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Engineering and Environmental Consultants

Natura Impact Statement

Lady's Island Lake Water Level

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1 SUMMARY OF FINDINGS

Project Title	Lady's Island Water Level Management
Project Proponent	Wexford County Council
Project Location	Our Lady's Island, Co. Wexford
Natura Impact Statement	In cases where an Appropriate Assessment is required a Natura Impact Statement (NIS) is prepared; it includes a report of a scientific examination of evidence and data, carried out by competent persons to identify and classify any implications of the project, individually, or in combination with other plans or projects, for Natura 2000 sites in view of the Conservation Objectives of the sites.
Conclusion	The proposal to build a flow control structure and manage water levels (and salinity) at Lady's Island will not result in an adverse impact on the Natura 2000 sites considered in this NIS, namely: • Lady's Island Lake SAC • Lady's Island Lake SPA • Carnsore Point SAC

2 INTRODUCTION

This Natura Impact Statement (NIS) has been undertaken by staff ecologists from Malachy Walsh and Partners, Engineering and Environmental Consultants, to determine whether a proposal to control water levels in Lady's Island Lake, through installation of a flow control structure between the lake and the sea (instead of regular cutting of the barrier beach) will adversely affect the integrity of Natura 2000 sites identified during the screening for Appropriate Assessment (see **Appendix 1**). The Screening for appropriate assessment determined that an appropriate assessment of the project was required as it cannot be excluded, on the basis of objective information, that the project, individually or in combination with other plan or projects, will have a significant effect on the Lady's Island SAC and Lady's Island SPA.

The Natura 2000 network, which stems from the Habitats Directive, comprises the collective of Special Areas of Conservation (SACs), designated under the EU Habitats Directive[1], and Special Protection Areas (SPAs) designated under the EU Birds Directive[2]. The Natura 2000 sites are selected to ensure the long-term survival of Europe's most valuable and threatened species and habitats.

The proposal is to install a drainage pipeline that will act to manage water levels in Lady's Island Lake. This will allow saline water to enter the lake in a controlled manner. The Lake Water Level Management project at Lady's Island is fully described in **Section 6**.

The proposal is necessary to the conservation management of Lady's Island SPA. Inconsistent water levels at Lady's Island Terns represent an ecological pressure with regard to Tern breeding. As noted in Healy (1997), breaching of the beach barrier is seen as a threat to the important tern colonies because when the outlet remains open for long periods the water level falls below a critical level allowing mammalian predators to reach the islands.

An NIS for the proposed development was submitted to An Bord Pleanála (ABP) in 2020, version E. A number of concerns were raised by ABP in response to this NIS, as follows:

- The screening report
- The potential adverse effects on qualifying interests in the Lady's Island Lake SAC
    - Lagoons and overtopping
    - Emergency cut
    - Cottonweed and overtopping
    - Proposed planting of marram grass
    - Further information request
- Climate change
- Overhead cable and gadwall (*Anas strepera*)
- Security of infrastructure
- Impact on Annex I non-qualifying interests (dune habitats)
- Errata/inconsistencies in the NIS

[1]Council Directive 92/43/EEC

[2]Council Directive 79/409/EEC

The proposal has been altered, and the screening for Appropriate Assessment and NIS have been amended to take account of the changes. This NIS document (version F) addresses the issues raised by ABP relating to the NIS. It is noted that the former proposal featured a rock armour lined channel buried in the barrier beach to act as an emergency method of allowing water to /from the lake on an intermittent basis. This component of the project no longer features. Additionally, under the previous proposal, the barrier beach (also referred to as a dune/gravel beach) would be re-profiled at the existing cut to reduce overtopping of seawater. This element of the project has also been removed.

2.1 REQUIREMENT FOR APPROPRIATE ASSESSMENT

Appropriate Assessment (AA) is the consideration of the potential impacts, on the integrity of Natura 2000 site(s), of proposed projects or plans, not connected with or necessary to the conservation management of a Natura 2000 site, either alone or in combination with other plans or projects, with respect to the structure and function and the Conservation Objectives of Natura 2000 sites. The requirement is pursuant to Article 6(3) of Directive 92/43/EEC which stipulates that certain projects and plans must be subjected to an "appropriate assessment" of their effects on the integrity of Natura 2000 site(s). Article 6(3) provides in full:

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

The assessment carried out under Article 6(3) must be completed before a decision is made; consent can only be given after the competent authority, either the relevant local authority or An Bord Pleanála, has determined that the proposal for which consent is sought would not, beyond a reasonable doubt, adversely affect the integrity of Natura 2000 sites in view of their Conservation Objectives.

2.1.1 Stages of Appropriate Assessment

The Appropriate Assessment process is a four-stage process with issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required. The stages are set out in **Appendix 2**.

As set out in the relevant guidance, the task of establishing whether a plan or project is likely to have an effect on a Natura 2000 site(s) is based on a preliminary impact assessment, known as screening for Appropriate Assessment, which determines whether there is a risk that the effects identified could be significant. The precautionary principle approach is required.

A screening for Appropriate Assessment, or Stage 1, which was undertaken concluded that significant effects on the Conservation Objectives of certain Natura 2000 sites that could, potentially, ensue from the proposed control of lake levels at Lady's Island could not, beyond reasonable scientific doubt, be ruled out and, therefore, an Appropriate Assessment was required. In cases

where an Appropriate Assessment (or Stage 2) is required, an NIS shall be prepared that shall include a report of a scientific examination of evidence and data, carried out by competent persons, to identify and classify any implications for Natura 2000 sites in view of the Conservation Objectives of the site(s). The purpose of the NIS is to provide information to the competent authority on which to base their Appropriate Assessment of the plan or project. The plan or project should be fully described particularly in relation to the aspects that could interact with the surrounding environment. It comprises consideration of the impact on the integrity of the Natura 2000 site of the project, either alone or in combination with other plans or projects, with respect to the site's structure and function and its Conservation Objectives. Additionally, mitigation of these impacts can be considered.

2.2 NATURA 2000 SITES SELECTED FOR APPROPRIATE ASSESSMENT

The screening for AA associated with this proposal concluded that significant effects on the Conservation Objectives of certain Natura 2000 sites that could, potentially, ensue from the proposed controlled lake levels at Lady's Island cannot be ruled out. Therefore, an appropriate assessment is required to determine whether the proposed development is likely to adversely affect the integrity of these Natura 2000 sites. These sites are:

- Lady's Island Lake SAC (site code 000704)
- Lady's Island Lake SPA (site code 004009) and
- Carnsore Point SAC (site code 002269)

These Natura 2000 sites (illustrated in **Figure 1**) are listed in **Table 1**, below with the protected habitats and/or species for whose protection and conservation the individual Natura 2000 sites are selected.

For Special Areas of Conservation these protected habitats and species are described as Qualifying Interests (QI) and for Special Protection Areas the protected species are described as Special Conservation Interests (SCI).

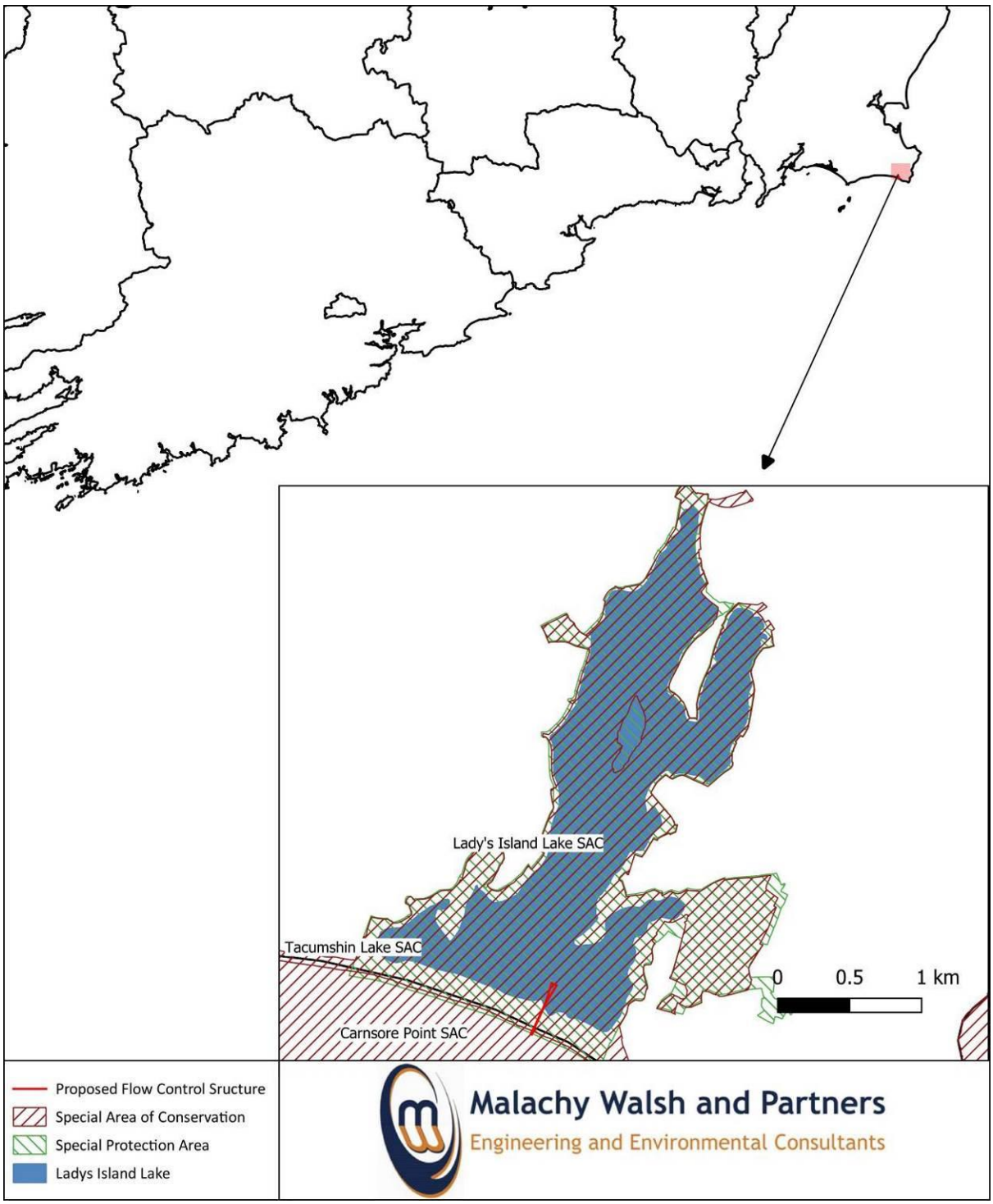


Figure 1: Location of Lady's Island Lake, Co. Wexford.

2.3 CHARACTERISTICS OF NATURA 2000 SITES

Table 1 below, lists the qualifying interests for the Natura 2000 sites selected for assessment in the NIS. Information pertaining to the Natura 2000 sites is from site synopses, Conservation Objectives documents and other information available on www.npws.ie. The following sections describe the characteristics and value of each of the three designated sites.

Table 1: Natura 2000 sites selected for inclusion in the NIS with CI's and SCI's listed.

Designated Site	Qualifying features of conservation interest
Lady's Island SAC (000704)	• Coastal lagoons* [1150] • Reefs [1170] • Perennial vegetation of stony banks [1220]
Lady's Island Lake SPA (004009)	• Gadwall (*Anas strepera*) [A051] • Black-headed Gull (*Chroicocephalus ridibundus*) [A179] • Sandwich Tern (*Sterna sandvicensis*)[A191] • Roseate Tern (*Sterna dougallii*)[A192] • Common Tern (*Sterna hirundo*) [A193] • Arctic Tern (*Sterna paradisaea*) [A194]
Carnsore Point SAC (002269)	• Mudflats and sandflats not covered by seawater at low tide [1140] • Reefs [1170]

Plate 1 View of section of the south-eastern shoreline of Lady's Island lagoon (left). View of Sgarbheen Island from Lady's Island – an important nesting location for migratory Terns.

2.3.1 Lady's Island Lake SAC (000704)

Situated in the extreme south-east of Ireland, this site comprises a shallow coastal lagoon separated from the sea by an impressive sandy-gravel barrier. The area of the SAC is ca. 507 hectares. The lake is 3.7 km in length and 1.3 km at its widest southerly point and covers an area of 299.6 hectares. The lagoon is up to 5 m deep though mostly shallower. Salinity of the lagoon is generally oligo-mesohaline but it is periodically tidal when the barrier is breached. Carnsore Point, formed by an intrusion of igneous granite, felsite and other intrusive rocks rich in silica, marks the south-eastern boundary of the site.

Plate 2 View of the 'cut' in the barrier beach at the southern end of Lady's Island SAC (left), showing a portion of the lagoon. The southern extent of the proposed development is located within the Carnsore Point SAC (right).

Surrounding land is low-lying agricultural land. Dune vegetation occurs over much of the barrier. The flora of the lagoon is typically brackish and includes Widgeonweed species *Ruppia* spp. and a range of freshwater green algae charophyte species.

The fauna of the lagoon is rich, with at least 13 lagoonal specialist species recorded. Swamp and marsh vegetation is particularly well developed at Ring Marsh in the south-east of the site. Elsewhere, the lagoon is fringed by marsh or wet grassland. Several small islands within the lagoon, where terns breed, are included in the site.

Lady's Island Lake is by far the largest and best example of a sedimentary lagoon in the country and one of the best in Europe. It is in a relatively natural condition, despite regular breaching of the barrier separating it from the sea. The flora is typically brackish and includes the Red Data Foxtail stonewort charophyte *Lamprothamnion papulosum*. The fauna of the lagoon is rich, with at least 13 lagoonal specialist species recorded. This coast comprises the best example in Ireland of a landward moving (transgressive) system of gravel-based barrier. The sequence of back barrier washover and seepage structures are among the best in Europe, and, indeed, Lady's Island remains the last intact example in Europe (NPWS Site synopsis).

The site supports typical vegetation of stony banks, including the Red Data Book species Cottonweed *Othanthus maritimum*. A total of six other Red Data Book plant species are present in the site. In addition to Cottonweed, two charophyte species and three other Red Data Book species occur within the site: Lesser Centaury (*Centaurium pulchellum*), Pennyroyal (*Mentha pulegium*) and Golden Dock (*Rumex maritimus*). Cottonweed, Lesser Centaury and Pennyroyal are all protected under the Flora (Protection) Order, 2015 (S.I. No. 356/2015). The rare plant Lesser centaury seeds in the Autumn and grows at a particular lake level within Lady's Island SAC. Lansdown and Ali (2013) notes that it grows in sheltered crevices, around freshwater springs and in seasonally inundated or wet depressions. It prefers open habitats and damp grassy places, especially near the sea. During the Coastal Monitoring Project (Ryle *et al*. 2009) and the Vegetated Shingle Monitoring (VSM) Project (Martin *et al*. 2017), Lesser Centaury *Centaurium pulchellum*, Pennyroyal *Mentha pulegium* and Golden Dock were *Rumex maritimus* were not recorded.

2.3.2 Lady's Island Lake SPA (004009)

Lady's Island Lake is by far the largest and best example of a sedimentary lagoon in the country and one of the best in Europe. It supports an excellent range of birds typical of lagoonal systems. In winter, there is a good diversity of waterfowl species, though most occur in relatively low numbers. The population of Gadwall *Anas strepera* is of national importance though part of the population is resident. There are regionally important populations of Greater Scaup *Aythya marila*, Whooper Swan *Cygnus cygnus* and Golden Plover *Pluvialis apricaria.* In summer, Western Marsh-harrier *Circus aeruginosus* is a regular visitor and nesting is a possibility. Lady's Island has an excellent diversity of breeding wildfowl and is one of the few sites in Ireland where Garganey *Anas querquedula* is considered to breed. The very localised Northern Shoveler *Anas clypeata* also breeds and it is one of the principal sites in Ireland for breeding Gadwall *Anas strepera*. The site is an internationally important site for breeding terns and is the largest tern colony in the country, with four species of tern present. It has the largest colony of Sandwich terns *Sterna sandvicensis* in the country. The population of Roseate tern *Sterna dougallii* is the second largest after Rockabill. The Arctic Tern *Sterna paradisaea* and Common Tern *Sterna hirundo* populations are of national importance. It also supports one of the largest colonies of Black-headed Gull *Larus ridibundus* in the country. Mediterranean Gull *Larus melanocephalus* has bred at the site since the late 1990s, the only known breeding site in the country. The terns have been studied since the 1960s, and National Parks and Wildlife Service have managed the colonies since 1993 as part of a long-term conservation programme. This programme includes wardening, habitat management, thorough monitoring of breeding parameters and ringing of chicks. Lady's Island is an important site for passage waders, including Ruff *Philomachus pugnax*, Curlew Sandpiper *Calidris ferruginea*, Green sandpiper *Tringa ochropus* and the very scarce Wood sandpiper *Tringa glareola*. The lagoon supports two Red Data Book charophyte species, Foxtail stonewort *Lamprothamnion papulosum* and Bearded stonewort *Chara canescens*. The site includes a designated refuge for fauna under the Wildlife Act.

A fish stock survey was conducted on Lady's Island Lake as part of the programme of fish monitoring for the Water Framework Directive (WFD) in September 2009. A total of seven fish species were recorded. Sand goby *Pomatoschistus minutus* was the most abundant species, followed by eel *Anguilla anguilla* and three-spined stickleback *Gasterosteus aculeatus*. Plaice *Pleuronectes platessa*, nine-spined stickleback *Pungitius pungitius*, flounder *Platichthys flesus* and cod *Gadus morhua* were also present (Central and Regional Fisheries Boards 2009)[3].

2.3.3 Carnsore Point SAC (002269)

Carnsore Point is situated to the south of Co. Wexford in the south-east of Ireland. It is formed by an intrusion of Igneous Granite, Felsite and other intrusive rocks rich in silica. Both on the shore and under the surface of the water, the reef is typically strewn with boulders, cobbles and patches of sand. It is exposed to prevailing wind and swells from the west. Tidal streams tend to be moderate but are strong in some areas. Offshore, Barrel's Rocks are extremely exposed to the full force of Atlantic swells.

Carnsore Point has good examples of littoral reefs moderately exposed to wave action and sublittoral reef communities very exposed to moderately exposed to wave action in which a number of rare species occur. The moderately exposed reef communities are distinguished by a luxuriant growth of the brown alga Knotted Wrack *Ascophyllum nodosum* in the midshore. Infralittoral reef

[3] http://www.wfdfish.ie/wp-content/uploads/2011/11/Ladys-Island-Lake_estuary_report_2009.pdf

areas have good, species-rich communities that are typical of exposed infralittoral reefs subject to moderate tidal streams. Conversely, the species poor community at Barrel Rocks is an extremely good example of a very exposed shallow reef community. The following species were recorded for infralittoral areas that are notable: *Tethyspira spinosa*, Yellow feathers *Gymnangium montagui*, Latticed corklet *Cataphellia brodricii,* Orange lights Seasquirt *Pycnoclavella aurilucens*, *Sidnyum elegans,* Lesser gooseberry sea squirt *Distomus variolosus* and Orange sea grapes *Stolonica socialis*. The circalittoral reefs have examples of several different community types that occur in tidal streams, and some are influenced by sand scour. The populations of the sponge *Tethyspira spinosa*, the *anthozoan* Latticed corklet *Cataphellia brodricii*, and the hydroids *Schizomavella sarniensis* and *Stolonica socialis*, are particularly important because they represent a substantial proportion of the entire populations that occur in Irish waters. The Green crenella *Musculus discors* beds are particularly noteworthy as they are the only beds in Ireland where the mussels are superabundant and species richness is high (63 species south of Carnsore Point and 79 species north-east of Terchen). The littoral sediment community that occurs at Carne Beach adds habitat diversity to the area and is a good example of a moderately exposed sand shore.

3 METHODOLOGY

3.1 APPROPRIATE ASSESMENT GUIDANCE

This Natura Impact Statement (NIS) has been undertaken in accordance with the European Commission Methodological Guidance on the provision of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC (EC, 2001) and the European Commission Guidance 'Managing Natura 2000 sites' (EC, 2000) and guidance prepared by the NPWS (DoEHLG, 2009).

3.2 CONSULTATION

Consultation was undertaken with:

- NPWS
- OPW
- Our Lady's Island Lake Drainage Committee
- Wexford County Council

During the development of the project, a number of meetings took place between MWP, NPWS, Wexford County Council and the Our Lady's Island Lake Drainage Committee. Meetings involving the above parties were held on the following dates:

- 15th December 2016
- 11th January 2017
- 31st May 2017
- 13th June 2018

3.2.1 NPWS advice on water levels and salinity in Lady's Island Lake lagoon habitat

Advice in relation to water levels and salinity issued to Our Lady's Island Lake drainage committee by email on 3/5/2017 by Ciara O Mahony, NPWS following an internal NPWS meeting on 16/3/2017 is provided below.

3.2.1.1 Water levels

The targets for water levels in the lake should be as follows:

- The lake should have a normal level of 4.0m OD Poolbeg (range of 3.8m to 4.2m OD Poolbeg) from mid-March to the end of August.
- The lake should have a minimum water level of 5.1m OD Poolbeg for at least one month in winter. From an ecological perspective, no maximum level is required for winter.

3.2.1.2 Salinity

Roden and Oliver (2012) give median salinity values for Lady's Island North and South based on all available data between 2009 and 2011. The median levels for the North and South of the Lake given in Roden and Oliver (2012) should be given as targets for salinity. These are as follows:

- Winter at Lady's Island Lake north 8.65 psu (practical salinity units), Lady's Island Lake south 20.45 psu.
- Summer at Lady's Island Lake north 23.25 psu, Lady's Island Lake south 23.15 psu.

These high levels reflect the practice of annual breaching of the barrier beach, which is a long-term damaging activity. NPWS accept that lower salinity levels are therefore acceptable provided that the typical and rare species of the lagoon are protected.

3.3 DESK STUDY

In order to complete the NIS certain information on the existing environment is required. A desk study was carried out to collate available information on the site's natural environment. This comprised a review of the following publications, data and datasets:

- OSI Aerial photography and 1:50000 mapping
- Other online mapping sources (online)
- National Parks and Wildlife Service (NPWS) (online)
- National Biodiversity Data Centre (NBDC) (online)
- BirdWatch Ireland
- Teagasc soil area maps (NBDC website)
- Geological Survey Ireland (GSI) area maps (online)
- Environmental Protection Agency (EPA) water quality data (online)
- South Eastern River Basin District (SERBD) datasets (Water Framework Directive) (online)
- Long-term changes in a brackish lagoon, Lady's Island Lake, South-East Ireland (Healy 1997)
- Water Levels at Lady's Island Lake, 1984-1996 (Hurley 1997)
- Study of Drainage Options for Lady's Island Lake and Tacumshin Lake (Parle 1998)
- Other information sources and reports footnoted in the course of the report and
- Birds of Conservation Concern in Ireland 2014-2019. Irish Birds 9: 523-544 (Colhoun and Cummins 2013)

The focus of the assessment is to determine whether Lake Water Level Management at Lady's Island will have a significant negative impact on the qualifying interest of the SAC or special conservation interests of the SPA. This assessment identifies the environmental aspects of the project that will interact with the ecological requirements or sensitivities of the target features, including the

installation a drainage pipeline to control water levels, and subsequent effects on salinity. The test of the assessment is whether the proposed development will have 'an adverse effect on the integrity of the site' in light of the sites conservation objectives. Where potentially significant effects are identified proven mitigation measures will be recommended.

Lady's Island Lake has been studied extensively in the past. Available data and literature relating to the site and water level management practices were reviewed during the course of this assessment. In particular, a document by Healy (1997) summarising seventeen years of observations on salinity, water-level, fauna and flora was reviewed. The data are uneven, having been acquired for a range of purposes. Differences in methods, sampling effort and frequency of observations have meant that few of the observed changes in the flora and fauna are fully quantifiable. However, general patterns of change have provided an insight into the dynamic nature of the system and the causes of fluctuations in conditions and biota.

A predictive assessment of salinity levels in Lady's Island Lake was undertaken using iterative calculations under the following scenarios: base freshwater inflow and saltwater inflow to lake; and saltwater inflow to lake without freshwater inputs. This assessment was based on lake water volumes, base (yearly average) freshwater inflows into the lake ($0.3m^3/s$), saltwater salinity of 34 psu and freshwater salinity of 0 psu. Lowering lake water levels with, and without freshwater inputs were modelled to forecast the time taken to bring the water level to a point that would allow effective saltwater influx. This assessment was based on tidal ranges and lake levels, and conveyance capacity of the flow control structure and pipeline.

3.4 FIELD SURVEYS

A site survey was conducted on the 11th of October 2018. The character of the barrier beach in the environs of the 'cut' was noted. The habitats at the footprint of the proposed pipeline and flow control structure were examined and the substrates were recorded. The approaches to the proposed development were assessed, and an access route from the local road network to the east of the proposed development involving least disturbance/avoidance of important habitats was selected. Likewise, a location for a site compound was chosen, based on minimising the impact on sensitive habitats, and proximity to the proposed works. The habitats at the footprint of the proposed development were examined and categorised according to the Heritage Council's 'A Guide to Habitats in Ireland' (Fossitt 2000). The Islands of Inish and Sgarbheen were viewed from Lady's Island. The largest streams feeding Lady's Island Lake were viewed. Locations viewed were photographed.

A search for the plant Cottonweed was carried out on the gravel barrier to the east of the 'cut' where this plant is known to occur. The distribution of this plant was recorded where it occurred close to the proposed development. Weather conditions on the day of the survey were unsettled. Some wave action on the lagoon impaired visibility.

4 DESCRIPTION OF LADY'S ISLAND LAKE

4.1 LOCATION AND PHYSIOGRAPHY

Lady's Island Lake is a natural, brackish, sedimentary percolating lagoon, situated on the south coast of County Wexford ca. 3km west of Carnsore Point. Lady's Island Lake is a coastal lagoon isolated from the sea but subject to wide fluctuations in water-level and salinity as a result of more or less regular breaching of the dune barrier (Healy 1997). It is separated from the sea by a natural sand and gravel barrier.

The natural sand and gravel barrier which impounds Lady's Island Lake is periodically breached/cut to relieve flooding. Evidence from historic OSI mapping (1837-1842) indicates that the 'cut' was open in 1840 to a width of approximately 100m at its narrowest at the centre and east of the current 'cut'. Breaching was carried out by local landowners manually until 1953. In 1954, Wexford County Council became involved in order to facilitate the Marian Pilgrimage and continued to manage the beach until 1988. The barrier was not breached in 1989, and in 1990 it was breached by local people. Since then, it has been breached by NPWS, under permission from the local Our Lady's Island Lake Drainage Committee, as necessary for the management of the tern nesting islands, and also on occasion for flooding reasons. According to Healy (1997), breaching of the barrier is usually carried out in March-April. Following completion of the 'cut', the water flows out for several days until the lagoon level falls below high-tide mark. The lagoon then becomes tidal and the 'cut' is allowed to seal naturally until it seals as a result of onshore and long-shore transport of beach sediment. The opening, and the lagoon may become re-isolated within two weeks, or it may remain open to the sea for up to 6 months (Healy 1997; Hurley 1997).

Plate 3 View of Lady's Island lake and the cut in March 2021.

The timing of the breach with respect to tides and weather conditions appears to affect the extent to which the water levels in the lake drop. Traditionally, the breach was cut in March close to St. Patricks Day (Hurley 1997) after the vernal equinoctial spring tides. These very high tides occur each

year a few days after the New or Full Moon closest to 21st March. Breaches before 21st March leave the weakened barrier very vulnerable to being overwashed if low atmospheric pressure, onshore gales, high seas, surges or Atlantic swells accompany spring tides (Golder Associates 2010).

Plate 4 Southern boundary of the lagoon at the 'cut' on 11th October 2018.

Plate 5 The cut being made at Southern end of Lady's Island lake in March 2021 (left) and completed cut (right).

On 11th October 2018, the 'cut' extended for ca. 250m along the barrier beach which separates the lagoon from the sea. Large accumulations of gravel/sand were recorded at the 'cut'. These marine derived substrates are being transported from the sea to the lagoon and are considered a risk in reducing the area of lagoon habitat, especially during the summer months when levels usually drop. Saline seepage from the gravel bed towards the lagoon was evident at the eastern end of the 'cut' (See **Plate 4**). The profile at the interface of the 'cut' and in-tact dune signified a significant flow of water (**Plate 4**), a likely occurrence during extreme high tides. It is apparent that the 'cut' in the barrier beach is now a feature of the barrier dune to the south of Lady's Island Lake, as it is an annual practice.

The lake and surrounding habitats are of international importance in terms of breeding and wintering birds, coastal habitats and flora, the geomorphological feature of the barrier, and lagoonal specialist flora and fauna. Consequently, the lagoon and adjacent terrestrial habitats have been designated as a Special Area of Conservation and a Special Protection Area. However, as noted by Healy (1997), breaching of the barrier beach is seen by many as a threat to aquatic life because it can result in high mortalities of flora and fauna. The lake may even appear "dead" after an extended period of tidal flow (Healy 1997).

There are two islands: Sgarbheen, which becomes submerged in late winter, and Inish, which is never submerged. The former 'Lady's Island' is now joined to the mainland by a causeway. Sediments range from mud at the northern end and in sheltered bays to coarse sand and gravel at the southern end. The bed is stony in places, e.g. at the southern end of the peninsula at Lady's Island and on the south shore, and there are numerous rocks in the south-east.

The dune barrier is composed of stratified coarse to fine gravels, topped with small aeolian sand-dunes, interrupted by relict washover fans (Carter and Orford 1980; Ruz 1989). Washover fans are formed by crestal overwashing and overtopping sedimentation when astronomical storm surges and high tides coincide, usually once every two or three years. This results in coarse/fine stratified gravels which merge landward into distinctive fan splays. The height of the barrier reaches 8-10m IOD (Irish Ordnance Datum = Chart Datum - 0.2m) but is lower at the point where the cut is made. The minimum width of the barrier in winter, from the edge of the lagoon to high-water mark on the shore, is a little over 300m (measured in March 1989). The mean spring tidal range of the open sea in the area is 3.6m (Healy 1997).

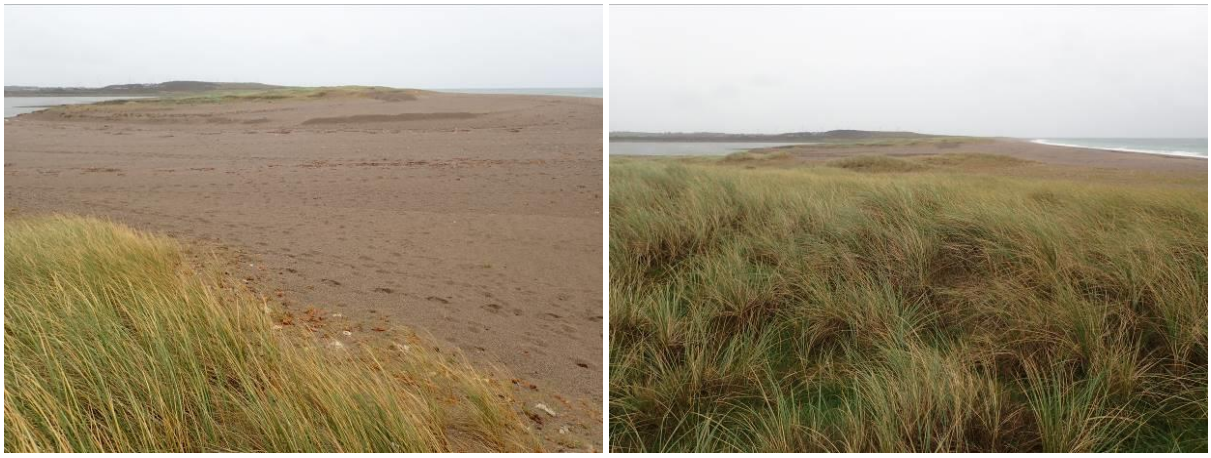


Plate 6 View east at western extent of the 'cut'. Fixed dune, shifting dune (white) and shingle in the foreground (left)'.

Malachy Walsh and Partners undertook an evaluation of drainage options for Lady's Island Lake on behalf of the National Parks and Wildlife Service with a view to determining the most appropriate design solution that would drain the lake in a controlled fashion, in order to reduce the potential impacts to the SACs and SPA in **Table 1**, and to better maintain the desired drainage of the surrounding area (Parle 2012). **Appendix 3** gives drainage solutions previously considered for Lady's Island Lake.

4.2 WATER LEVELS

Fluctuations in water level at Lady's Island Lake follow a regular seasonal pattern, rising in winter to reach a maximum in spring when the barrier is usually breached (Healy 1997). Water levels in Lady's Island Lake are due to a combination of factors including rainfall, inflowing streams, seepage through the beach and evapotranspiration. Lake levels also rise due to inflows from wave action overtopping the barrier beach.

Breaching of the barrier is carried out when the spring water level is high, usually in April, but it may be delayed until May, or considered unnecessary. Following completion of the cut, the water flows out for several days until the lagoon level falls below high tide mark. The lagoon then becomes tidal.

During tidal periods, the water falls well below levels which would be reached as a result of loss by seepage and evaporation and large expanses of the substratum are exposed. A tidal range of 80cm was measured in the lagoon in July 1983. A working document based on the Appropriate Assessment model into the cutting of the sand barrier at Our Lady's Island Lake (Golder Associates 2010) recommended that breaching should not be permitted to proceed (based on ecological concerns), and that alternative solutions needed to be investigated and fully assessed.

A bar forms across the sealed opening build up as a result of onshore and longshore transport of beach sediment. This bar finally stabilises and seals the opening. During the period 1975-8 and in March 1989 the final level of the bar was 6.8m 0D, which is nearly 3m above extreme high water of spring tides, although waves may wash over during storms. The water-level in the lagoon usually remains above mean tide level, even in summer, so the amount of landward percolation is probably always small (Healy 1997). Landward seepage of saltwater is usually observed in late summer and early autumn, i.e. when the water level is low. It is not clear whether landward seepage would continue to take place if the water level in the lagoon were allowed to stabilise naturally (Healy 1997).

When lake levels are well above normal tide levels there would be a tendency for lake water to seep seawards most of the time. Records indicate that such effects could lower the lake levels by up to 0.8m and greater. Lake level lowering of 0.6 to 0.8m was noted a number of times between 1984 and 1996, and a lowering of 1.7m was recorded in 1979 (Parle 2012). An account of water levels at Lady's Island is provided by Hurley (2016). **Figure 2** and **Table 2** summarises known water levels in the lagoon and some land levels.

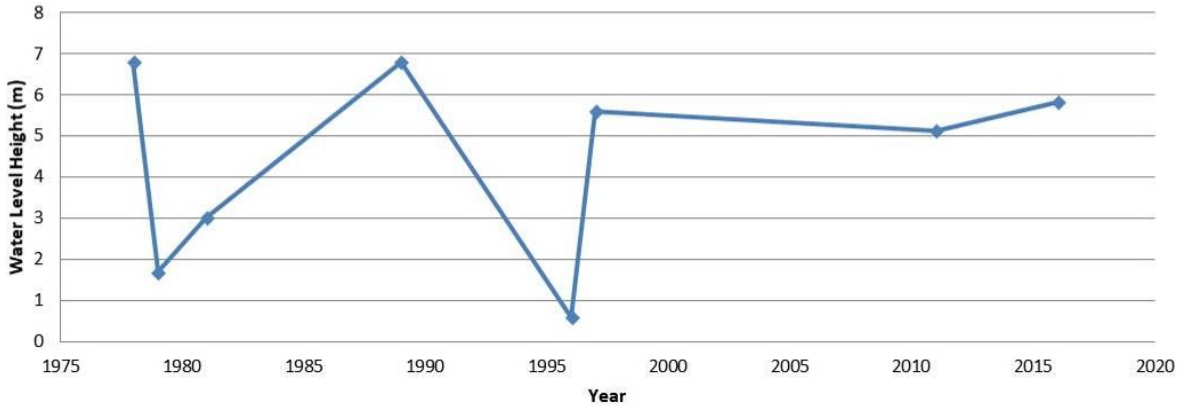


Figure 2: Historical extreme high and low levels water levels at Lady's Island.

Table 2: Some comparative land and water levels at Lady's Island Lake (from Hurley 2017a)

Lake Level (m ODP)	Land and/or water level
11.29	Maximum spot height recorded on the barrier (Zenith, 2002).
11.09	Mean of six spot heights on Rostonstown Burrow (that is, the portion of the barrier west of The Cut) (range 11.08-11.30) (Zenith 2002).
9.51	Mean of three spot heights on Burrow (that is, the portion of the barrier east of The Cut) (range 6.69-7.71) (Zenith 2002).
7.7	Approximate mean elevation of the EU Annex I habitat type: Perennial vegetation of stony banks' (NPWS 2120_NCADist_subset 2015 shapefile and Zenith 2002).
7.00	Approximate elevation of natural gaps in the barrier's seaward ridge.
6.99	Probable maximum height that water level in the lagoon could naturally rise to in the past before breaching began.

Lake Level (m ODP)	Land and/or water level
6.80	Approximate natural stable height that the breach plug grew to during the 1980s in the interval between one breaching of the barrier and the next (Healy 1989).
6.70	Level of low parts of the road through Lady's Island village (Parle 2012).
6.00	Height of the top of the Wexford County Council staff gauge.
5.88	Highest known lake level recorded in the 32-year period September 1984 to present. That level was reached and/or exceeded on five occasions: 25 March 1988 (5.80), 28 February 1990 (5.80), 8 January 2001 (5.87), 7 March 2007 (5.86) and 18 February 2014 (5.84) (Hurley, 1997 to present). When water level exceeds 5.80m ODP, the Community Centre floods, there is extensive flooding in the valley upstream of St. Iberius Bridge and electrical installations in the Wexford County Council Waste Water Treatment Plant (WWTP) are threatened. An electricity outage in the WWTP results in failure of the pumps and a strong potential of a pollution incident in the lagoon.
5.77	Highest known lake level recorded (March 1979) in the 5-year period 1977-1981: (Healy, Bates and McGrath 1982 and Healy 1989).
5.60	Estimated height at which water level in the lake would probably stabilise naturally if the barrier was not breached (personal communication, Bill Carter); a level in the range 5-6m was also suggested (Healy 1989).
5.40	Height at which the pilgrimage route around Lady's Island is impassable due to flooding. Most lakeshore marginal land is flooded right around the lake; some of Bob Butler's land floods and Paddy Pettit's lakeshore roadway is subjected to wave erosion.
5.21	Preferred maximum lake level from an environmental point of view (Parle 2012). Also, maximum water level specified in the NPWS Request for Tender dated 11 July 2016.
5.21	The outlier at the southern tip of Inish is submerged.
5.10	NPWS: "The lake should have a minimum water level of 5.1m OD Poolbeg for at least one month in winter. From an ecological perspective, no maximum level is required for winter". (Minutes of the Lady's Island Lake water Level Structure Design Stage Committee meeting of 31 May 2017.
5.08	The island of Sgarbheen is inundated.
5.06	When water level in the lagoon rises above 4.50m it triggers growing concerns in the Lady's Island area about marginal lands and the pilgrimage route becoming spongy if not partially flooded. As water levels rise further, field drains and septic tanks back up. 5.0m ODP is the water level in the lagoon that local tourism, pilgrimage, agricultural and wildfowling interests appear to regard as the maximum level that water in the lake should be allowed to rise in the period 31 December to 17 March. Outside this period lower maximum levels apply.
4.90	Estimated extreme sea level with a 0.5% annual exceedance probability (AEP) (approximate 200-year event on average) (Parle 2012).
4.92	Preferred mean lake level from an environmental point of view (Parle 2012).
4.70	Much of the outlier at the southern tip of Inish is flooded.
4.62	Preferred minimum lake level from an environmental point of view (Parle 2012). Also, minimum water level specified in the NPWS Request for Tender dated 11 July 2016.
4.50	Threshold that triggers the calling of a meeting of the Lady's Island Lake Drainage Committee with a view to breaching the barrier.
4.43	Estimated extreme sea level with a 50% annual exceedance probability (AEP) (approximate 2-year event on average) (Parle 2012).
4.3	Gadwall are known to nest equally well at high and low water levels (personal communication, Dave Daly, Tern Warden).
4.2	Maximum tolerated water level by nesting terns (personal communication, Dave Daly, Tern Warden). Part of the outlier at the southern tip of Inish is flooded.
4.00	NPWS: "The targets for water levels in the lake should be; the lake should have a normal level of 4.0m OD Poolbeg (range of 3.8m to 4.2m OD Poolbeg) from mid-March to the end of August." (minutes of the Lady's Island Lake Water Level Structure Design Stage Committee meeting of 31 May 2017). Ideal water level in March to dry out lakeside sites used by nesting terns on the islands of Inish and Sgarbheen. Also, the minimum water level desirable during the tern nesting season (early April-end of July). Lower water levels are undesirable for two reasons: (1) terns seldom nest

Lake Level (m ODP)	Land and/or water level
	below this level even when space to do so is available, and (2) lower levels facilitate easier access to the tern colonies by mammalian predators swimming out from the mainland (personal communication, Dave Daly, Tern Warden). At water level 4.0m ODP/1.30m ODM, the shortest distances from Inish and Sgarbheen to the mainland are approximately 225m and 110m respectively. As water level drops, these distance decline, reducing to almost zero at low water when the lake tides 4.0m ODP/1.30m ODM is also the water level in the lagoon that, with perhaps some slight deviation, appears to be favoured by local tourism, pilgrimage, agricultural and wildfowling interests during the period 17 March to 30 September. "... local opinion on appropriate water levels; 17th March to 30th Sept 4.0m ODP max ..."(minutes of the Lady's Island Lake Water Level Structure Design Stage Committee meeting of 31 May 2017).
3.80	Estimated level of mean high-water spring tides (MHWST) (Parle 2012).
3.71	The outlier at the southern tip of Inish is fully exposed.
3.70	"..MHWS is 3.7m ODP..." (minutes of Lady's Island Lake Water Level Structure Design Stage Committee meeting of 31 May 2017).
3.63	Lowest level that can be read by the OPW data logger.
3.16	Level of the lake bed at the base of the staff gauge in 1984
3.10	Estimated level of mean high-water neap tides (MHWNT) (Parle 2012).
2.70	Mean sea level and Ordnance Datum Malin (ODM).
2.20	Lowest known lake level recorded in the 5-year period 1977-1981: October 1981 (Healy, Bates and McGrath 1982 and Healy 1989).
1.80	Estimated level of mean low water neap tides (MLWNT) (Parle 2012).
1.10	Estimated level of mean low water spring tides (MLWST) (Parle 2012).
0.00	Ordnance Datum Poolbeg (ODP).

