OD). The construction of a new canopy to the East elevation at a maximum height of c. 7.530m and at an overall height of 19.030m OD (Ground LEVEL AT 11.500M OD), an existing stone sculpture relocation, along with new soft and hard landscaping and all associated site engineering works to be provided to the site measuring 0.70 hectares. The University Campus falls within an Architectural Conservation Area (ACA), which contains Protected Structures including Plassey Bridge, Plassey House, Plassey Mill, Plassey Mountain, Milford House and Gate Lodge which are all at least 200mm from the proposed development. [Pl. Ref. 16630]
- Permission was sought for the construction of an external lift to the south of the Foundation Building, University of Limerick, Sreelane, Castletroy, Co. Limerick. The development will consist of a three storey lift enclosure (16.5m^2) between the upper plaza level and lower ground floor terrace level with a glazed link to the first floor level of the Foundation Building. The lift enclosure (13.2m high) will be clad in brickwork, concrete spandrel panels and copper roofing to match the existing building. The site is located circa 155m from Plassey House (protected structure) and circa 542m from Plassey Mill and Headrace (protected structure). The University of Limerick campus falls within architectural campus falls within an architectural conservation area. [Pl. Ref. 18396]
- Permission was sought for extension of the existing common room mezzanine at the Millstream Building, University of Limerick, Sreelane, Co. Limerick. The

development will comprise of a mezzanine extension of 59.5 sq.m and minor elevational modifications. The site is located circa 153 metres from Plassey House (a protected structure) and circa 509m from Plassey Mill and Headrace (a protected structure). The University of Limerick campus falls within an Architectural Conservation Area. [Pl. Ref. 20543]

- Permission was sought for the erection of a temporary pedestrian and vehicular entrance at the end of Drumroe Estate, construct an internal access road to the existing carpark and clubhouse, close up the existing access road as shown on plans and incorporate closed off section of existing roadway into the carpark and all associated site works. [Pl. Ref. 181064]
- Permission was sought for the change of use from light industrial to office use. [Pl. Ref. 21428]

Other Irish Water Projects identified within the vicinity of the Lower River Shannon include:

- Demolition of existing inlet works and pumping station. Construction of a new inlet works, inlet and storm and final effluent pumping stations, storm tank, control building and all ancillary site works (Adare WwTP) (pl ref: 191200), approximately 15km southwest of the development site.
- Demolition of existing sludge bed. Construction of new inlet works, storm tank, picket fence thickener, pumping stations, control buildings and all ancillary site works (Croom WwTP) (pl ref: 191201) approximately 15km southwest of the development site.

Other permitted Discharges located along the Lower River Shannon include:

- Primary discharge and stormwater overflow 20km downstream of Castletroy - D0045-01 – Shannon Town
- Stormwater overflow 8.2km upstream of Castletroy: DTEMP0008-01
- Stormwater overflow 9.8km downstream of Castletroy: DTEMP0007-01 Limerick
- Primary discharge and stormwater overflow 43km downstream of Castletroy - D0502-01 Foynes
- Primary discharge 55km downstream of Castletroy - D0504-01 Glin

The existing listed discharges above are of significant distances from the Castletroy discharge. The Waste Assimilative Capacity of the Lower River Shannon at the time of writing, as described in **Section 11.4.3**, is such that there will be no cumulative effects to the aquatic habitats and fauna of the Lower River Shannon.

The potential for cumulative effects on water quality of the Lower River Shannon as a result of the Proposed Development in-combination with the downstream discharge from the Bunlicky Wastewater Treatment Plant was also considered. Bunlicky WwTP is 13km downstream of Castletroy. It currently serves a population equivalent of 186,233PE (2020 AER) and is due to undergo a development project which will upgrade the treatment capacity of wastewater and sludge processes on the site. Due to the distance downstream and mixing of flow with other tributaries, there will be no cumulative effects from the combination of Castletroy effluent with current or future discharges from the Bunlicky WwTP on aquatic habitats and species of the Lower River Shannon.

At the time of writing, there is no evidence for the construction phase of nearby developments coinciding with the construction phase of the Proposed Development. Nor will the Proposed Development interact with any of the projects listed above. Therefore, the possibility of

cumulative impacts occurring during the construction phase of the Proposed Development is considered to be imperceptible.

Conclusion of Cumulative Assessment

Following the detailed assessment provided in the preceding sections, it is concluded that, the proposed development will not result in any residual negative impacts on local biodiversity or biodiversity in the wider area when considered on its own. There is therefore no potential for the proposed development to contribute to any cumulative adverse effects on biodiversity when considered in-combination with other plans and projects or other discharges into the Lower River Shannon.

The proposed development, with improved treatment capacity, will support future planning applications within the agglomeration to ensure provision of appropriate wastewater treatment and to maintain the aquatic habitats and species of Lower River Shannon in good condition.

In the review of the projects and other discharges that was undertaken, no connection, that could potentially result in additional or cumulative impacts was identified. Neither was any potential for different (new) impacts resulting from the combination of the various projects and plans in association with the proposed development.

Taking into consideration the reported residual impacts from other plans and projects in the area and the predicted impacts with the current proposal, no residual cumulative impacts have been identified with regard to biodiversity.

11.7 Conclusion

This Report has provided an assessment of all potential direct or indirect impacts on biodiversity in the vicinity of the development site.

It is concluded that the existing discharge from Castletroy WwTP is compliant with EPA treatment standards and is not having an observably negative effect on aquatic habitats and species. It has been demonstrated that the calculated future concentrations of BOD, ammonia and ortho-phosphate within the effluent from the Plant will be below Environmental Quality Standards (EQS's) for the Lower River Shannon and will be in compliance with the objectives of the Water Framework Directive. Therefore, there is no potential for the operation of the development to result in significant negative effects on aquatic biodiversity of the Lower River Shannon.

It has been shown that there will be a biodiversity net gain on the site once landscaping measures are implemented through the creation of additional habitat including woodland, treelines, bat boxes and bird boxes. In addition, the creation of additional habitat will provide competition against invasive species within the site.

Identified pathways for impact on wildlife through disturbance during construction including the badger sett within the site and bats in the wider area have been blocked through mitigation. The proposed lighting scheme is designed in line with relevant guidance for wildlife and will replace the existing external lighting which is unsuitable for wildlife. Identified pathways for deterioration in the aquatic environment during construction have also been blocked through mitigation.

Where the potential for any impact on an ecological receptor has been identified, the pathway by which any such impact may occur has been robustly blocked through the use of avoidance, appropriate design and mitigation measures as set out within this report and its appendices.

The measures ensure that the construction and operation of the proposed development does not significantly impact any ecological feature in the immediate or wider environment.

Therefore, it can be objectively concluded that the Proposed Development, individually or in combination with other plans or projects, will not negatively impact biodiversity at any geographic scale.

11.8 References

Birds Directive (2009/47/EC) – http://ec.europa.eu/environment/naturelegislation/birdsdirective_/index_en.htm

BirdWatch Ireland websitehttp://www.birdwatchireland.ie/

Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (Habitats Directive) and Directive 2009/147/EC (codified version of Directive 79/409/EEC as amended) (Birds Directive) – transposed into Irish law as European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477/2011)

DEHLG (2009) Appropriate Assessment of Plans and Projects in Ireland: Guidance for Planning Authorities. DEHLG, Dublin.

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

EC (2001) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC.

EC (2002) Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission.

EC (2007a) Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. Office for Official Publications of the European Communities, Luxembourg. European Commission.

EC (2013) Interpretation Manual of European Union Habitats. Version EUR 28. European Commission, DG Environment.

EC (2018) Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg. European Commission.

EPA website: http://www.epa.ie.

European Communities (Conservation of Wild Birds) Regulations, 1985, SI 291/1985 & amendments – http://www.irishstatutebook.ie.

European Communities (Environmental Impact Assessment) Regulations, 1989 to 2006.

European Communities (Natural Habitats) Regulations, SI 94/1997, SI 233/1998 & SI 378/2005 – http://www.irishstatutebook.ie.

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

Habitats Directive (92/43/EEC).

Inland Fisheries Ireland website http://www.fisheriesireland.ie/

Irish Water (2021) – Irish Water's Biodiversity Action Plan – Embedding Biodiversity into Water Services.

Irish Water (2021) – Irish Water Biodiversity Guidance for Irish Water Developments - IW-AMT-GL-021

Irish Water (2018) – Landscape Treatment Guidelines – IW-AMT-GL-009

Kelly, F.L., Connor, L., Matson, R., Coyne, J., Feeney, R., Morrissey, E. and Rocks, K. (2015) Water Framework Directive Fish Stock Survey of Transitional Waters in the Shannon International River Basin District – Shannon Estuary, Fergus Estuary and Limerick Docks 2014. Inland Fisheries Ireland, 3044 Lake Drive, Citywest Business Campus, Dublin 24, Ireland.

Marnell, F., Kelleher, C. & Mullen, E. (2022) Bat mitigation guidelines for Ireland v2. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland

National Biodiversity Data Centre website http://www.biodiversityireland.ie/

NPWS (2013) The Status of EU Protected Habitats and Species in Ireland. Conservation Status in Ireland of Habitats and Species listed in the European Council Directive on the Conservation of Habitats, Flora and Fauna 92/43/EEC.

NPWS of the DEHLG (2013) The Report on Status of Habitats and Species in Ireland: Technical Reports and Forms.

NPWS Protected Site Synopses available on http://www.npws.ie/en/ProtectedSites/.

Preston C.D. et. al. (2002). New Atlas of the British and Irish Flora. Oxford University Press.

Scottish Natural Heritage. (2016). Assessing connectivity with Special Protection Areas (SPAs). Guidance Version 3.

Water status data available on http://www.epa.ie and http://www.wfdireland.ie

Wildlife Act 1976 and Wildlife (Amendment) Act 2000.