4.2.1 Water level rise

Water levels in Lady's Island Lake rise in winter, and as there is no natural outlet for water except by seepage through the sand and gravel dune barrier that impounds the lagoon, and via evaporation. This results in flooding of surrounding land and can potentially back-up sewers. The rise in water level starts in September-October and by the end of January water has usually covered most of Sgarbheen Island and part of the pilgrimage path which borders the Lady's Island peninsula. By the end of January water has usually covered most of Sgarbheen, part of the pilgrimage path which borders the Lady's Island peninsula and the stony beach on Inish where common and Arctic terns nest. From about December, Bunargate Pool in the south-west which is isolated in summer, becomes joined to the lagoon, allowing mixing of the waters and their fauna. From September to March the lagoon level normally rises a little over 2m ODP and, if the breach is not made, stabilises at between 5m and 6m ODP until the summer drop in level. A water level range of 3.02 m was recorded between 1976 and 1981 (Healy 1997). Healy (1997) notes that the average depth of the lagoon in summer is only an estimated 2m. The winter rise represents a major change in volume and results in considerable dilution of salts. The most rapid recorded water level rise occurred due to overtopping of the barrier beach in December 1989 when the lake level rose by 0.5m overnight equivalent to an average inflow rate of 50m^3/s (Parle 2012).

4.2.2 Water level fall

Periodically, when water levels in the lake are high, the lake is drained by forming a cut in the sand/gravel bank (dune barrier) that separates the lagoon from the sea (Parle 1998). The flooding relief is typically undertaken in spring by cutting a channel through the barrier to let out excess water.

In years when breaching has not been carried out, Healy (1997) notes that water levels stabilise at around 5.6m AOD and start to fall in early summer when evaporation and seepage through the barrier exceed inputs from streams, drainage and run-off from surrounding land, and direct rainfall. **Table 3** gives water levels at Lady's Island Lake and corresponding wetted areas and volumes. It is noted that Poolbeg datum plane is 2.59m below Malin Head datum plane.

Table 3: Lady's Island Lake water levels, and corresponding wetted areas and volumes (based on Lady's Island Lake Critical Level Contours drawing 17821 SK01).

Lake level - Over Datum Poolbeg (ODP)	Lake level - Over Datum Malin (ODM)	Lake Area (m^2)	Water volume (m^3)
7.59	5	5,657,379.00	21,347,545.50
7.09	4.5	5,303,624.00	18,518,856.00
6.59	4	4,651,984.00	15,867,044.00
6.09	3.5	4,381,334.00	13,541,052.00
5.59	3	4,004,068.00	11,350,385.00
5.09	2.5	3,649,736.00	9,348,351.00
4.59	2	3,274,883.00	7,523,483.00
4.09	1.5	3,001,101.00	5,886,041.50
3.8	1.21	2,877,786.04	5,015,722.21
3.59	1	2,788,489.00	4,411,387.14
3.49	0.9	2,700,865.10	4,132,538.24
3.39	0.8	2,613,241.20	3,862,451.73
3.29	0.7	2,525,617.30	3,601,127.61
3.19	0.6	2,437,993.40	3,348,565.88
3.09	0.5	2,350,369.50	3,104,766.54
2.99	0.4	2,262,745.60	2,869,729.59
2.89	0.3	2,175,121.70	2,643,455.03
2.79	0.2	2,087,497.80	2,425,942.86
2.69	0.1	1,999,873.90	2,217,193.08
2.59	0	1,912,250.00	2,017,205.69
2.34	-0.25	1,650,351.75	1,539,143.19
2.09	-0.5	1,388,453.50	1,126,555.25
1.59	-1	864,657.00	432,328.50

4.3 SURFACE WATER CATCHMENT

The lake drains a catchment area of about 19km^2. Lake levels rise due to inflows from rainfall on the catchment. The lagoon is 3.7km long (north-south) with a maximum width of 1.8km (east-west) and covers a maximum area in winter of about 450ha.

Figure 3 shows the afferent watercourses to Lady's Island Lake and point pressures on water quality. The Coldblow Stream (EPA code 13C38) is a 2nd order watercourse of ca. 1.5km long that feeds Lady's Island Lake from the north-east. The Kisha Stream (EPA code 13K14) flows into the northernmost tip of Lady's Island Lake. This stream is the largest afferent surface water feed to the lake. The Eardownes Little, Racecourse, Trane and Strand Streams are minor streams that flow into Lady's Island Lake form the west. The average inflow rate less evapotranspiration was estimated to be 0.3m^3/s (Parle 1998). One of the most rapid rises recorded occurred in August 1996 when the lake level rose by 340mm in 4 days due to extremely heavy rainfall. This is equivalent to an average inflow rate of 4.4m^3/s and to an equivalent lake rise of less than half the rainfall (180mm) (Parle 2012). Using the flow duration curve provided by the EPA Hydrotool application[4] for the Kisha

[4] http://watermaps.wfdireland.ie/HydroTool/Viewer.aspx?Site=Hydro&reloadkey=true

Stream, the largest feeder stream of Lady's Island Lake, the 50%ile flow (flow equalled or exceeded 50% of the time) of this watercourse is given as 0.055m^3/s. Given that the Kisha sub-catchment drains and area of 5.8km^2, and that the entire catchment of Lady's Island Lake is in the order of 19km^2, the extrapolated 50%ile flow equates to 0.18m^3/s.

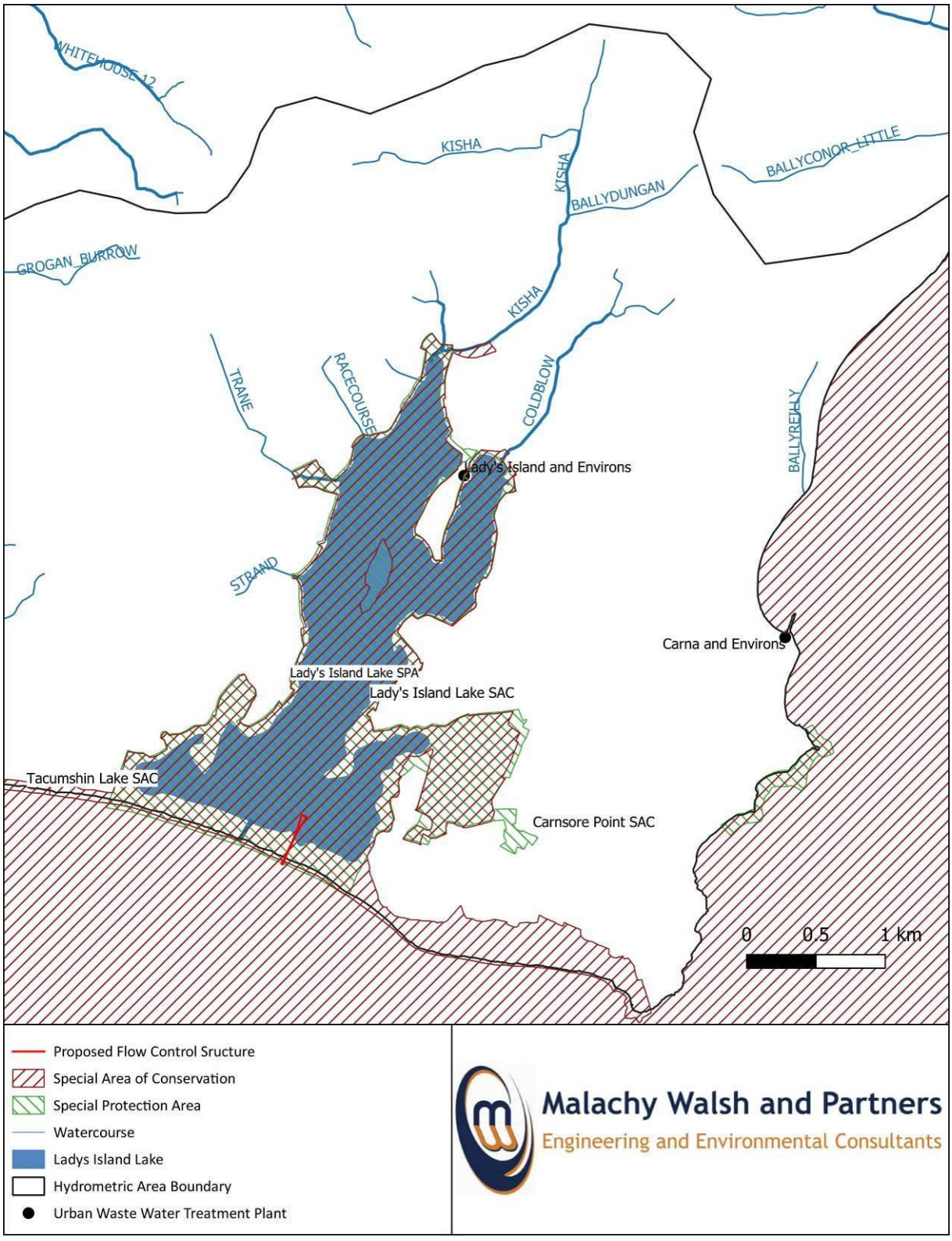


Figure 3: Afferent watercourses to Lady's Island Lake and point pressures on water quality.

Plate 7 The Coldblow Stream feeds Lady's Island Lake from the north-east (left). The Kisha Stream is the largest surface water input to Lady's Island lake (right).

4.4 GROUNDWATER

Lady's Island Lake is located over the Bridgetown groundwater body (EU code: IE_SE_G_022). This Groundwater Body (GWB) has an area of 137km^2. The Bridgetown GWB Summary of Initial Characterisation[5] describes this GWB and notes that the terrestrial ecosystems associated with this GWB are Wexford Slobs and Harbour, Ballyteige Burrow and Tacumshin Lake. There is likely to be very little recharge to this groundwater body because of the thick layer of almost impermeable till overlying it. Where there are sand and gravel deposits these represent the most likely location for recharge although the gravel layers appear to be underlain by the till so there may be no hydraulic connection between the gravel and the bedrock. This groundwater body is a poor aquifer and cannot be expected to produce large discharges for public supply. There is minimal recharge through the thick overburden. Groundwater flow is in short shallow flow paths in the upper 10m of the weathered zone through features and joints. Since recharge is minimal, only small discharge is expected which will occur along the coast and to surface water bodies where the subsoil thickness and permeability allow hydraulic connectivity.

4.5 SALINITY

Due to freshwater feeder stream inputs at the northern extremity of the lake, the salinity there is often extremely low (Oligohaline; <5 psu). Similarly, due to saltwater seepage, barrier overtopping and spray at the southern extremity of the lake, the salinity there is often extremely high (Euhaline; >30 psu). However, as pointed out in Hurley (2017b), studies show that these effects are very limited in spatial extent as the main body of the lagoon is very well mixed both horizontally and vertically (Healy 1997; ASU 2004; and Neill 2006).

At a value of 17 psu the proportion of saltwater to freshwater in a brackish waterbody is roughly equal. On that basis, a somewhat arbitrary classification of lagoons is made between high salinity lagoons (average salinity >17 psu) and low salinity lagoons (average salinity <17 psu) (Roden and Oliver, 2012).

Table 4 gives a review of 43 years of low salinity status (<17 psu) and high salinity status (>17 psu) at Lady's Island Lake. These data give a somewhat broader basis for the classification of the salinity status of the lagoon than can be achieved by the snapshot surveys conducted in a shorter timeframe. It can be concluded that Lady's Island Lake has probably functioned as a high salinity

[5] https://jetstream.gsi.ie/iwdds/delivery/GSI_Transfer/Groundwater/GWB/BridgetownGWB.pdf

lagoon in recent years (post-1975) (Hurley 2017b). However, it needs to be borne in mind that the data presented above result from snapshot surveys sometimes conducted on just one day during the year in question, that data are available for only 58% of the years of the 43-year survey period and that the data are not correlated in any way to time of year, to when the barrier was breached, rainfall inputs, seawater inputs via storm surges, seepage and spray, evaporation, etc. It is not known if highs and lows are cyclical or, if they are, what could be causing that effect. It is known that the relationship between salinity and water level is approximately linear (OPW 1990). As noted in Hurley (2017b), there are differing views on the average salinity status of Lady's Island Lake (see **Table 5**). As highlighted in Hurley (2017b), the only way to accurately establish the salinity status of Lady's Island Lake is to measure the electrical conductivity of the water in the lagoon on an ongoing basis.

Table 4: Review period of 43 years (1975-2017) of low salinity status (<17 psu) and high salinity status (>17 psu) at Lady's Island Lake. Adapted from Hurley (2017b).

18 years (42% of the 43-year review period) with no salinity data	25 years (58% of the 43-year period) with salinity data	
	14 years (56% of the 25 years with salinity data) when the lagoon had **high salinity** status	11 years (44% of the 25 years with salinity data) when the lagoon had **low salinity** status

Table 5: Differing views on the average salinity status of Lady's Island Lake.

Salinity status	Source
Medium (5-18 psu):	Roden and Oliver (2012) *["Mesohaline"),* (winter low of 8.65 psu at northern end to summer high of 23.25 psu at southern end).
Low (<17 psu):	*"Salinity of the lagoon is generally oligo-mesohaline but it is periodically tidal when the barrier is breached"* (NPWS, 2015).

Roden and Oliver (2012) give median salinity values for Lady's Island North and South based on all available data between 2009 and 2011. The median winter salinity value for Lady's Island North and Lady's Island South between 2009 and 2011 is given as 8.65 psu and 20.45 psu, respectively. The median summer salinity value for Lady's Island North and Lady's Island South between 2009 and 2011 is given as 23.25 psu and 23.15 psu, respectively. Lady's Island North is categorised as Mesohaline and Lady's Island South is categorised as Meso-euhaline.

Seawater at approximately 34 psu enters the lagoon by seepage through the barrier, by salt spray being washed into the lagoon from the barrier, by occasional overwash of the entrance bar and, most importantly, by tidal flow following breaching. Salinities of between 2 psu and 40 psu have been recorded in the lagoon as a whole. At most times when the lagoon was isolated the salinity was 0.5-2.0 psu higher at the southern end than at Lady's Island and lower in the extreme north, where a small stream enters. Concentrations of 2-19 psu were recorded here between 1977 and 1991, but an exceptional level of 26 psu was reached in September 1990. All other point sources of fresh water have no significant effect, and the main body of the lagoon has a more or less uniform salinity. Vertical stratification has been observed during calm weather in summer. Bunargate Pool also receives some fresh water, and during its periods of isolation, which can last for up to nine months, the salinity falls below that of the lagoon.

Seasonal fluctuations in salinity corresponded to changes in water-level. In years when the breach sealed early before any significant tidal exchange could take place (e.g. in 1977, 1978 and 1979), the

annual range was from 6-8 psu in winter to 12-16 psu in summer. Occasional higher summer readings near the southern end (Healy *et al.* 1982) may be due to landward seepage of seawater during spring tides under favourable conditions, i.e. when lagoon levels are low and tides high, or after storms when seawater, perhaps concentrated by evaporation, drains from the barrier. Some high salinities at the southern end in autumn-spring may have been due to overwash of the inlet bar, e.g. in November 1977, December 1978 and October 1981; there was no evidence of washover at other places.

In years when there was a major influx of tidal seawater (e.g. 1980, 1981, 1983), the salinity throughout most of the lagoon rose from < 10 psu before breaching, to >25 psu after two weeks, and in six of the seventeen years for which measurements were available salinities in summer reached over 30 psu. Variations from year to year were chiefly caused by differences in the proportion of lagoon water which was replaced by sea water during periods of tidal flow. This depended on the length of time the inlet remained open, which in turn depended on tides and weather, and the degree of mixing brought about by winds. In calm weather, tidal water flows north through the centre of the lagoon and ebbs along the same route, so that regions on either side are little affected. However, even when the opening closes quickly, the salinity throughout the lagoon can rise rapidly, especially if there are strong cross-winds during tidal flow (e.g. in 1980).

The wide range of salinities measured means that the lagoon's inhabitants can experience conditions corresponding to almost all categories of mixohaline (brackish) waters: oligohaline (0.5-5.0 psu), mesohaline (5-18 psu), polyhaline (18-30 psu) and euhaline (30-40 psu) (Venice System, 1958). During the period of these observations, there were changes in the salinity regime every two to four years, with high-salinity poly-euhaline phases in 1975-7, 1980-4 and 1988-90 alternating with low-salinity oligo-mesohaline phases in 1977-9 and 1985-7. The reasons for this pattern of cyclical change are not known. During high-salinity phases there were wide seasonal fluctuations in salinity, while in low-salinity phases differences between summer and winter were relatively small.

4.6 WATER QUALITY

Reports since the early 1980's show that the eutrophication problem in Lady's Island Lake has been persistent. The coastal lagoon surveys for NPWS state that Lady's Island Lake is one of the most heavily impacted lagoon sites in the country in terms of water pollution and eutrophication (Oliver, 2007). Evidence from the few lagoon-specific studies undertaken suggests that once impacted (particularly by nutrient enrichment) lagoons may be slow to recover from impacts due to changes in water quality becoming self-perpetuating through internal recycling (Johnston & Gulliland 2000). There is a theory that this is the case in Lady's Island Lake, and that the thick sludge on the lake bottom which is exposed when water levels drop may be contributing to the problem. A number of effects on lagoon flora and fauna may result from nutrient enrichment in lagoons including direct physiological or metabolic effects, increased growth of algae including toxic algal blooms, and associated competition for light and reduction in oxygen content in the water (Johnston & Gulliland 2000). Nutrient enrichment and eutrophication have resulted in the conservation status of habitat structures and functions at Lady's Island lagoon being defined as Unfavorable-Bad.

The Lady's Island Agglomeration is serviced by Lady's Island Waste Water Treatment Plant, which is located at the rear Shrine. The plant is designed to cater for a population equivalent of 300 P.E. or 18Kg of BOD daily with secondary discharge standard with N and P removal. The estimated Dry Weather Flow discharge based on the calculated P.E. of 215 is 35.9 cubic meters per day assuming

167 l/head/day. There is one single discharge from the Lady's Island Waste Water Treatment Plant which is the Primary Discharge point (SW1), which discharges treated effluent to Lady's Island Lake[6].

It is noted that large areas of aquatic macrophytes have disappeared in Lady's Island Lake, together presumably with the fauna associated with them. The authors further note that while lagoonal biota is characteristically tolerant of extreme variations in environmental conditions and can tolerate the stresses caused by nutrient enrichment and deoxygenation better than many other non-lagoonal species, there are limits to such tolerance, and damaging algal blooms and fish kills have been reported at this site.

Wexford County Council commissioned the EPA to carry out water quality surveys in 2003, 2004 and 2006 of the lake and its feeder streams (Neill 2004 & 2006). It is noted that these were carried out in different months during each year. Wexford County Council have commissioned the EPA to undertake further analyses over the years and undertook sampling of the lake and feeder streams in 2009.

The lake is fed by a few small streams (See **Figure 3**). Organic nitrogen and orthophosphates regularly exceeded the limits in several of the streams, suggesting pollution from agricultural sources (Neill 2004 & 2006). Lagoon sites are listed as transitional waters under the Water Framework Directive (Directive 2000/60/EC). **Table 6** gives the latest available transitional Waterbody WFD Status of Lady's Island Lake (WFD code IE_SE_060_0100)[7].

Table 6: Transitional Waterbody WFD Status of Lady's Island Lake 2010-2015 IE_SE_060_0100 (EPA 2015).

Paramater	Status
Ecological Status or Potential	Bad
Biological Status or Potential	Bad
Hydromorphological conditions	High
General conditions	Moderate
Nutrient Conditions	Moderate
Other Aquatic Flora status	Bad
Other Nutrient Conditions	Moderate
Other Oxygenation Conditions	Moderate
Oxygenation Conditions	Moderate
Phosphorous conditions	Moderate
Orthophosphate	Moderate
Supporting Chemistry Conditions	Moderate

Key sources of nutrient input resulting in eutrophication may include surrounding farms, residential septic tanks and sewage treatment plant discharges. There is debate as to which nutrient is limiting in coastal waters and some authors consider that lagoons may pass through successive shifts in limitation, i.e. a shift to phosphorus limitation following enrichment by nitrogen. The limiting nutrient will depend on the characteristics of the site and may vary spatially (particularly in sites with a pronounced environmental gradient) or seasonally (Johnston & Gulliland 2000). The results of the EPA survey in April 2006 indicate that nitrate and orthophosphate are equally limiting to algal growth, and excessive levels of these nutrients are discharging to the lake (Neill 2006).

[6] http://www.epa.ie/licences/lic_eDMS/090151b280397c88.pdf

[7] EPA, 2015. *EPA Maps.* [Online] Available at: https://gis.epa.ie/EPAMaps/ [Accessed 02 05 2018].

Nitrogen and Phosphorus are biologically active substances that are freely removed from water by plants and algae especially during the spring-autumn period. Therefore, eutrophication is not always evident from the analyses of these nutrients in water samples, and chlorophyll levels which reflect the biomass of plant and algae can provide a better indicator of nutrient enrichment (Neill 2004 & 2006). More detail on specific water quality indicators is provided below.

4.6.1 Chlorophyll-a

Chlorophyll-a levels were recorded in 2009 and ranged from 22.5µg/l in February to 400µg/l in August. These exceptionally high levels indicate the lake is hyper-eutrophic (Phosphorous Regulations state that levels above 75 mg/m^3 are considered hyper-eutrophic). Water transparency was correspondingly low. This is a historical issue as water quality has been poor since the mid 1980's (Hurley 1997).

4.6.2 Molybdate Reactive Phosphorus (MRP)

In 2009 levels were generally higher in feeder streams than in the lake, the highest level recorded was 0.67mg/l in August. Data suggests this is a historical trend, with levels of 0.85mg/l recorded in April 1995; sources of this pollution have not been published.

Final effluent from the Lady's Island sewage treatment plant entering the lagoon was stated as poor in 2004, with levels of 3.9mg/l recorded. High levels were recorded at 6.6mg/l in November 2003. Levels in influent in March 2004 were greater than in the effluent, recorded at 2.6mg/l and 4.1 mg/l respectively. This was the case in August of the same year with the influent recorded at 8mg/l and the effluent at 10.56mg/l (Golder Associates 2010). An EPA survey in April 2006 indicated that nitrate and orthophosphate are equally limiting to algal growth (Golder Associates 2010). Poor quality of effluent discharged to Lady's Island Lake is considered to represent an ecological pressure on the lagoon.

4.7 FLORA

The flora of the lagoon is typically brackish with two species of Tasselweed (*Ruppia maritima* and *R. cirrhosa*) and the Red Data Book charophyte species *Lamprothamnion papulosum* and *Chara canescens* (both lagoonal specialists) occurring. The dominant macrophytes as documented by Healy (1997) were *R. cirrhosa* or *Potamogeton pectinatus*, depending on the salinity. Oliver (2007) notes that large areas of aquatic macrophytes have disappeared from Lady's Island Lake, together presumably with the fauna associated with them. It is possible that the level of nutrient enrichment is approaching a critical level at which these taxa can no longer survive (Oliver 2007). The main impacts on Lady's Island Lake, as identified in Oliver (2007) is eutrophication from surrounding farmland, farmyards, septic tanks and sewage treatment plant resulting in repeated algal blooms and fishkills. Indeed, Lady's Island Lake has suffered from repeated algal blooms and fish kills and is considered still very much under threat due to excessive nutrients which cause smothering with blanket weed (*Cladophora* spp.) and death of invertebrates and fish (Oliver, 2007).

The 'perennial vegetation of stony banks' habitat supports Cottonweed *Othanthus maritimum*. Lesser Centaury (*Centaurium pulchellum*), Pennyroyal (*Mentha pulegium*) and Golden Dock (*Rumex maritimus*) also occur in the SAC. Lesser centaury, a rare plant, seeds in the Autumn and grows at a particular lake level within Lady's Island SAC. This plants' habitat is silt and clay sea-shores and shoreside meadows. Foxtail stonewort *Lamprothamnium papulosum* is considered a lagoonal

specialist deemed to be so important and vulnerable that it is subject of a Red Data Book for Britain and Ireland (Doris 2001). It usually grows on sand, gravel or pebbles in less than 2 metres water depth and is intolerant of strong water currents or wave action. Previous British and Irish work indicates that Red Data Foxtail stonewort charophyte *L. papulosum* occurs within a salinity range of 10 ppt to 30 ppt, but studies elsewhere have found viable populations in up to 40 ppt whilst recent work in Britain has found the species in sites as low as 5 ppt. Charophytes are associated with unpolluted sites because most species cannot tolerate high levels of phosphates and nitrates (UK Marine Special Area of Conservation 1999).

4.8 AQUATIC MACROFAUNA

The number of faunal species recorded in Lady's Island Lake is unusually large for a single lagoon, these systems being generally poor in species. Between 1975 and 1991, 97 macrofaunal species (> 1mm in shortest diameter) were identified and a further eleven unidentified taxa recognised (Healy 1997). Also identified, but not included here, were some smaller taxa: eight Enchytraeidae, eleven Rotifera, two Copepoda and two Ostracoda. Among the species recorded, twelve were lagoonal specialists, more or less confined to enclosed, non-tidal brackish waters (Verhoeven 1980; Barnes 1989; Davidson *et al.* 1991; Bamber *et al*. 1992), sixteen had a more general distribution in brackish waters, including salt-marshes and estuarine habitats, 43 were euryhaline marine species with various capacities for tolerating reduced salinity, and 29 are commonly found in fresh water. The lagoonal and brackish water species were generally the most abundant (Healy 1997).

Invertebrate species associated with Lady's Island lagoon include spattered diver beetle (*Agabus conspersus*). It is red-listed as Endangered in Ireland as a whole and is a priority species for Northern Ireland. During a detailed study of the lake in 1996, macroinvertebrate surveys were carried out at several locations (Healy 1997). Among 38 taxa recorded, four of the species were marine, 6 poly-mesohaline, 13 euryhaline, 4 oligo-mesohaline, and 6 limnic. Eight of the species were listed as lagoonal specialists in Britain (Davidson *et al*. 1991). Some limnic and low salinity (oligomesohaline) species such as *Sigara dorsalis, Sigara concinna, Notonecta viridis, Noterus clavicornis, Enochrus bicolor, Potamopyrgus antipodarum* and *Ischnura elegans* were confined to the north end of the lake and Bunargate Pool but some others normally associated with low salinity were found near the barrier (Healy, 1997).

4.9 AVIFAUNA

Lady's Island Lake is of ornithological importance for both breeding and wintering birds and is also an important stop-over point for passage migrants. Lady's Island Lake supports one of the best examples of a lagoonal bird fauna in the country and is of particular note for its breeding colonies of Sandwich Tern, Roseate Tern, Common Tern and Arctic Tern, all species which are listed on Annex I of the E.U. Birds Directive. In addition, several other species that have been recorded within the site are also listed on Annex I of this directive, i.e. Marsh Harrier, Ruff, Wood Sandpiper, Whooper Swan, Little Egret, Golden Plover and Mediterranean Gull. The site is important both for breeding and wintering birds and is one of the top sites in the country for Gadwall. The importance of the site for terns is recognised by the designation of the islands on which they breed as a Refuge for Fauna.

In winter the water levels rise and flood surrounding land. This occurs as there is no natural outlet for water except by evaporation and by seepage through the sand and gravel dune barrier that impounds the lagoon. The rise in water level starts in September-October and by the end of January water has usually covered most of Sgarbheen Island and part of the pilgrimage path which borders

the Lady's Island peninsula. Inish Island is never completely covered, but its stony beach, where Arctic and Common terns nest, becomes submerged. Local farmers have access tracks to land around the lake edge which also become flooded (Golder Associates 2010, Healy, *et al.* 1997).

Daly *et al* (2012) identified Hedgehog *Erinaceus europaeus*, Brown rat *Rattus norvegicus* and Stoat *Mustela erminea hibernica* as predators to nesting birds on the islands of Lady's Island. Daly *et al.* (2012) highlighted the importance of Brown Rat eradication before commencement of the nesting season. It was found that a stoat had most likely killed three adult and twelve dead Sandwich Tern chicks in June and sixteen roseate chicks and one adult in July. Signs were put up requesting lake-users to remain on the southern end of the lake to reduce disturbance to the area.

The findings of the latest tern colony surveys at Lady's Island (Daly *et al.* 2012, Daly *et al.* 2016) are given below. These reports highlight the importance of regulating the water level of Lady's Island Lake.

4.9.1 2016 surveys

The most recent management and monitoring of the Lady's Island Lake Tern colony commenced on the 15th March 2016 and continued until the 4th August 2016. The total number of gull and tern nests recorded was 6248, an overall 6.7% increase on that of 2015. All gulls were recorded in higher numbers than the previous year. Sandwich Terns *Sterna sandivensis* decreased by 117 pairs (6.6%) to 1682. A total of 1012 Common *Sterna hirundo* and 844 Arctic Tern *Sterna paradisaea* nests were recorded. This gave a combined total of 1856, a 3.1% increase on that of 2015. The mean clutch size for Common and Arctic Terns was 2.36 and 1.79 respectively. The number of Roseate Tern pairs nested was 209, which is a 2.8% decrease on that recorded in 2015, with a mean clutch size of 1.43 per egg laying pair, and a hatching success of 85%. This study also noted 25 pairs of Gadwall *Anas strepera* bred on the northern end of Inish, and three pairs on the southern end, one within the roseate colony. The mean temperature was 13.3 degrees Celsius and the mean rainfall was 70.9mm for the survey period. The lagoon was breached twice in 2016; the first was on the 02/02/16 when the water level was at 5.83m, the second was on the 15/03/16. The result of this was an average water level at 3.9m from May to July (Daly *et al.* 2016). It is noted that these water levels were reduced to the range of 3.8-4.2m ODP of the current proposal for the time of year (March-August). This differs from previous reports on Terns in Lady's Island Lake where lake levels had been both above and below the proposed water levels, and where negative responses in terms of Tern ecology ensued.

4.9.2 Management and monitoring report on Lady's Island Lake Tern colony (2012)

The 2012 management and monitoring report on Lady's Island Lake Tern colony found the total number of gull and tern nests recorded was 4968, a 2.9% increase on that of 2011. However, weather and depredation had a negative effect on all breeding species, with eggs and chicks depredated throughout the colonies on Inish. Water levels from April to July were at their highest since 2005 with a monthly mean average height of 4.35m recorded on their staff gauge. Between the 20th of June and the 9th of July, levels rose from 4.36m to 4.56m, following heavy rain (Daly *et al*. 2012). These levels are above the proposed water levels of 3.8-4.2m ODP for this time of year. The reduction in water levels in the lagoon should in turn reduce the negative effects of high-water levels identified by this study. Further issues with water levels and Tern spp.'s were identified in the 2011 Tern Report which stated that the water level was 5.14m on the 4th of March but following a breaching of the dune barrier the levels had dropped to 3.56m OD by the 12th of April. This level was,

however, considerably lower by the 7th of March which allowed mammalian species (e.g. Hedgehog *Erinaceus europaeus*, Brown rat *Rattus norvegicus* and Stoat *Mustela erminea hibernica* all identified as predators during these studies) access to the island of Sgarbheen (Daly et al. 2011). The proposed water levels for this time of year (March – August) are set out to be 4m ODP preventing levels dropping too low and allowing mammalian predators access across to Sgarbheen Island (Daly *et al.* 2011).

4.9.2.1 Sandwich Terns

In 2012, 1692 pairs of Sandwich Terns *Sterna sandvicensis* nested on Inish a reduction of 239 pairs since the previous year. No pairs nested on Sgarbheen, perhaps due to that colony being lost in 2011, when a hedgehog was suspected of depredating 150 clutches in mid-June. The mean clutch size was 1.31 with first two chicks hatching on the 24th May.

Sandwich Terns *Sterna sandivensis* decreased by 239 pairs (12%) to 1692. A total of 968 Common *Sterna hirundo* and 538 Arctic Tern *Sterna paradisaea* nests recorded. This gave a combined total of 1524, a 10% increase on that of 2011. However, survival rate was estimated to be 66%, due to a high rate of depredation and poor weather conditions.

4.9.2.1.1 Common Tern

A total of 968 breeding pairs of Common Tern *Sterna hirundo* were recorded in 2012. A total of 890 pairs nested on Inish and 78 on Sgarbheen, the mean clutch size was 2.37. The first arrived on March 31st, the first egg recorded on May 10th and the first chick was noted on June 10th. Common terns nesting area on Sgarbheen higher ground was dominated by silverweed *Potentilla anserina*, Creeping bent grass *Agrostis stolonifera* and scentless mayweed *Tripleurospermum inodorum.* On Inish the higher ground was dominated by silverweed *Potentilla anserina* and Creeping bent grass *Agrostis stolonifera* (Daly *et al*. 2012).

The central, southern part of Inish was not submerged by winter water levels in 2012. Inundation creates suitable nesting habitat for Common Terns providing patches of bare ground with dead leaf litter and small deposits of grit and sand. A dense covering of Couch Grass *Agropyron repens* covered the central area during the season, and no Common Terns nested there. Mallard, Gadwall and three pairs of Black-headed Gulls were the only species found nesting during census work (Daly *et al.* 2012).

4.9.2.1.2 Arctic Terns

A total of 369 Arctic Tern *Sterna paradisaea* pairs nested on Inish with a further 161 on Sgarbheen, a total of 530 breeding pairs with a mean clutch size of 1.81. The first two Arctic Terns were recorded on Inish on the 11th April with the first egg on the 14th May. The first chicks hatched on the 11th of June. Arctic Tern nesting habitat is confined to the lower zone on the eastern side of Sgarbheen with silverweed *Potentilla anserina* and creeping bent grass *Agrostis stolonifera* dominant. On Inish again they are confined to the lower zone dominated by saltmarsh rush *Juncus gerardii*, silverweed *Potentilla anserina*, creeping bent grass *Agrostis stolonifera* and Sea aster *Aster tripolium.*

4.9.2.1.3 Roseate Terns

A total of 126 breeding pairs of Roseate Terns *Sterna dougallii* were recorded nesting on the southern end of Inish. This was a decrease of 29 pairs (23%) on that recorded in 2011. The mean clutch size was 1.55 per egg laying pair, with a hatching success of 70%. The first egg was laid on the 13th May, four days later than 2011. The main laying period was from the 13th May to the 19th June.

The number of chicks depredated was 18. Weather and depredation greatly reduced egg /chick survival rates with a total of 58 eggs known to have failed, gone missing or be depredated and 47 chicks missing (presumed depredated) or found dead.

5 CONSERVATION OBJECTIVES OF THE NATURA 2000 SITES SELECTED FOR APPROPRIATE ASSESSMENT

According to the Habitats Directive, the conservation status of a natural habitat will be taken as 'favourable' within its biogeographic range 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
- the conservation status of its typical species is favourable as defined below.

According to the Habitats Directive, the conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' within its biogeographic range 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
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Conservation Objectives for each site are available on www.npws.ie. These have been accessed for the sites listed in **Table 1**. Generic Conservation Objectives were available for the following site:

- Lady's Island Lake SPA (004009) (Published 21/2/2018)

Site specific and more detailed Conservation Objectives were available for the following site:

- Lady's Island Lake SAC (000704) (Published 23/4/2019)
- Carnsore Point SAC (002269) (Published 21/10/2011)

5.1.1 Lady's Island Lake SAC (000704)

Site specific Conservation Objectives are available for the Lady's Island SAC (NPWS, 2019) i.e. to maintain or restore the favourable conservation condition of the Annex I habitats for which the SAC has been selected. Conservation Objectives are based on the ecological requirements of a habitat/species.

5.1.2 Lady's Island Lake SPA (004009)

The Conservation Objective of Lady's Island Lake SPA is to maintain or restore the favourable conservation condition the wetland habitat at as a resource for the regularly-occurring migratory waterbirds that utilise it (NPWS 2018b). The bird species listed as Special Conservation Interests for

this SPA are Gadwall *Anas strepera* [A051], Black-headed Gull *Chroicocephalus ridibundus* [A179], Sandwich Tern *Sterna sandvicensis* [A191], Roseate Tern *Sterna dougallii* [A192], Common Tern *Sterna hirundo* [A193], Arctic Tern *Sterna paradisaea* [A194].

5.1.3 Carnsore Point SAC (002269)

Specific Conservation Objectives are available for the Carnsore Point SAC (NPWS, 2011) i.e. to maintain or restore the favourable conservation condition of the Annex I habitats for which the SAC has been selected.

6 DESCRIPTION OF PLAN/PROJECT

6.1.1 Project Description and Purpose

There are numerous problems with the current management of the water level of Lady's Island Lake, from both an ecological and human welfare perspective. The Our Lady's Island drainage committee demands controlling flooding of surrounding lands while the NPWS must ensure that the conservation interests associated with the lake are maintained in a favourable conservation condition. The proposed works have the intended purpose of controlling lake and salinity levels.

Unmanaged lake and salinity levels may pose a threat to flora and fauna in Lady's Island Lake, which is an SAC and SPA for the habitats that occur in the lake, and species it supports. In the past, lake levels have been so lowered as to threaten the lake's value as an area of environmental interest with high water levels threatening Terns. The lake area can become tidal for a period following a 'cut'. This can result in an increase in the salinity of the lake water with potentially adverse environmental impacts.

High lake levels pose the risk of flooding adjacent farmland flooding and waste treatment system percolation problems. On the contrary, during very low water levels, large areas of foul smelling lake bottom have been exposed during and the appearance of the area changes considerably. Re-establishment of the beach barrier is unpredictable and brings with it uncertainty in relation to water levels and salinity concentrations. The purpose of the proposed development is to allow management of water levels in cognisance of ecological requirements and for the local residential community. The development is proposed is to alleviate problems that have been documented in the past due to breaching the barrier beach as outlined below (as indicated in MWP, 1998, unless otherwise stated):

- The lake area can become tidal for a period following a 'cut'. Usually the cut closes within a matter of weeks. However, the cut has remained open for months in some instances. Though the cut is initially narrow, water flowing from the lake can lowers and widen the cut by an uncontrolled amount. A width of cut up to 263m has occurred in the past.
- The barrier beach is vulnerable to overtopping by wave action. Overtopping caused an overnight increase in water level of 0.5m during December 1989. The area of the cut is particularly vulnerable to overtopping.
- Early breaching has often coincided with rough seas resulting in the barrier sealing quickly and the objective of lowering water levels not being achieved, while late breaching has typically coincided with calmer seas resulting in a danger of late closure of the breach and much consequent saline intrusion (Healy, 1997).

- Annual breaching has also resulted in a significant volume of the sand and gravel barrier being washed out to sea each year, and at present the level of the barrier is relatively low, enabling seawater to overtop it on a frequent basis during periods of high tides combined with stormy weather.

A proposed drainage pipeline will act to manage water levels in Lady's Island Lake. The pipeline will allow saline water to enter the lake in a controlled manner and allow controlled drainage of the lake to the sea. Drawings of the proposed development are provided in **Appendix 4**. The project is necessary to the management of the SPA, where terns require certain water levels during their nesting season, noting also however that there are potential significant negative impacts on the Lady's Island SAC (code 000704). It is proposed to manage water levels according to NPWS advice (**Section 3.2.1**), as illustrated in **Figure 4**.

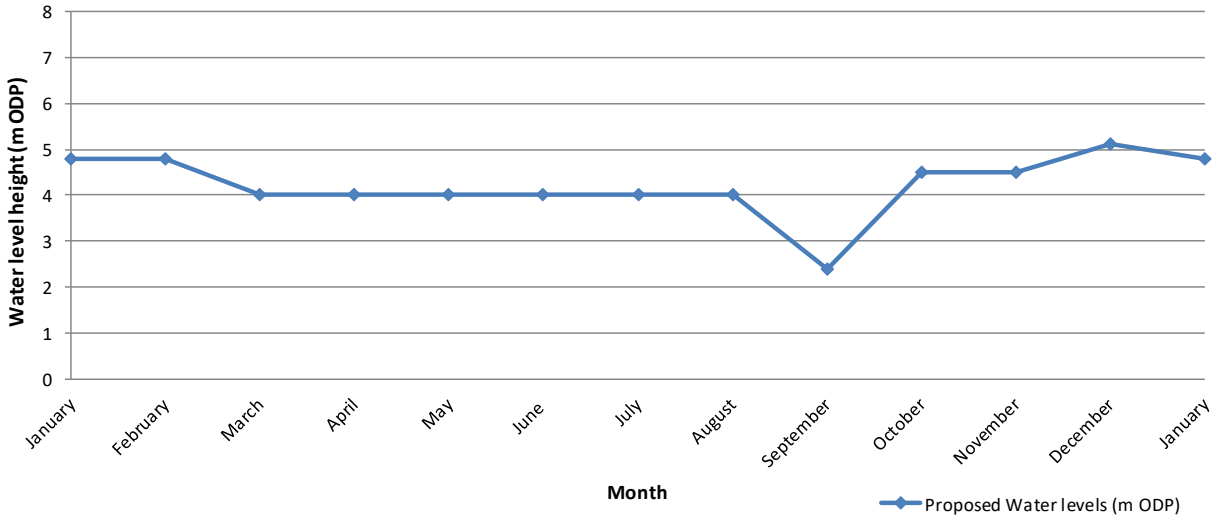


Figure 4: Proposed water levels at Lady's Island Lake.

Plate 8 View west at the approximate location of the junction box at the beach fronting Lady's Island Lake i.e. Carnsore Point SAC (left). View south towards sea from crest of 'cut' (right).

The project aims to achieve to have a normal level of 4.0m OD Poolbeg (range of 3.8m to 4.2m OD Poolbeg) from mid-March to the end of August. This will protect nesting terns from predation by isolation from the mainland. The lake water level will be lowered to 2.4m OD Poolbeg during Sept/Oct to allow saline influx, to increase salt levels. For at least one month in winter, the project

aims to lower the water level of Lady's Island Lake to 5.1m OD Poolbeg. From an ecological perspective, no maximum level is required for winter.

The Winter targets for salinity at Lady's Island Lake north and south is 8.65 psu and 20.45 psu respectively. The Summer targets for salinity at Lady's Island Lake north and south is 23.25 psu and 23.15 psu respectively.

A flow control structure (of approximately 100m^2 plan area) will be located in the lake at the landward side of the barrier beach. It will be partially submerged in the lake. An associated dredged drainage channel of approximately 3,000m^2 plan area will be required to ensure the functionality of the flow control structure.

Plate 9 Sand dune system associated with the barrier beach to the east of the 'cut' at Lady's Island Lake (left). This part of the due system is subject to mush disturbance by excavation and mechanical movement of sand (right).

A concrete junction box (approximately 4m x 6m x 5m) will connect the concrete pipes running from the flow control structure in the lake to the ductile iron pipes extending seawards through the beach. This junction box includes a manhole for maintenance purposes. The junction box is located within the profile of the existing beach and will be hidden from view after construction. The junction box doubles as a retaining structure taking wave forces on the long axis of the ductile iron pipes.

Plate 10 Indicative location of the drainage channel associated with the flow control structure in the lagoon at the landward side of the barrier beach (left). View south towards 'cut'/sea shore and indicative pipeline route (right).

6.1.2 Characteristics of the Project

The proposal is described below and has been confirmed with Wexford County Council.

Introduction	Project Introduction: The proposed works consist of • A drainage pipeline. The pipeline will act to manage water levels in the lake and to allow saline water to enter the lake in a controlled manner. The pipeline will consist of 2 No. 1.2m internal diameter pipes with a reinforced concrete flow control structure at the Lake end and an outlet on the beach fronting Lady's Island Lake.
Size, scale, area, land-take	Land-take: • The foot-print of the proposed pipeline and associated works will be located within the boundary of the Lady's Island Lake SPA and SAC. • A flow control structure (of approximately 100m^2 plan area) will be located in the lake at the landward side of the barrier beach. It will be partially submerged in the lake. An associated dredged drainage channel of approximately 3,000m^2 plan area will be required to ensure the functionality of the flow control structure. The weir inlet to the flow control structure will be set at 2.09mODP (-0.5mODM). • 2 no. 1.2m ϕ (internal diameter) concrete pipelines will extend approximately 200m southwards from the flow control structure to a junction box (20m^2 plan area) located within the beach fronting Lady's Island Lake. This proposed junction box is located within the existing beach profile. This profile will be reinstated after construction, concealing the junction box and concrete pipes. • 2 no. 1.2mϕ ductile iron pipes will extend southwards 32m from the junction box to their outlet in the intertidal zone. These pipes will be supported by 15m long steel piles and associated concrete pile caps. There will be 2 no. 300mm x 500mm concrete struts between each pile cap. The natural profile of the beach will conceal the majority of this structure. • A buried power line will extend from the nearest power point along the existing access path and within the beach to the pipeline flow control structure.
Details of physical changes that will take place during the various stages of implementing the proposal	Flow control Structure Construction: The flow control structure will be constructed of the following: • A hot dip galvanised steel trash/safety screen at the inlet of the flow control structure; • 2no. stainless steel penstock plates to regulate flow through the structure;

- Reinforced concrete housing structure (13m x 6 m x 8m);
- Actuators to open and close the penstock plates;
- A control kiosk (approximately 1.8mx1.8mx2.4m) located on top of the flow control structure;
- Manhole to allow for maintenance works to flow control structure;
- Water and salinity level monitors within the structure and in the lake towards its northern end.

Concrete Pipes Construction:
2no. Concrete pipes (1.2m internal diameter, 1.4m outer diameter) will extend approximately 200m south from the flow control structure to a junction box located within the existing sand dune profile. These pipes will be ground bearing. The pipe invert level is proposed to be 0.89mODP (-1.7mODM).

Junction Box Construction:
A concrete junction box (approximately 4m x 6m x 5m) will connect the concrete pipes running from the flow control structure in the lake to the ductile iron pipes extending seawards through the beach. This junction box includes a manhole for maintenance purposes. The junction box is located within the profile of the existing beach and will be hidden from view after construction. The junction box doubles as a retaining structure taking wave forces on the long axis of the ductile iron pipes.

Ductile Iron Pipes:
The ductile iron pipes will span between the pile bents. The purpose of the pile bents and ductile iron pipes over the seawards section of the pipeline is to cater for beach profile changes and the ongoing retreat of the barrier beach. The piles provide vertical and lateral support to the pipeline.

2no. Ductile iron pipes (1.2m internal diameter, 1.255m external diameter) will extend approximately 32m seawards from the junction box to the pipeline's outfall in the intertidal zone. These ductile iron pipes will be supported by 4no. pile and pile cap arrangements spaced at regular intervals. Each pile and pile cap arrangement consists of 2 no. raked 406*20 Circular Hollow Section (CHS) steel piles, approximately 15m long each, and a 1m x 2.3m x 3.6m approx. concrete pile cap. The natural profile of the beach will conceal the majority of the pipeline. The pipe invert level will be 0.89mODP (-1.7mODP).

Rock Armour Constraint Cut:
The amended application **excludes** the original proposed rock armour constraint cut.

	Reprofiled Barrier Beach: It is NOT proposed to reprofile the barrier beach in the immediate vicinity of the proposed works, nor to plant this area with marram grass. Power Line. It is proposed to provide a power line from the nearest power point to the flow control structure. This line will be buried at the side of the existing access track to the beach and buried within the beach as it crosses the open beach area to the flow control structure. Access Path Access to the structure during the construction and operational phases will be via an existing access path and across an open beach area. It is NOT proposed to construct a specific path for the purposes of the development. Lady's Island Lake Water Levels: The proposed works have the intended purpose of controlling lake levels. High lake levels pose the risk of flooding adjacent farmland. However, unmanaged lake levels and salinity levels may pose a threat to flora and fauna in the lake, which are integral to the SPA and SAC status of the lake. An annual programme of the proposed works' management of these lake levels is as follows: • In September, when the terns have left the lake, the lake level will be drawn down to +2.2mODP to +2.6mODP. Then for the next 2-4 weeks seawater will be allowed into the lake with little outflows. This is to allow salinity levels within the lake to be raised. During this time outflows are to be limited to minimise saline water in the vicinity of the pipe being discharged back to sea before mixing fully with fresh water in the lake. • In October the inflow is to be stopped and the outlet closed until lake levels rise to approximately +4.4 to 4.6m ODP. During the winter period lake levels are to be allowed rise to 5.1mODP and be maintained at or above this level for a period of at least one month, following which lake levels are to be maintained between +4.6mODP and +5.0mODP until March when levels are to be drawn down to +3.8 to 4.2mODP to facilitate the terns. • From March to August lake levels are to be maintained within the range +3.8mODP to +4.2mODP. For this to be achieved initial levels should be maintained close to +4.2mODP to ensure that lake levels do not go below the 3.8mODP lower level due to evapotranspiration effects.
Description of resource requirements for the construction/operation	Equipment: • 2 no. excavators;

and decommissioning of the proposal (water resources, construction material, human presence etc)	• Crane and pile leaders; • Sheet-piling temporary works; • 30 no. concrete delivery truck visits; • 60 no. haulage truck visits; Material: • Electrical Kiosk and power connection; • 200 no. 2m long 1.2m inner diameter concrete pipes; • 8 no. 8m long 1.2 inner diameter ductile iron pipes; • 300m^3 concrete; • 60T reinforcement; • 12,000m^3 excavation; • Penstock plates and manifold; • Manhole; • Access covers; • Intake trash screen; • Level monitors at flow control structure; • Salinity monitors at flow control structure and in the lake; • 8 no. 15m long 406x20 Circular hollow section piles.
Description of timescale for the various activities that will take place as a result of implementation (including likely start and finish date)	• Mobilisation/demobilisation will take approximately 1 month. • Construction of the flow control structure will take approximately 2 months. • Construction of the concrete pipes will take 3 months. • Construction of the junction box and ductile iron pipeline will take approximately 3 months. • The Start and the Finish Dates have not been confirmed. It would be best, from an ease of constructability point of view, if the works were commenced in spring/summer and start on the seaward side. A possible timeframe for works would be March-November. It may however take longer than 9 months.
Description of wastes arising and other residues (including quantities) and their disposal	• Excavated material will be placed on adjacent areas and replaced on top of the pipeline upon completion of works. Excavated material will also be used in the re-profiled barrier beach. The substrates removed in order to install the pipeline and flow control structure comprise gravels and sands. Any materials not conforming to these particle sizes will not be used

	to reconstruct habitats. • All construction wastes will be safely stored on site before disposal off-site.
Identification of wastes arising and other residues (including quantities) that may be of particular concern in the context of the Natura 2000 network	• N/A
Description of any additional services required to implement the project or plan, their location and means of construction	• Secure construction site compound with bunded areas for storage of plant and material. This will be located approximately 50m from the proposed development to the south of Lady's Island Lake and will not impact on any ecologically important habitat. Access to the site will be from the local road network and via existing tracks along the southern shore of the lagoon.

7 IDENTIFICATION OF OTHER PROJECTS OR PLANS OR ACTIVITIES

This section outlines likely impacts on the Natura 2000 sites potentially affected by the proposed development. These impacts can arise from planned developments and/or recurring/existing practices at a local level. Threats, pressures and activities with impacts on the Natura sites potentially affected by the proposed development are given in the Natura 2000 Standard Data Forms and are provided below.

7.1 PLANS

A search of the Wexford County Council website indicates pending planning permission at two sites that may impact on Lady's Island Lake. Permission is pending since 17.04.18 for the erection of a straw bed agricultural shed, effluent storage tank, and all ancillary site works (Application no. 20180485). This site is located in the townland of Nineteenacres, Lady's Island to the north east of the site. Permission is also pending since 18.04.18 for the erection of a straw storage shed and associated site works in an existing farmyard located at the northerly point of the lake at Eardowns Great Lady's Island (Application no. 20180492).

7.2 DIFFUSE AND POINT SOURCES OF POLLUTION

Polluting substances from point (industrial pollutants, wastewater effluents, stormwater sewers) and diffuse (urban and agricultural runoff) sources associated with ongoing activities in the Lady's Island Lake area are included in this section. There are no waterbodies within the Ballyteigue-Bannow catchment are at risk from forestry however, the majority of the area is at risk from agricultural practices.

The following is a list of known point sources that contribute nutrients to Lady's Island lake and may be adversely affecting water quality:

- Primary effluent emissions point at Lady's Island lake (EPA 2011)
- A secondary sewage treatment plant, agglomeration of <500 people on the northern side and
- Public toilet discharge exits into the lake.

In 2011 an EPA Inspectors Report on a Waste Water Discharge Certificate of Authorisation Application for Lady's Island (A0241-01) stated that the agglomeration currently has a population equivalent (p.e.) of 219. The agglomeration is serviced by one waste water treatment plant (WWTP). The WWTP provides tertiary treatment, consisting of primary settlement, rotating biological contactors and phosphorous removal, and has a design capacity of 300 p.e. The WWTP discharges to the Lady's Island Lake (EPA 2011).

7.3 OTHER THREATS, PRESSURES AND ACTIVITIES

The threats, pressures and activities with impacts on Lady's Island SAC, Lady's Island SPA and Carnsore Point SAC are given below. These have been taken from the NPWS Natura 2000 Standard data forms for these sites. These are considered significant impacts and activities that can contravene the Conservation Objectives of these sites.

Cumulative impacts are described in more detail in **Section 9.3**.

7.3.1 Lady's Island SAC

The most important impacts and activities with high effect on Lady's Island SAC are outlined in **Table 7**. High ranking negative impacts relate to human induced changes in hydraulic conditions along with pollution to surface waters (limnic & terrestrial, marine & brackish).

Table 7: Impacts and activities on the Lady's Island Lake SAC (from the Natura 2000 - Standard Data Form).

Code	Activity	Rank	inside/outside/both [i|o|b]
E03	Discharges	High	i
G01.03.02	Off-road motorized driving	High	i
A09	Irrigation	Medium	i
H01	Pollution to surface waters (limnic & terrestrial, marine & brackish)	High	i
J02.06.01	Surface water abstractions for agriculture	Medium	i
H01.05	Diffuse pollution to surface waters due to agricultural and forestry activities	Medium	i
E03.01	Disposal of household / recreational facility waste	Medium	i
A04.03	Abandonment of pastoral systems, lack of grazing	Medium	i
I01	Invasive non-native species	Medium	b
J02	Human induced changes in hydraulic conditions	High	i

Rank: H = high, M = medium, L = low Pollution: N = Nitrogen input, P = Phosphor/Phosphate input, A = Acid input/acidification, T = toxic inorganic chemicals, O = toxic organic chemicals, X = Mixed pollutions i = inside, o = outside, b = both.

7.3.2 Lady's Island SPA

The most important impacts and activities with high effect on Lady's Island SPA are outlined in **Table 8**. Walking, horse riding and non-motorised vehicles are identified as a high-ranking threat.

Table 8: Impacts and activities on the Lady's Island Lake SPA (from the Natura 2000 - Standard Data Form).

Code	Activity	Rank	inside/outside/both [i|o|b]
H	Pollution	L	i
F03.01	Hunting	L	i
C01.01.02	Removal of beach materials	L	o
K03.04	Predation	M	o
A08	Fertilisation	M	o
G01.02	Walking, horseriding and non-motorised vehicles	H	i
G01.01	Nautical sports	M	i

Rank: H = high, M = medium, L = low Pollution: N = Nitrogen input, P = Phosphor/Phosphate input, A = Acid input/acidification, T = toxic inorganic chemicals, O = toxic organic chemicals, X = Mixed pollutions, i = inside, o = outside, b = both.

7.3.3 Carnsore Point SAC

The most important impacts and activities with high effect on Carnsore Point SAC are outlined in **Table 9**. Removal of beach materials as well as fishing and harvesting aquatic resources are among the threats identified as a high ranking in this SAC.

Table 9: Impacts and activities on Carnsore Point SAC (from the Natura 2000 - Standard Data Form).

Code	Activity	Rank	inside/outside/both [i|o|b]
F02	Fishing and harvesting aquatic resources	H	i
F02.03	Leisure fishing	L	i
F02.03.01	Bait digging / collection	L	i
F02.01.01	Potting	M	i
F02.01.02	Netting	M	i
C01.01.02	Removal of beach materials	H	i
K01.01	Erosion	H	i
E03	Discharges	H	i
D03.01.02	Piers / tourist harbours or recreational piers	H	i

Rank: H = high, M = medium, L = low Pollution: N = Nitrogen input, P = Phosphor/Phosphate input, A = Acid input/acidification, T = toxic inorganic chemicals, O = toxic organic chemicals, X = Mixed pollutions i = inside, o = outside, b = both.

8 IDENTIFICATION OF POTENTIALLY ADVERSE EFFECTS

It has been concluded that the proposed management of Lady's Island Lake is likely to have a significant effect, or significant effects cannot be ruled out at this stage, on the following Natura 2000 sites:

- Lady's Island Lake SAC (site code 000704)
- Lady's Island Lake SPA (site code 004009) and
- Carnsore Point SAC (site code 002269).

When Natura 2000 sites are selected for stage 2 assessments, then all the qualifying features of conservation interest must be included in that stage of the assessment. However, when assessing

impact, qualifying features are only considered relevant where a credible or tangible source-pathway-receptor link exists between the proposed development and a protected species or habitat type. In order for an impact to occur there must be a risk initiated by having a 'source' (e.g. nearby watercourse), a 'receptor' (e.g. a protected species associated aquatic or riparian habitats), and an impact pathway between the source and the receptor (e.g. a watercourse which connects the proposed development site to the site designated for the protection of the aforementioned species). Identifying a risk that could, in theory, cause an impact does not automatically mean that the risk event will occur, or that it will cause or create an adverse impact. However, identification of the risk does mean that there is a latent possibility of ecological or environmental damage occurring, with the level and significance of the impact depending upon the nature of the risk, the extent of the exposure to the risk and the characteristics of the receptor.

Bearing in mind the scope, scale, nature and size of the project, its location relative to the distribution of the species and habitats listed and the degree of connectedness that exists between the project and the potential receptors, it is considered that not all of them are within the zone of potential impact of the proposal. An evaluation based on these factors to determine which species and habitats are the plausible ecological receptors for potential impacts of the unmitigated proposal has been conducted in **Section 8.1** to **8.3** below. This evaluation determined that certain habitats and species (listed in **Tables 10 – 12** below) should be selected for further assessment as plausible ecological receptors.

8.1 LADY'S ISLAND LAKE SAC

Table 10 lists the qualifying features of the Lady's Island Lake SAC and evaluates through a scientific examination of evidence and data whether or not these features should or should not be selected for further assessment in the NIS. The qualifying features that are selected for further assessment are discussed further in the section followed by an assessment of potentially significant effects arising from the proposed Lady's Island Lake Water Level Management project.

Table 10: Identification of potentially significant impacts to qualifying features of the Lady's Island Lake SAC.

Qualifying Feature	Potential for Significant Impacts	Rationale
Coastal lagoons	Yes	Lady's Island Lake is a large, natural sedimentary, back-barrier seepage lagoon with no natural outlet to the sea. The lagoonal flora of Lady's Island Lake is typically brackish with two species of Tasselweed (*R. maritima* and *R. cirrhosa*) and the Red Data Book charophyte species *L. papulosum* and *Chara canescens* (both lagoonal specialists). Green filamentous algaes *Cladophora* spp. and *Enteromorpha* spp. occur in the lagoon. A rich swamp and freshwater marsh vegetation occurs at Ring Marsh. Elsewhere, the lagoon is fringed by marsh or wet grassland. A total of 97 macrofaunal species has been recorded over 17 years of observations (unpublished, in Healy *et al*, 1997). At least 13 lagoonal specialist species have been recorded, and at least four of these species appear to be rare. The fauna of the lagoon is rich but this is not always apparent, however, because the community undergoes wide fluctuations in species composition and abundance due to breaching. According to Healy (1997), the fauna documented in 1996 was poor by comparison with 1977-78 (Healy *et al*. 1982) when more than 58 species were recorded. Fluctuations in populations according to the changing salinity regime were manifested through corixids and beetles becoming abundant and diverse when the salinity fell below 10 psu and fish and crustaceans replacing

Qualifying Feature	Potential for Significant Impacts	Rationale
		them during high salinity phases (Healy *et al*. 1982). Galvin (1992) recorded 49 taxa in the lake (including the Bunargate Pool), including 9 lagoonal specialists. When sampled in 1996, the fauna appeared to be in an intermediate phase and a strong North-South gradient in marine influence which was also demonstrated by differences in salinity. In that year, extensive tidal exchange brought in a wide range of marine species which coexisted with a low salinity fauna that had become established during the previous year. Three coleopteran indicator species were recorded in 1996, indicating an ecologically well-developed site, and two of these are very rare species (*Atheta gyllenhalli* and *A. liliputana).* Permanent impacts on coastal lagoon through water level management during operation. The depletion of plant and benthic communities could occur through rapid salinity changes. The salinity "shock" effect within the lagoon, especially the southern end of the lake near the flow control structure could cause mortalities of freshwater and oligohaline species. Conversely, there could be a significant reduction of the inflow of tidal water, thereby reducing the brackish component of the lagoon and species intolerant of reduced salinity i.e. flora and fauna adapted to life towards the poly-euhaline end of the salinity scale. Dredging of substrates at the flow control structure could potentially affect water quality. The release and mobilisation of nutrients in the substratum could lead to elevated levels of nutrients in the water column. This effect would be concentrated at the excavation site and could lead to widespread eutrophication (enrichment) of lake water. The effects will depend on the concentration of nutrients, water circulation and resilience of biota. The effects of eutrophication are generally manifested in algal blooms which may blanket other aquatic vegetation and can cause depletion of oxygen from the water, noxious odours, outcompeting of other vegetation and in severe cases the death of fish and invertebrate fauna (Oliver, 2007). Water quality impacts could be exacerbated.
Reefs	No	The only area of exposed immobile reef habitat identified from aerial photography and from an examination of reef communities in the environs of the proposed development is at Carnsore Point which is located ca. 2.5km to the east.
Perennial vegetation of stony banks	Yes	The gravel-based barrier landward moving (transgressive) system which stretches along the seaward part of the lagoon is a component of a system regarded as the best example in Ireland. The sequence of back barrier washover and seepage structures are among the best in Europe and, Lady's Island remains the last "intact" example in Europe. Cottonweed (*Otanthus maritimus*) is an extremely rare plant which has its main Irish population on the gravel barrier adjacent to the lagoon. It is a well-known botanical rarity in the British Isles with its only established station on the gravel barrier at Lady's Island lake. There would be a direct impact on perennial vegetation of stony banks during construction through accessing the proposed development site and trenching for electrical supply installation.

8.1.1 Potentially Affected Qualifying Feature Descriptions

A description of the qualifying features which have been identified as being potentially significantly affected by the proposed development is given below. This information has been sourced from the NPWS (2011a and 2011b).

8.1.1.1 Coastal lagoons

Coastal lagoons (habitat code 1150) is a priority habitat in Annex I of the Habitats Directive. A coastal lagoon is a lake or pond that is fully or partially separated from the sea by a permeable barrier that can be entirely natural such as shingle or can be an artificial embankment. Salinity varies depending on such factors such as freshwater inputs and barrier permeability. Lagoons support unique assemblages of flora and fauna, particularly invertebrates. In Ireland, coastal lagoons are considered to be in bad conservation status due to issues such as drainage and water pollution (NPWS 2013).

Variability is one of the most characteristic features of lagoons. Variations in water volume, temperature, water chemistry, and especially salinity, and the consequent changes in flora and fauna, are all greater than in most other aquatic environments (Healy 2003). The principal causes are tides, climate, and exceptional events such as storms or floods. Seasonal changes in water volume and salinity are generally tolerated by the inhabitants, most of which are adapted to gradual fluctuations. Daily incursions of tidal water, and the larger amounts at spring tides, have their greatest impact near the inlets and on the central lagoon bed, and in the larger lagoons may hardly reach the more distant parts of the system unless there are strong winds to cause mixing. Sudden large influxes of sea water have the greatest effect on fauna and flora as they are largely unpredictable, and species may be unable to adjust to such rapid changes. Periodic mass mortalities associated with tidal exchange following breaching of the barrier at Lady's Island Lake have been observed (Healy 1997). Oliver (2007) notes that small, homogeneous systems are the most vulnerable as there may be no refuge areas where sections of populations may survive. Lagoon and dune habitats at the proposed development site are indicated in **Figure 5**, noting that the proposed development is in a dynamic intertidal area subject to erosion and deposition. Marine community types of special conservation area interest in the environs of the proposed development are illustrated in **Figure 6**. Intertidal sediment community occurs strip along the beach at the southern boundary of Lady's Island Lake SAC. Directly south of this lies Carnsore Point SAC. The reef habitat indicated in the inset maps as **Figure 5** and **Figure 6** is within Carnsore Point SAC. Is actually more distant from the proposed development than indicated in these maps.

Healy (1997) states that breaching is seen by many as a threat to aquatic life because it can result in high mortalities of flora and fauna. The lake may even appear "dead" after an extended period of tidal flow. However, long-term studies (unpublished) have shown that the community recovers with no obvious loss of species (Healy *et al*, 1997).

Dispersion of sediments during construction stage could liberate nutrients in the water. Algal blooms in lagoons may be an entirely natural process especially in response to a change in salinity and the addition of a limiting nutrient, such as phosphate in seawater, which may trigger a bloom when mixed with nitrate rich river water. However, in many sites these blooms and sometimes obvious fish-kills appear to be a much more recent phenomenon associated with changes in land use within the catchment of watercourses entering the lagoon (Oliver 2007). Temporary algal blooms sometimes occur following flooding after a period of drought, but these are probably natural (Healy 1997).

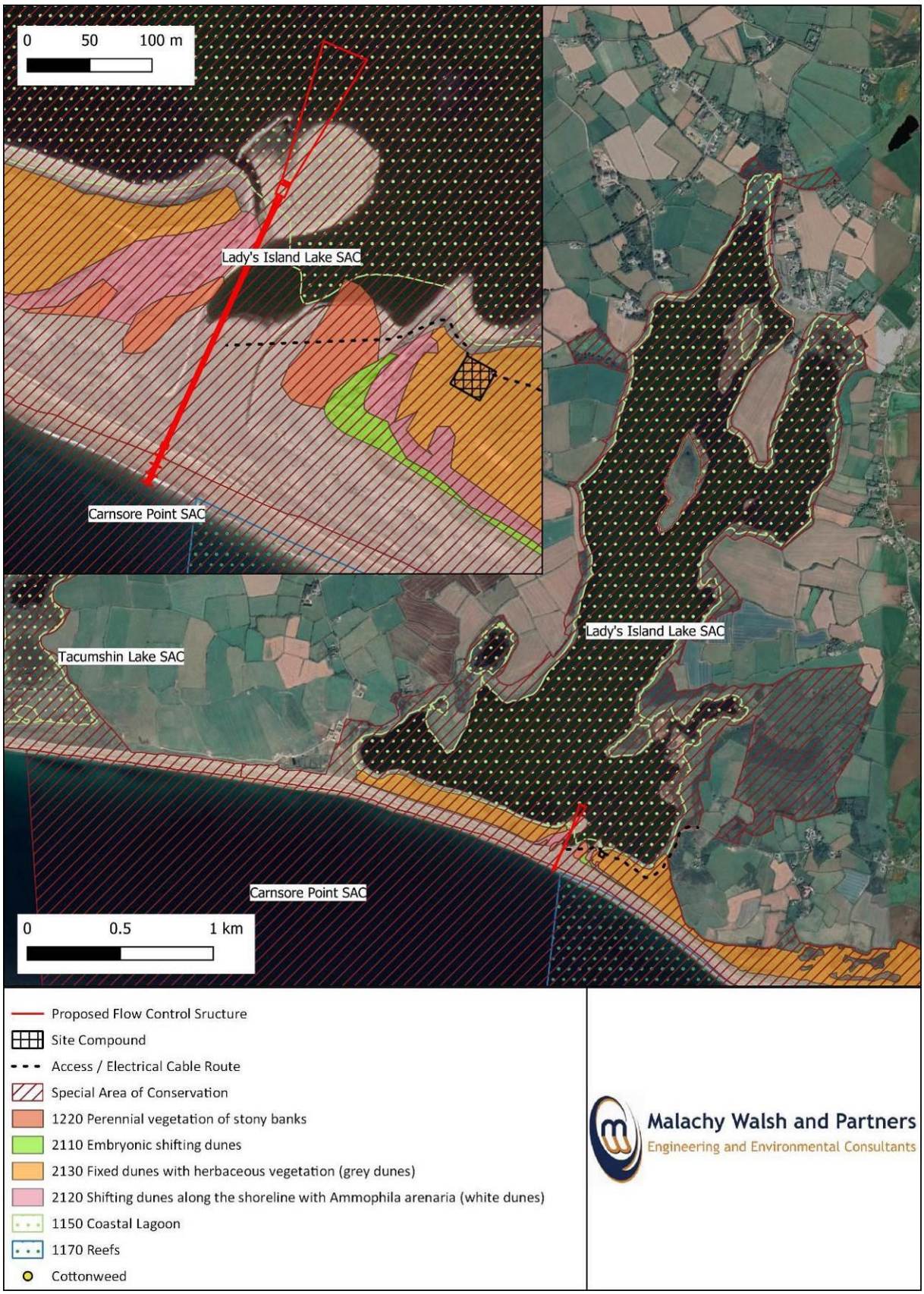


Figure 5: Lady's Island Lake SAC Conservation Objectives Coastal Habitats (indicative) in the vicinity of the proposed development (adapted from shapefiles downloaded from NPWS.ie)

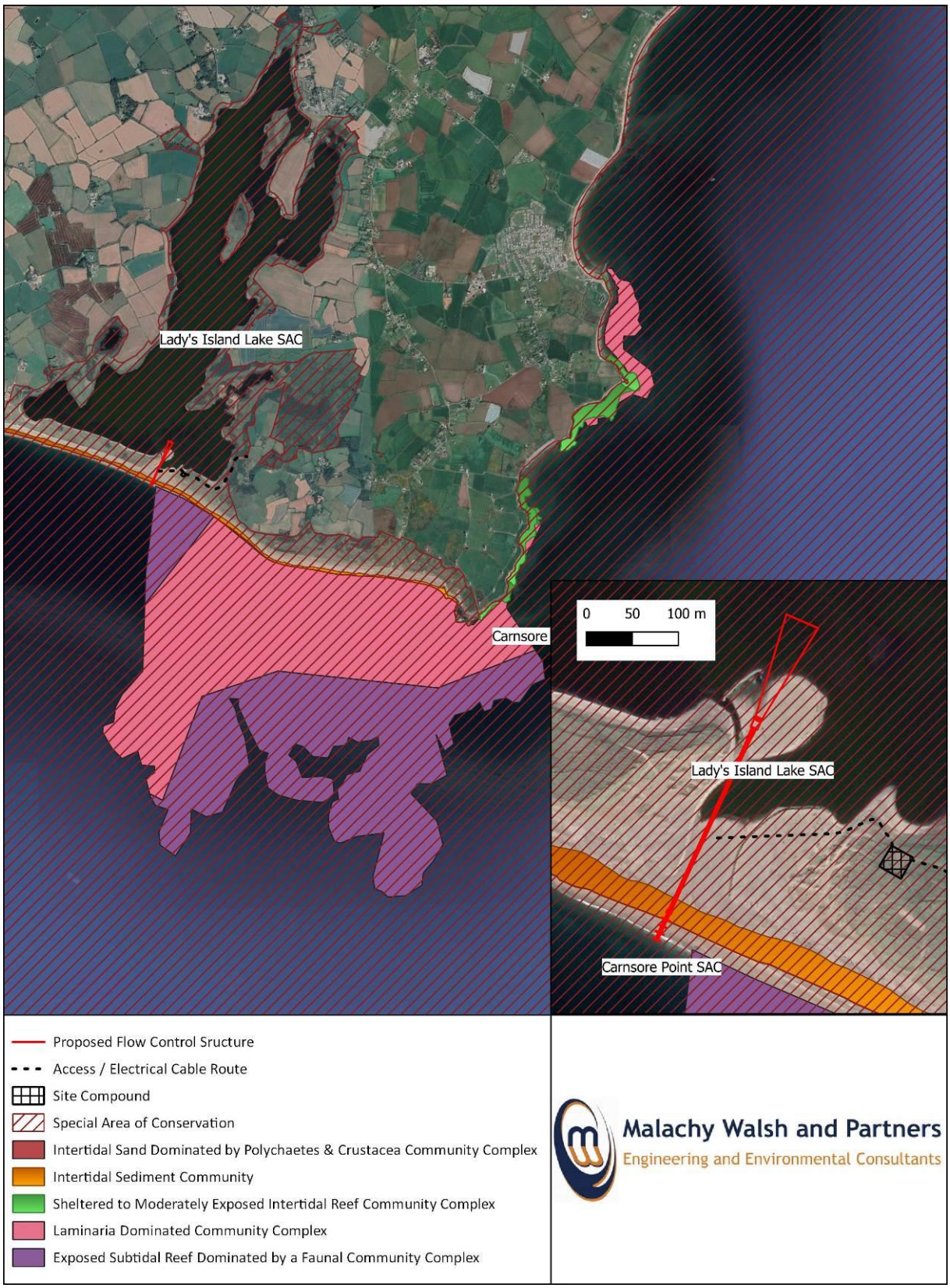


Figure 6 Marine community types of special conservation area interest in the environs of the proposed development

A strong N-S salinity gradient and a wide range of substrate types can explain the high level of species richness reported in the lagoon (Healy 1997). Long-term observations on Lady's Island Lake, which experiences wide fluctuations in conditions due to periodic breaching of the barrier followed by occasional mass mortalities, demonstrated the presence of three components of the fauna which

respond differently to major disturbance: (a) a variable contingent of marine species which colonise through the temporary inlet but cannot breed in the lagoon and are only temporary inhabitants, (b) freshwater and oligohaline species which colonise during low salinity phases and disappear when conditions become highly saline, and (c) a suite of brackish water species whose populations fluctuate but are never fully extinguished (Healy 1997). Species turnover in this lagoon, therefore, only affects a section of the community while the true resident species are more or less constant and persistent. As part of a recent compilation of water beetle records, it appears that 'brackish-water' beetles have declined considerably in Ireland and this may include brackish water beetles found in lagoons (Oliver 2007).

8.1.1.2 Perennial vegetation of stony banks

Perennial vegetation of stony banks (habitat code 1220) occurs along the southern boundary of Lady's Island Lake. Martin *et al.* (2017) classifes the shingle at Lady's Island SAC as 'Bar and fringing beach', over an area of 1.25ha within the SAC. The following standard definition is presented in Irish Wildlife Manuals No. 98 by Martin *et al.* (2017): 'Vegetated shingle occurs along the coast where shingle (cobbles, pebbles, and gravel ≥ 2 mm) has accumulated to form elevated ridges or banks above the high tide mark. Most of the rocky material should be less than 250 mm in diameter to be considered in this habitat category.

On the upper beach, the pioneer community can be characterised by perennial species such as sea beet (*Beta vulgaris* subsp. *maritima*), sea-kale (*Crambe maritima*), rock samphire (*Crithmum maritimum*), cleavers (Galium aparine), yellow-horned poppy (*Glaucium flavum*), sea pea (*Lathyrus japonicus*), wild radish (*Raphanus raphanistrum* subsp. *maritimus*), curled dock (*Rumex crispus*), sea campion (*Silene uniflora*), perennial sow-thistle (*Sonchus arvensis*) and sea mayweed (*Tripleurospermum maritimum*). The majority of the area within this pioneer community is usually bare shingle.

At the top of the beach, and moving inland, a wider range of vegetation types can be found at larger shingle sites including a lichen-rich community and coastal forms of grassland, heath and scrub. The majority of the grassland and scrub communities are rooted within soil, whereas the pioneer community is usually rooted in gravel, sand or organic matter (e.g. decomposing seaweed and other plant material). Once the soil layer on top of the shingle is more than 30cm deep, the community is no longer defined as perennial vegetation of stony banks.

Species diversity is determined by the degree of exposure and by substrate stability, coarseness and size. The presence of lichens indicates long term stability'. The Near Threatened species yellow-horned poppy (*Glaucium flavum*) was recorded within the perennial vegetation of stony banks habitat during the Vegetated Shingle Monitoring (VSM) Projec (Martin *et al.* 2017). This plant was also recorded at the study site during the October 2018 survey carried out to inform this report.

The 2004-2006 CMP mapping indicates an area of ca. 1640m^2 of shingle beach (1220) occurring at Lady's Island SAC, noting that this survey was carried out in September 2004, and that conditions may have changed in the intervening period.

Cottonweed *Othanthus maritimum* is found at the barrier system of Lady's Island. Cottonweed is classed as 'Critically Endangered' in the Red list of Irish Vascular Plants 2016. The population of this notable species was recorded as 30 flowering and non-flowering stalks covering a 30m x 10m area

during the VSM, a decline from 1,717 flowering and non-flowering stalks in 1997 (Martin 1998). It has this classification as there is <50 individual plants now growing in Ireland (Devlin 2018). During the survey of the barrier undertaken by MWP during October 2018, ca. 10 Cottonweed plants were recorded ca. 200m east of the proposed flow control structure. An artificially created bed comprising fine gravel/sand and supporting 2 Cottonweed plants was found ca. 240m east of the proposed flow control structure. For the continued survival of *Otanthus maritimus* at the site management practices should ensure that an open community is maintained as the species appears to decline in a taller *Ammophila arenaria* dominated sward. During the Coastal Monitoring Project (Ryle *et al*. 2009) and the VSM Project, Cottonweed, Lesser Centaury and Pennyroyal were not recorded.

Cottonweed is a perennial member of the Compositae, about 30 cm high, producing small yellow flowers in late summer. It appears that the continued existence of the species here is related to an unusual combination of sedimentological, geomorphological and human factors. However, increasing pressures on the Cottonweed habitat may lead to virtual eradication of the plant within the not too distant future (Carter *et al.* 1981). The gravel-dominated barrier of Lady's Island Lake is overlain with small aeolian dunes. It is composed of stratified coarse to fine gravels with median grain sizes between 0 and 4 (0.06-1.0 mm), topped with small aeolian sand dunes, interrupted by relict washover fans (Ruz 1989). At the point where the breach is made, laminations of coarse sediments representing washover fans are visible at the cut face (Orford and Carter 1984). Lady's Island gravel beach barrier is geomorphologically unusual in that it shows many facets of recent crestal overwashing and overtopping sedimentation (Carter and Orford 1981). Typically, the upper beach and ridge crest comprises coarse/fine stratified gravels which merge landward into distinctive fan splays. The high level (up to +9 m IOD) gravels are deposited during periods when astronomical storm surges and high tides coincide, usually once every two or three years. The gravel-dominated character of the sediment means that aeolian deflation is largely ineffective and wind-blown dunes are limited to small irregular "decorations" atop the marine process-formed ridge (Carter *et al.* 1981). However, the barrier crest has now stabilised at 5-12 m OD and washover only occurs in the region of the breach. The coarse sediments of the barrier allow extensive seaward seepage which is sufficient to prevent the formation of outlet streams (Orford and Carter 1984).

The area of 'Perennial vegetation of stony banks' was assessed as Favourable during the Coastal Monitoring Project (CMP) (Ryle *et al*. 2009). The area decreased from 1.42 ha during the CMP to 1.25 ha. during the VSM due to succession to Embryonic shifting dunes (2110), natural erosion and anthropogenic activities (shingle extraction)[8]. 'Perennial vegetation of stony banks' habitat also increased in area in some locations, particularly due to the development of this habitat after extreme storm events, however these increases were not enough to offset the losses. There was a loss of area due to anthropogenic activities which was equivalent to less than 1% per year since the CMP, so the Area was assessed as Unfavourable-Inadequate (deteriorating) during the VSM. The conservation status of perennial vegetation of stony banks habitat within Lady's Island SAC was assessed as Unfavourable-Inadequate, with respect to area, structure and function, and future prospects (Martin *et al.* 2017).

[8] 024_Ladys Island Lake_v1.0 Vegetated shingle monitoring survey

Priorities for achieving Favourable conservation status for [1220] Vegetated shingle in Ireland are given in Martin *et al.* (2017). The data collected during the VSM have shown that the major reasons for an unfavourable assessment of area were shingle extraction and recreational pressure. In addition, the main reason for an unfavourable assessment of structure and functions and future prospects were new coastal defences installed since 1992, with agricultural intensification, tracks, walking and horse riding, and litter also recorded as important negative impacts when assessing future prospects. All of the issues listed, except the installation of new coastal defences, can be adequately dealt with within comprehensive management plans for the individual sites where these impacts occur.

The proposed development will not alter tidal overtopping of the barrier beach. During construction, a trench will be made in the section of the beach that is already affected by the annual 'cut'. There will be trenching associated with electrical cable installation required through ca. 60 m of 'Perennial vegetation of stony banks' habitat. There would be potential direct impacts on the habitat 'Perennial vegetation of stony banks' due to machinery tracking but this will be minimised by avoidance. Overtopping will not be affected during operation stage.

Plate 11 Cottonweed ca. 200m east of the proposed flow control structure (left). Cottonweed ca. 240m east of the proposed flow control structure (right) in an area developed for this plant.

Plate 12 Yellow-horned poppy (*Glaucium flavum*) in shingle habitat within (left) and north (right) of the footprint of the proposed flow control structure.

8.2 LADY'S ISLAND LAKE SPA

Table 11 lists the qualifying features of the Lady's Island Lake SPA and evaluates through a scientific examination of evidence and data whether or not these features should or should not be selected for further assessment in the NIS. The qualifying features that are selected for further assessment are discussed further in the section followed by an assessment of potentially significant effects arising from the proposed Lady's Island Lake Water Level Management project.

The Tern nest is typically a shallow scrape on raised, open, unvegetated sand, gravel, mud or bare coral substrates preferably far from upright vegetation (del Hoyo *et al.* 1996) on sandy islands, rocky calcareous islets, sand-spits, sand-dunes and shingle beaches (Snow and Perrins 1998). Nesting Terns utilise Sgarbheen and Inish Islands in Lady's Island Lake.

Twelve small streams feed into Lady's Island Lake, which has no natural outflow to the sea. Water levels rise with winter rainfall and with over-wash from the sea during storms and high tides. Mechanical breaching of the sand barrier is carried out to lower the lake levels. Breaching the gravel barrier is seen as a threat to the important tern colonies because when the outlet remains open for long periods the water level falls below a critical level allowing mammalian predators to reach the islands. Recent reports on Tern populations at Lady's Island Lake highlight the importance of regulating the water level of Lady's Island Lake. Daly *et al.* (2012) for example, noted that depredation during low lake level had a negative effect on all breeding species, with eggs and chicks depredated throughout the colonies on Inish. The regulation proposed as part of the management of levels in Lady's Island Lake will also prevent extremes which result in inundation of water into the nesting habitats of Terns. For example, Daly *et al.* (2016) indicates that the 'cut' was opened on the 2nd February at a level of 5.83m on the staff gauge, whereupon, the lake emptied, and water levels rose to 4.48m requiring a second cut on the 15th March.

The project aims to achieve a normal level of 4.0m OD Poolbeg (range of 3.8m to 4.2m OD Poolbeg) from mid-March to the end of August. This will protect nesting terns from predation by isolation from the mainland. Controlled regulation will prevent extremes which result in inundation of Island nesting habitat, and island colonisation by predatory mammals.

The impact of the proposed development on the conservation interest 'Wetlands and Waterbirds' relates to lagoonal habitat. This has been discussed in **Section 8.1.1** and will be discussed further in **Section 9.2.1**.

The Islands of Inish and Sgarbheen are 1.5km and 2.5km north of the proposed development, respectively. The construction phase of the proposed development will not therefore cause a significant disturbance impact on the nesting sites of Gadwall or Terns on Inish and Sgarbheen, considering distance from proposed development.

Table 11: Identification of potentially significant impacts to qualifying features of Lady's Island SPA.

Qualifying Feature	Potential for Significant Impacts	Rationale
Gadwall (*Anas strepera*)	Yes	The Gadwall is Amber listed due to the occurrence of few breeding pairs and a localised wintering population. The Gadwall is a scarce breeding species with less than 50 breeding pairs in Ireland and is considered relatively uncommon in winter. The nest is a well-hidden hollow in grass and leaves positioned on the ground in thick vegetation such as nettles *Urtica* spp. grass tussocks, thick bushes, rushes or tall grass (BirdLife International, 2018a). Daly *et al.* (2016) found that 25 pairs bred on the northern end of Inish, and three pairs on the southern end, one within the roseate colony. Daly *et al.* (2012) recorded approximately 16 pairs in 2012 (some nests noted late in the season may have been those of relaying pairs). The species inhabits highly productive and eutrophic freshwater marsh or lake habitats in open lowland grassland, showing a preference for sheltered, shallow, standing or slow-flowing waters with abundant emergent vegetation. The species is predominantly herbivorous, its diet consisting of the seeds, leaves, roots and stems of aquatic plants (submerged and emergent) as well as grasses and stoneworts *Chara spp.* (Kear 2005). The species is threatened by pollution (Kear 2005) and disturbance from recreational use of freshwater wetlands (Pease *et al*. 2005). The food plants of Gadwall includes stonewort *Chara spp.* The composition of plant assemblages in the lake could be altered by changes to salinity and the feeding opportunities of Gadwall could therefore be affected. Gadwall nesting would not be affected with the proposed management of lake levels. Gadwall feeding could be affected by floral changes in Lady's Island Lake.
Black-headed Gull (*Chroicocephalus ridibundus*)	No	Black-headed gull is Red listed due to a decline in the breeding population and range. Birds are resident with numbers increasing in winter with birds from Britain and northern Europe. Daly *et al.* (2012) found that Black-headed Gulls increased by 160 pairs (10%) to 1616. Two 'walk-through' nest censuses were carried out by Daly *et al.* (2016), one in Colony A on the northern end of Inish and one in Colony B on the southern end of Inish on 5th May, recording a total of 2380 nests. A small colony of 49 nests was also censused on Sgarbheen. Black-headed Gull numbers increased at Lady's Island Lake by 417 pairs (21%) to 2429 (Daly *et al.* 2016). Black-headed Gulls in colony B and were noted taking tern chicks throughout the early part of the hatching when common/arctic chicks were small enough to be taken. Four nests and their contents were removed from the vicinity of the roseate tern colony (Daly *et al.* 2016). The population of this species in the study area is steadily increasing. Gull species proliferation is recognised as a threat to Terns in the SAC. There is little/no risk to this species associated with the proposed development.
Sandwich Tern	Yes	Sandwich tern is Amber listed due to a decline in breeding

Qualifying Feature	Potential for Significant Impacts	Rationale
(*Sterna sandvicensis*)		range and because the breeding population is localised and therefore vulnerable. Populations of colonies fluctuate dramatically between years. Present in Ireland from March to September, with occasional winter records[9]. Its diet consists predominantly of surface-dwelling marine fish (Snow and Perrins, 1998), 9-15 cm long (del Hoyo *et al*. 1996) as well as small shrimps, marine worms and shorebird nestlings. The species responds favourably to habitat management such as vegetation clearance and can be readily attracted to suitable nesting habitats by the use of decoys (del Hoyo *et al*. 1996). Breeding pairs are also known to be attracted to coastal locations where artificial nesting sites have been constructed (e.g. beaches of bare shingle and islands or rafts covered with sparse vegetation) (Burgess and Hirons 1992). A conservation scheme for the protection of gull and tern breeding colonies in coastal lagoons and deltas (e.g. Po Delta, Italy) involves protection from human disturbance, prevention of erosion of islet complexes, habitat maintenance and the creation of new islets for nest sites (Fasola and Canova 1996). The scheme particularly specifies that bare islets with 30-100 % cover of low vegetation (sward heights less than 20 cm) should be maintained or created as nesting sites (Fasola and Canova 1996). The proposed development would bring about positive impacts through better control of water levels and prevention of flooding of nest sites. There could be adverse impacts on foraging however, related to water quality changes and disturbance owing to dredging.
Roseate Tern (*Sterna dougallii*)	Yes	The Roseate tern is Amber listed, having moved from the Red list in the recent assessment of birds of conservation concern, because the breeding population is localised and therefore vulnerable. The Roseate tern occurs in internationally important numbers in Ireland with an estimated 72% of the European population. This is a migratory coastal seabird that feeds by plunge diving. It dives from a greater height than other terns. The species breeds in large, dense single- or mixed-species colonies that may contain several thousands of pairs (del Hoyo *et al*. 1996). Its diet consists predominantly of small pelagic fish (del Hoyo et al. 1996), particularly sandeel (Newton and Crowe 2000), sprat, sometimes clupeids and gadoids (Newton and Crowe 2000), although it will also take insects and marine invertebrates (del Hoyo *et al*. 1996) such as crustaceans. Sandeels are particularly important during chick rearing (Newton and Crowe 2000). Natural predators can often take a great toll on localised colonies, particularly when terns are disturbed from the nest by other birds and humans (Birdlife International 2018c). Habitat loss in northern Europe is not a major problem but has caused the local extinction of some colonies, as have extreme weather events (Avery *et al*. 1995).

[9] https://www.birdwatchireland.ie/IrelandsBirds/GullsTerns/SandwichTern/tabid/355/Default.aspx

Qualifying Feature	Potential for Significant Impacts	Rationale
		Positive impacts will occur through better control of water levels and prevention of flooding of nest sites. There could be adverse impacts on foraging however, related to water quality changes and disturbance.
Common Tern (*Sterna hirundo*)	Yes	Common tern is Amber listed due to a decline in breeding range and because the breeding population is localised and therefore vulnerable. Birds winter in Africa. During the breeding season the species is vulnerable to human disturbance at nesting colonies (Buckley and Buckley 1984, (e.g. from off-road vehicles, recreation, motor-boats, personal watercraft and dogs) del Hoyo *et al.* 1996), and to the flooding of nest sites as a result of naturally fluctuating water levels (Buckley and Buckley 1984). It suffers predation at nesting colonies from rats (especially on islands) (Buckley and Buckley 1984, del Hoyo *et al.* 1996) and from expanding populations of large gull species (del Hoyo *et al*. 1996) such as Herring Gulls (Buckley and Buckley 1984) (gulls may also prevent the species from nesting in the area by colonising it first) (del Hoyo *et al.* 1996). The species is susceptible to other threats including organochlorine pollution, over-fishing by man (Hagemeijer and Blair 1997) and fatalities from wind turbine collisions (Everaert and Stienen 2007). The proposed development would bring about positive impacts through better control of water levels and prevention of flooding of nest sites. There could be adverse impacts on foraging however, related to water quality changes and disturbance.
Arctic Tern (*Sterna paradisaea*)	Yes	Arctic tern is Amber listed due to a decline in breeding range and because the breeding population is localised and therefore vulnerable. Birds winter in the Arctic. Its diet consists predominantly of fish as well as crustaceans (especially planktonic species), molluscs, insects (e.g. caterpillars, Chironomidae) and earthworms (del Hoyo *et al.* 1996). It will also take berries in the early spring on arrival on its breeding grounds but does not readily switch to other prey items when preferred prey supplies fail (del Hoyo *et al*. 1996). The species is potentially threatened by climate change because it has a geographically bounded distribution: its global distribution is restricted to within c.10o latitude from the polar edge of continent and within which 20-50% of current vegetation type is projected to disappear under doubling of CO_2 levels (Birdlife International, 2018d). In northern Britain the collapse of sand eel stocks have caused a crash in the population (Gochfeld *et al*. 2014). Pollution is likely a major factor in the species decline and yachting and other leisure activities have led to an increase in disturbance. Declines have also been correlated with gull abundance within its European range (Hagemeijer and Blair 1997). Positive impacts will occur through better control of water levels and prevention of flooding of nest sites. Due to

Qualifying Feature	Potential for Significant Impacts	Rationale
		uncertainty regarding water quality and disturbance impacts, there exists potential for impacts on the lagoon habitat and Terns.
Wetlands and waterbirds	Yes	Lady's Island Lake SPA comprises a shallow, brackish coastal lagoon separated from the sea by a sand and shingle barrier. It supports one of the best examples of a lagoonal bird fauna in the country and is of particular note for its breeding colonies of Sandwich Tern, Roseate Tern, Common Tern and Arctic Tern, all species which are listed on Annex I of the E.U. Birds Directive. It is likely that there would be an overall benefit to wetlands and waterbirds. Due to uncertainty regarding water quality and disturbance impacts, there exists potential for impacts on the lagoon habitat, which is a key component of the SPA, and on the birds that utilise the habitat.

8.3 CARNSORE POINT SAC

Table 12 lists the qualifying features of the Carnsore Point SAC and evaluates through a scientific examination of evidence and data whether or not these features should or should not be selected for further assessment in the NIS. The qualifying features that are selected for further assessment are discussed further in the section followed by an assessment of potentially significant effects arising from the proposed Lady's Island Lake Water Level Management project.

Table 12: Identification of potentially significant impacts to qualifying features of the Carnsore Point SAC.

Qualifying Feature	Potential for Significant Impacts	Rationale
1140 Mudflats and sandflats not covered by seawater at low tide	No	This habitat occurs within the SAC to the north east of Carnsore Point, ca. 3km east of the proposed flow control structure. Target 1 of NPWS (2011) stipulates that the permanent habitat area is stable or increasing, subject to natural processes. Target 2 states that 'Intertidal sand dominated by polychaetes and crustacea community complex' should be conserved in a natural condition. The proposal will not affect these targets as there will be no direct impacts or significant secondary ecological effects to mudflat and sandflat communities.
1170 Reefs	Yes	Reef habitat occurs intertidally and sub-tidally to the south east of the proposed flow control structure, where 'Exposed Subtidal Reef Dominated by a Faunal Community Complex' occurs less than 50m from the proposed junction box, with the dual pipeline ca. 35m from this habitat. This reef could be adversely affected by physical disturbance during construction and will therefore be considered in more detail. Adverse effects on water quality may have a significant impact on reef communities, due to releasing poor quality water into sea.

Reef habitat is a widespread marine feature with immobile hard substrate available for colonisation by epifauna. Reef habitat types include gravels, cobbles, boulders and bedrock as well as biogenic conglomerations. Areas of reef habitat are mapped within the Carnsore Point SAC. The increased suspended sediments in the water column will deposit on the seabed either within or outside of the bay, while the finer fractions may remain in suspension. There is a risk of changes to the community structure of this habitat from sediment deposition. The requirement to carry out pipeline installation

works close to reef habitat represents a potential impact to reef habitat via tracking of machinery, though it is not envisaged that the project will not result in any significant habitat loss or alteration. This feature of interest will be assessed in more detail. Reef habitat identified from NPWS mapping indicates reef community ca. 35m to the east of the proposed pipe at its southern extent (see **Figure 5**). Adverse effects on water quality may have a significant impact on reef communities, due to potential release of water of poor quality into sea during/after dredging operations.

8.3.1 Potentially Affected Qualifying Feature Description

8.3.1.1 Reefs

Reef habitats are widespread marine features with stable hard substrate available for colonisation by plants and animals. Irish reefs range from the intertidal to 4500m below the sea surface and more than 400km from the coast. Intertidal and shallow subtidal reefs are dominated by red and brown algal species. Within Carnsore Point SAC, reef habitat is recorded intertidally on Burrow Beach and from Carnsore Point to the north of Greenore Point. Subtidally, reef is present throughout the site from low water to depths of approximately 40m. It occurs to the south of Carnsore Point and Burrow Beach extending several kilometres to the southern boundary of the SAC. Intertidally, the reef largely consists of boulders; however, sloping bedrock is recorded at Carnsore Point. The majority of subtidal reef at this site occurs as a mosaic of boulders on bedrock. A small area of flat or sloping bedrock is recorded close to shore at Carnsore Point (CO supporting doc).

Ecologically, the reef within Carnsore Point SAC can be categorised into three main groups:

- sheltered to moderately exposed intertidal reef community complex
- exposed subtidal reef dominated by a faunal community complex and
- *Laminaria* dominated community complex.

'Exposed Subtidal Reef Dominated by a Faunal Community Complex' occurs less than 50m from the proposed junction box, with the proposed pipeline installation ca. 35m from this habitat. There is therefore potential for alteration of this habitat by transport of sediment from the works area, or through water quality impacts.

'Laminaria Dominated Community Complex' occurs ca. 560m to the south east of the flow control structure. 'Laminaria dominated community' normally occurs on bedrock in exposed conditions between the low water mark and 20 meters depth (NPWS, 2013c). Assemblages of *Laminaria* are recognised as being among the most ecologically dynamic and biologically diverse of habitats on the planet. Kelp species are the most common prominent constituents of the temperate lower intertidal and subtidal rocky shore. *Laminaria* dominated communities are keystone communities within the Saltee Islands SAC, this area also located off the southern Wexford coast, to the west of the Carnsore Point SAC. This habitat is of considerable importance to the overall ecology and biodiversity of a habitat by virtue of their physical complexity. Taking into account geographical separation of any impacts associated with construction stage, and the effects of significant dilution of freshwater during operation stage, this community type will not be adversely affected by the proposed development and will not be considered any further.

Sheltered to moderately exposed intertidal reef community complex occurs ca. 1050m to the south east of the proposed flow control structure. This intertidal reef occurs as boulders and sloping

bedrock. The reef biota is largely composed of a variety of lichen species on the upper shore and of combinations of fucoids elsewhere on the shore. In sheltered areas, the red algae *Porphyra purpurea* and the freshwater tolerant genus *Ulva* sp. occur, while on moderately exposed reef, encrusting barnacles are found. Taking into account geographical separation of any impacts associated with construction stage, and the effects of significant dilution of freshwater during operation stage, this community type will not be adversely affected by the proposed development and will not be considered any further.

9 ASSESSMENT OF POTENTIALLY SIGNFICANT EFFECTS

Healy (1997) notes that not all lagoons have conditions which fluctuate as widely as Lady's Island Lake, but all are subject to an amount of unpredictable change, so that snapshot studies, used to compare lagoons for purposes of classification or assessment of conservation value, are liable to show up differences in salinity and living communities that are no more than transitory. A delayed response to changing salinity may explain the failure by some authors to find a relationship between salinity and features such as species-richness and presence or absence of a particular species (e.g. de Kroon *et al*. 1985; Barnes 1987). An inventory of brackish water resources would need to take into account the geomorphology and hydrology of the sites, as well as recent history, if the information were to be in any way predictive and the final classification meaningful. The accounts of impacts given hereunder are based on studies of Lady's Island Lake, where possible.

9.1.1 Habitat loss

The proposed development is located largely within the Lady's Island Lake SAC and SPA. The southern extent of the proposed pipeline (seaward end) is located outside of these designated sites and is within the Carnsore Point SAC.

9.1.1.1 Lady's Island Lake SAC

As the proposed development is located on the shoreline of Lady's Island Lake, the construction works will impact directly on the Annex I habitat type 'Coastal lagoons'. The installation of the flow control structure pipe and associated dredged drainage channel will result in a temporary direct impact on the lagoon habitat. The area of lagoonal substrate requiring removal will be the proposed development footprint, and any additional area required to lower the bed of the lagoon for pipeline installation. The footprint of the pipeline and drainage channel within the lagoon represents an area of ca. 3000m^2. Lagoon habitat will not be lost by these activities. The lagoon habitat affected in this area will altered however during the construction works, with dredging of the drainage channel causing alteration of lagoon habitat during maintenance.

During the current survey, the visible lagoon substrate in the area affected by the pipeline was composed of gravel and sand. It is considered that these particles had been recently deposited during a tidal surge. This observation is based on the lack of flora and loosely compacted substrate, signifying fresh sedimentation, most likely originating from the sea and/or gravel/sand barrier. Indeed, the presence of fresh seaweed at the landward side of the crest at the 'cut' supports this idea. At the landward side of the 'cut', the substrate comprised mostly fine gravel. This part of the lagoon is unlikely to support an important plant community however due to the highly mobile nature of the substrates, and at least annual throughput of saline water after the 'cut' is made.

The direct impacts associated with removing substrates from the lagoon will be of low magnitude and will only impact on a relatively small area of the lagoon with respect to the overall lagoon area of 299.6 ha. The direct impact of the footprint of the development (ca. 0.3ha) represents <.01% of the overall lagoon habitat.

In the area associated with the 'cut' on the barrier beach, there are large accumulations of sediment in the range 2-250mm. The substrate in this area is dominated by fine gravel and sand, with the gravel size generally increasing towards the lagoon. NPWS (2019) has mapped 'Perennial vegetation of stony banks', the only qualifying Interests of Lady's Island SAC associated with dunes, based on data from the Vegetated Shingle Monitoring Project (Martin *et al*. 2017) (see **Figure 5**). Perennial vegetation of stony banks' was surveyed and mapped in the sub-site Lady's Island Lake (VSM site code 024) to give a total estimated area of 0.97ha within Lady's Island Lake SAC. The footprint of the proposed development is not within the 'Perennial vegetation of stony banks' habitat. Most of the 'cut' area does not correspond to the habitat 'Perennial vegetation of stony banks' selected as a feature of interest in the Lady's Island SAC, as the substrates are below the high tide level and are mostly sands at higher elevations. Some shingle habitat occurs on higher ground at the western boundary of the 'cut'. With the exception of the western 'cut' - dune interface, the form of this sediment is flat in profile and does not correspond to 'Perennial vegetation of stony banks' noting by definition, that this habitat occurs where shingle has accumulated to form elevated ridges or banks above the high tide mark. The proposed development is not considered to have direct impacts on such shingle habitat which support vegetation of conservation concern in Lady's Island SAC.

NPWS (2019) has mapped Annex I non-qualifying Interests of Lady's Island SAC and these are indicated in **Figure 5.** The footprint of the proposed development does not overlap 'Embryonic shifting dunes' or 'Fixed dunes with herbaceous vegetation' (grey dunes). There is a patch of 'Embryonic shifting dunes' [2110] associated with the eastern side of the 'cut' beach ca. 10m south of the proposed access / electrical cable route. This habitat is associated with the western and southern fringe of the dune system to the east of the cut and would not be affected by the proposed development. The proposed site compound and access / electrical cable route occur in 'Fixed dunes with herbaceous vegetation' [2130]. The proposed site compound and access / electrical cable route have been selected based on their degraded condition, areas subject to ongoing anthropogenic disturbance via vehicular and pedestrian access.

Plate 13 Areas mapped as 'Fixed dunes with herbaceous vegetation' in the NPWS conservation objectives document for Lady's Island Lake SAC. The proposed access / electrical cable route (left) and proposed site compound (right) occur in parts of this habitat degraded by human use. Intact grey dune habitat can be seen in

the foreground (right). Such intact areas will be avoided insofar as possible and can be at the proposed compound location.

Plate 14 Area mapped as 'Fixed dunes with herbaceous vegetation' at the proposed site compound: view west (left) and view east (right).

Based on NPWS mapping, the proposed flow control structure runs along the fringe of 'Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) to the west of the 'cut'. Based on the site visit, however the proposed flow control structure does not intersect with this habitat, as it had likely eroded. The area of the intersection of the flow control structure actually comprised fine sand supporting no vegetation contiguous with the wider area of sediment at the cut.

During the Coastal Monitoring Project (Ryle *et al* 2009), Cottonweed was recorded in the Fixed dunes (grey dunes, *2130) and within Marram dunes (white dunes, 2120). This plant was also recorded in shingle habitat ca. 200m and 240m east of the proposed flow control structure, during the October 2018 survey (see **Figure 5**). The habitats supporting this plant could potentially be damaged/lost during construction stage in the event that machinery tracked over it, or due to machinery induced changes in dune dynamics in the environs.

There is potential for lagoon habitat loss through pollution, eutrophication and salinity changes. For example, nutrient mobilisation and dispersal in the water, even at low levels could also shift communities within the lake, especially considering that nutrients locked in organic substrates in the system may be at a critically high level and cause an ecosystem collapse in part of the lake. These environmental variables are discussed in more detail in the sections below.

9.1.1.2 Lady's Island Lake SPA

The affected lagoonal area overlaps with the Special Conservation Interest 'Wetland & Waterbirds' of Lady's Island SPA. The loss of this wetland habitat corresponds to Coastal lagoon habitat as discussed in **Section 8.1.1**, above.

The proposed regulation of water levels aims to ameliorate the nesting habitats of birds of conservation interest in Lady's Island SPA via isolating islands from the mainland during the nesting season. There will be no loss of bird nesting habitat on Inish and Sgarbheen Islands with the current proposal.

9.1.1.3 Carnsore Point SAC

The beach at the southern end of the proposed drainage pipeline lies to the south of the barrier beach. It is a high energy environment and is within the Carnsore Point SAC. The intertidal littoral habitat at the southern end of the proposed pipeline comprises coarse sand (1-4mm) and is classified as 'Sand shore (LS2)'. There would be a permanent loss of this habitat where the pipe is exposed and where piles (and associated caps) are located. There would be temporary loss of this habitat along the pipeline route during construction stage.

9.1.2 Habitat alteration

9.1.2.1 Lady's Island Lake SAC

Lagoons are expanses of shallow coastal saltwater, of varying salinity and water volume, wholly or partially separated from the sea by sand banks or shingle, or, less frequently, by rocks. Salinity may vary from brackish water to hypersalinity depending on rainfall, evaporation and through the addition of fresh seawater from storms, temporary flooding of the sea in winter or tidal exchange[10].

The current proposal will not alter the physiography (physical geography) of Lady's Island Lake. There will be not change to the overtopping regime. Percolation lagoons are transient features normally formed by natural processes of sediment transport, which may be eroded and swept away over a period of years or decades or may become infilled by movement of the shingle bank[11].

The current proposal will alter water levels in a controlled manner as follows: September (+2.2m ODP to +2.6m ODP with seawater allowed into the lake for 2-4 weeks); October (inflow stopped until lake levels rise to ca. +4.4 to 4.6m ODP; Winter (allowed rise to 5.1m ODP and maintained at or above this level for at least one month); maintained between +4.6m ODP and +5.0m ODP until March when levels are to be drawn down to +3.8 to 4.2m ODP to facilitate the terns; and from March to August (maintained within the range +3.8m ODP to +4.2m ODP). The regulation of the waters levels as proposed will stabilise water levels in an annual time frame. The controlled expansion and contraction of levels, and hence volume/area will be within the minima and maxima experienced in past times.

Based on calculations, it is anticipated that dropping lake water levels from 3.59m ODP (1m ODM) and 4.06m ODP to -0.25m ODP will take ca. 15 days and 19 days respectively, assuming no freshwater inflow from feeder streams. Assuming a freshwater inflow of $0.3m^3/s$ from feeder streams, is anticipated that dropping lake water levels from 3.59m ODP (1m ODM) and 4.06m ODP to -0.25m ODP will take ca. 18 days and 22 days respectively.

Water levels in the lagoon will vary over a range of ca. 3m, with simultaneous alteration of the wetted area of the lake. This will likely result in annual shifts of vegetative cover, dependent on water level but also on salinity. The volume and area of the lake will be more predictable. For example, at 4.5m ODP during October, the lake volume and area would be $7.52x10^6m^3$ and 327.5ha. At 2.34m ODP, within the minimum proposed range in September, the lake volume and area would be $1.52x10^6m^3$ and 165ha. Approaching the maximum level, at 5.01m ODP during Winter, the lake volume and area would be $9.34x10^6m^3$ and 365ha. Based on the minimum proposed level above, the

[10] http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf

[11] http://www.ukmarinesac.org.uk/activities/lagoons/l2.htm

projected increase in water volume and lake area is ca. 500% and 121% respectively. In lake volume terms, there would be an increase from a minimum to a maximum by a factor of ca. 6, during which time the lake area would expand by a factor of 2.2.

Water quantity and quality in a lagoon is influenced by the rate at which the lagoon loses or gains water from evaporation, precipitation, groundwater input, surface runoff, and exchange with the ocean (Allen *et al*. 1981). The flushing rate (rate at which water enters, circulates through, and exits the lagoon) is a fundamental physical property and controls the retention time of waterborne constituents. With controlled connectivity to the sea, the rate at which water enters, circulates through, and exits will be managed, thereby exerting influence on the physical properties of the lagoon, noting that retention time of water and its constituents is a fundamental characteristic of the lagoon.

Beds of Tasselweed and charophytes play an important role in influencing the shape and stability of the shoreline. Such flora regulates dissolved oxygen (Nixon and Oviatt 1972) and filter suspended matter (Bertness 2007). Lady's Island Lake provides essential habitat for many plants, fish and macroinvertebrate species. They enhance the biodiversity of the lagoon by providing a physical refuge from predation and also serve as nursery and feeding habitats for a variety of organisms (Harris *et al.* 2004). Dropping water levels as proposed, during September, will probably result in loss of areas of benthic vegetative community that has grown in during the previous summer months, due to desiccation. Any such loss will occur in shallow submerged parts of the lake during the summer months. Areas of lower elevation subject to desiccation during this draw-down period will be so for a shorter period and may survive until water levels start to rise again. The fact that water levels will be maintained during the growing season and the fast-colonising nature of the floral community in the lake lessens this impact however. For example, Foxtail stonewort *L. papulosum* can quickly recolonize from the spore bank when suitable conditions reoccur, and habitats for *L. papulosum* may be transient, due to salinity fluctuations or desiccation in the absence of rainfall/freshwater inputs[12].

Under the current proposal, the minimum the lake area will be 165ha, corresponding to 2.34m ODP. Submerged vegetative lagoonal communities and the fauna they support can therefore potentially occur in at least 165ha of the lake continuously, notwithstanding pollution, excessive depth, or another ecologically damaging event. The proposal will therefore likely bring stability to the Lady's Island lagoonal ecosystem.

Dredging of substrates at the flow control structure within the lagoon, and along the beach could potentially affect water quality in the lagoon and in the sea. The impacts of nutrient enrichment in the lagoon includes direct metabolic effects (for example the foxtail stonewort most frequently occurs at sites where soluble reactive phosphate is below 10µg/l) increase in growth of epiphytic, floating, ephemeral, benthic and phytoplanktonic algae and associated competition with lagoonal vegetation of conservation interest, and indirect effects on lagoonal fauna. The effects of eutrophication are generally manifested in algal blooms which may blanket other aquatic vegetation and can cause depletion of oxygen from the water, noxious odours, outcompeting of other vegetation and in severe cases the death of fish and invertebrate fauna (Oliver, 2007). The addition

[12] https://www.marlin.ac.uk/species/detail/1701

of a limiting nutrient, such as phosphate in seawater, could trigger a bloom when introduced to the lagoon during construction or operation stages. This occurs annually during the current management practice of breaching the barrier beach, when saline water enters the lagoon.

Sea buckthorn *Hippophae rhamnoides* has formed small dense thickets in several parts of the *2130 Fixed dunes (grey dunes) at Lady's Island Lake (Martin *et al*. 2017). This is a highly invasive species on sand dunes in Ireland, which reduces plant species diversity and excludes rare species (Binggeli *et al*, 1992). It may also contribute to drying out dune slacks through evapotranspiration. The plant spreads quickly by suckering and is an Amber listed invasive plant species (ISI 2016). The spread of this plant, if facilitated by the proposed development could have significant negative impacts on dune habitats, reduce floral diversity and reduce potential recolonization of rare plants e.g. Cottonweed.

Alteration of habitat may also occur via salinity and other water quality changes. Potential salinity and other water quality impacts are discussed in more below.

9.1.2.2 Lady's Island Lake SPA

Any impacts on habitats in the lagoon, as identified above in **Section 8.1.1.1** could impact on flora and fauna in the lagoon, and therefore on the birds dependent on these for sustenance, especially for Tern during the breeding season.

9.1.2.3 Carnsore Point SAC

Reef habitat occurs within Carnsore Point SAC less than 50m from the proposed junction box, with the proposed pipeline ca. 35m from this habitat. An examination of the beach revealed that the reef habitat is at least 100m from the footprint of the proposed development. There is nonetheless potential for alteration of this habitat by transport of sediment from the works area, or through water quality impacts.

The continuous effects of longshore drift and onshore erosion/deposition will likely bring about constant/regular profile change to the beach in the environs of the southern end of the pipeline and associated piles, especially where these structures are above the level of the beach.

9.1.3 Disturbance and/or displacement of species

9.1.3.1 Lady's Island Lake SAC

Lady's Island Lake is a heterogeneous waterbody with regard to its salinity and therefore the biological communities it supports can vary according to location within the lake. The proposed development will allow sea water into Lady's Island Lake and bring about salinity changes, so salinity will be maintained to some degree. The rate of influx to and quantities of sea water deposited to the lake via the proposed flow control structure would determine the biological community composition of Lady's Island Lake during operation stage. A function of the proposed development will be to replace the practice of breaching. The proposed development with result in a more gradual influx of saltwater, allowing biota to adapt, and remove the need to breach the barrier. Regular influx of sea water is a fundamental aspect in maintaining a lagoonal habitat, so the proposed development is considered to represent a positive impact in terms of salinity in Lady's Island Lake.

Healy (1997) noted that the wide fluctuations in water-level in Lady's Island Lake mean poorly developed fringing beds of emergent reeds and sedges mostly limited to the northern end and a few

sheltered bays. Submerged macrophytes grew luxuriantly or were nearly absent, depending on the salinity. During extended oligo-mesohaline periods, *Potamogeton pectinatus* L. *and Ruppia cirrhosa* (Petagna) Grande, in varying proportions, formed dense beds in shallow water, together with species of *Cladophora* and *Enteromorpha*, and *Chaetomorpha* sp. in deep water. *Potamogeton pectinatus* increased and *R. cirrhosa* declined during extended periods of low salinity (<16 psu), while in periods when the salinity remained > 16 psu. *R. cirrhosa* completely replaced *P. pectinatus, Ruppia inaritihnus L.* appeared, *Chaetomorpha* disappeared, *Enteromorpha* was seasonally abundant near the shore, and the charophytes *Lamprothamnium papulosum* and *Chara canescens* could be found in sandy or stony shallows. Most of these species disappeared within a few months during extended periods of tidal flow when salinity reached 30 psu or more, although some *Ruppia* rhizomes survived to regenerate the following spring. They were replaced by *Chondra filum* (L.), scattered plants of *Polysiphonia, Ceramium* and other unidentified Rhodophyceae, and when high salinities persisted *Fucus* sp. became established in stony areas. Macrophyte beds were absent or poorly developed from mid- 1981 until 1986 while summer salinities were high but recovered. The proposed management could bring about changes to the plant community, responding to ambient conditions as outlined above.

Healy (1997) found that temporal changes in faunal composition and abundance were, as for macrophytes, linked to shifts in the salinity regime and the extent of tidal incursions. Changes in the relative abundance of the dominant species (semi-quantitative and subjective estimates only) during the period 1976-81 revealed two suites of species which replaced each other in oligo-mesohaline and poly-euhaline phases. A high proportion of the species associated with oligo-mesohaline conditions were insects, many of which can also live in fresh water (Hemiptera, Trichoptera, Odonata, Coleoptera, Chironomidae); others are found in many low medium-salinity lagoons and lagoon-like systems (*Cordylophora caspia, Neomysis integer, Gammarus zaddachi, Idotea chelipes, Lekanesphaera hookeri, Conopeum seurati*) or are freshwater species which tolerate some salt (*Corixa panzeri, Notonecta viri dis, Potamopyrgus antipodarum, Pungitius pungitius*). Meso-euhaline phases were marked by a decrease in low-salinity species and the presence of com mon species of seashores and estuaries (*Arenicola marina, Praunus flexuosus, Crangon crangon, Carcinus maenas, Idotea baltica, Potamoschistus microps, Platichthys flesus, Pleuronectes platessa*) and of non-tidal brackish waters with frequent influxes of seawater (*Cerastoderma glaucum, Hydrobia ventrosa*). Only three or four species appeared to tolerate both ends of the salinity range for extended periods: *Hediste diversicolor, Palaemonetes vaoians, Anguilla anguilla* and possibly *Gasterosteus aculeatus*.

Periods of gradual change, such as that monitored between 1976 and 1978, were punctuated by sudden changes brought about by extended tidal periods which sometimes caused widespread mortalities e.g. in 1985. As the water-level fell following breaching, the benthic fauna of shallow water was exposed and individuals of *Cerastoderma glaucum, Mya areniaria, Arenicola marina*, and *Carcinus maenas* could be seen dying at the surface, especially during warm weather. It appears likely that pelagic macrofaunal populations would have been severely depleted by being washed out to sea, the effects being greatest when there was good mixing of sea and lagoon water or a long tidal period. Surviving benthic and pelagic individuals were subjected to a rapid rise in salinity, and salt concentrations often increased further owing to evaporation after the inlet closed, only falling to polyhaline levels in late autumn or winter. Survivors were also vulnerable to predation by marine fish and crustaceans which had entered with the tides. In years when low water-level and high

salinity persisted for several months, previously common species often disappeared completely from the main body of the lagoon.

Compared with the recent and historical management of the lagoon through annual cutting of the barrier, the proposed development will permit significant input of tidal water, thus the salinity of the lagoon can be controlled and requirements for lagoon ecosystems maintained. The proposal to allow the flow of saline water to the lake will represent an annual addition of water with phosphate to enter the waterbody. There is potential for disturbance of substrates at construction stage. The introduction of a potentially algal limiting nutrient such as phosphate and mobilisation of nutrients in substrate would increase the potential for impacts associate with algal blooms, e.g. D.O. fluctuations and loss of aquatic life. It is likely that the proposed development will affect the water chemistry of Lady's Island Lake SAC thus affecting the functioning of the ecosystem and the conservation of a rare habitat and its typical species. Oliver (2007) indicates the possibility that the level of nutrient enrichment in Lady's Island Lake may be approaching a critical level at which these taxa can no longer survive and noted the disappearance of large areas of aquatic macrophytes, together presumably with the fauna associated with them.

Considering the potential water quality impacts of the proposal, as detailed in **Section 9.1.5**, there is potential for community changes and disturbance/displacement of species. This could manifest through salinity/nutrient concentrations at the threshold or exceed the tolerance of plants established in the lake. For example, there could be a south to north shift in plant communities more tolerant of saline conditions in the event of consistently higher salinities in this area during September. A relatively dry winter and homogenisation of lake water following a large saline influx may bring about abnormally high salinity at the northern part of the lake. Conversely, a wet summer and high lake levels in September may limit the net amount of saline water distributed around the lake, if the hydraulic gradient (sea-lake differential) is insufficient to allow enough sea water into the lake. This could have disturbance/displacement impact on biota in either the north south direction or vice versa, depending on their environmental requirements. Indeed, Lady's Island Lake has suffered from repeated algal blooms and fish kills and is considered still very much under threat due to excessive nutrients which cause smothering with blanket weed (*Cladophora* spp.) and death of invertebrates and fish (Oliver 2007).

At Lady's Island Lake, there are certain areas, dependent on lake levels and mixing, that are considered buffered from rapid salinity changes, due to their isolated aspect. For example, from about December, Bunargate Pool in the south-west which is isolated in summer, becomes joined to the lagoon, allowing mixing of the waters and their fauna. Bunargate Pool also receives some fresh water, and during its periods of isolation, which can last for up to nine months, the salinity falls below that of the lagoon. Similarly, Healy (1997) found that the marshy region at the extreme northern end, although experiencing a substantial fall in water-level, was scarcely affected by tidal water and the salinity remained low. Isolated pools, diluted by rainwater, often persisted throughout the summer here and in the marshy region east of the causeway at Lady's Island (Healy 1997).

Since such isolated areas areas are less prone to mixing, they are somewhat insulated from the effects of pollution and other water quality impacts. Such pockets are deemed important areas for wildlife and are considered to act somewhat as reserves in terms of their isolation from the lake at large. The presence of these areas would reduce any potential long-term impact on lake biodiversity,

with a stock of flora and fauna surviving in refuges potentially replenishing the lake once conditions stabilise. Invertebrate species associated with Lady's Island lagoon include spattered diver beetle (*Agabus conspersus*), red-listed as Endangered in Ireland, eight species listed as lagoonal specialists in Britain including limnic, low salinity (oligomesohaline) species confined to the north end of the lake. The variation of salinities and presence of isolated areas within Lady's Island Lake are intrinsic characteristics of this lagoon and are considered to protect overall lagoonal diversity and safeguard species richness of the waterbody.

The proposed development is not expected to disturb or displace species to a degree that incurs significant impacts for the following reasons. It is considered that construction stage impacts to the lagoon will be limited to the southern end of the lake in the environs of excavation works. The bulk of sediment in the works areas (mostly sand) can be expected to fall quickly to the bed of the lake. Transport of finer particles will be limited due to the absence of currents in the lake. Any water quality impacts, or impacts related to light reaching the bed of the lake are deemed confined to the lake in the vicinity of the barrier beach, noting the heteroenous character of the lake and limited mixing in the waterbody. Studies in the past have shown that the lake quickly recolonises following an episode of biotic loss e.g. Healy (1997).

High salinity levels recorded in the lake reflecting the practice of annual breaching of the barrier is identified as a long-term damaging activity. Long-term observations on Lady's Island Lake indicates subsequent occasional mass mortalities of flora and fauna. Doris (2001) for example, states that the saline lagoon habitat of Charophytes in Lady's Island Lake is threatened, inter alia, by changes in salinity from the regular cutting of the sand bar which separates the lake from the sea. During operation stage of the proposed development, salinity will be relatively stable with respect to the current management. This will prevent extremes and perhaps allow the development of a more stable ecosystem in the lake.

9.1.3.2 Lady's Island Lake SPA

The main impact associated with construction and maintenance is displacement and avoidance of foraging birds from the southern end of the lagoon and adjacent sea. Pile driving associated with pipeline construction is identified as a potential concern as vibration/sound can be propagated indefinitely through the medium of water. Sound energy can have harmful effects on aquatic and marine fauna, as well as avoidance impacts. The occurrence of shallow areas in the environs of the proposed development and the option of piling out of water will reduce propagation of energy to sensitive fauna. Any maintenance dredging (annual at most) would have a lesser impact than any construction phase disturbance impacts. The magnitude of potential disturbance/displacement impacts are difficult to quantify, as they are dependent on season, degree of dredging, methodologies used to undertake the works, and preservation of the lagoonal character of the Lady's Island Lake. Depletion of population, or possibly desertion of any one of the birds of conservation interest from Lady's Island Lake would constitute a significant impact on the SPA.

The desired impact of the proposal is to manage water levels. The regulation proposed will prevent extremes which result in inundation of water into the nesting habitats of Terns. This will improve nesting conditions and is therefore expected to favour birds of special conservation interest in Lady's Island Lake, namely Gadwall, Sandwich Tern, Roseate Tern, Common Tern and Arctic Tern. Breaching the gravel barrier is seen as a threat to the important tern colonies because when the outlet remains

open for long periods the water level falls below a critical level allowing mammalian predators to reach the islands. Under the current proposal, this practice would cease.

The installation of a powerline to supply power to the electrical kiosk at the flow control structure could disturb birds during construction phase. The proposed powerline (along the local road network/away from beach) will be installed along a track used by public pedestrians and vehicles. The proposed powerline is not expected to incur any significant impacts on the bird populations of Lady's Island SAC.

Adverse water quality impacts could affect bird feeding and breeding habitats by impacting lagoon ecology and therefore affecting prey items. Any pollution impacts resulting from the proposed development are likely confined to the southern extent of the lake, so any water quality impacts are not expected to impact on bird feeding around Inish and Sgarbheen. Elevated suspended solids in the sea adjacent to the proposed works location could impact on the feeding efficiency of terns hunting. Disturbance caused by the works could displace birds from preferred feeding areas. Disturbance impacts could reduce feeding efficiency and increase energy demands on birds of special conservation interest in Lady's Island SPA. This effect would be temporary however and limited to an insignificant portion of available foraging grounds.

The importance of the lagoon as a foraging area for fledged birds is recognised. Any impacts on water quantity or quality as identified in the preceding sections (see also **Section 9.1.5**) could impact on flora and fauna in the lagoon, and therefore on the birds dependent on these for sustenance, especially for Tern during the breeding season.

9.1.3.3 Carnsore Point SAC

There are no species listed as CI's in the Carnsore Point SAC.

9.1.4 Salinity

9.1.4.1 Lady's Island Lake SAC

Healy (1997) notes that seawater at approximately 34 psu enters Lady's Island lagoon by seepage through the barrier, by salt spray being washed into the lagoon from the barrier, by occasional overwash of the entrance bar and, most importantly, by tidal flow following breaching. Salinity levels in the lake will be monitored at the northern end of the lake and at the flow control structure.

During the proposed salinity recharge period in September, outflows will be limited to minimise saline water inflow and raise salinity in the lagoon. Fluctuations in lagoon faunal populations can be expected according to the changing salinity regime, with controlled sea water influx at approximately 34 psu. For example, corixids and beetle diverse and abundance would probably increase with reduced salinity while fish and crustaceans replacing them during high salinity phases, in line with a study by Healy *et al*. (1982). The faunal community in the mixing zone near the flow control structure can generally be expected to be in a transient phase during saline recharge. The North-South gradient in marine influence in Lady's Island Lake, is demonstrated by differences in salinity, and as documented by past studies, will continue with the proposed development, albeit in a more controlled manner. Animals and plants that live in saline lagoons tend to be able to cope with changes in salinity and temperature, and this ability lets them outcompete their marine counterparts. The danger to lagoon organisms is not so much from the saltwater itself, which they

can tolerate to a certain extent, but from closely related marine species that can outcompete them[13].

Depletion of plant and benthic communities could occur through rapid salinity changes. The salinity "shock" effect within the lagoon, especially the southern end of the lake, near the flow control structure, could potentially cause mortalities of freshwater and oligohaline species. Conversely, there could be a significant reduction of the inflow of tidal water, thereby reducing the brackish component of the lagoon and species intolerant of reduced salinity i.e. flora and fauna adapted to life towards the poly-euhaline end of the salinity scale. A major rainfall event in the catchment prior to or during the recharge period could limit the potential for saline recharge.

Lady's island salinity winter targets for north and south are 8.65 psu and 20.45 psu respectively. The Summer targets for salinity at north and south are 23.25 psu and 23.15 psu respectively. During operation stage, the proposal will help stabilise salinity in the lagoon. At operation stage, according to mathematical predictions, with a base inflow of 0.3m^3/s and allowing a seawater influx that raises lake levels from -0.25m to +0.50m ODM (3.09m ODP), salinity could be raised from 0, 5 and 10 psu to 12, 15 and 18 psu respectively. Assuming no freshwater inputs, allowing seawater influx that raise lake levels from -0.25m to +0.50m ODM (3.09m ODP), salinity could be raised from 0, 5 and 10 psu to 17, 19 and 22 psu respectively.

Given that a 50%ile extrapolated flow to Lady's Island Lake equates to only 0.18m^3/s, the influx of fresh water is likely to be less than 0.3m^3/s, so the expected salinities provided above during a base inflow of 0.3m^3/s scenario are probably higher than would be expected during the recharge period. This takes account of the fact that normally, the wettest months are December and January while the driest are during the summer[14], inferring that the salinity increases post recharge could theoretically be closer to the 22 psu level. It is considered therefore that the Winter targets can be met with the operation of the project.

9.1.4.2 Lady's Island Lake SPA

Impacts on the plant life and macroinvertebrates due to salinity changes outlined in **Section 9.1.4.1**, above, will alter the feeding patterns of birds using Lady's Island lagoon. The magnitude of impact is dependent on the level of ecological change and is not expected to show greater variance than the existing regime i.e. annual breaching of the barrier beach.

9.1.4.3 Carnsore Point SAC

The impact of the proposed development on salinity in the Carnsore Point SAC is assessed as insignificant, regarding the relative size of the lagoon and its associated catchment, and tidal mixing along the shore.

9.1.5 Water quality and resource

9.1.5.1 Lady's Island Lake SAC

The proposed development has the potential to alter the water chemistry/salinity of the Lady's Island Lake SPA and SAC, thus affecting

[13] https://www.nature.scot/habitats-and-ecosystems/habitat-types/coast-and-seas/coastal-habitats/saline-lagoon

[14] https://www.met.ie/climate

the functioning of the ecosystem and the conservation of a rare habitat and its typical species. Salinity is discussed separately, above, given the importance of this key parameter in Lady's Island Lake. An aim of the project however is to have favourable salinity levels in the lagoon for flora and fauna, as well as improving the hydrographic regime for same. A function of the proposed development will be to replace the practice of breaching. The proposed development with result in a more gradual influx of saltwater, allowing biota to adapt, and remove the need to breach the barrier. Under the proposed development operation, water volumes in the lake will undergo less dramatic changes, allowing less resilient biota time to acclimatise/move to more suitable refuges in the lake.

There is the potential during the construction phase of the proposed development for contaminated surface water runoff to enter Lady's Island Lake SAC. Contaminated surface water runoff from a construction site could contain hydrocarbons such as hydraulic oils and diesel, cement-based compounds and wastewater discharges from welfare facilities. These impacts can be mitigated.

Biological features of lagoons, which may potentially be affected by changes in water quality include the charophytes, other lagoonal aquatic plants (tasselweed, pondweed), lagoonal invertebrates, fish and birds. The following water quality (other than salinity) issues are identified: nutrient enrichment, toxic contamination and Turbidity.

Nutrients are transported to lagoons from surface water and groundwater flows and through exchange with the ocean. Because nutrient availability often limits primary productivity, coastal lagoons can foster high rates of primary production, thereby supporting high rates of secondary production compared to other aquatic ecosystems (Nixon 1982, 1995). However, primary production that exceeds the demands of consumers can lead to eutrophication (Valiela *et al*. 1992). Eutrophication is characterized by excessive phytoplankton and macroalgal blooms and subsequent hypoxia, reduced light penetration (McGlathery 2001), stress and die-offs of marine organisms, loss of seagrass beds, changes in food web interactions and community structure, and loss of biodiversity (National Research Council 2000). Organic enrichment is likely to be a concern at Lady's Island lagoon given that lagoonal sediments are naturally high in organic material, and that it is probably critically enriched. Healy (1997) notes that an annual cycle of nutrient uptake and release can be envisaged, with submerged macrophytes removing nutrients from the water during the growing phase and releasing them gradually in autumn and winter when deciduous stems accumulate in banks on the shoreline. Additional nutrients from agricultural run-off and domestic effluents increased during the 1977 and 1991 period and phytoplankton blooms (diatoms, filamentous chlorophytes or cyanophytes, depending on the season), the first of which was observed in 1979, have become more frequent (Healy 1997). Evidence from the few lagoon-specific studies undertaken suggests that once impacted (particularly by nutrient enrichment) lagoons may be slow to recover from impacts due to changes in water quality becoming self-perpetuating[7].

During construction stage, there is the potential for contaminated water runoff to arise from open excavations, accidental leakage or spillage of hazardous substances (such as cement/concrete, diesel and hydraulic fluids) and/or contaminated runoff from material storage areas. Evidence from oil spill impacts in North America shows that oil residues are

very persistent and can have long-term impacts on benthic communities, vegetation and wildlife[15]. If lagoon habitat at Lady's Island Lake was to become contaminated by hydrocarbons, gaseous exchange between the water and air environment would be limited due to the barrier effect of a film on top of the water. With continuing biological respiration beneath the surface of the water (microbial and biological metabolism), biota could eventually be smothered due to de-oxygenation.

Increased Turbidity associated with disturbance of lagoon substrates (construction and operation stages) would increase light attenuation and smothering, or inhibition of feeding of lagoonal invertebrates. Similarly, the eventual settlement of mobilised sediment could impact lagoonal plant photosynthetic process and energy conversions to the detriment of submerged flora, with knock-on effects on dependent fauna including birds.

9.1.5.2 Lady's Island Lake SPA

The proposed development has the potential to alter the water chemistry/salinity of the Lady's Island Lake SPA and SAC, thus affecting the functioning of the ecosystem and the birds that utilise the lake. A primary aim of the proposed development is maintaining salinity within a specified range, thereby likely improving primary production across plant assemblages in in Lady's Island Lake SPA the therefore improving feeding opportunities for birds.

9.1.5.3 Carnsore Point SAC

The water quality effects discussed above could also occur within the intertidal zone of the sea adjacent to the 'cut'. The potential for significant water quality impacts on marine habitats would be of low magnitude due to tidal fluctuations and associated dilution/dispersion.

9.2 ASSESSMENT OF EFFECT ON CONSERVATION OBJECTIVES

9.2.1 Lady's Island SAC

Conservation Objectives for Lady's Island SAC have been recently published (NPWS 2019). These Conservation Objectives have attributes, measures and targets for 'Coastal lagoons', 'Perennial vegetation of stony banks' and 'Reefs' which are the conservation interests of the Lady's Island SAC. Oliver (2007) was a key document in preparing Conservation Objectives for lagoons throughout Ireland and for which Lady's Island SAC was a focus of study. Structure and functions relates to the physical components of a habitat (structure) and the ecological processes that drive it (functions). For lagoons these include attributes such as salinity, hydrology and various water quality attributes (NPWS 2019a).

Table 13 gives the assessment of effect of the project on the Lady's Island SAC Conservation Objectives for features of interest identified as being potentially significantly affected.

[15] https://www.ukspill.org/spill-archive/resources/PREMIAM-Final-for-Web.pdf

Table 13: Assessment of effect of project on the Lady's Island SAC Conservation Objectives for features of interest identified as being potentially significantly affected.

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
Coastal lagoons [1140]	Habitat area/ hectares	Area stable or increasing, subject to natural processes. Favourable reference area	The area of Lady's Island lagoon is mapped as 299.6ha. The proposal aims to control lagoon water levels from a minimum of +2.2m ODP to +2.6m ODP during September to a maximum of 5.1m ODP for one month in Winter, with a range of 3.8m to 4.2m ODP from mid-March to the end of August. The wetted area of the lagoon will therefore fluctuate seasonally, according to water levels. Annually, the lagoonal area will decrease to a minimum of ca. 165ha (corresponding to 2.34m ODP) and increase to a maximum of 365ha (corresponding to 5.09m ODP). The proposed controlled ranges will be within historically recorded minima and maxima. For example, when the 'cut' is made, the water level can drop so low that the waterbody become tidal. Conversely, flooding at times when water is trapped behind the barrier can cause back-up of local sewers. The volume and area of the lake will be more predictable with the proposed management. In lake volume terms, there would be an increase from a minimum to a maximum by a factor of ca. 6, during which time the lake area would expand by a factor of 2.2. The proposed development will not have a significant impact on lagoonal area, with reference to baseline levels. With discontinued inward transportation of substrates from the sea to the lagoon at the 'cut', the proposed development will likely prevent continued loss of depth of water levels in the southern part of the lagoon. This is characterised as a positive influence of the proposal. Water volumes and salinity can be expected to improve regarding fluctuations, when compared to the current management practice of breaching. Monitoring will be required to manage salinity and lake levels.	Yes, including monitoring of lake levels and salinity
	Habitat distribution/ occurrence	No decline, subject to natural processes.	Lady's Island Lake is a transient ecosystem which undergoes fluctuation in water levels and salinity. The habitats present are dependent on attributes such as hydrology, salinity, and various other water quality parameters. The proposed development is not expected to result in a significant impact on the distribution of lagoon habitat.	No

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Salinity regime/ Practical salinity units (psu)	Annual median annual salinity and temporal variation within natural ranges	Lagoons can vary considerably in salinity both within and between sites depending on the volume and timing of inflowing and outflowing fresh and seawater. Salinities of between 2 psu and 40 psu have been recorded in Lady's Island Lake as a whole. Salinity is highly unstable in the lagoon as it is influenced by numerous factors including saltwater intrusion (seepage, overtopping and breaching), evaporation and influx of freshwater from the catchment. Salinity also varies geographically within the waterbody. Salinity is probably the most important variable in the classification of lagoon types (Roden and Oliver 2012). With reference to the target for the salinity regime attribute: *median annual salinity and temporal variation within natural range*, the natural range within Lady's Island lake is not well established due to the influence of the 'cut'. The natural range of salinity in the lake is therefore difficult to establish. During construction stage, there exists the potential for a large influx of sea water to the lagoon, since the level of the proposed intake, pipeline and flow control structure will be below the level high tide. The impact of the proposed development on salinity however can be mitigated during construction by avoiding creation of a connection between the lagoon and the sea. Under the current situation, re-establishment of the beach barrier is unpredictable and brings with it uncertainty in relation to water levels and salinity concentrations. With the project in place the lagoon will no longer experience a tidal phase, as brought about by the 'cut' in the past. Lady's island salinity winter targets for north and south are 8.65 psu and 20.45 psu respectively. The Summer targets for salinity at north and south are 23.25 psu and 23.15 psu respectively. These are median levels which are specified in Oliver (2013). During operation stage, the proposal will help stabilise salinity in the lagoon. According to mathematical predictions, with a base inflow of 0.3m^3/s and allowing a seawater influx that raises lake levels from -0.25m to +0.50m ODM (3.09m ODP), salinity could be raised from 0, 5 and 10 psu to 12, 15 and 18 psu respectively. Assuming no freshwater inputs, allowing seawater influx that raise lake levels from -0.25m to +0.50m ODM (3.09m ODP), salinity could be raised from 0, 5 and 10 psu to 17, 19 and 22 psu respectively. It is considered that the Winter targets can be met. Salinity will be monitored in the lake during operation stage by the project proponent to maintain the seasonal levels outlined above and can be expected to improve upon the current situation.	Yes
	Hydrological Regime/ metres	Annual water level fluctuations and minima within natural ranges	The maximum depth of Lady's Island Lake lagoon is recorded as 6m (NPWS 2019). Fluctuations in water depth are a natural feature of lagoon hydrology. However, if water levels fluctuate beyond their natural values due to issues such as drainage, the condition of the habitat can deteriorate. The proposed development will maintain levels between 2.34m ODP and 5.09m ODP. This will not have a significant impact on lagoonal area, with reference to baseline levels. The proposed development could prevent the natural hydrodynamics of water passing through the re-profiled gravel barrier. For example, high lagoon water levels in winter could prevent ingress of saline water from the sea.	Yes

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Barrier: connectivity between lagoon and sea/ permeability	Appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management	The morphology of the barrier between a lagoon and sea determines how it functions ecologically. Changes to the barrier can be due to natural processes such as storms, but they can also be modified through human intervention. The barrier at Lady's Island comprises a vegetated shingle sand bank with a cut that has been recorded as early as 1840 to control lake levels. The existing management regime involves partial removal/lowering of the gravel/sand barrier, with unpredictable effects on water levels, salinity and deposition. The current management of water levels within Lady's Island SAC has been identified as a risk to the integrity of the lagoon. The proposal has been designed to bring about a more stable lagoon-sea interface which will bring about connectivity benefits. As noted in NPWS (2013a), active management is sometimes necessary, particularly if the lagoon is artificial. Indeed, according to Oliver (2007), Lady's Island conservation value as a lagoon relies on active management. The target for the attribute barriers in NPWS (2013a) is deemed applicable to Lady's Island: connectivity between lagoon and sea is: appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management. The proposed development constitutes appropriate management considering the unpredictability, and associated ecological effects, of the conventional 'cut'.	
	Water quality: Chlorophyll a/ µg/L	Annual median chlorophyll a within natural ranges and less than 5µg/L	This attribute indicates the level of phytoplankton in the water column. Roden and Oliver (2013) assume that, for shallow lagoons in "natural" condition, primary productivity is dominated by the benthos rather than the plankton. Phytoplankton tends to increase in density in response to increasing nutrient levels. Excessive shading from phytoplankton can reduce submergent macrophyte colonisation of the littoral zone of lagoons. Once impacted by nutrient enrichment, lagoons may be slow to recover from impacts due to changes in water quality being recycled. Oliver (2007) indicates the possibility that the level of nutrient enrichment in Lady's Island Lake may be approaching a critical level. There is potential for disturbance of substrates at construction stage and during maintenance dredging, if required. The introduction of a potentially algal limiting nutrient such as phosphate (from the seawater) and mobilisation of nutrients in substrate during would increase the potential for primary phytoplankton production. The impact of the proposed development on this attribute during construction would be related to disturbance of substrates and mobilisation of nutrients at the southern end of the lagoon. Likewise, maintenance dredging could cause similar pollution. This impact is temporary however and can be mitigated. During operation when saltwater intrusion occurs in September, nutrient concentrations could rise to a critical level. Potential for this impact is deemed low given that saline influx is proposed at the end of the growing season when temperatures are decreasing, and growth rates depressed.	Yes

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Water quality: Molybdate Reactive Phosphorus (MRP)/ mg/L	Annual median MRP within natural ranges 0.1mg/L	This limit is required to ensure that excessive shading from phytoplankton does not reduce submergent colonisation of the littoral zone. The impact of the proposed development on this attribute during construction would be related to disturbance of substrates and mobilisation of MRP at the southern end of the lagoon. Likewise, maintenance dredging could cause MRP increases. This impact is temporary however and can be mitigated. During operation when saltwater intrusion occurs in September, MRP concentrations would rise. This would be offset however by maintenance of high-water levels over the winter once, when daily inputs to the lake will be from feeder streams, thereby diluting MRP.	No
	Water quality: Dissolved Inorganic Nitrogen (DIN)/ mg/L	Annual median DIN within natural ranges and less than 0.15mg/L.	The limit for set nitrogen is to ensure that excessive shading from phytoplankton does not reduce submergent colonisation. The impact of the proposed development on this attribute during construction would be related to disturbance of substrates at the southern end of the lagoon. Likewise, maintenance dredging could cause increased concentrations. This impact is temporary however and is highly unlikely to affect this measure.	No
	Depth of macrophyte colonisation/ Metres	Macrophyte colonisation to at least 2m depth	Where a lagoon is less than 2m deep, it is expected that macrophyte colonisation would extend to the full depth (NPWS 2019). The mobilisation of nutrients via substrate disturbance (construction and operation) and conveyance of nutrients (particularly Phosphorus) from the sea during September when raising water levels by saltwater influx could cause enrichment. In response to the addition of a limiting nutrient, an algal bloom could be triggered, depriving submerged macrophytes plants of light. As water temperatures will be lowest when this takes place and considering the higher temperatures required for development of an algal blooms, impacts on macrophyte colonistation depth are not reasonably foreseeable.	No
	Typical plant species/ Number and m^2	Maintain number and extent of listed lagoonal specialists, subject to natural variation	The flora of the lagoon is typically brackish with two species of Tasselweed (*Ruppia maritima* and *R. cirrhosa*) and the charophyte species *Lamprothamnion papulosum* and *Chara canescens* (both lagoonal specialists). As lagoon specialist species do not easily recolonise, their presence is one of the indicators of long-term continuity of quality. At operation stage, the proposed development will aim to preserve the physical components of lagoon habitat and the ecological processes that drive it, by efforts to control hydrology and salinity.	No
	Typical animal species/ Number	Maintain listed lagoon specialists, subject to natural variation	The lagoon supports at least 13 specialist invertebrates including three coleopteran indicator species. This indicates an ecologically well-developed site. Improved management of the lagoon aims to improve the lagoonal ecosystem by stabilising the ecological processes that drive it e.g. salinity. The management proposal is expected to assist this objective.	No

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Negative indicator species/ Number and % cover	Negative indicator species absent or under control	Negative indicator species include non-native alien species as well as those that are not typical of the habitat. Low salinity, shallow water and elevated nutrient levels increase the threat of un-natural encroachment by reedbeds. The proposal will likely reduce the incidence of negative indicator species, as unfavourable conditions for these will be brought about by maintaining salinity within the range suitable for lagoonal specialists. There exists the potential for importation of non-native species to site with deployment of machinery and equipment, during construction and operation phases.	Yes
Perennial vegetation of stony banks [1220]	Habitat area/ hectares	Area stable or increasing, subject to natural processes, including erosion and succession	Vegetated shingle occurs along the coast where shingle (cobbles, pebbles, and gravel ≥ 2 mm) has accumulated to form elevated ridges or banks above the high tide mark. This habitat occurs along the southern boundary of Lady's Island Lake where the coverage has been mapped as 0.97ha (NPWS 2019). The 'cut' has probably contributed to the extent of 'Perennial vegetation of stony banks' within the SAC, due to geomorphological variation. There is no loss of 'Perennial vegetation of stony banks' habitat within the footprint of the proposed development as deduced from mapping in NPWS (2019). The current level of the 'cut' and adjacent areas of sand are not above the high tide level during a regular storm, as apparent from the October 2018 site visit, when there was evidence of recent overtopping and mobilisation of sand. During construction phase, the topography of the proposed development site will be altered by excavation and storage of sand, so in the event of a storm, there could be changes to the profile of the subject area and therefore alteration of 'Perennial vegetation of stony banks' habitat given that the proposed flow control structure lies adjacent to this habitat. The proposed access and electrical cable would be through ca. 60 m of this habitat, the latter element requiring trenching. The area of habitat potentially affected would be 600 m^2 at most, taking a conservative width of 10 m affected. Mitigation is required for this Conservation Objective, including the need to avoid this habitat where possible and minimise the footprint associated with access and electrical cable works.	Yes
	Habitat distribution/ occurrence	No decline, or change in habitat distribution, subject to natural processes including erosion and succession	The habitat is located south of Lady's Island Lake and west of Carnsore Point in the SAC (NPWS 2019). A proportion of the area of this habitat south of Lady's Island Lake lies adjacent to the footprint of the proposed development. The proposed development represents an artificial modification to the 'cut' section of the barrier beach to the south of Lady's Island Lake. It is noted that the 'cut' section is already a highly modified part of the barrier beach and the 'Perennial vegetation of stony banks' habitat that has developed in this area is a result of the 'cut' and ongoing 'cut' maintenance. During construction phase, the topography of the proposed development site will be altered by excavation and storage of sand, so in the event of a storm, there could be changes to the profile of the subject area and therefore alteration of 'Perennial vegetation of stony banks' habitat given that the proposed development lies adjacent to this habitat.	Yes

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Physical structure: functionality and sediment supply/ Presence-absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	The health and on-going development of the habitat relies on a continuing supply of shingle sediment. This may occur sporadically as a response to storm events rather than continuously. Interference with the natural coastal processes, through offshore (or onshore) extraction or coastal defence structures in particular, can interrupt the supply of sediment and lead to beach starvation. During the current field survey, it was found that gravels were being transported to the landward side of the 'cut' crest and splaying out into the lagoon habitat. The 'cut' may be compromising the supply and natural circulation of sediment to higher elevations along the barrier beach. The proposed development will likely result in deposition of the gravel associated with 'Perennial vegetation of stony banks' at higher elevations along the re-profiled 'cut', and also possibly along adjacent areas, thereby replicating a more natural deposition regime in the area. The current circulation of sediment at the 'cut' will be changed significantly. Based on data from Martin *et al.* (2017), shingle extraction was recorded as a negative impact on the habitat in the Lady's Island Lake sub-site. The project proponent will have to put measures in place to control gravel extraction.	Yes
	Physical structure: disturbance/percentage	No more than 20% of the habitat affected by disturbance	Disturbance can include damage from heavy trampling, vehicle damage and removal of substrate (NPWS (2019). The proposed development will require heavy machinery to carry out the works. Access and electrical cabling is required through ca. 60 m of this habitat. It is also considered that there is potential for machinery intrusion into 'Perennial vegetation of stony banks' habitat so mitigation will be required.	Yes
	Vegetation structure: zonation/ occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	The VSM (Martin *et al.* 2017) recorded two communities of perennial vegetation of stony banks in the Lady's Island Lake sub-site - a pioneer community and a grassland community; however, the more stable grassland community was only recorded outside the boundary of the SAC. Habitats associated with the vegetated shingle in Lady's Island Lake SAC include sand dune habitats and a lagoon (NPWS 2019). Dune habitats adjacent to 'Perennial vegetation of stony banks' habitat at the 'cut' are 'Embryonic shifting dunes' (2110) and 'Shifting dunes along the shoreline with *Ammophila arenaria* (2120, white dunes)'. Grey dunes or 'Fixed dunes with herbaceous vegetation' (2130) occur at the proposed site compound and along the proposed access / electrical cable route. Mitigation will be required to avoid disturbance of these habitats and minimise insofar as possible the landtake where avoidance is not possible.	Yes

Feature of Interest	Attribute/ Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Vegetation composition: communities and typical species/ Occurrence	Maintain the typical species within the range of vegetated shingle communities	Species diversity is determined by the degree of exposure and by substrate stability, coarseness and size. The installation of the flow control structure will alter the geomorphological character of the section of barrier beach at the 'cut' during construction. Mitigation will be required to avoid insofar as possible disturbance of shingle habitats.	Yes
	Vegetation composition: negative indicator species/ Percentage	Negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be present in more than 60% of monitoring stops	Negative indicators include non-native species, species indicative of changes in nutrient status and species not considered characteristic of the habitat. For example, Cottonweed species appears to decline in taller Marram grass *Ammophila arenaria* dominated sward. Mitigation will be required to prevent the importation and spread of non-native species.	Yes

9.2.2 Lady's Island SPA

The objective for Lady's Island SPA is to maintain or restore the favourable conservation condition of the bird species listed as Special Conservation Interests for this SPA:

- Gadwall (*Anas strepera*) [A051]
- Black-headed Gull (*Chroicocephalus ridibundus*) [A179]
- Sandwich Tern (*Sterna sandvicensis*) [A191]
- Roseate Tern (*Sterna dougallii*) [A192]
- Common Tern (*Sterna hirundo*) [A193]
- Arctic Tern (*Sterna paradisaea*) [A194] and
- Wetland and Waterbirds [A999]

To acknowledge the importance of Ireland's wetlands to wintering waterbirds, "Wetland and Waterbirds" may be included as a Special Conservation Interest for some SPAs that have been designated for wintering waterbirds and that contain a wetland site of significant importance to one or more of the species of Special Conservation Interest. Thus, a second objective of the Lady's Island SPA is outlined in NPWS (2018) as follows: To maintain or restore the favourable conservation condition of the wetland habitat at Lady's Island Lake SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

In the absence of site specific Conservation Objectives for Lady's Island SPA, Conservation Objectives Cork Harbour SPA (NPWS 2014b) and Rockabill SPA (NPWS 2013b) were applied to the current project. Cork Harbour SPA has three special conservation interests in common with Lady's Island SPA: Common Tern *Sterna hirundo*; Black-headed Gull *Chroicocephalus ridibundus* and Wetlands. Rockabill SPA has Roseate Tern and Arctic Tern as special conservation interests.

Table 14 gives the assessment of effect of the project on the Lady's Island SPA Conservation Objectives for special conservation interests identified as being potentially significantly affected.

Table 14: Assessment of effect of the project on the Lady's Island SPA Conservation Objectives for special conservation interests identified as being potentially significantly affected. Attributes, measures and targets for Common Tern and Wetlands based on the NPWS (2014) Conservation Objectives for Cork Harbour SPA. Attributes, measures and targets for Roseate Tern and Arctic Tern from the Rockabill SPA.

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
Common Tern	Breeding population abundance: apparently occupied nests (AONs)/ Number	No significant decline	A total of 968 breeding pairs of Common Tern *Sterna hirundo* were recorded in 2012. A total of 890 pairs nested on Inish and 78 on Sgarbheen. The operational stage of the project will maintain water levels in Lady's Island Lake that favour nesting Terns, by isolating the islands used for nesting from the mainland and preventing predation by mammals. This is regarded as a positive impact. Disturbance impacts during construction phase could potentially affect the breeding population however, so works will need to be timed to avoid the peak breeding season.	Yes
	Productivity rate: fledged young per breeding pair / Mean number	No significant decline	In 2016, the mean clutch size for Common Terns was 2.36. This attribute relates to nesting and feeding. The proposal will help productivity rates by stabilising water levels during the breeding season. Inundation of nest sites during winter creates suitable nesting habitat for Common Terns providing patches of bare ground with dead leaf litter and small deposits of grit and sand. Inish and Sgarbheen will be submerged by the winter water levels proposed. This constitutes a positive effect. Disturbance impacts during construction phase could potentially affect the breeding population.	Yes
	Distribution: breeding colonies / Number; location; area (hectares)	No significant decline	Common tern breeding colonies can be sited in both coastal and inland areas using a wide variety of habitats including sandy, rocky or well-vegetated islands in estuaries, lakes and rivers. This species can also use artificial substrates (Del Hoyo *et al.* 1996). Disturbance impacts during construction phase may potentially affect the breeding colony. Timing of the construction and maintenance works will need to be carried to minimise disturbance impacts on terns.	Yes
	Prey biomass available / Kilogrammes	No significant decline	Key prey items: Small fish, crustaceans, insects and occasionally squid. Key habitats: common tern forage in/over shallow coastal waters, bays, inlets, shoals, tidal-rips, drift lines, beaches, saltmarsh creeks, lakes, ponds or rivers. Foraging range: max. 37km, mean max. 33.81km, mean 8.67km (Birdlife International Seabird Database (Birdlife International, 2014)). The potential for the proposal to affect food supply is based primarily on water quality and salinity which has the potential to affect lagoon/aquatic ecology as discussed under Lady's Island SAC.	Yes

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Barriers to connectivity / Number; location; shape; area (hectares)	No significant increase	Seabird species can make extensive use of marine waters adjacent to their breeding colonies. Foraging range: max. 37km, mean max. 33.81km, mean 8.67km (BirdLife International Seabird Database (Birdlife International 2014)) The proposed works will be carried out over a 9-month period so there would be some disturbance at the southern end of the lake. The construction and operation phases will not obstruct terns' accessing the sea however as the works are limited to a specific area at a considerable distance from Tern nest sites.	No
	Disturbance at the breeding site / Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population	The Islands of Inish and Sgarbheen are 1.5km and 2.5km north of the proposed development, respectively. The construction phase of the proposed development will not therefore cause a significant disturbance impact on the nesting sites of Terns on Inish and Sgarbheen, with regard to the distance and duration of the proposed development. The impact of displacement and avoidance of foraging birds from the southern end of the lagoon and adjacent sea is regarded as a temporary impact and not significant.	No
Roseate Tern	Breeding population abundance: apparently occupied nests (AONs) / Number	No significant decline	The number of Roseate Tern pairs nested in 2016 was 209, a 2.8% decrease on that recorded in 2015, with a mean clutch size of 1.43 per egg laying pair, and a hatching success of 85%. The operational stage of the project will maintain water levels in Lady's Island Lake that favour nesting Terns, by isolating the islands used for nesting from the mainland and preventing predation by mammals. This is regarded as a positive impact. Disturbance impacts during construction phase could potentially affect the breeding population however, so works will need to be timed to avoid the peak breeding season.	Yes
	Productivity rate: fledged young per breeding pair / Mean number	No significant decline	The Roseate Tern mean clutch size inn2016 was 1.43 per egg laying pair, and a hatching success of 85% pairs, which is a 2.8% decrease on that recorded in 2015. Disturbance impacts during construction phase could potentially affect the breeding population, so works will need to be timed to avoid the peak breeding season.	Yes
	Distribution: breeding colonies / Number; location; area (hectares)	No significant decline	Disturbance impacts during construction phase may potentially affect the breeding colony. Timing of the construction and maintenance works will need to be carried to minimise disturbance impacts on terns.	Yes

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Prey biomass available / Kilogrammes	No significant decline	Key prey items: small schooling marine fish, very rarely small crustaceans. Key habitats: shallow and upwelling areas, including tide rips and shoals, over sandy bottoms. Foraging range: max. 30km, mean max. 18.28km, mean 12.3km (BirdLife International Seabird Database (Birdlife International 2013)). In 2012, the main prey items recorded during nest provisioning on Rockabill SPA were clupeids and sandeels (62.5% and 35.1% respectively). There are potential water quality impacts during construction, which could affect the ecology of Lady's Island Lake and subsequently prey items of Roseate Tern. Measures will be required to avoid/minimise water pollution.	Yes
	Barriers to connectivity / Number; location; shape; area (hectares)	No significant increase	Seabird species make extensive use of the marine waters adjacent to their breeding colonies. Foraging range: max. 30km, mean max. 18.28km, mean 12.3km (BirdLife International Seabird Database (Birdlife International 2013)). The proposed works will be carried out over a 9-month period so there would be some disturbance at the southern end of the lake. The construction and operation phases will not obstruct terns' accessing the sea however as the works are limited to a specific area.	No
	Disturbance at the breeding site / Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population	The Islands of Inish and Sgarbheen are 1.5km and 2.5km north of the proposed development, respectively. The construction phase of the proposed development will not therefore cause a significant disturbance impact on the nesting sites of Terns on Inish and Sgarbheen, with regard to the distance and duration of the proposed development. The impact of displacement and avoidance of foraging birds from the southern end of the lagoon and adjacent sea is regarded as a temporary impact and not significant.	No
Arctic Tern	Breeding population abundance: apparently occupied nests (AONs) / Number	No significant decline	A total of 844 Arctic Tern nests were recorded in 2012. A total of 890 pairs nested on Inish and 78 on Sgarbheen. The operational stage of the project will maintain water levels in Lady's Island Lake that favour nesting Terns, by isolating the islands used for nesting from the mainland and preventing predation by mammals. Disturbance impacts during construction phase could potentially affect the breeding population so works will need to be timed to avoid the peak breeding season.	Yes

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Productivity rate: fledged young per breeding pair / Mean number	No significant decline	This attribute relates to nesting and feeding. In 2016, the mean clutch size for Arctic Terns 1.79. The proposal will help productivity rates by stabilising water levels during the breeding season. Inundation of nest sites during winter creates suitable nesting habitat for Common Terns providing patches of bare ground with dead leaf litter and small deposits of grit and sand. Inish and Sgarbheen will be submerged by the winter water levels proposed. This constitutes a positive effect. Disturbance impacts during construction phase could potentially affect the breeding population.	Yes
	Distribution: breeding colonies / Number; location; area (hectares)	No significant decline	Common tern breeding colonies can be sited in both coastal and inland areas using a wide variety of habitats including sandy, rocky or well-vegetated islands in estuaries, lakes and rivers. This species can also use artificial substrates (Del Hoyo *et al*. 1996). Disturbance impacts during construction phase could potentially affect the breeding colony. Timing of the construction and maintenance works will need to be carried to minimise disturbance impacts on terns.	No
	Prey biomass available / Kilogrammes	No significant decline	Key prey items: Small fish, crustaceans and other invertebrates. Key habitats: include open waters and shallow bays, rocky shores, tidal flats, shoals, tide rips, ocean fronts and upwellings. Foraging range: max. 20.6km, mean max. 12.24km, mean 11.75km (BirdLife International Seabird Database (Birdlife International 2013)). The potential for the proposal to affect food supply is based primarily on water quality and salinity which has the potential to affect lagoon/aquatic ecology. There are potential water quality impacts during construction, which could affect the ecology of Lady's Island Lake and subsequently prey items of Arctic Tern.	Yes
	Barriers to connectivity / Number; location; shape; area (hectares)	No significant increase	Seabird species make extensive use of the marine waters adjacent to their breeding colonies. Foraging range: max. 20.6km, mean max. 12.24km, mean 11.75km (BirdLife International Seabird Database (Birdlife International, 2013)). The proposed works will be carried out over a 9-month period so there would be some disturbance at the southern end of the lake. The construction and operation phases will not obstruct terns' accessing the sea however as the works are limited to a specific area.	No

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Disturbance at the breeding site / Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population	The Islands of Inish and Sgarbheen are 1.5km and 2.5km north of the proposed development, respectively. The construction phase of the proposed development will not therefore cause a significant disturbance impact on the nesting sites of Terns on Inish and Sgarbheen, with regard to the distance and duration of the proposed development. The impact of displacement and avoidance of foraging birds from the southern end of the lagoon and adjacent sea is regarded as a temporary impact and not significant.	No
Gadwall	Population trend / Percentage change	Long term population trend stable or increasing	A 2016 study (Daly *et al.* 2016) noted that 25 pairs of Gadwall bred on the northern end of Inish, and three pairs on the southern end. The food plants of Gadwall includes stoneworts *Chara spp.* The composition of plant assemblages in the lake could be altered by changes to water quality and salinity, so the feeding opportunities of Gadwall could therefore be affected. Mitigation will be required to minimise water quality impacts.	Yes
	Distribution / Number and range of areas used	No significant decrease in the range, timing or intensity of use of areas by Gadwall, other than that occurring from natural patterns of variation	Birds using the southern end of the lake could be adversely affected by water quality impacts habitats impacting lagoon ecology and negatively affecting prey items. There could therefore be a decrease in the range of use of areas by Gadwall, so mitigation will be required prevent significant changes to the floral community the southern extent of the lake. Gadwall nesting would not be affected with the proposed management of lake levels.	Yes
Black-headed Gull	Population trend / Percentage change	Long term population trend stable or increasing	The population of this species in the study area is steadily increasing. Adverse water quality impacts could affect bird feeding and breeding habitats by impacting lagoon ecology and therefore affecting prey items. To ensure the population continues to increase, water quality in the lake will need to be maintained, requiring mitigation.	Yes

Special conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation Required
	Distribution / Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation	The colony uses the Islands of Inish and Sgarbheen for breeding. These areas could potentially be affected by water level changes, but this impact is positive, as predation potential will be reduced.	No
Wetlands	Habitat area / Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the mapped area, other than that occurring from natural patterns of variation	The wetland habitat area of Lady's Island Lake corresponds to the overall lagoon area of 302.72ha. (mapped as a transitional water). The wetted area of Lady's Island Lake will fluctuate according to the management regime proposed i.e. between ca. 165ha. (2.34m ODP) and 365 ha. (5.09m ODP). Ongoing management will be required during operation stage.	Yes

9.2.3 Carnsore Point SAC

Conservation Objectives for Carnsore Point SAC are given in NPWS (2011a). NPWS have also produced a marine Conservation Objectives supporting document for Carnsore Point SAC (NPWS 2011b).

The development of a community complex target arises when an area possesses similar abiotic features but records a number of biological communities that are not regarded as being sufficiently stable and/or distinct temporally or spatially to become the focus of conservation efforts. In this case, examination of the available data from Carnsore Point identified a number of biological communities whose species composition overlapped significantly. Such biological communities are grouped together into what experts consider are sufficiently stable units (i.e. a complex) for conservation targets (marine Conservation Objectives supporting document).

Sheltered to moderately exposed intertidal reef community complex has been identified as being potentially significantly affected. This reef community occurs less than 50m from the proposed development. The estimated areas of the communities within the reefs habitat 'Sheltered to moderately exposed intertidal reef community complex' is 24ha. NPWS (2011b) note that this is based on spatial interpolation and therefore should be regarded as indicative. Significant continuous or ongoing disturbance of the communities should not exceed an approximate area of 15% of the interpolated area of each community type, at which point an inter-departmental management review is recommended prior to further licensing of such activities (NPWS 2011b). Proposed activities or operations that cause significant disturbance to communities but may not necessarily represent a continuous or ongoing source of disturbance over time and space may be assessed in a context specific manner giving due consideration to the proposed nature and scale of activities during the reporting cycle and the particular resilience of the receiving habitat in combination with other activities within the designated site (NPWS 2011b). Any impacts of the proposed development during construction stage would be temporary and confined to the environs of the proposal. Impacts would not be at a level to have significant impacts on the Lady's Island SAC during construction and operation, and conservation targets set in NPWS (2011b) would not be contravened.

Table 15 gives the assessment of effect of the project on the Lady's Island SPA Conservation Objectives for features of interest identified as being potentially significantly affected.

Table 15: Assessment of effect of project on the Carnsore Point SAC Conservation Objectives for features of interest identified as being potentially significantly affected. Based on Carnsore Point SAC Conservation Objectives (NPWS 2011).

Conservation interest	Attribute / Measure	Target	Assessment of Potentially Significant Effects	Mitigation required
Reefs	Habitat Distribution / Occurrence	The distribution of reefs should remain stable, subject to natural processes.	Reef habitat occurs in intertidally and sub-tidally to the south east of the proposed flow control structure, where 'Exposed Subtidal Reef Dominated by a Faunal Community Complex' occurs less than 50m from the proposed junction box, with the dual pipeline ca. 35m from this habitat. This reef could be adversely affected by physical disturbance during construction.	Yes
	Habitat area / Hectares	The permanent habitat area is stable, subject to natural processes.	Habitat area was estimated as 1,847ha, using 2010 survey data. There should be no direct impacts on habitat area. Secondary impacts on this habitat could ensue from deposits of fine substrates emitted from construction process.	Yes
	Community structure / Biological composition	The following reef community complexes should be maintained in a natural condition: Intertidal reef community complex; and Subtidal reef dominated by echinoderms and sponges community complex.	Sheltered to moderately exposed intertidal reef community complex corresponding to an estimated area of 24ha. This reef community occurs ca. 35m to the east of the southern extent of the proposed pipe. Exposed subtidal reef dominated by a faunal community complex corresponding to an estimated area of 1,382ha occurs within the SAC further east. The structure and function of these reefs may be negatively affected by the effects of sedimentation, where sand derived from the proposed development site could be transported intertidally to reef.	Yes
	Community extent / Hectares	The extent of Laminaria dominated community should be conserved, subject to natural processes.	An extensive area of the Laminaria dominated community complex is recorded from south of Carnsore Point between the lower shore and approximately 10m depth. The estimated area is 442ha. Laminaria dominated communities are considered keystone communities that are of considerable importance to the overall ecology and biodiversity of a habitat by virtue of their physical complexity. Though unlikely, the community extent of this habitat may be negatively affected by the effects of sedimentation, where sand derived from the proposed development site could be transported intertidally to reef.	Yes
	Community structure / Biological composition	The biology of the Laminaria dominated community should be conserved, subject to natural processes	Adverse effects on water quality may have a significant impact on reef biological composition, due to potential release of water of poor quality into sea during construction phase and dredging.	Yes

9.3 ASSESSMENT OF POTENTIALLY SIGNIFICANT CUMULATIVE EFFECTS

The current pressures on Lady's Island Lake and its biota includes discharges to waters from WWTP, and ongoing activities listed in **Section 7**. Of the various threats/impacts affecting Irish coastal lagoons, Oliver (2007) notes that many could be regarded as co-variables and some may be synergistic. For example, many lagoons that are regarded as eutrophic due to excessive use of fertilisers on agricultural land may also receive nutrients from human effluents, while others may be naturally eutrophic due to an accumulation of marine algae in a relatively closed system from tidal inflows or overtopping of the barrier during storms. Similarly, removal of beach materials increases the risk of natural erosion of the barrier. There is relatively little information available from NPWS concerning impacts on coastal lagoon habitat contained in Site Impact Reports (Oliver 2007). The effects of the water level and salinity changes resulting from water level management practices at lady's Island may be combining with other impacts on the site, most notably eutrophication, compounding potential damage to the site and its species. The potentially significant cumulative effects of the proposed development are discussed below.

9.3.1 Shingle extraction

During the vegetated shingle monitoring survey of Lady's Island Lake (Martin *et al*. 2017), shingle extraction and the presence of rock armour were recorded as negative impacts for 'Perennial vegetation of stony banks', while storm activity was recorded as a positive impact for this habitat, as it created new habitat for colonisation.

There is potential for significant cumulative effects from disturbance to the sand barrier during the construction phase of the project, and possibly on shingle habitat, noting the evolving character of the 'cut' and possible build-up of shingle in areas affected during construction.

9.3.2 Non-native species

During the vegetated shingle monitoring survey of Lady's Island Lake another negative impact included a lack of grazing, paths and tracks, invasive non-native species (*Hippophae rhamnoides*). This is a highly invasive species on sand dunes in Ireland, which reduces plant species diversity and excludes rare species (Binggeli *et al.* 1992). The plant spreads quickly by suckering and is an Amber listed invasive plant species (ISI 2016). Likewise, during the CMP, 'Structure and Functions' of Fixed dunes (grey dunes) along the southern shore of Lady's Island SAC were assessed as 'Unfavourable-Bad' because of the effects of recreational activities and the spread of bracken *Pteridium aquilinum*.

There is potential for significant cumulative effects via the spread of non-native and invasive species during the construction phase of the project.

9.3.3 Climate change

The combined effects of increased temperature, sea level, and storms and the variability in weather patterns will likely stress Lady's Island lagoon. Due to the extensive erosion of coastal systems within Ireland during the winter storms of 2013/14 and evidence that an increase in Atlantic storms over the last few decades could be due to climate change (Masselink *et al.* 2016), the impact of climate change on all sand dune habitats.

It is not known what effect predicted sea level rise will have on coastal lagoons. In many cases this is a natural process which would be difficult to prevent but could easily be reduced by reworking

barrier material. However, lagoons are dynamic landforms and losses due to erosion may be compensated by natural formation of others.

OPW guidance on climate change indicates that sea level will rise in the future. The estimated sea level rise depends on the climate change scenario modelled. Estimates for three scenarios are recommended by the OPW when assessing coastal flood and erosion risk. In addition to rise due to warming seas and melting ice caps there are rises due to land movement relative to sea level. The Greater Dublin Drainage Strategy Study indicates that the southern half of Ireland is slowly sinking – at an estimated rate of 0.05m per 100 years. Therefore the total change in sea level on the south coast of Ireland for the three scenarios to 2100 are estimated as:

- Mid range scenario (MRS) 0.55m
- High end scenario (HES) 1.05m
- Extreme high end scenario (EHES) 1.55m

At present the maximum desired lake level is 5.1mODP or 2.51mODM. The present-day high tide levels are 0.4 and 1.1mODM. They will rise to the values given in **Table 16** below.

Table 16 Climate change: tide Levels mODM / mODP

Tide	Current	2100		
		MRS	HES	EHES
MHWS	1.1/3.69	1.65/4.24	2.05/4.64	2.65/5.24
MHWN	0.4/2.99	0.95/3.54	1.45/4.04	1.95/4.54
MTL	-0.25/2.34	0.3/2.89	0.8/3.39	1.3/3.89

The above table indicates that high tide levels are likely to remain below the preferred maximum lake levels (5.1mODP) for all but the EHES and a spring tide. It should be noted that the maximum preferred lake level is estimated to be over 1m above that of the Mid Tide Level event in the EHES case.

Currently, the estimated 1% AEP extreme water level is 2.49mODM (5.08mODP) which is approximately equivalent to the preferred maximum lake level. This and other extreme water levels will rise in the future reducing the ability to drain during such tides. However, such tides are infrequent (1% AEP means there is a 1 in 100 chance of such a water level being exceeded in a one year period) and short lived (if a 2.49mODM tide occurs during what would normally be a spring tide, it will be following by a low tide at -0.21mODM (2.38mODP) or below and consequently will have only a temporary impact on the capacity of the pipeline to drain the lake. The long-term drainage capacity of the pipe will be dictated more by normal tides than by the surge tides.

As the above table indicates sea level rise will reduce the available head of water driving water through the pipe from the lake into the sea. However, the velocity of the flow through the pipe is approximately proportional to the square root of the head difference between the lake and the sea and consequently a halving of the available head will result in a lesser loss of capacity, approximately 30%.

Table 17 Climate change pipeline drainage capacity

	Sea Level Rise Scenario			
	Current	MRS	HES	EHES
Max Preferred Lake Level mODM.	2.51	2.51	2.51	2.51
MTL	-0.25	0.3	0.8	1.3
Head Difference	2.76	2.21	1.71	1.21
Relative Pipeline Capacity[1]	100%	89%[1]	79%	66%

1 *Pipeline relative capacity (2.21/2.76)^0.5 = 0.89.*

Guidance from the OPW in relation to increased stream/ river flows regarding climate change when assessing river channel capacity at bridges suggests increasing flows by 20%. An assessment of the pipeline capacity indicated that to increase flows by 20% the available head has to increase by 44% (1.2^2). While this would appear to indicate a considerable decrease in capacity of the pipeline to lower lake levels in the future it should be noted that while to increase pipe capacity requires what may appear to be a considerable increase in head – much (80%) of the future flow will be taken at the current head difference.

The structure will continue to operate in the face of increased sea levels and river flows due to climate change albeit with a reduced discharge capacity, perhaps in the order of 70 % (89% from sea level rise by 80% from increased river flows) of the current capacity.

There is potential for significant cumulative effects from climate change during the construction and phase of the project, relating to physiography and water quality but these impacts can be mitigated at construction phase. At operation phase the proposed development is not expected to have a significant cumulative impact on the Natura 2000 network as it will bring stability to the surrounding environment relative to ongoing annual cutting of the barrier beach.

9.3.4 Modification of Hydrographic Functioning

Lady's Island Lake, the second largest sedimentary lagoon in the country, is deliberately breached annually in order to lower water levels, which also allows marine currents to enter (Oliver 2007). According to Healy *et al.* (1997), breaching of the sand/shingle barrier modifies the hydrology of the lagoon, upsets sediment dynamics, and the hydrological regime of the lagoon could lead to changes in salinity and upset the present feeding and breeding habitat for birds.

The operation phase of the project will alleviate the regular and significant pressure/risk associated with breaching the barrier. There is potential for significant positive cumulative effects from successful operation phase of the project.

9.3.5 Silting up and drying out

Silting up and drying out are two inter-related natural processes in lagoons leading eventually to the formation of dry land. This is a complex process which includes the deposition of sediments either from rivers or from the sea, or both, the accumulation of organic material from within the lagoon itself, encroachment of marginal vegetation which encourages the increase in the trapping of sediments and also by onshore movement of the barrier. Lagoons are essentially ephemeral systems forming a temporary component of the dynamic interaction of river and coastal landforms.

The proposed development aims to stabilise the Lady's Island lagoon ecosystem by controlling water levels and salinity. This will replace cutting the barrier beach annual, so the project will counteract the process of silting up and drying out through control of water levels and removal of substrates during maintenance of the channel in the environs of the flow control structure.

9.3.6 Accumulation of organic material

Accumulation of organic material is a process often resulting from natural eutrophication but appears to be becoming more frequent and more severe due to nutrient enrichment resulting from human activities. The natural process results from a build-up of plant material within the lagoon or as a result of large amounts of marine algae being dumped in the lagoon following overtopping of the barrier during storms and onshore winds.

Although the accumulation is often concentrated in certain areas, floating vegetation and nutrients are easily spread by water currents throughout the lagoon. Rafts of material, especially the filamentous algas *Cladophora* spp., *Enteromorpha* spp. and the lagoon form of *Chaetomorpha linum* are often blown by the wind to all parts of the lagoon and the impact affects the entire water body. These algas can also "blanket" the water surface preventing light penetration to lower levels and aquatic fauna reaching the surface, thereby threatening both the photosynthesis of benthic vegetation and respiration of aquatic fauna.

Similar impacts can be caused by stimulation of biomass production due to nutrient enrichment resulting from human activities. For example, rafts of Cladophora in Lady's Island Lake blanketed large areas of the lagoon negatively impacting on other lagoonal species and resulting in fish kills.

9.3.7 Circuits and tracks

Leisure activities such as motor bike and quad bike racing can also damage the barrier protecting the lagoon. The pressure for such activities is likely to increase but unlikely to be permitted especially on the barrier. Such uses are "Notifiable Actions" in designated areas, and therefore require permission from the Minister. Such permissions are unlikely to be granted in the future. There are several tracks on the landward side of the barrier to the east of the 'cut'. This area is accessible from the local road. Vehicular access to the barrier beach is likely impacting on dune habitats and potential distribution of Cottonweed within the SAC.

9.3.8 Water pollution

The major impact affecting the quality of lagoon habitat is water pollution in the form of excessive nutrient enrichment mostly from agricultural sources, but also due to domestic effluents from an increase in urbanisation and commercial/industrial activities. Over 61% of habitat area is regarded as eutrophic and this impact is particularly severe in Lady's Island lagoon (Oliver 2007).

Water pollution due to human activities appears to be the major threat to Irish coastal lagoons at the present time (Oliver 2007), affecting 52.9% of lagoon sites and 61.6% of the current area of habitat in the country and is found on all parts of the coastline. This is mostly in the form of eutrophication, which is the process of nutrient enrichment of a water body due to inputs resulting from human activities anywhere in the catchment area which causes changes in water quality and biological community. This process, through water circulation of the water, generally affects the entire lagoon though it may be more concentrated in some sheltered areas or areas close to a direct nutrient input and the effects will depend on the concentration of nutrients, water circulation and

resilience of biota. The effects of eutrophication are generally manifested in algal blooms which may blanket other aquatic vegetation and can cause depletion of oxygen from the water, noxious odours, outcompeting of other vegetation and in severe cases the death of fish and invertebrate fauna. It is difficult, however, to distinguish between entirely natural processes of nutrient enrichment and those caused by human activities, especially in lagoons, which are naturally variable, especially in terms of salinity, but also many other environmental variables. The following assessment is based on personal or anecdotal evidence of algal blooms, noxious odours, anoxia and fish kills (Oliver 2007).

The inflow of nutrients is generally regarded to be from agricultural sources, though some is undoubtedly from other human activities which have increased recently due to an increase in housing and the increase in the use of detergents in modern homes. The impacts of eutrophication affect the entire lagoon though in large lagoons this impact may be less severe than in a small lagoon due to dilution in a large water body. Undoubtedly, excessive nutrient enrichment is the major impact affecting coastal lagoon habitat in Ireland and this is mostly from agricultural activities but it can also be a natural process (EU Impact Code 952) resulting especially in lagoons from the accumulation of marine algae washed into the lagoon during storms through tidal inlets or by overtopping the barrier (Oliver 2007).

The Lady's Island WWTP discharges treated water to Lady's Island lake. In 2005 a new waste water treatment plant which included a phosphorus removal system. The dosing system aims to achieve a phosphorus level of <2mg/l P in the final effluent (required by the Urban Wastewater Treatment Regulations S.I 254/2001 for sensitive waters). Wexford County Council results from Feb to Aug 2009 indicate that levels of orthophosphate in the final effluent range from 0.16-0.33 mg/l (Golder Associates 2010). The results of MRP in 2014 were recorded as Moderate by the EPA (EPA 2014). While recent results from the effluent discharge of the Waste Water Treatment Plant indicate improvements, the presence of a direct discharge into the lake is of concern as there is always the potential for breakdown or malfunction. It is also apparent that the area is still receiving nutrients from non-point sources e.g. agricultural, via the feeder streams. It is suggested that historical pollution has resulted in nutrient retention within the system which is continuing to have devastating effects in terms of ongoing plankton blooms.

9.3.9 Cumulative impacts on Terns

Terns are particularly vulnerable to human disturbance (del Hoyo *et al*. 1996) especially near breeding colonies on beaches early in the breeding season (Bourne and Smith 1974). For example, Sandwich Tern is sensitive to disturbance from coastal wind farms (Garthe and Huppop 2004). There is a fourteen wind turbine Wind Farm at Carnsore Point, located ca. 2km to the east of Lady's Island SPA.

Terns are threatened by the loss or degradation of its favoured breeding habitats through inundation, wind-blown sand and erosion (del Hoyo *et al*. 1996) and have suffered previous local declines from to exposure to bioaccumulated organochlorine pollutants in marine fish (del Hoyo *et al* 1996). Other serious threats identified within the species European range include recreational disturbance, coastal developments, pollution, land-use affecting vegetation and predation (Garthe and Flore 2007).

10 MITIGATION

To avoid or reduce the risks associated with the potential impacts, the mitigation measures described below will be followed to reduce impact significance and adhere with the Conservation Objectives for the affected Natura 2000 sites.

10.1 CONSTRUCTION PHASE

This section outlines construction practices and includes the environmental management measures which are to be implemented during the construction phase of the project to ensure that it is constructed in accordance with best practice, with minimum impact on the surrounding environment. The construction mitigation measures outlined here provide the main Project Contractor (PC) and a Project Ecologist (See **Section 10.1.3.4**) with measures to ensure compliance with environmental requirements.

A concise list of the primary construction mitigation measures are outlined in **Appendix 5** (Environmental Commitments). This is a summary of the full measures outlined here, aimed at providing environmental awareness for a prospective contractor. Implementation of the full mitigation will be required by the appointed contractor however.

10.1.1 Method Statements

Method Statements are used to translate the project requirements into planned systems of work instructions to the site staff and operatives. They are prepared for activities identified in the specification and risk assessments and are issued to all personnel responsible for and involved with the activity concerned.

They define the proposed method of working for an element or section of work taking into account the particular requirements of the project including site conditions, safety hazards, the contract drawings, specification or code of practice. They define the proposed use of plant, labour and materials, any hold points or permits and may be supplemented by drawings, sketches and produce data as necessary.

The principle aim of a Method Statement is to ensure that:

- resources are available prior to start
- tasks are thought out in advance and
- safe working methods are defined, and workers involved are aware of the risks associated with the task.

Prior to the commencement of any activities deemed to involve a significant risk or identified at pre-commencement meetings, the contractor will develop a written Method Statement.

These Method Statements will:

- cover key activities identified through the programme, and be job-specific
- identify responsible personnel
- identify the required control measures and arrangements and

- be in accordance with the safety standards including the specific risks outlined in the Preliminary Health & Safety Plan.

Details of these Method Statements should be used in safety awareness talks/toolbox talks prior to the work commencing. Environmental and security issues will also be considered where appropriate.

During the course of construction, amendments and alterations could be required to a Method Statement for the following reasons (and records of same will be maintained on file, i.e. in the Method Statement Register):

- during construction, the contractor could have improved the methods employed to carry out the task
- a new approach, differing significantly from the original proposal could be used and
- revised information is received from the employer.

The Contractor Method Statements will adopt a standard format that will be used for all statements produced.

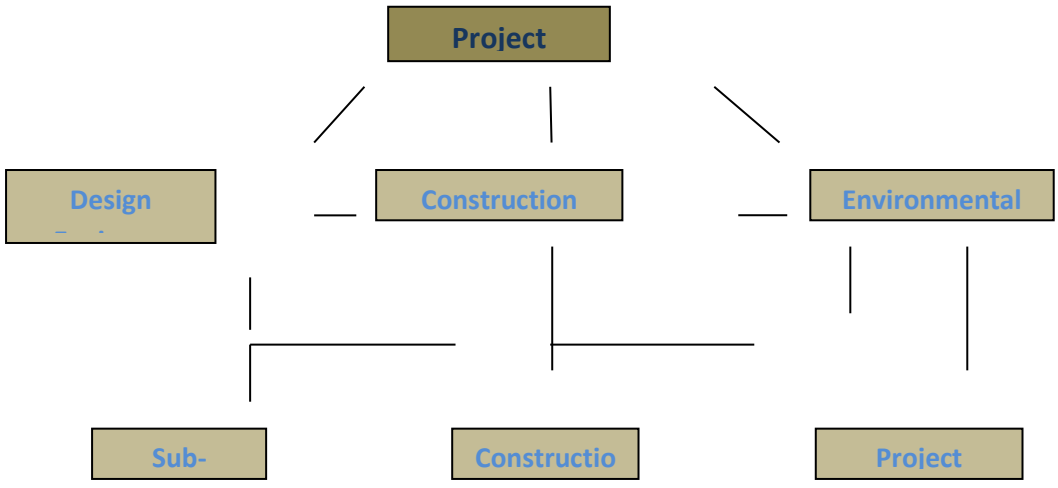
A register of Method Statements generated throughout the project will be maintained on file and stored centrally in the management office.

Detailed Method Statements will be prepared by the Contractor appointed to the works, prior to the commencement of construction.

10.1.2 Construction & environmental management organisation structure, duties & responsibilities

10.1.2.1 On-site organisational structure and responsibility

An example of an Organisational Structure for the Contractor's Project Team is included below. This structure will be defined by the Contractor and will include the names of the assigned personnel with the appropriate responsibility and reporting structure reflected. The appointed Contractor will be *required to finalise the Organisational Structure* for the project and outline the specific responsibilities for the roles required.



10.1.2.2 Duties and Responsibilities

The general role of key people on site implementing construction mitigation will be:

- The Project Manager - liaises with the Project Team in assigning duties and responsibilities to individual members of the main contractor's project team
- The Construction Manager - liaises with the Environmental Manager when preparing site works where there is a risk of environmental damage and manages the construction personnel and general works
- The Design Engineer - undertakes and certifies the Design and supervises the standard of works, including geotechnical aspects (Geotechnical engineer may need to be consulted in relation to structure and stability of re-profiled beach), and
- The Environmental Clerk of Works (Project Ecologist) - ensures that Method Statements are developed, implemented and maintained in light of environmental sensitivities and that environmental due diligence is practiced during construction. The PE tasks at the construction site are described below in **Section 10.1.3.4**.

The roles and responsibilities outlined below are indicative and will be updated on the appointment of the main contractor.

10.1.3 Personnel

10.1.3.1 Project Manager

A Project Manager is to be appointed on behalf of the main Contractor to manage and oversee the works. The Project Manager is responsible for:

- Compiling Method Statements
- Implementing the Health and Safety Plan
- Management of the construction project
- Liaison with the client/developer
- Liaison with the Project Team
- Assigning duties and responsibilities in relation to Method Statements
- Production of construction schedule
- Materials procurement and
- Maintaining a site project diary.

10.1.3.2 Construction Manager

The Construction Manager manages all the works to construct the flow control structure and installation of electrical cabling, on behalf of the main contractor. The Construction Manager reports to the Project Manager. The Construction Manager is responsible for:

10.1.3.2.1 Site-specific Method Statements

- Liaising with the Environmental Manager in preparing site-specific Method Statements for all Works activities where there is a risk of environmental damage, by incorporating relevant

Environmental Control Measures and referring to relevant Environmental Control Measure Sheets

- Liaising with the Environmental Manager in reviewing and updating site-specific Method Statements for all Works activities where Environmental Control Measure and Environmental Control Sheets have been altered and
- Liaising with the Environmental Manager where third party agreement is required in relation to site-specific Method Statements, Environmental Control Measures and/or Environmental Control Measure Sheets.

10.1.3.2.2 General

- Being aware of all Environmental Commitments and Requirements
- Ensuring that all relevant information on project programming, timing, construction methodology, etc., is communicated from the Project Manager, to the Environmental Manager in a timely and efficient manner in order to allow pre-emptive actions relating to the environment to be taken where required
- Programming and planning of excavation works and communicating this schedule to the Environmental Manager
- Ensuring that adequate resources are provided to design and install any environmental interventions
- Liaising with the Design Engineer and providing information on environmental management to the Design Engineer during the course of the construction phase
- Liaising with the Project Team in assigning duties and responsibilities in relation to Method Statements to individual members of the main contractor's project staff and
- Ensuring that the Environmental Manager performs regular and frequent environmental site inspections.

10.1.3.3 Design Engineer

The Design Engineer is appointed by the Contractor for the works. The Design Engineer reports to the Project Manager and is responsible for:

- Design of the works
- Review and approval of relevant elements of the Method Statements – assist the Construction Manager with the overall review
- Participating in Third Party Consultations and
- Liaising with Third Parties through the Environmental Manager.

10.1.3.4 Project Ecologist

Ecological monitoring will be undertaken for the duration of the construction phase construction. Monitoring is the taking of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective (Elzinga *et al*. 2001). A Project Ecologist (PE)/Environmental Clerk of Works with appropriate experience and expertise will be employed to oversee and/or conduct pre-construction surveys, review Method Statements and supervise the works with respect to the environmental sensitivities. The PE will be awarded a level of authority

and will be allowed to stop construction activity if there is potential for adverse environmental effects and will ensure that all the mitigation measures outlined are implemented.

10.1.3.4.1 General

- Being familiar with the contents, environmental commitments and requirements;
- Being familiar with baseline data gathered pre-construction
- Check all areas of dune habitat in the environs of the site for the presence of Cottonweed and species potentially harmful plants (non-native and invasive), as such plants may have established since the October 2018 survey
- Assisting the Construction Manager/Environmental in liaising with the Design Engineer and the provision of the information on environmental management to the Design Engineer during the course of the construction phase
- Implementing the environmental procedures of Method Statements
- Liaising with the Construction Manager to ensure that the control measures set out in the Schedule of Environmental Protection Measures are implemented
- Liaising with the client/developer in relation to environmental issues and
- Auditing the construction works from an environmental viewpoint.

10.1.3.4.2 Site-specific Method Statements

- Liaising with the Construction/Environmental Manager in preparing site-specific Method Statements for all Works activities where there is a risk of environmental damage. These site-specific Method Statements should incorporate relevant Environmental Control Measures and take account of relevant Environmental Control Measure Sheets
- Liaising with the Construction Manager in reviewing and updating site-specific Method Statements for all Works activities where Environmental Control Measure and Environmental Control Sheets have been altered and
- Liaising with the Construction Manager where third party agreement is required in relation to site-specific Method Statements, Environmental Control Measures and/or Environmental Control Measure Sheets.

10.1.3.4.3 Third party consultations

- Overseeing, ensuring coordination and playing a lead role in third party consultations required statutorily, contractually and in order to fulfil best practice requirements
- Ensuring that the minutes of meetings, action lists, formal communications, etc., are well documented and that the consultation certificates are issued to the Design Engineer as required
- Liaising with all prescribed bodies during site visits, inspections and consultations
- Where new Environmental Control Measures are agreed as a result of third party consultation, ensuring that any relevant Method Statements are amended accordingly
- Where new Environmental Control Measures are agreed as a result of third party consultation, the Environmental Manager should liaise with the Construction Manager in updating relevant site-specific Method Statements and
- Where required, liaising with the Construction Manager in agreeing site-specific Method Statements with third parties.

10.1.3.4.4 Licensing

- Ensuring that all relevant works have (and are being carried out in accordance with) the required permits, licences, notifiable actions, certificates, planning permissions, etc.
- Bringing to the attention of the Project, Design and Construction Team any timing and legal constraints that may be imposed on the carrying out of certain tasks.

10.1.3.4.5 Waste management documentation

- Holding copies of all permits and licences provided by waste contractors
- Ensuring that any operations or activities that require certificates of registration, waste collection permits, waste permits, waste licences, etc. have appropriate authorisation and
- Gathering and holding documentation with the respect to waste disposal.

10.1.3.4.6 Legislation

- Keeping up to date with changes in environmental legislation that may affect environmental management during the construction phase
- Advising the Construction Manager of these changes and
- Reviewing and amending Method Statements in light of these changes and bringing the changes to the attention of the main contractor's senior management and subcontractors.

10.1.3.4.7 Environmental induction training and environmental tool box talks

- Ensuring that Environmental Induction Training is carried out for all the main contractor's site personnel. The induction training may be carried out in conjunction with Safety Induction Training
- Check that relevant staff are familiar with emergency response procedures and trained in the use of spill kits and
- Providing toolbox talks on Environmental Control Measures associated with Site-specific Method Statements to those who will undertake the work.

10.1.3.4.8 Environmental incidents/spillages

- Prepare and be in readiness to implement at all times an Emergency Response Plan
- Notifying the relevant statutory authority of environmental incidents and
- Carrying out an investigation and producing a report regarding environmental incidents. The report of the incident and details of remedial actions taken should be made available to the relevant authority, the Design Engineer and the Construction Manager.

10.1.3.4.9 Site environmental inspections

- Carrying out regular documented inspections of the site to ensure that work is being carried out in accordance with the Environmental Control Measures and relevant site-specific Method Statements, etc.
- Carrying out a daily inspection of bunded areas, fencing
- Compiling inspection reports, and
- Liaising with the Construction Manager to organise any repairs or maintenance required following the daily inspection of the site.

10.1.4 Environmental Commitments

10.1.4.1 Sediment and erosion controls

10.1.4.1.1 Purpose

Sediment and erosion control measures are described for the management of water quality and run-off on the site, for the protection of lagoonal and intertidal areas.

- There will be no direct pumping of soiled waters from areas such as flooded excavation holes or pits to the foreshore or lagoon. Release of suspended solids to all waters will be controlled by interception (settling lagoon/silt trap) and management of site run-off. This will likely involve pumping.
- Pumping of waters soiled by excavation of organic rich substrates within Lady's Island Lake will not be permitted to the sea.
- The drainage channel excavations within the lagoon will be carried out within a cordoned-off area in order to create a hydrological divide between the works area and the lagoon habitat outside of the direct impact zone. A silt curtain, aqua-barrier or other form of partition will be required to retain disturbed substrates to the water column with the confines of the sealed area.
- There will be no excavations carried out that risk development of a connection between the sea and Lady's Island Lake. Any works that enable overland flows between the sea and Lady's Island Lake will not be permitted.
- Concrete work will be carried out in the dry using sand-bags (or other similar method) to ensure that any concrete used will not contaminate the lagoon. The works areas at the proposed flow control structure, pipeline and junction box may require dewatering for excavation/concrete works.
- Works which may result in large quantities of saline water entering the lagoon, such as trenching between the sea and lagoon will timed to avoid extreme tides, and
- Weather forecasts will be monitored during the construction phase so that construction involving excavations can be avoided prior to and during periods of heavy rainfall. The 24 hour advance meteorological forecasting service from Met Éireann will be used.

10.1.4.1.2 Responsibility

- The Environmental Manager is responsible for ensuring that appropriate water quality reduction prevention measures are put in place and that water sampling is carried out. Where standards are breached and remedial action is taken, an investigation must be carried out in conjunction with the Construction Manager, and further samples must be taken to verify that the situation has returned to normal.

10.1.4.2 Excavated Materials and Spoil Management

10.1.4.2.1 Purpose

To describe measures for the management of all excavations and excavated soil and rock on the site

10.1.4.2.2 Excavated Materials and Spoil Management

- Careful planning of excavations will be required in the intertidal zone to limit erosion of intertidal substrates – this may require protection of excavated areas from incoming/receding tides.
- Excavations at the 'cut' will be carried out in a manner that prevents uncontrolled flows between the lagoon and the sea.
- Areas to be excavated will be clearly marked prior to excavations taking place to avoid unnecessary excavation.
- In areas where trenching takes place within 'Perennial vegetation of stony banks' habitat larger grade sediment (>2mm) will be segregated from fine sediment (<2mm) where there is such variation, to allow for reinstatement of this habitat
- Excess sediment/gravel from the lagoon and other areas in the environs of the 'cut' will require storage. This sediment and other excavated material will be stored in bunded areas within the site for later use or removed from the site.
- Any organically rich and/or anoxic substrates excavated from the lagoon will be segregated and stored in a bunded area within the site for later removal or removed immediately from the site to a location approved by Wexford Co. Co.
- The level and spatial extent of the excavations within the lagoon will be according to design and will not be exceeded – this is important with regard to subsequent maintenance dredging.
- All site excavations will be supervised by a Site Engineer.
- The timing of excavations will be such that they are carried out as required, not weeks in advance, as spring tides will occur bi-weekly and high tides will occur daily and
- The timing of excavations will be such that they are carried out as required, not weeks in advance.

10.1.4.2.3 Responsibility

- All site excavations and all construction works will be supervised by the Construction Manager and inspected by the Design Engineer
- The Design Engineer will monitor ground stability within the site throughout the construction phase
- The Project Manager will oversee the phasing of the excavation and machinery movement across the site
- Construction personnel will be informed of the measures to prevent pollution of transitional waters
- The Design Engineer and Sub-contractors will have responsibilities as appropriate and
- All responsibilities will be finalised by the Appointed Contractor. The Environmental Manager is responsible for ensuring that appropriate water quality reduction prevention measures are put in place and that water sampling is carried out. Where standards are breached and remedial action is taken, an investigation must be carried out in conjunction with the Construction Manager, and further samples must be taken to verify that the situation has returned to normal.

10.1.4.3 Timing of works

Lady's Island SPA is known to support an important Tern population listed as special conservation interests in the Lady's Island SPA. To reduce the potential for disturbance impacts on Terns and other breeding/nesting birds, it is recommended that the outfall installation works which are located at the shore be commenced during August/September. This timing is in cognisance that the works are expected to last 9 months and that peak breeding/nesting activity is during June/July. Maintenance dredging will be undertaken outside of peak tern breeding season.

The southern extent of the flow control structure component of the project is within intertidal an area, so the timing of construction in intertidal areas will depend on the tidal regime. The appointed contractor will require a tide timetable so that works can be best scheduled according to low tide times. There are tide timetables available online e.g. http://www.ukho.gov.uk/easytide/EasyTide/index.aspx gives tide times for Carnsore Point.

10.1.4.4 Concrete control

10.1.4.4.1 Purpose

To describe measures for the management of cementitious material on site for the protection of intertidal and lagoonal (transitional) waters from any spillages - cement and concrete at certain levels are toxic to plants, invertebrates and fish.

10.1.4.4.2 General

- Measures must be taken during all aspects of construction to ensure that no cement or concrete is allowed to enter intertidal waters
- The use of concrete with a suitable drying time or appropriate protection of working areas must be used where tidal sequences result in any risk of tidal contact with newly-concreted areas
- Concrete pouring should only be done in fully-isolated shuttered locations
- Pouring should be undertaken in suitable tidal conditions - the contractor will need to be aware of and vigilant of tidal and lunar cycles
- If concrete is to be made up onsite, then a bunded area at a distance from the sea should be used for this process to minimise to the greatest extent any risk of concrete or concrete product contamination of water
- Concrete pours shall not be carried out during forecasted periods of heavy rainfall. Weather forecasts will be monitored during the construction phase. The 24 hour advance meteorological forecasting service from Met Éireann will be used
- To reduce the potential for cementitious material entering the sea or Lady's Island Lake, concrete pours will be supervised by the Construction Manager, a suitably qualified engineer and the Environmental Manager
- To reduce the risk of spillages to transitional waters, there will be no on-site batching of concrete. All concrete will be supplied ready-mixed by licensed suppliers and
- To prevent spillages to transitional waters, the surrounding areas will be isolated from the concrete works, prior to the concrete pours taking place, by installing shuttering to contain the concrete. The shuttering will stay in place until the concrete has cured.

10.1.4.4.3 Concrete Wash Down Water

- Pours will not take place during heavy rainfall. Weather forecasts will be monitored during the construction phase. The 24 hour advance meteorological forecasting service from Met Éireann will be used
- To reduce the volume of cementitious water, washout of concrete trucks will not take place onsite. Concrete trucks will be washed out off site at the source quarry
- To reduce the volume of cementitious water, only concrete chutes will be washed down onsite. The concrete trucks will wash down their chutes at a designated chute wash down area in the site compound. The wash down area will consist of a polythene lined bunded area of adequate capacity
- If concrete is to be made up onsite (acknowledging that most concrete will be delivered by truck), then the bunded area with a sealed with an impermeable robust liner within the site compound will be used to minimise any risk of concrete or concrete product contamination of water
- This designated chute wash down area will also be used to effectively treat concrete wash water arising from the washing out cement mixers and the cleaning of tools and equipment
- Wash-water from the washing out of mixers and other equipment will be undertaken off-site at the end of each day and
- Related concrete wastes arising from the above will be managed as per **Section 10.1.4.10**.

10.1.4.4.4 Responsibilities

- The Construction Manager, the Environmental Manager and appropriate engineer will supervise all concrete pours
- The Environmental Manager is responsible for ensuring that appropriate water pollution prevention measures are put in place and that water sampling is carried out. Where standards are breached he/she will carry out an investigation and in conjunction with the Construction Manager, he/she will ensure remedial action is taken and further samples taken to verify that the situation has returned to normal and
- The Environmental Manager is responsible for ensuring spill kits are readily available in vulnerable locations and that booms for watercourses are long enough and have adequate anchorage.

10.1.4.5 Hydrocarbon control

10.1.4.5.1 Purpose

To describe measures for the management of all fuel and oils on site for the protection of intertidal waters from any spills and for the protection of water quality.

10.1.4.5.2 Refuelling

- Construction machinery and vehicles will only be refuelled in designated refuelling areas distant from the shoreline using a prescribed re-fuelling procedure to prevent hydrocarbons pollution
- These designated areas will be checked daily by the Environmental Manager for the presence of oil/fuel spills

- Refuelling will be carried out using 110% capacity double bunded mobile bowsers. The refuelling bowser will be operated by trained personnel. The bowser will have spill containment equipment which the operators will be fully trained in using
- To reduce the potential for fuel spillages, only designated trained operators will be authorised to refuel vehicles and machinery and
- To reduce the potential for oil leaks, only vehicles and machinery will be allowed onto the site that are mechanically sound. All machinery will be maintained in good working order, free from leakage of fuel or hydraulic fluid. An up to date service record will be required from the main contractor.

10.1.4.5.3 Oil storage

- Leakages of oil or fuel from oil or fuel stores at the site compound will be avoided by storing these oils and fuels in bunded tanks
- The scale of potential impacts on water quality will be reduced by only storing the required volume of oils for the works taking place at the time
- Access to oil stores will be controlled by only storing oils within a secure steel container located in the site compound
- Collision with oil stores will be prevented by storing oils within a steel container in a designated area of the site compound away from vehicle movements
- Leakages of oil from oil stores will be prevented by storing these oils in secure bunded areas which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container. Taps, nozzles or valves will be fitted with a lock system
- Major leakages will be prevented through monitoring oil storage tanks/drums for leaks and signs of damage. This will be carried out by the Environmental Manager and
- Long term storage of waste oils will not be allowed on site. These waste oils will be collected in leak-proof containers and removed from the site for disposal or re-cycling by an approved service provider.

10.1.4.5.4 Oil Leakages

- To minimise the potential for water quality impacts, the bunded refuelling areas will be used for overnight parking of excavators and dump trucks
- Potential leaks from delivery vehicles will be reduced by visually inspecting all delivery vehicles for major leaks. Contractors supplying concrete and crushed stone to the site will be contractually required to supply their products using roadworthy vehicles
- Potential leaks from any other plant used will be mitigated by contractually requiring the suppler to supply plant that are in good working order, up to date in servicing and free of leaks
- Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits; preferential pathways will be blocked with an oil absorbent boom until the fuel/oil spill has been cleaned up and all oil and any contaminated material removed from the area. This contaminated material will be properly disposed of in a licensed facility

- The Environmental Manager will be immediately informed of the oil leak/spill, and will assess the cause and the management of the clean-up of the leak or spill. They will inspect nearby drains for the presence of oil, and initiate the clean-up if necessary
- Immediate action will be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks will be kept at the site compound and also in all site vehicles and machinery
- Correct action in the event of a leak or spill will be facilitated by training all vehicle/machinery operators in the use of the spill kits and the correct containment and cleaning up of oil spills or leaks. This training will be provided by the Environmental Manager at site induction and
- In the event of a major oil spill, a company who provide a rapid response emergency service for major fuel spills will be immediately called for assistance, their contact details will be kept in the site office and in the spill kits kept in site vehicles and machinery.

10.1.4.6 Emergency Response Plan

10.1.4.6.1 Purpose

To describe measures for the prevention of an environmental accident or incident and the response required to minimise the impact of such an event.

10.1.4.6.2 Procedure

In the event of an environmental emergency, all personnel will react quickly and adhere to this procedure. All site personnel will be inducted in the provisions of the **Emergency Response Plan.** The following outlines some of the information, on the types of emergency, which must be communicated to site staff:

- Release of hazardous substance - Fuel or oil spill
- Concrete spill or release of concrete
- Flood event – extreme rainfall event
- Environmental buffers and exclusion zones breach
- Housekeeping of materials and waste storage areas breach
- Stop works order due to environmental issue or concern (threat to archaeological or ecological feature) and
- Fire on site (cross-reference site Safety Emergency Plan as appropriate).

If any of the above situations occur; the Emergency Response Plan is activated. The Environmental Manager will most likely be responsible for overseeing the Emergency Response Plan (to be confirmed upon appointment of Contractor) and will be prepared and ready to implement the plan at all times. The Environmental Manager will be immediately informed and report to the scene. He/she must be aware of the

- Nature of the situation – brief description of what has happened
- Location of the incident
- Whether any spill has been released and
- Whether the situation is under control.

The Emergency Response Plan must be completed by the appointed Contractor.

10.1.4.6.3 Oil Spillages

The following list outlines issues likely to be appropriate for inclusion in such a plan:

- Site staff will report the spillage immediately to the Environmental Manager or Construction Manager
- Where relevant, the Environmental Manager will report the spillage to Inland Fisheries Ireland and Mayo County Council
- Where possible, the source of pollution will be identified
- Switch off all sources of ignition
- Use absorbent materials from the spill kit to mop up the spill (sand or absorbent materials will be used rather than detergents)
- Place boom around any affected water as a precaution
- Do not wash spillage. Washing will only make the situation worse and disperse the pollutant
- Shovel contaminated sand/earth/absorbent granules into sacks or skips and
- A specialist oil removal company or contaminated soil company will remove pooled oil and/or soils contaminated oil.

10.1.4.6.4 Concrete Spillages

The following list outlines issues likely to be appropriate for inclusion in such a plan:

- Site staff will report the concrete spillage immediately to the Environmental Manager or Construction Manager
- Where relevant, the Environmental Manager will report the spillage to Inland Fisheries Ireland and Mayo County Council
- If there is a risk of concrete spreading into intertidal zone, any preferential pathways will be blocked using the absorbent booms, which will prevent concrete flowing downslope to transitional waters
- Do not wash spillage into drainage system. Washing will only make the situation worse and extend the pollution to other water bodies/drainage systems
- If the spill has already reached drains, acid may be added to the drains by the Environmental Manager to neutralise the alkalinity of the concrete and
- Shovel contaminated concrete granules into sacks or skips for treatment in a Roadside Concrete Wash unit.

10.1.4.6.5 Contacts

As an Environmental Control Measure, the Environmental Manager will append the relevant contact details to the Emergency Response Plan document. Examples of such contact details include:

- Environmental Manager
- Specialist oil removal Company
- Wexford County Council
- Inland Fisheries Ireland and
- National Parks and Wildlife Service.

10.1.4.6.6 Location of Emergency Spill Kits

- A map indicating the location of all emergency spill kits will be attached to the Emergency Response Plan document and
- Emergency oil spill kits will also be carried in all site vehicles and machinery and in the site office.

10.1.4.6.7 Responsibility

- The Environmental Manager will prepare and finalise an Emergency Response Plan to be ready to respond to any incident
- All site personnel will report any spillages of oil or chemicals to the Environmental Manager and Construction Manager immediately and
- As appropriate, the Environmental Manager will report the spillage to the western RBD of IFI, local authority and any other relevant authority.

10.1.4.7 Site Training and Environmental Awareness

10.1.4.7.1 Purpose

To describe measures for the training of all site personnel in the protection of the environment and the relevant controls.

10.1.4.7.2 Scope

All site personnel and construction teams which may influence environmental impacts.

10.1.4.7.3 Procedure

An initial site environmental induction and ongoing training will be provided to communicate the main provisions of this Environmental Operational Plan (EOP) to all site personnel. Two-way communication will be encouraged to promote a culture of environmental understanding and protection.

The following outlines some of the information which will be communicated to site staff:

- Environmental procedures of the EOP
- Environmental buffers and exclusion zones
- Housekeeping of materials and waste storage areas and
- Environmental Emergency Response Plan.

10.1.4.7.4 Housekeeping and Storage of hazardous materials

- Hazardous materials marked with the following symbols will only be stored in the secure storage container in the site compound.

- Subcontractors will provide a copy of the Material Safety Data Sheets for all hazardous substances brought on site.

All finalised EOP policies will be adhered to, in the management of fuels and oils, concrete, and installation of sediment and erosion controls and drainage features. All finalised details will be communicated with site personnel. Environmental training records will be retained in the site office.

10.1.4.7.5 Responsibility

Responsibility lies with the Environmental Manager, Construction Manager and all other site personnel.

10.1.4.8 Protection and Reinstatement of Habitats and Flora

10.1.4.8.1 Purpose

To describe the measures for the management, protection and reinstatement of habitats and flora on the site.

10.1.4.8.2 Procedure

The following measures will be put in place to minimise any disturbance or impact to habitats and flora:

- Minimise the 'footprint' of the development
- Habitat disturbance during construction work should be strictly confined to the direct land-take of the flow control structure, access / electrical cable route and site compound
- Micrositing of boundaries will take place to avoid sensitive habitats insofar as possible
- Access to the proposed development site will be from the local road network i.e. from Lady's Island village south to the townland of Chour at the eastern side of Lady's Island Lake
- There are several existing tracks on the landward (south) side of the barrier to the east of the 'cut' accessible from the local road. Access from the local road network to the site compound, work areas at the 'cut' and Lady' Island Lake will be via an existing track along the southern shore of the lake/lagoon.
- A construction site compound of dimension 25m X 25m will be set up near the western end of the access track. This location has been selected based on its current impacted/compacted condition, which has occurred due to regular vehicular traffic and parking
- The site compound will consist of bunded areas for storage of machinery and material. Temporary secured cabins, toilets and other materials and machinery will also be stored/located in this area. The site compound and machinery etc. will be secured at times when construction staff are not present on site
- Where there is little/no vegetative cover on loose soils / sands heavy duty road mats will be installed along the access tracks and at the site compound, providing temporary roadways and work areas for heavy plant, machinery and multiple vehicles. This measure is required to prevent erosion. There may be a requirement to increase mat coverage depending on conditions throughout the work period and
- The access from the local road to the site compound, the site compound, and the works area required to carry out construction will be demarcated by secure stakes and robust high visibility tape prior to construction. This layout will be decided to ensure habitats of conservation interest will be avoided insofar as possible. Tracking of machinery, storage and site personnel etc. will be confined to the agreed demarcated boundaries for the duration of the construction stage of the project.

The barrier beach in the immediate vicinity of the proposed works will be excavated and disturbed during construction. The following measures will be put in place to reinstate habitats:

- Excavated materials and spoil management will be followed as outlined in **Section 10.1.4.2**
- The substrates removed during construction will comprise mostly gravels and sands. These materials will be stored on-site in areas with no vegetation and used to backfill trenches, with coarser sediment (>2mm) used at the top of the reinstated areas and finer sediment used at lower levels
- The works areas will be graded to match pre-construction levels and profiles insofar as possible
- The project proponent will have to put measures in place to control gravel extraction. This could include CCTV and notices placed at access roads prohibiting the removal of beach materials.

10.1.4.8.3 Responsibility

- Environmental Manager
- Construction Manager
- Project Ecologist.

Plate 15 Access to the site compound will be via the existing track at the northern side of the barrier beach (left). The site compound will be located in an area already exposed to frequent disturbance (right).

10.1.4.9 Power supply

10.1.4.9.1 Purpose

To describe measures for the installation of a power supply line and minimising the impact on birds.

10.1.4.9.2 Procedure

All power supply will be of underground type. The route of any power supply line will be in line with / adjacent to existing tracks / disturbed areas insofar as possible, as per **Section 10.1.4.8**. Any trenching required to lay an underground duct/cable will follow best practice as follows:

- Prior to trenching commencing the route is inspected and marked out on the ground. Preparatory measures are then put in place along the extent of the route including any required warning notices, temporary barriers to protect adjacent habitats, traffic management measures, etc.

- Areas where materials can be stored or stockpiled are identified
- Trench will be excavated to required depth during which topsoil/sand will be segregated from other soil types (e.g. subsoil)
- Excavated material will be stored for use during backfilling
- Dusting will be laid in the trench
- Excavated topsoil/sand will be used to backfill the trench to reinstate to original level - any surplus material will be subsoil
- Surplus material will be carried off site in line with waste management
- Reinstated ground along the trench footprint will be left to recolonise naturally

Sediment and erosion controls as outlined in **Section 10.1.4.1**, and excavated materials and spoil management as outlined in **Section 10.1.4.1** will be followed during trenching.

Guidance on the construction and features of the power supply to the electrical kiosk will follow Flynn and Nairn (2012) '*Ecology Guidelines for Electricity Transmission Projects A Standard Approach to Ecological Impact Assessment of High Voltage Transmission Projects*[16]'.

10.1.4.9.3 Responsibility

Wexford County Council will be responsible for implementation of these measures.

10.1.4.10 Non-native and invasive species control

10.1.4.10.1 Purpose

To describe the measures reduce the risk of spread and importation of non-native and invasive species.

10.1.4.10.2 Procedure

The following measures will be put in place to risk of spread and importation of non-native and invasive species.

- All plant and equipment will be checked for attached debris or plant fragments, and if present, these will require power washing prior to entry to site
- All plant and equipment will be similarly checked prior to leaving the site, and subsequently properly cleaned if required
- Any areas identified as supporting non-native plants will need to be treated in accordance with established non-native species control guidance
- Non-native species control prevention will be in accordance with NRA (2010) and IFI guidelines[17]
- The use of equipment that has been used in known infested waters will be avoided and
- The IFI documents 'Invasive species biosecurity guidelines for boaters' (IFI, 2013)[18] and 'IFI Biosecurity Protocol for Field Survey Work (IFI, 2010)[19] will be available at the site compound

[16] http://www.eirgridgroup.com/site-files/library/EirGrid/EirGrid-Ecology-Guidelines-for-Electricity-Transmission-Projects.pdf

[17] https://www.fisheriesireland.ie/Biosecurity/biosecurity.html

[18] https://www.fisheriesireland.ie/extranet/invasive-species-1/360-invasive-species-biosecurity-guidelines-for-boaters-leaflet-1.html

for the duration of the works. The above guidance documents outline the necessary measures for all staff in contact with the water or using equipment in contact with water. The protocols in these documents and will form the basis of biosecurity in the lagoon during the proposed works.

10.1.4.10.3 Responsibility

- Environmental Manager
- Construction Manager
- Project Ecologist.

10.1.4.11 Waste management

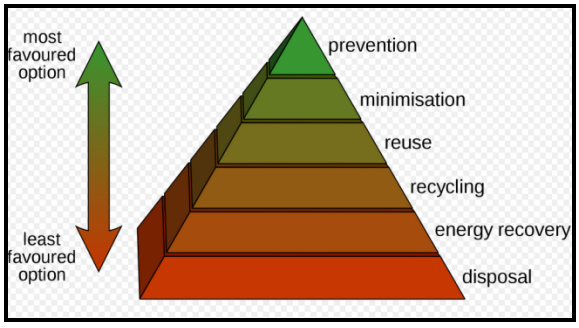
10.1.4.11.1 Purpose

To describe measures for the management of all wastes associated with the construction of the project.

10.1.4.11.2 Waste Management Plan

A Waste Management Plan will be prepared for the construction phase. The waste management plan will take account of the following:

- Regard will be had to the Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (DoEHLG, July 2006) in preparing and maintaining this plan.
- The Waste Management Hierarchy (illustrated below) will be assessed and applied.
- The Construction Phase Waste Management Plan will address the following aspects of the Project:
    - Analysis of the waste arising/material surpluses
    - Specific waste management objectives for the project
    - Methods proposed for prevention, reuse and recycling of wastes, and
    - Material handling procedures.



The Waste Management Plan will contain individual headings describing the following:

- Description of the Project
- Wastes arising including proposals for minimisation/reuse/recycling
- Estimated cost of waste management and
- Record keeping procedures.

[19] https://www.fisheriesireland.ie/component/docman/?task=doc_download&gid=73&Itemid=

As part of the record keeping procedures, the Environmental Manager will keep records provided by waste contractors of all waste being removed from site. The Environmental Manager will record waste removed from site on a quarterly basis. This information will be recorded in a standard format.

10.1.4.11.3 General Waste

- Access to materials will be controlled. A dedicated storage area will be provided in the site compound for the storage of building materials such as cables, plastic lining for the settlement pond, blocks, tools and equipment, absorbent booms, pipes etc.
- Access to stored materials will be restricted; the site compound will be securely fenced from the outset and will be locked when there are no site personnel present.
- To contain and manage construction phase waste, multiple skips will be provided at the site compound; one for recyclable waste and others for various construction wastes. These skips will be emptied when required by a licensed waste management company and
- To contain and manage waste oil, any waste oil will be collected and stored in drums in the site compound within the prefabricated bunded storage unit and will be removed and disposed of by a licensed waste management company without delay.

10.1.4.11.4 Waste water from staff facilities

- During the construction phase, staff facilities will be provided at the site compound. There will be no discharge of effluent or waste water on site. Waste water tank and sewage will be emptied as required by a vacuum tanker and removed from site to a licensed facility. No water will be sourced on site; any water required will be delivered. These staff facilities will be removed at the end of the construction phase.

10.1.4.11.5 Responsibility

- The Environmental Manager will be responsible for creating and updating the Waste Management Plan.
- The Environmental Manager will be responsible for identifying a waste contractor to remove waste that can be recycled or reused. He/she will obtain records for all waste leaving the site for this purpose and
- It is the Construction Managers responsibility to organise the removal of skips from his/her area when they are full.

10.1.4.12 Construction Noise

10.1.4.12.1 Purpose

To describe measures for the management of impacts from construction noise.

10.1.4.12.2 Procedure

- Where reasonably practicable, noisy plant or processes will be replaced by less noisy alternatives.
- Plant will be properly and regularly maintained.
- Compressors, if needed, will be 'sound related' models fitted with properly lined and sealed acoustic covers which will be kept closed whenever machines are in use.
- All vehicles and mechanical plant will be fitted with effective exhaust silencer.s
- Use of vibrating hammer to be made for pile driving in order to reduce noise generation and propagation.

- Working at times of low tide when piling and
- The practise of 'ramping up' the hammer when starting each pile driving event, in order to 'warn' the fauna in the area. This start-up strategy should be employed each time the pile driving is initiated.

10.1.4.12.3 Responsibility

- The Construction Manager will be familiar with the noise sensitive receptors and alert the Environmental Manager in good time prior to work commencing in the areas closest to any noise sensitive receptors and
- The Environmental Manager will review any relevant planning conditions in updating this plan.

10.2 OPERATIONAL PHASE

The operational phase of the proposed development pertains to the management of water levels in Lady's Island Lake by the flow control structure. The annual management regime has been designed to improve nesting conditions for birds that use the islands on Lady's Island Lake and maintain salinity so that the lake remains a transitional waterbody.

10.2.1 Water levels

Wexford Co. Co. will be responsible for maintaining water levels at the prescribed levels. Annual water level management will be according to the characteristics of the proposal as outlined in **Section 6.2**. The lake should have a normal level of 4.0m OD Poolbeg (range of 3.8m to 4.2m OD Poolbeg) from mid-March to the end of August. The lake should have a minimum water level of 5.1m OD Poolbeg for at least one month in winter. From an ecological perspective, no maximum level is required for winter. (It is expected that a maximum will be set by the Our Lady's Island Lake Drainage Committee, in terms of flood risk for community infrastructure). It is important that this management regime is adhered to as departures from this schedule could be detrimental for nesting terns.

Accurate measurement of water levels will be required to ensure proper management of water levels in Lady's Island Lake. A water level data logger will be installed at a suitable and easily accessible location in Lady's Island Lake. This instrument will automatically and continuously record fluctuations in water level. Water level data logs are stored in the datalogger's memory and can be downloaded using software or can be collected by other means such as a smart device app, telemetry, or data acquisition system. Telemetry is recommended as it provides access to data in real time. Real-time automated alerts can be sent via text or email when specified levels exceed pre-defined limits. This will allow prompt action to be taken.

Recharge of saline water to Lady's Island Lake during September will be assisted by an automated flow control system installed at the flow control structure. This will be synchronised with the tidal/lunar cycle so that penstocks controlling flow will close with loss of level difference between the lake and the rising high tide, and open once there is enough head in the lagoon relative to the ebb tide. Likewise, releasing water from the lagoon to lower levels, saline influx will not take place by reversing the aforementioned sequence.

10.2.2 Salinity

It will be necessary during saline recharge phase (September) to ensure that salinity levels do not allow the development of a strongly brackish community throughout the lake - this is unlikely given that raising salinity levels are potentially challenging. Colonisation of the lake with a flora/fauna community that favours high salinity could out-compete biota adapted to lower salinity and cause a shift in ecosystem dynamics throughout the waterbody. Weather is regarded as significant factor in the dispersion and mixing of salt in Lady's Island Lake. To prevent loss of species diversity, salinity levels will need to be monitored throughout the lake during recharge. There will be a requirement for expedient regulation of flows based on salinity results. Monitoring of salinity will take account of prevailing weather conditions at all times and especially during recharge of saline water.

Salinity will be recorded within the flow control structure, in the lake towards its northern end, and near the centre of the lake. Obtaining salinity from the centre of the lake is important given that the main body of the lagoon is very well mixed both horizontally and vertically. Robust monitoring meters suitable for deployment with telemetry systems will be used, in order to provide data to a PC remotely. Utilising telemetry in deployment will reduce site visits and can be set to provide warnings automatically during a substantial salinity change. Salinity meters will be calibrated according to manufacturer's instructions. Wexford Co. Co. will be responsible for deployment and servicing of salinity meters and storing all salinity data. Monitoring stations will be easily accessible to maintenance and calibration of equipment. Monitoring equipment will be placed in secure, purpose-built housing.

Wexford Co. Co. will operate the flow control structure in consultation with NPWS so that extreme low salinity status (Oligohaline; <5 psu) at the northern end of the lake, and high salinity status (Euhaline; >30-40 psu) at the southern end of the lake is not brought about, or avoided insofar as possible during operation. Control of saline intrusion and subsequent mixing with freshwater will aim to achieve salinity levels within normal historical ranges at Lady's Island Lake. The median levels for the North and South of the Lake given in Roden and Oliver (2012) are targets for salinity. These are as follows:

- Winter at Lady's Island Lake north 8.65 psu Lady's Island Lake south 20.45 psu and
- Summer at Lady's Island Lake north 23.25 psu, Lady's Island Lake south 23.15 psu.

Achieving this level on a regular annual basis will buffer against salinity shocks and stabilise the transitional ecosystem of Lady's Island Lake. In the event of high rainfall levels, and/or higher than normal freshwater inflows in September, saline recharge should still be performed around high tides, and water should be allowed flow from the lake around low tide time.

The learning experiences of the early years of operation of flow control, and related salinity monitoring records will be used to inform management on a year-by-year basis.

10.2.3 Maintenance dredging

A dredged drainage channel of ca. 2,700m^2 will be required within the lagoon to ensure the functionality of the flow control structure. Maintenance dredging will not be permitted below the level of works carried out at construction stage, with reference to the design levels. Any maintenance dredging of the drainage channel within the lake will be undertaken outside of the peak Tern breeding season which is from April to September. Access to the lake will be along the

same route as for construction stage. The contractor/authority carrying out dredging will do so in line with appropriate environmental measures to prevent pollution, including hydrocarbon and sediment control and will access the lake along the shore when water levels are low. Maintenance dredging will be undertaken outside of peak tern breeding season.

10.2.4 Natura 2000 Site management

There are a number of competing interests among the main stakeholders with regard the management of the lake levels. For example, local farmers have access tracks to land around the lake edge which also become flooded (Healy 1997). The Our Lady's Island Lake Drainage Committee was formed in July 1990 as a short-term bridging group to manage breaching pending the advancement of a proposed long-term engineering solution (Hurley 1997). The Drainage Committee have managed breaching since this time and the NPWS is one of a number of stakeholders represented on the committee. The committee demands controlling flooding of surrounding lands while the NPWS must ensure that the conservation interests associated with the lake are maintained in a favourable conservation condition. Going forward, the management proposal outlined in this document must be agreed and signed off by all parties involved, so that there can be no future deviation from management which brings about the best results for the ecosystems at Lady's Island Lake. Wexford County Council will manage lake levels in consultation with public agencies and Our Lady's Island Lake Drainage Committee. Indeed, Martin *et al.* (2017) notes the importance of a concerted effort by local authorities, supported by State bodies such as the Office of Public Works and National Parks and Wildlife Service, to appropriately assess all future construction and maintenance works for coastal defences, especially those within SACs.

Site-specific Conservation Objectives have been established for Lady's Island Lake SAC (000704) but not for Lady's Island Lake SPA (004009). Ireland is a signatory to the EU Habitats and Wild Bird Directives, which together seek to protect and improve Europe's most important and threatened habitats and species. NPWS is working to publish site specific Conservation Objectives for all European sites. Pending completion and implementation of the proposed project, Conservation Objectives for Lady's Island SPA will need to be developed using an approach based on the new management regime, as well as on best available information about these sites and their qualifying features. For example, in relation to Tern nesting, Daly *et al.* (2016) recommended reducing the amount of high grass and tussocks by strimming early in the season.

11 RESIDUAL IMPACTS

The residual impacts are the expected impacts that remain after the proposal has been applied and mitigation has been taken into account.

A summary of residual impacts on conservation objectives of Natura 2000 sites potentially affected by the proposed development are provided in **Table 18** – **Table 20** (**Section 11.1 – 11.3**) for the three Natura 2000 sites considered in this report. With the proposed construction of the flow control structure and associated works, there is a risk to habitats, water quality and birds. A list of mitigation measures has been developed however upon which Method Statements will be devised by the contractor to reduce environmental risks. Construction and environmental management organisational structure, as well as duties and responsibilities assigned to specific staff undertaking the works to ensure mitigation implementation. The contractor will adhere to a range of

environmental commitments, including sediment and erosion control measures for the management of water quality and run-off on the site. Other environmental commitments include excavated materials and spoil management, appropriate timing of the works, concrete and hydrocarbon control, an emergency response plan, site training and environmental awareness, non-native and invasive species control, waste management, and minimising construction noise. The residual impact of the proposed construction works will not be significant and are not expected to contravene the Conservation Objectives of the local Natura 2000 sites.
During operation phase, the management of water levels and salinity as proposed will likely improve the ecological stability of Lady's Island Lake. The flora of the lake can be expected to benefit by moving away from extreme variation of water levels and salinities, with positive effects on a variety of lagoonal specialists such as stoneworts. With seasonal management of water levels, the colonies of Terns nesting on the Islands of Lady's Island Lake will be afforded more reliable protection from mammalian predators, increased nesting habitat value and likely improved feeding opportunities in the lake.

The proposed management will help alleviate problems that have been documented in the past due to breaching the barrier beach as outlined below (from Parle 1998, unless otherwise stated):

- Lake levels have been so lowered as to threaten the lake's value as an area of environmental interest. In addition, large areas of foul smelling lake bottom have been exposed and the appearance of the area changes considerably.
- The lake area can become tidal for a period following a 'cut'. This can result in an increase in the salinity of the lake water with potentially adverse ecological impacts. Usually the cut closes within a matter of weeks. However, the cut has remained open for months in some instances. Though the cut is initially narrow, water flowing from the lake can lower and widen the cut by an uncontrolled amount. A width of cut up to 263m has occurred in the past.
- The barrier beach is vulnerable to overtopping by wave action. Overtopping caused an overnight increase in water level of 0.5m during December 1989. The area of the cut is particularly vulnerable to overtopping. Overtopping can result in large quantities of saline water entering the lagoon, with associated mass mortalities of flora and fauna observed in the past. In a site visit during October 2018, there was evidence of recent overtopping. Overtopping also occurred at the end of 2018 (email from Ciara O'Mahony of NPWS on 21/12/2018) and
- Early breaching has often coincided with rough seas resulting in the barrier sealing quickly and the objective of lowering water levels not being achieved, while late breaching has typically coincided with calmer seas resulting in a danger of late closure of the breach and much consequent saline intrusion (Healy 1997).

The residual impact of the proposed lake level and salinity management is expected to be positive, with reference to the current practice of breaching the barrier, which has been a long, uncoordinated affair.

Reinstatement of the sedimentary barrier beach at the 'cut' as proposed will provide dune habitat and possibly increase the range of stable shingle habitat in an area that currently comprises highly mobile substrates incapable of supporting vegetation. This could facilitate the development and restoration of 'Perennial vegetation of stony banks', a habitat of conservation interest in the SAC

whose conservation status was assessed in the as Unfavourable-Inadequate with respect to area, structure and function, and future prospects in the VSM project (Martin *et al.* 2017).

If the mitigation measures are not carried out fully and fail to be adopted throughout the proposed project, it could result in a significant negative impact on certain conservation interests of the Lady's Island SAC and Lady's Island SPA. If the proposed mitigation measures are adopted fully and correctly during the project it is considered that the proposed development works will not have a 'Significant' Negative Impact on the key ecological features of the Lady's Island SAC, Lady's Island SPA and Carnsore Point SAC. Provided that the recommended mitigation measures are implemented in full, it is not expected that significant impacts will result to the qualifying features identified for appraisal in this NIS and thus it is not expected that the proposal will have an adverse impact on Natura 2000 sites.

11.1 LADY'S ISLAND LAKE SAC

Table 18: Summary of residual impacts of the proposed Lady's Island Lake Water Level Management project on features of interest in Lady's Island Lake SAC .

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Coastal lagoons [1140]	Habitat area/ hectares	Area stable or increasing, subject to natural processes. Favourable reference area	Lake levels will be better managed thus having a positive effect	Monitoring of lake levels and salinity, and regulation by Wexford County Council. See **Section 10.2.1** 'Water levels' and **Section 10.2.2** 'Salinity' and ongoing management (**Section 10.2.5**).	Improved stability of lake levels and salinity concentrations. The proposed development will not have a significant negative impact on lagoon area
	Habitat distribution/ occurrence	No decline, subject to natural processes.	The proposed development is not expected to result in a significant impact on the distribution of lagoon habitat.	No specific mitigation required	Improved stability of lake levels and salinity concentrations.
	Salinity regime/ Practical salinity units (psu)	Annual median annual salinity and temporal variation within natural ranges	During construction phase, there is potential for a significant quantity of salt-water to enter the lagoon from the sea. During operation phase, salinity could be raised from 0, 5 and 10 psu to 12, 15 and 18 psu respectively, with freshwater inputs. Assuming no freshwater inputs, salinity could be raised from 0, 5 and 10 psu to 17, 19 and 22 psu respectively.	Preventing a flow of saline water to the lake during construction stage Regulation of water levels and salinity during operation stage to achieve targets set by NPWS.	Salinity is currently highly unstable in the lagoon as it is influenced by numerous factors including overtopping and breaching. The proposed management will replace the current practice of barrier beach breaching and the associated tidal phase of the lagoon. Indeed, according to Oliver (2007), Lady's Island conservation value as a lagoon relies on active management. With implementation of the plan, the project is expected to have a positive impact on lagoon salinity.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
	Hydrological Regime/ metres	Annual water level fluctuations and minima within natural ranges	The construction of the proposed development could allow the release of lagoon water to the sea, or entry of sea water to the lagoon, thereby affecting the lakes depth. During operation phase, the proposed development will maintain levels between 2.34m ODP and 5.09m ODP.	Prevent an uncontrolled hydrological connection between the sea and the lagoon during construction stage. Regulation of water levels and operation stage.	The maximum depth of Lady's Island Lake lagoon is recorded as 6m. Fluctuations in water depth are a natural feature of lagoon hydrology. The proposed development will not have a significant impact on lagoonal area, with reference to baseline levels.
Coastal lagoons [1140]	Barrier: connectivity between lagoon and sea/ permeability	Appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management	The proposal has been designed to bring about a more stable lagoon-sea interface. The proposed development constitutes appropriate management, considering the unpredictability, and associated ecological effects, of the conventional 'cut'.	Lady's Island conservation value as a lagoon relies on active management.	The existing management regime involves partial removal/lowering of the gravel/sand barrier, with unpredictable effects on water levels, salinity and deposition. The proposed management will replace the current practice of barrier beach breaching and the associated tidal phase of the lagoon. With implementation of the plan, the project is expected to have a positive impact on the hydrological connection between the lagoons and sea.
Coastal lagoons [1140]	Negative indicator species/ Number and % cover	Negative indicator species absent or under control	Potential for importation of non-native species to site with deployment of machinery and equipment, during construction and operation phases.	Non-native and invasive species control protocols will be implemented as per **Section 10.1.4.10**	Low salinity, shallow water and elevated nutrient levels increase the threat of un-natural encroachment by reedbeds. The proposal will likely reduce the incidence of negative indicator species, as unfavourable conditions for these will be brought about by maintaining salinity and depth within the range suitable for lagoonal specialists.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Coastal lagoons [1140]	Water quality: Chlorophyll a/ µg/L	Annual median chlorophyll a within natural ranges and less than 5µg/L	Potential for disturbance of substrates at construction stage and during maintenance dredging, if required. This could increase phytoplankton in the water column and therefore increase Chlorophyll a levels.	Carrying out works behind a silt curtain to limit the spread of sediment from the works site. Working in accordance with a suite of environmental commitments (**Section 10.1.4**) including: • *Sediment and erosion controls* • *Excavated Materials and Spoil Management* • *Concrete and hydrocarbon controls* Works to follow prescribed method statements. A comprehensive construction & environmental management organisational structure put in place. Duties and responsibilities implemented by project manager, with input from ecologist (Section 10.1.2).	Sediment mobilisation during the construction and operation stages will be confined to the southern extent of the lake in the environs of the flow control structure/pipeline. Noting that the level of nutrient enrichment in Lady's Island Lake may be approaching a critical level, and that the proposal will allow controlled entry of sea water to the lagoon, the operational impact will be positive, with less phytoplankton in the water column and increased submergent macrophyte colonisation of the littoral zone. Overall, the proposed development will assist reaching the Chlorophyll a concentration target.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Coastal lagoons [1140]	Water quality: Molybdate Reactive Phosphorus (MRP)/ mg/L	Annual median MRP within natural ranges 0.1mg/L	Potential for disturbance of substrates at construction stage and during maintenance dredging, if required. This could increase MRP in the water column and therefore increase Chlorophyll a levels. Likewise, maintenance dredging could cause MRP increases. During operation when saltwater intrusion occurs in September, MRP concentrations would rise. This would be offset however by maintenance of high-water levels over the winter once, when daily inputs to the lake will be from feeder streams, thereby diluting MRP.	Carrying out works behind a silt curtain to limit the spread of sediment from the works site. Working in accordance with a suite of environmental commitments (**Section 10.1.4**) including: • *Sediment and erosion controls* • *Excavated Materials and Spoil Management* • *Concrete and hydrocarbon controls* The works will be carried out following prescribed method statements. A comprehensive construction & environmental management organisational structure will be put in place. Duties and responsibilities will be implemented by a project manager, with input from an ecologist (**Section 10.1.2**). Lake management: operation stage mitigation as per **Section 10.2**	The construction and operation phases involve mitigation to prevent mobilisation of sediment. Furthermore, sediment will be removed from the lake during maintenance dredging, noting that this may remove phosphorus in lake substrates in the affected area. The proposed development will therefore likely contribute positively to MRP concentrations.
Coastal lagoons [1140]	Water quality: Dissolved Inorganic Nitrogen (DIN)/ mgL	Annual median DIN within natural ranges and less than 0.15mg/L.	Impact of the proposed development on this attribute during construction related to disturbance of substrates at the southern end of lagoon. Likewise, maintenance dredging could cause increased concentrations. Impact is temporary however and highly unlikely to affect this measure.	Mitigation provided for other water quality parameters during construction stage (**Section 10.1.4**, **Section 10.1.2**) Lake management: operation stage mitigation as per **Section 10.2**.	Neutral to positive impact on annual median DIN.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Coastal lagoons [1140]	Depth of macrophyte colonisation / Metres	Macrophyte colonisation to at least 2m depth	Mobilisation of nutrients via substrate disturbance (construction and operation) and conveyance of nutrients to the lake from the sea by saltwater influx could cause enrichment.	Mitigation provided for other water quality parameters during construction stage (**Section 10.1.4**, **Section 10.1.2**) Lake management: operation stage mitigation as per **Section 10.2**.	More stable physico-chemical water conditions are envisaged with operation of the proposed development. Some temporary reduction in depth of colonisation possible if macrophytes present within the area around the pipeline, noting the absence of macroflora in this area during the October 2018 survey. Overall, considering lake levels will be more stable, and controlled within a certain range during operation, macrophyte depths targets will be favoured, resulting in a positive outcome for this attribute.
Coastal lagoons [1140]	Typical plant species/ Number and m^2	Maintain number and extent of listed lagoonal specialists, subject to natural variation	At operation stage, the proposed development will aim to preserve the physical components of lagoon habitat and the ecological processes that drive it, by efforts to control hydrology and salinity.	Mitigation provided for other water quality parameters during construction stage (**Section 10.1.4**, **Section 10.1.2**) Lake management: operation stage mitigation as per **Section 10.2**.	More stable physico-chemical water conditions are envisaged with operation of the proposed development. Overall, considering lake levels will be more stable, and controlled within a certain range during operation, macrophyte depths targets will be favoured, resulting in a positive outcome for this attribute.
Coastal lagoons [1140]	Typical animal species/ Number	Maintain listed lagoon specialists, subject to natural variation	Mobilisation of nutrients via substrate disturbance (construction and operation) and conveyance of nutrients to the lake from the sea by saltwater influx could cause enrichment. The management proposal is expected to assist this objective.	Mitigation provided for other water quality parameters during construction stage (**Section 10.1.4**, **Section 10.1.2**) Lake management: operation stage mitigation as per **Section 10.2**.	More stable physico-chemical water conditions are envisaged with operation of the proposed development. Overall, considering lake levels will be more stable, and controlled within a certain range during operation, macrophyte depths targets will be favoured, resulting in a positive outcome for this attribute.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Perennial vegetation of stony banks [1220]	Habitat area/ hectares	Area stable or increasing, subject to natural processes, including erosion and succession	'Perennial vegetation of stony banks' habitat, largely pioneer habitat will be lost during construction, but will be reinstated	Habitat will be reinstated as per **Section 10.1.4.2.**	The loss of shingle habitat cannot be avoided at construction stage. With the passing of time and coastal activity (storms, tides), habitats at the can be expected to become more stable. New shingle habitat will develop at the site beach at a higher elevation than the existing shingle habitat.
Perennial vegetation of stony banks [1220]	Habitat distribution/ occurrence	No decline, or change in habitat distribution, subject to natural processes including erosion and succession	A proportion of the area of this habitat south of Lady's Island Lake lies within the footprint of the proposed development, where an electrical cable supply and associated trenching is required through ca. 60 meters of this habitat. Erosion and accretion processes at the proposed development site will likely be more consistent with the barrier beach in general, which has seen a decline in 'Perennial vegetation of stony banks' habitat in recent times.	Habitat will be reinstated as per **Section 10.1.4.2.**	Likely development of shingle habitat at the crest and landward side of the lagoon will support this target.
Perennial vegetation of stony banks [1220]	Physical structure: functionality and sediment supply/ Presence-absence of physical barriers	Maintain the natural circulation of sediment and organic matter, without any physical obstructions	Change to the physiography of the barrier beach at the 'cut' current may change circulation of sediment in the environs of works area in the short term (< 1 yr).	Habitat will be reinstated as per **Section 10.1.4.2.** Project proponent to put measures in place to prevent/control gravel extraction.	The 'cut' is likely compromising the supply and natural circulation of sediment to higher elevations along the barrier beach. Post construction, there will no longer be a requirement to undertake annual dredging to form the 'cut', so functionality and sediment supply impacts associated with this activity will be removed.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Perennial vegetation of stony banks [1220]	Physical structure: disturbance/ percentage	No more than 20% of the habitat affected by disturbance	The proposed development will require heavy machinery to carry out the works, where trenching of ca. 60 m is required through this habitat. The area of habitat disturbed by the proposed development can be expected to be ca. 600m^2 (taking a width of 10m impacted). This area represents ca. 0.06% of the 0.97 ha. of this habitat mapped in the SAC, well below 20%.	Minimising impacted area by careful site management (See **Section 10.1.4.8 '**Protection of Habitats and Flora')	Disturbance impacts estimated to <1% of the habitat area cannot be avoided but will be minimised. Post construction, there will no longer be a requirement to undertake annual dredging to form the 'cut', so disturbance impacts associated with this activity will be removed.
Perennial vegetation of stony banks [1220]	Vegetation structure: zonation/ occurrence	Maintain range of coastal habitats including transitional zones, subject to natural processes including erosion and succession	Area of some dune habitats adjacent to the 'cut' will be temporarily reduced during construction stage, noting that their extent adjacent to the 'cut' is likely maintained by annual breaching of the barrier beach. Post construction, dune habitats to the east and west of the 'cut', including fixed dunes will likely develop over time to join and form a continuous dune system along the southern shore of Lady's Island Lake.	Minimising impacted area by careful site management (See **Section 10.1.4.8 '**Protection of Habitats and Flora') Habitat will be reinstated as per **Section 10.1.4.2.**	Sediment dynamics for shingle habitat may be ameliorated by stabilising the beach barrier at the 'cut', with more even distribution of gravels along the barrier and potentially enhancing development of washover fans. A more stable grassland shingle community may eventually develop within the SAC, noting that only a pioneer shingle community community was only recorded within the boundary of the SAC during the VSM study (Martin *et al.* 2017).
Perennial vegetation of stony banks [1220]	Vegetation composition : communities and typical species/ Occurrence	Maintain the typical species within the range of vegetated shingle communities	The footprint of the proposed development on this habitat is at an area of little / no vegetation, so impact is minimal / none	Minimising impacted area by careful site management (See **Section 10.1.4.8 '**Protection of Habitats and Flora') Habitat will be reinstated as per **Section 10.1.4.2.**	Currently, the 'cut' is prone to regular disturbance and does not currently support a well-established rooted plant community. The development of a floral shingle community is more likely post construction and would be a positive attribute for the target.

Feature of Interest	Attribute/ Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Perennial vegetation of stony banks [1220]	Vegetation composition : negative indicator species/ Percentage	Negative indicator species cover in any individual monitoring stop should not be more than 25%; no negative indicator species should be present in more than 60% of monitoring stops	Importation of non-native species.	Prevent the importation and spread of non-native species as per **Section 10.1.4.10**.	The development of a floral shingle community is predicted at the proposed development site and would be a positive attribute for the target.

11.2 LADY'S ISLAND LAKE SPA

Table 19: Summary of residual impacts of the proposed Lady's Island Lake Water Level Management project on features of interest in Lady's Island Lake SPA. Attributes, measures and targets for Common Tern and Wetlands based on the NPWS (2014) Conservation Objectives for Cork Harbour SPA. Attributes, measures and targets for Roseate Tern and Arctic Tern from the Rockabill SPA.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Common Tern	Breeding population abundance: apparently occupied nests (AONs)/ Number	No significant decline	Disturbance impacts during construction phase	Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**	The operational stage of the project will maintain water levels in Lady's Island Lake that favour nesting Terns, by isolating the islands used for nesting from the mainland and preventing predation by mammals. This is regarded a positive impact.
Common Tern	Productivity rate: fledged young per breeding pair / Mean number	No significant decline	Disturbance impacts during construction phase	Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**	The proposal will help productivity rates by stabilising water levels during the breeding season and inundating nesting areas at Inish and Sgarbheen during winter. intended to decrease predation of eggs and chicks. This constitutes a positive impact for fledged young per breeding pair.
Common Tern	Distribution: breeding colonies / Number; location; area (hectares)	No significant decline	Disturbance impacts during construction phase may potentially affect the breeding colony.	Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**	The proposal will not cause a decline in breeding colonies. Stabilising water levels during the breeding season and inundating nesting areas at Inish and Sgarbheen during winter has will likely have the intended effect of decreasing predation of eggs and chicks. This constitutes a positive impact for this attribute.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Common Tern	Prey biomass available / Kilogrammes	No significant decline	Proposal has potential to affect food supply via water quality and salinity impacts.	Lagoon/aquatic ecology will be protected as follows. Carrying out works behind a silt curtain to limit the spread of sediment from the works site. Working in accordance with a suite of environmental commitments (**Section 10.1.4**) including: • *Sediment and erosion controls* • *Excavated Materials and Spoil Management* • *Concrete and hydrocarbon controls* Working according to prescribed method statements. A comprehensive construction & environmental management organisational structure will be put in place. Duties and responsibilities will be implemented by a project manager, with input from an ecologist (**Section 10.1.2**).	Key prey items such as small fish, crustaceans, insects and occasionally squid will not be impacted so there will be no impact on prey biomass available.
Common Tern	Barriers to connectivity / Number; location; shape; area (hectares)	No significant increase	Proposal does not represent a barrier to connectivity	No specific mitigation required. Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**.	Proposed works carried out over a 9-month period so some disturbance at the southern end of the lake. The construction and operation phases will not obstruct terns' accessing the sea however as the works are limited to a specific area. No significant barrier to connectivity.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Common Tern	Disturbance at the breeding site / Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population	Impact of displacement and avoidance of foraging birds from southern end of lagoon and adjacent sea regarded a temporary impact and not significant.	No specific mitigation required. Works timed to avoid the peak breeding season (See **Section 10.1.4.12** 'Construction Noise' and **Section 10.1.4.3** 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**.	Human activities will not occur at levels that adversely affect the breeding tern populations
Roseate Tern / Arctic Tern	Breeding population abundance: apparently occupied nests (AONs) / Number	No significant decline	Disturbance impacts during construction phase	Works timed to avoid the peak breeding season. See **Section 10.1.4.12** 'Construction Noise' and **Section 10.1.4.3** 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**.	The operational stage of the project will maintain water levels in Lady's Island Lake that favour nesting Terns, by isolating the islands used for nesting from the mainland and preventing predation by mammals. This is regarded as a positive impact.
Roseate Tern / Arctic Tern	Productivity rate: fledged young per breeding pair / Mean number	No significant decline	Disturbance impacts during construction phase	Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**	The proposal will help productivity rates by stabilising water levels during the breeding season and inundating nesting areas at Inish and Sgarbheen during winter. intended to decrease predation of eggs and chicks. This constitutes a positive impact for fledged young per breeding pair.
Roseate Tern / Arctic Tern	Distribution: breeding colonies / Number; location; area (hectares)	No significant decline	Disturbance impacts during construction phase may potentially affect the breeding colony.	Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**	The proposal will not cause a decline in breeding colonies. Stabilising water levels during the breeding season and inundating nesting areas at Inish and Sgarbheen during winter has will likely have the intended effect of decreasing predation of eggs and chicks. This constitutes a positive impact for this attribute.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Roseate Tern / Arctic Tern	Prey biomass available / Kilogrammes	No significant decline	Proposal has potential to affect food supply via water quality and salinity impacts.	Lagoon/aquatic ecology will be protected as follows. Carrying out works behind a silt curtain to limit the spread of sediment from the works site. Working in accordance with a suite of environmental commitments (**Section 10.1.4**) including: • *Sediment and erosion controls* • *Excavated Materials and Spoil Management* • *Concrete and hydrocarbon controls* Working according to prescribed method statements. A comprehensive construction & environmental management organisational structure will be put in place. Duties and responsibilities will be implemented by a project manager, with input from an ecologist (**Section 10.1.2**).	Key prey items such as small fish, crustaceans, insects and occasionally squid will not be impacted so there will be no impact on prey biomass available.
Roseate Tern / Arctic Tern	Barriers to connectivity / Number; location; shape; area (hectares)	No significant increase	Proposal does not represent a barrier to connectivity	No specific mitigation required. Works timed to avoid the peak breeding season (See Section 10.1.4.12 'Construction Noise' and 10.1.4.3 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**.	Proposed works carried out over a 9-month period so some disturbance at the southern end of the lake. The construction and operation phases will not obstruct terns' accessing the sea however as the works are limited to a specific area. No significant barrier to connectivity.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Roseate Tern / Arctic Tern	Disturbance at the breeding site / Level of impact	Human activities should occur at levels that do not adversely affect the breeding common tern population	Impact of displacement and avoidance of foraging birds from southern end of lagoon and adjacent sea regarded a temporary impact and not significant.	No specific mitigation required. Works timed to avoid the peak breeding season (See **Section 10.1.4.12** 'Construction Noise' and **Section 10.1.4.3** 'Timing of works'. Lake management: operation stage mitigation as per **Section 10.2**.	Human activities will not occur at levels that adversely affect the breeding tern population
Gadwall	Population trend / Percentage change	Long term population trend stable or increasing	Composition of plant assemblages in the lake could be altered by changes to water quality and salinity, so feeding opportunities of Gadwall could be affected.	Avoidance / minimise water quality impacts. Working in accordance with a suite of environmental commitments (**Section 10.1.4**)	Long term population trend can be expected to be more stable, due to enhanced lake management.
Gadwall	Distribution / Number and range of areas used	No significant decrease in the range, timing or intensity of use of areas by Gadwall, other than that occurring from natural patterns of variation	Birds using the southern end of the lake could be adversely affected by water quality impacts habitats	Impacts to lagoon ecology will be protected by working in accordance with a suite of environmental commitments (**Section 10.1.4**)	Gadwall nesting may be improved with proposed management of lake levels.

Special conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Black-headed Gull	Population trend / Percentage change	Long term population trend stable or increasing	Birds using the southern end of the lake could be adversely affected by water quality impacts habitats	To ensure the population continues to increase, water quality in the lake will need to be maintained. Impacts to lagoon ecology will be protected by working in accordance with a suite of environmental commitments (**Section 10.1.4**)	Overall improvement in lagoon ecology expected to improve foraging and will not negatively affect the long-term population trend.
Black-headed Gull	Distribution / Range, timing and intensity of use of areas	No significant decrease in the range, timing or intensity of use of areas by black-headed gull, other than that occurring from natural patterns of variation.	Use of Islands could potentially be affected by water level changes, but this impact is positive.	None required.	Overall improvement in lagoon ecology expected to improve foraging and will not negatively affect the range, timing and intensity of use of areas.
Wetlands	Habitat area / Hectares	The permanent area occupied by the wetland habitat should be stable and not significantly less than the mapped area, other than that occurring from natural patterns of variation.	Lake levels will be better managed thus having a positive effect.	Monitoring of lake levels and salinity, and regulation by Wexford County Council. See **Section 10.2.1** 'Water levels' and **Section 10.2.2** 'Salinity' and ongoing management (**Section 10.2.5**).	Improved stability of lake levels and salinity concentrations. The proposed development will not have a significant negative impact on lagoon area.

11.3 CARNSORE POINT SAC

Table 20: Summary of residual impacts of the proposed Lady's Island Lake Water Level Management project on features of interest in Carnsore Point SAC .

Conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Reefs	Habitat Distribution / Occurrence	The distribution of reefs should remain stable, subject to natural processes.	Reef could be adversely affected by physical disturbance during construction.	Avoidance of reef habitat – see **Section 10.1.4.8** 'Protection of Habitats and Flora'	The distribution of reefs will remain stable.
Reefs	Habitat area / Hectares	The permanent habitat area is stable, subject to natural processes.	Secondary impacts on this habitat could ensue from deposits of fine substrates emitted from construction process.	Water quality mitigation as per **Section 10.1.4** 'Environmental commitments'	Habitat area will be maintained.
Reefs	Community structure / Biological composition	The following reef community complexes should be maintained in a natural condition: Intertidal reef community complex; and Subtidal reef dominated by echinoderms and sponges community complex.	Structure and function of reef may be negatively affected by sedimentation.	Water quality mitigation as per **Section 10.1.4** 'Environmental commitments'.	Sheltered to moderately exposed intertidal reef community complex corresponding to an estimated area of 24ha.

Conservation interest	Attribute / Measure	Target	Summary of impact	Mitigation summary	Summary of residual impact
Reefs	Community extent / Hectares	The extent of Laminaria dominated community should be conserved, subject to natural processes.	Though unlikely, the community extent of this habitat may be negatively affected by the effects of sedimentation. The biology of the Laminaria dominated community should be conserved.	Water quality mitigation as per **Section 10.1.4** 'Environmental commitments'	The extent of Laminaria dominated community will be conserved.
Reefs	Community structure / Biological composition	The biology of the Laminaria dominated community should be conserved, subject to natural processes	Adverse effects on water quality may have a significant impact on reef biological composition, due to potential release of water of poor quality into sea during construction phase and dredging.	Water quality mitigation as per **Section 10.1.4** 'Environmental commitments'.	The biology of the Laminaria dominated community will be conserved.
Mudflats and sandflats not covered by seawater at low tide	Habitat area / Hectares	The permanent habitat area is stable or increasing, subject to natural processes.	None identified - habitat occurs ca. 3km east of the proposed development. No direct impacts or significant secondary ecological effects to mudflat and sandflat communities.	None required	The permanent habitat area will be stable or increasing
Mudflats and sandflats not covered by seawater at low tide	Distribution / Hectares	The following community complex should be conserved in a natural condition: Intertidal sand dominated by polychaetes and crustacea community complex	None identified - habitat occurs ca. 3km east of the proposed development. No direct impacts or significant secondary ecological effects to mudflat and sandflat communities.	None required	The permanent habitat area will be stable or increasing

12 CONCLUSION

Unmanaged lake and salinity levels may pose a threat to flora and fauna in Lady's Island Lake. In the past, lake levels have been so lowered as to threaten the lake's value as an area of environmental interest with high water levels threatening Terns. The lake area can become tidal for a period following a 'cut'. This can result in an increase in the salinity of the lake water with potentially adverse environmental impacts. The purpose of the proposed development is to allow management of water levels in cognisance of conservation measures which are necessary to achieve favourable conservation status and correspond to the ecological requirements of the habitats and species for which the site is designated. The ecological requirements involve all the ecological needs, including both abiotic and biotic factors, which are deemed necessary to ensure the conservation of the habitat types and species, including their relations with the physical environment (air, water, soil, vegetation, etc.).

In conclusion, provided the recommended mitigation measures are implemented in full it is not expected that the proposal to manage water levels and salinity at Lady's Island will result in an adverse residual impact on the conservation objectives of the Natura 2000 sites considered in this NIS, namely:

- Lady's Island Lake SAC
- Lady's Island Lake SPA and
- Carnsore Point SAC.

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Appendix 1
Screening Report

Malachy Walsh and Partners
Engineering and Environmental Consultants

Screening for Appropriate Assessment

Lady's Island Lake Water Level Management

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ISSUE FORM	
Project number	17281
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1 SUMMARY OF FINDINGS

1.1 SCREENING FOR APPROPRIATE ASSESSMENT

Project Title	Lady's Island Water Level Management
Project Proponent	Wexford County Council
Project Location	Our Lady's Island, Co. Wexford
Screening for Appropriate Assessment	The Screening for Appropriate Assessment is undertaken to determine the potential for likely significant effects of a project, individually, or in combination with other plans or projects, in view of the conservation objectives of the site on a Natura 2000 Site.
Conclusion	It has been concluded with regard to the proposed water level management project at Lady's Island that significant effects cannot be ruled out at this stage, on the following Natura 2000 sites: • Lady's Island Lake SAC (site code 000704) • Lady's Island Lake SPA (site code 004009) and • Carnsore Point SAC (site code 002269) and thus must proceed to Appropriate Assessment and a Natura Impact Statement prepared.

2 INTRODUCTION

2.1 PURPOSE OF ASSESSMENT

This Screening for Appropriate Assessment has been undertaken to determine the potential for significant impacts on a proposal for the management of water levels, in Lady's Island Lake, on nearby sites with European conservation designations (i.e. Natura 2000 Sites).

This Screening for Appropriate Assessment has been undertaken by Malachy Walsh and Partners ecologists.

2.2 LEGISLATIVE CONTEXT

The Habitats Directive (92/43/EEC) seeks to conserve natural habitats and of wild fauna and flora by the designation of Special Areas of Conservation (SACs) and the Birds Directive (79/409/EEC) seeks to protect birds of special importance by the designation of Special Protected Areas (SPAs). It is the responsibility of each member state to designate SPAs and cSACs, both of which will form part of Natura 2000, a network of protected sites throughout the European Community. The Habitats Directive has been transposed into Irish law and the relevant Regulations are the European Communities (Birds and Natural Habitats) Regulations 2011. The current assessment was conducted within this legislative framework and also the DoEHLG (2009) guidelines.

2.3 STAGES OF APPROPRIATE ASSESSMENT

The Appropriate Assessment process is a four-stage process with issues and tests at each stage. An important aspect of the process is that the outcome at each successive stage determines whether a further stage in the process is required. The stages are set out in **Appendix 1**.

3 ASSESSMENT METHODOLOGY

3.1 APPROPRIATE ASSESMENT GUIDANCE

This Screening for Appropriate Assessment, or Stage 1 has been undertaken in accordance with the European Commission Methodological Guidance on the provision of Article 6(3) and 6(4) of the 'Habitats' Directive 92/43/EEC (EC, 2001) and the European Commission Guidance 'Managing Natura 2000 sites' (EC, 2000) and guidance prepared by the NPWS (DoEHLG, 2009).

3.2 DESK STUDY

In order to complete the Screening for Appropriate Assessment certain information on the existing environment is required. A desk study was carried out to collate available information on the site's natural environment. This comprised a review of the following publications, data and datasets:

- OSI Aerial photography and 1:50000 mapping, and other online mapping sources (online)
- National Parks and Wildlife Service (NPWS) (online)
- National Biodiversity Data Centre (NBDC) (online)
- BirdWatch Ireland
- Geological Survey Ireland (GSI) area maps (online)
- Environmental Protection Agency (EPA) water quality data (online)
- South Eastern River Basin District (SERBD) datasets (Water Framework Directive) (online)
- Other information sources and reports footnoted in the course of the report

3.3 SCREENING FOR APPROPRIATE ASSESSMENT

As set out in the NPWS guidance, the task of establishing whether a plan or project is likely to have an effect on a Natura 2000 site(s) is based on a preliminary impact assessment using available information and data, including that outlined above, and other available environmental information, supplemented as necessary by local site information and ecological surveys. This is followed by a determination of whether there is a risk that the effects identified could be significant. The precautionary principle approach is required.

Once the potential impacts that may arise from the proposal are identified the significance of these is assessed through the use of key indicators:

- Habitat loss
- Habitat alteration
- Habitat or species fragmentation
- Disturbance and/or displacement of species
- Water quality and resource.

4 SCREENING FOR APPROPRIATE ASSESSMENT

Screening for Appropriate Assessment (Stage 1) determines the need for a full Appropriate Assessment (Stage 2) and consists of a number of steps, each of which is addressed in the following sections of this report:

4.1 Establish whether the project is necessary for the management of a Natura 2000 site
4.2 Description of the project (*Lady's Island Lake Water Level Management*)
4.3 Identification of Natura 2000 sites potentially affected
4.4 Identification and description of individual and cumulative impacts of the project
4.5 Assessment of the significance of the impacts on the integrity of Natura 2000 sites
4.6 Conclusion of screening stage

4.1 MANAGEMENT OF NATURA 2000 SITES

The proposal is connected with the conservation management of a Lady's Island Lake, which is designated within the following Natura 2000 sites: Lady's Island Lake SAC (site code 000704) and Lady's Island Lake SPA (site code 004009). In terms of the SPA, water level management is necessary for the terns nesting on islands within the Lake.

With regard to Lady's Island Lake SAC, and in the absence of conservation objectives for this site, a likely conservation objective target in relation to Coastal lagoons habitat is 'appropriate hydrological connections between lagoons and sea, including where necessary, appropriate management'. This objective has been taken from the conservation objectives for the Tralee Bay and Magharees Peninsula, West to Cloghane SAC, which also features lagoon habitat.

4.2 DESCRIPTION OF PLAN/PROJECT

4.2.1 Brief Project Description

Lady's Island Lake is a lagoon lake on the south coast of County Wexford. The lake is fed by runoff from the surrounding catchment and is held in place by a barrier beach between it and the sea. The lake is a designated Special Area of Conservation (SAC) for a number of coastal habitats and Special Protected Area (SPA) for breeding and wintering birds.

In order to control flooding the lake is presently drained by cutting a channel through the barrier beach and letting water flow uncontrolled through the channel. The channel is initially shallow and narrow but the water exiting the lake gradually makes the channel much wider and deeper than the initial cut. The width of the channel can grow to greater than 100m wide and the channel can deepen considerably lower than the initial cut level. This method of drainage is not controlled and can lower the level of the lake below that which is desirable for ecological interests. It can also cause the lake to become tidal for an indeterminate period, which influences the salinity of the lake.

The current project involves installing a drainage pipeline and flow control structure at the southern end of the lake which will act to manage water levels in Lady's Island lake. The pipeline will allow saline water to enter the lake in a controlled manner and allow controlled drainage of the lake to the sea. A flow control structure (of approximately 100m^2 plan area) will be located in the lake at the landward side of the barrier beach. It will be partially submerged in the lake. An associated dredged

drainage channel of approximately 3,000m^2 plan area will be required to ensure the functionality of the flow control structure.

4.2.2 Purpose of the Project

The purpose of this project was to review the various engineering solutions to meet the requirements of the management of the lake levels, that is, to control lake levels to avoid flooding of surrounding lands while ensuring sufficient lake levels to the ecology of the lake. The project is necessary to the management of the SPA, where terns require certain water levels during their nesting season, noting also however that there are potential significant negative impacts on the Lady's Island SAC (code 000704).

4.2.3 Site Location

Lady's Island Lake is a natural, brackish, sedimentary percolating lagoon, situated on the south coast of County Wexford ca. 3km west of Carnsore Point. Lady's Island Lake is a coastal lagoon isolated from the sea but subject to wide fluctuations in water-level and salinity as a result of more or less regular breaching of the dune barrier (Healy, 1997). **Figure 1** shows the location of Lady's Island Lake.

4.2.4 Description of the Site

Lady's Island Lake is situated in the extreme south-east of Ireland and is comprised of a shallow, brackish coastal lagoon separated from the sea by a 200m long sand and shingle barrier. The lake is 3.7 km in length and 1.3 km at its widest, southerly point. The lake and its two islands, Inish and Sgarbheen, are designated Special Protection Areas (SPA), holding internationally important numbers of breeding terns. This site is of high conservation importance, having three habitats which are listed on Annex I of the EU Habitats Directive and one of these (lagoons) with priority status.

Our Lady's Island lake is situated in the Ballyteigue-Bannow catchment (EPA Code: 13). This catchment has an Area of 660.05 km^2. This catchment includes the area drained by all streams entering tidal water between Greenore Point and Railway Bridge, Great Island, Co. Wexford, draining a total area of 654km^2. There are no large urban centres in the catchment. The only urban centres in this catchment are Lady's Island, Kilmore Quay, Bridgetown, Wellingtonbridge, Duncannon, and Campile. The total population of the catchment is approximately 26,593 with a population density of 41 people per km^2.

The catchment has an undulating topography and is underlain by a series of volcanic and metamorphic rocks. The main bedrock geology of Lady's Island Lake is Carnsore Granite. Saltees Granite and Kilmore Quay Group-Banded quartzo-feldspathic paragneisses makes up the bedrock of the northern part of the lake and Greenore Point Group- Foliated amphibolites with minor schists is the bedrock to the north of the lake[1].

[1] https://www.gsi.ie/en-ie/Pages/default.aspx

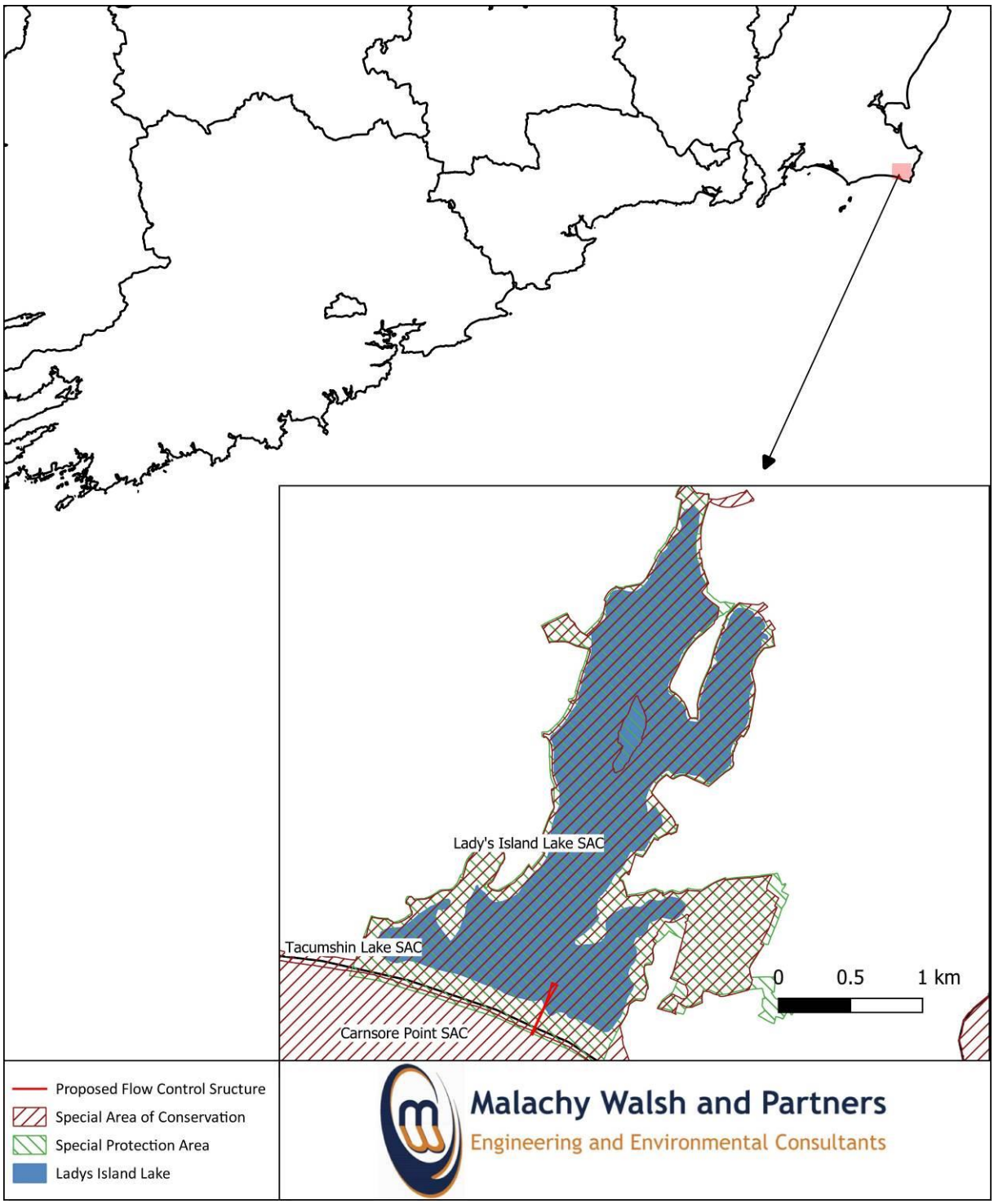

Figure 1: Location of Lady's Island Lake, Co. Wexford.

4.2.5 Characteristics of the Project

The proposal is described below and has been confirmed with Wexford County Council.

Introduction	Project Introduction: The proposed works consist of • A drainage pipeline. The pipeline will act to manage water levels in the lake and to allow saline water to enter the lake in a controlled manner. The pipeline will consist of 2 No. 1.2m internal diameter pipes with a reinforced concrete flow control structure at the Lake end and an outlet on the beach fronting Lady's Island Lake.
Size, scale, area, land-take	Land-take: • The foot-print of the proposed pipeline and associated works will be located within the boundary of the Lady's Island Lake SPA and SAC. • A flow control structure (of approximately 100m^2 plan area) will be located in the lake at the landward side of the barrier beach. It will be partially submerged in the lake. An associated dredged drainage channel of approximately 3,000m^2 plan area will be required to ensure the functionality of the flow control structure. The weir inlet to the flow control structure will be set at 2.09mODP (-0.5mODM). • 2 no. 1.2m ϕ (internal diameter) concrete pipelines will extend approximately 200m southwards from the flow control structure to a junction box (20m^2 plan area) located within the beach fronting Lady's Island Lake. This proposed junction box is located within the existing beach profile. This profile will be reinstated after construction, concealing the junction box and concrete pipes. • 2 no. 1.2mϕ ductile iron pipes will extend southwards 32m from the junction box to their outlet in the intertidal zone. These pipes will be supported by 15m long steel piles and associated concrete pile caps. There will be 2 no. 300mm x 500mm concrete struts between each pile cap. The natural profile of the beach will conceal the majority of this structure. • A buried power line will extend from the nearest power point along the existing access path and within the beach to the pipeline flow control structure.
Details of physical changes that will take place during the various stages of implementing the proposal	Flow control Structure Construction: The flow control structure will be constructed of the following: • A hot dip galvanised steel trash/safety screen at the inlet of the flow control structure; • 2no. stainless steel penstock plates to regulate flow through the

	structure; • Reinforced concrete housing structure (13m x 6 m x 8m); • Actuators to open and close the penstock plates; • A control kiosk (approximately 1.8mx1.8mx2.4m) located on top of the flow control structure; • Manhole to allow for maintenance works to flow control structure; • Water and salinity level monitors within the structure and in the lake towards its northern end. Concrete Pipes Construction: 2no. Concrete pipes (1.2m internal diameter, 1.4m outer diameter) will extend approximately 200m south from the flow control structure to a junction box located within the existing sand dune profile. These pipes will be ground bearing. The pipe invert level is proposed to be 0.89mODP (-1.7mODM). Junction Box Construction: A concrete junction box (approximately 4m x 6m x 5m) will connect the concrete pipes running from the flow control structure in the lake to the ductile iron pipes extending seawards through the beach. This junction box includes a manhole for maintenance purposes. The junction box is located within the profile of the existing beach and will be hidden from view after construction. The junction box doubles as a retaining structure taking wave forces on the long axis of the ductile iron pipes. Ductile Iron Pipes: The ductile iron pipes will span between the pile bents. The purpose of the pile bents and ductile iron pipes over the seawards section of the pipeline is to cater for beach profile changes and the ongoing retreat of the barrier beach. The piles provide vertical and lateral support to the pipeline. 2no. Ductile iron pipes (1.2m internal diameter, 1.255m external diameter) will extend approximately 32m seawards from the junction box to the pipeline's outfall in the intertidal zone. These ductile iron pipes will be supported by 4no. pile and pile cap arrangements spaced at regular intervals. Each pile and pile cap arrangement consists of 2 no. raked 406*20 Circular Hollow Section (CHS) steel piles, approximately 15m long each, and a 1m x 2.3m x 3.6m approx. concrete pile cap. The natural profile of the beach will conceal the majority of the pipeline. The pipe invert level will be 0.89mODP (-1.7mODP).

	Rock Armour Constraint Cut: The amended application **excludes** the original proposed rock armour constraint cut. Reprofiled Barrier Beach: It is NOT proposed to reprofile the barrier beach in the immediate vicinity of the proposed works, nor to plant this area with marram grass. Power Line. It is proposed to provide a power line from the nearest power point to the flow control structure. This line will be buried at the side of the existing access track to the beach and buried within the beach as it crosses the open beach area to the flow control structure. Access Path Access to the structure during the construction and operational phases will be via an existing access path and across an open beach area. It is NOT proposed to construct a specific path for the purposes of the development. Lady's Island Lake Water Levels: The proposed works have the intended purpose of controlling lake levels. High lake levels pose the risk of flooding adjacent farmland. However, unmanaged lake levels and salinity levels may pose a threat to flora and fauna in the lake, which are integral to the SPA and SAC status of the lake. An annual programme of the proposed works' management of these lake levels is as follows: • In September, when the terns have left the lake, the lake level will be drawn down to +2.2mODP to +2.6mODP. Then for the next 2-4 weeks seawater will be allowed into the lake with little outflows. This is to allow salinity levels within the lake to be raised. During this time outflows are to be limited to minimise saline water in the vicinity of the pipe being discharged back to sea before mixing fully with fresh water in the lake. • In October the inflow is to be stopped and the outlet closed until lake levels rise to approximately +4.4 to 4.6m ODP. During the winter period lake levels are to be allowed rise to 5.1mODP and be maintained at or above this level for a period of at least one month, following which lake levels are to be maintained between +4.6mODP and +5.0mODP until March when levels are to be drawn down to +3.8 to 4.2mODP to facilitate the terns. • From March to August lake levels are to be maintained within the range +3.8mODP to +4.2mODP. For this to be achieved

	initial levels should be maintained close to +4.2mODP to ensure that lake levels do not go below the 3.8mODP lower level due to evapotranspiration effects.
Description of resource requirements for the construction/operation and decommissioning of the proposal (water resources, construction material, human presence etc)	Equipment: • 2 no. excavators; • Crane and pile leaders; • Sheet-piling temporary works; • 30 no. concrete delivery truck visits; • 60 no. haulage truck visits; Material: • Electrical Kiosk and power connection; • 200 no. 2m long 1.2m inner diameter concrete pipes; • 8 no. 8m long 1.2 inner diameter ductile iron pipes; • 300m^3 concrete; • 60T reinforcement; • 12,000m^3 excavation; • Penstock plates and manifold; • Manhole; • Access covers; • Intake trash screen; • Level monitors at flow control structure; • Salinity monitors at flow control structure and in the lake; • 8 no. 15m long 406x20 Circular hollow section piles.
Description of timescale for the various activities that will take place as a result of implementation (including likely start and finish date)	• Mobilisation/demobilisation will take approximately 1 month. • Construction of the flow control structure will take approximately 2 months. • Construction of the concrete pipes will take 3 months. • Construction of the junction box and ductile iron pipeline will take approximately 3 months. • The Start and the Finish Dates have not been confirmed. It would be best, from an ease of constructability point of view, if the works were commenced in spring/summer and start on the seaward side. A possible timeframe for works would be March-

	November. It may however take longer than 9 months.
Description of wastes arising and other residues (including quantities) and their disposal	• Excavated material will be placed on adjacent areas and replaced on top of the pipeline upon completion of works. Excavated material will also be used in the re-profiled barrier beach. The substrates removed in order to install the pipeline and flow control structure comprise gravels and sands. Any materials not conforming to these particle sizes will not be used to reconstruct habitats. • All construction wastes will be safely stored on site before disposal off-site.
Identification of wastes arising and other residues (including quantities) that may be of particular concern in the context of the Natura 2000 network	• N/A
Description of any additional services required to implement the project or plan, their location and means of construction	• Secure construction site compound with bunded areas for storage of plant and material. This will be located approximately 50m from the proposed development to the south of Lady's Island Lake and will not impact on any ecologically important habitat. Access to the site will be from the local road network and via existing tracks along the southern shore of the lagoon.

4.3 IDENTIFICATION OF OTHER PROJECTS OR PLANS OR ACTIVITIES

4.3.1 Plans

A search of the Wexford County Council website indicates pending planning permission at two sites that may impact on Lady's Island Lake. Permission is pending since 17.04.18 for the erection of a straw bed agricultural shed, effluent storage tank, and all ancillary site works (Application no. 20180485). This site is located in the townland of Nineteenacres, Lady's Island to the north east of the site. Permission is also pending since 18.04.18 for the erection of a straw storage shed and associated site works in an existing farmyard located at the northerly point of the lake at Eardowns Great Lady's Island (Application no. 20180492).

4.3.2 Diffuse and Point Sources of Pollution

Polluting substances from point (industrial pollutants, wastewater effluents, stormwater sewers) and diffuse (urban and agricultural runoff) sources associated with ongoing activities in the Lady's Island Lake area. There are no waterbodies within the Ballyteigue-Bannow catchment are at risk from forestry however, the majority of the area is at risk from agricultural practices.

The following is a list of known point sources that contribute nutrients to Lady's Island lake and may be adversely affecting water quality:

- Primary effluent emissions point at Lady's Island lake (EPA, 2011)
- A secondary sewage treatment plant, agglomeration of <500 people on the northern side and

In 2011 an EPA Inspectors Report on a Waste Water Discharge Certificate of Authorisation Application for Lady's Island stated that the agglomeration currently has a population equivalent (p.e.) of 219. The agglomeration is serviced by one waste water treatment plant (WWTP). The WWTP provides tertiary treatment, consisting of primary settlement, rotating biological contactors and phosphorous removal, and has a design capacity of 300 p.e. The WWTP discharges to the Lady's Island Lake (EPA, 2011).

4.4 IDENTIFICATION OF NATURA 2000 SITES

4.4.1 Zone of Impact Influence

The 'zone of influence' for a project is the area over which ecological features may be affected by biophysical changes as a result of the proposed project and associated activities. The screening stage of AA involves compiling a 'long list' of European sites within a zone of potential impact influence for later analysis which may or may ultimately not be significantly impacted upon by the proposal. All Natura 2000 sites within 15km of the proposal location will be characterised in the context of the rationale for designation and qualifying features, in accordance with NPWS guidance. Following this, the potential impacts associated with the proposal will be identified before an assessment is made of the likely significance of these impacts.

As described above, the test for the screening for Appropriate Assessment is to assess, in view of best scientific knowledge, if the development, individually or in combination with other plan/project is likely to have a significant effect on a Nature 2000 site. If there are any significant, potentially significant, or uncertain effects, it will be necessary to proceed to Appropriate Assessment and submit an NIS.

4.4.2 Identification of Natura 2000 Sites

Adopting the precautionary principle in identifying potentially affected European sites, it has been decided to include all cSACs and SPAs, within a 15km radius of the proposal site. The proposed development site has been taken as the footprint of the flow control structure and Lady's Island Lake, as the lake would be impacted by regulation. **Table 1** below lists designated cSACs and SPAs within 15km or the anticipated zone of the proposal site including their proximity (also illustrated in **Figure 1**). Given the nature, scope, scale and location of the works, it is not considered that the proposal will significantly affect Natura 2000 sites outside of those considered here.

4.4.3 Characteristics of Natura 2000 Sites and Ramsar Sites

Table 2 below lists all designated SACs and SPAs within 15km or the anticipated zone of influence of the proposal site, and their features of interest. Information pertaining to designated sites is from site synopses, conservation objectives and other information available on www.npws.ie. Each of the designated sites within 15 km of the proposed development are discussed below in terms of their quality and importance and other site characteristics.

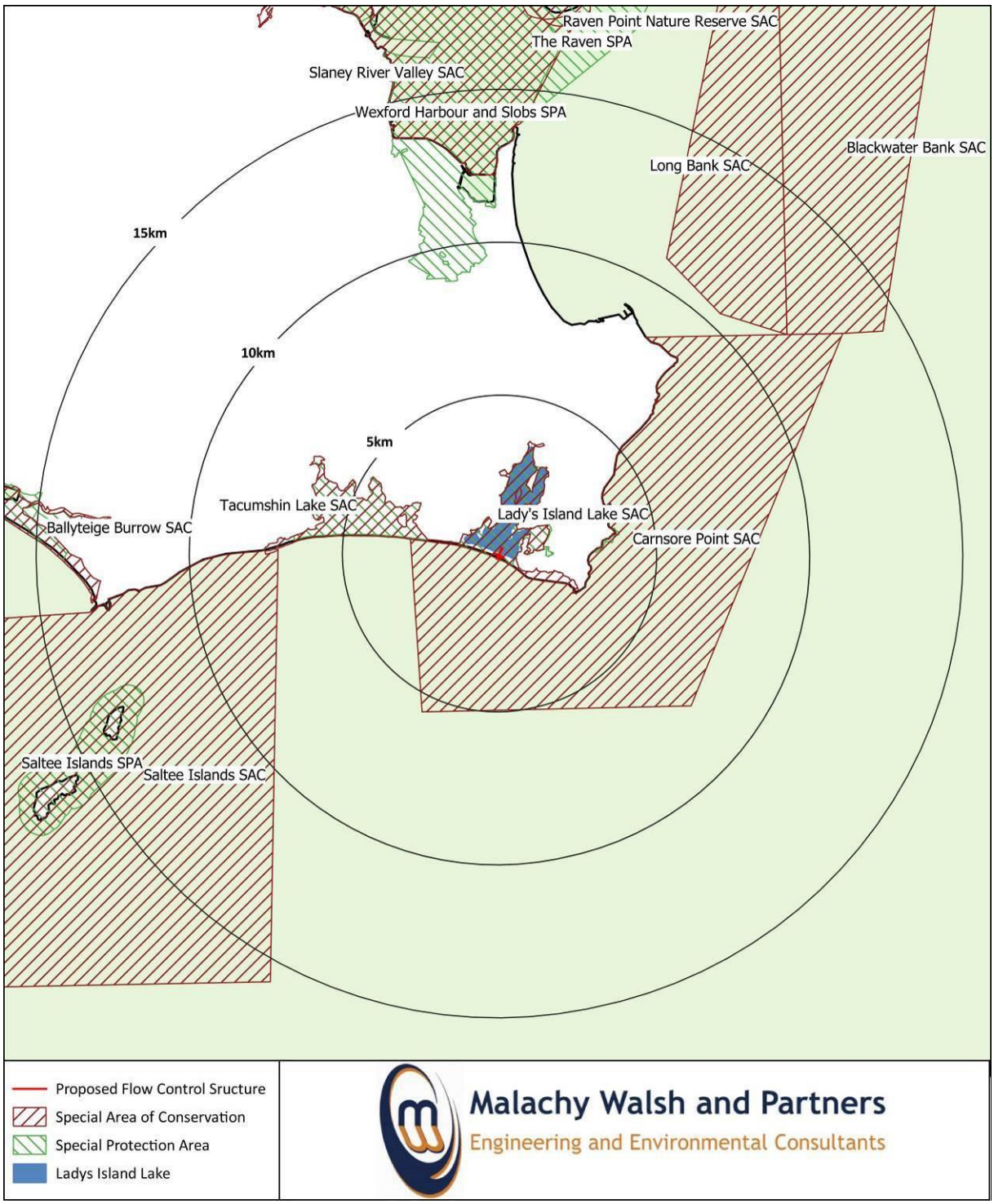

Figure 2: Designated Natura 2000 sites within 15km of the proposed development

Table 1: Designated conservation sites within 15km radius of proposed development

No.	Designated Site	Site Code	Proximity of site to nearest point of designated site
1	Lady's Island Lake SAC	000704	0km, some of the works are within this site
2	Lady's Island Lake SPA	004009	0km, some of the works are within this site
3	Carnsore Point SAC	002269	0km, some of the works are within this site
4	Tacumshin Lake SAC	000709	2.2km to the west
5	Tacumshin Lake SPA	004092	2.2km to the west
6	Wexford Harbour and Slobs SPA	004076	8.7km to the north-west
7	Saltee Islands SAC	000707	7km to the west
8	Long Bank SAC	002161	10km to the north-east
9	Blackwater Bank SAC	002953	11km to the north-east
10	Slaney River Valley SAC	000781	12km to the north-west
11	The Raven SPA	004019	13.8km to the north
12	The Raven Ramsar Site	333	13.8 km to the north
13	Saltee Islands SPA	004002	12.3Km to the south-west
14	Ballyteige Burrow SAC	000696	12.4km to the west
15	Ballyteige Burrow SPA	004020	13.2km to the west

Table 2: Designated site with qualifying features of conservation interest

Designated Site	Qualifying features of conservation interest
Lady's Island SAC (000704)	• Coastal lagoons* [1150] • Reefs [1170] • Perennial vegetation of stony banks [1220]
Lady's Island Lake SPA (004009)	• Gadwall (*Anas strepera*) [A051] • Black-headed Gull (*Chroicocephalus ridibundus*) [A179] • Sandwich Tern (*Sterna sandvicensis*)[A191] • Roseate Tern (*Sterna dougallii*)[A192] • Common Tern (*Sterna hirundo*) [A193] • Arctic Tern (*Sterna paradisaea*) [A194]
Carnsore Point SAC (002269)	• Mudflats and sandflats not covered by seawater at low tide [1140] • Reefs [1170]
Tacumshin Lake SAC (000709)	• Coastal lagoons* [1150] • Annual vegetation of drift lines [1210] • Perennial vegetation of stony banks [1220] • Embryonic shifting dunes [2110] • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120]
Tacumshin Lake SPA (004009)	• Little Grebe (*Tachybaptus ruficollis*) [A004] • Bewick's Swan (*Cygnus columbianus bewickii*) [A037] • Whooper Swan (*Cygnus 17etanu*) [A038] • Wigeon (*Anas 17etanus17*) [A050] • Gadwall (*Anas strepera*) [A051] • Teal (*Anas crecca*) [A052] • Pintail (*Anas acuta*) [A054] • Shoveler (*Anas clypeata*) [A056] • Tufted Duck (*Aythya fuligula*) [A061] • Coot (*Fulica atra*) [A125] • Golden Plover (*Pluvialis apricaria*) [A140]

Designated Site	Qualifying features of conservation interest
	• Grey Plover (*Pluvialis squatarola*) [A141] • Lapwing (*Vanellus vanellus*) [A142] • Black-tailed Godwit (*Limosa limosa*) [A156] • Wetland and Waterbirds [A999]
Wexford Harbour and Slobs SPA (004076)	• Little Grebe *Tachybaptus ruficollis* [A004] wintering • Great Crested Grebe *Podiceps cristatus* [A005] wintering • Cormorant *Phalacrocorax carbo* [A017] wintering • Grey Heron *Ardea cinerea* [A028] wintering • Bewick's Swan *Cygnus columbianus* [A037] wintering • Whooper Swan *Cygnus cygnus* [A038] wintering • Light-bellied Brent Goose *Branta bernicla hrota* [A046] wintering • Shelduck *Tadorna tadorna* [A048] wintering • Wigeon *Anas 18etanus18* [A050] wintering • Teal *Anas crecca* [A052] wintering • Mallard *Anas platyrhynchos* [A053] wintering • Pintail *Anas acuta* [A054] wintering • Scaup *Aythya marila* [A062] wintering • Goldeneye *Bucephala clangula* [A067] wintering • Red-breasted Merganser *Mergus serrator* [A069] wintering • Hen Harrier *Circus cyaneus* [A082] post-breeding/roost • Coot *Fulica atra* [A125] wintering • Oystercatcher *Haematopus ostralegus* [A130] wintering • Golden Plover *Pluvialis apricaria* [A140] wintering • Grey Plover *Pluvialis squatarola* [A141] wintering • Lapwing *Vanellus vanellus* [A142] wintering • Knot *Calidris canutus* [A143] wintering • Sanderling *Calidris alba* [A144] wintering • Dunlin *Calidris alpina* [A149] wintering • Black-tailed Godwit *Limosa limosa* [A156] wintering • Bar-tailed Godwit *Limosa lapponica* [A157] wintering • Curlew *Numenius arquata* [A160] wintering • Redshank *Tringa tetanus* [A162] wintering • Black-headed Gull *Chroicocephalus ridibundus* [A179] wintering • Lesser Black-backed Gull *Larus fuscus* [A183] wintering • Little Tern *Sterna albifrons* [A195] breeding • Greenland White-fronted goose *Anser albifrons flavirostris* [A395] wintering • Wetlands [A999]
Saltee Islands SAC (000707)	• Mudflats and sandflats not covered by seawater at low tide1140 • Large shallow inlets and bays [1160] • Reefs [1170] • Vegetated sea cliffs of the Atlantic and Baltic coasts [1230] • Grey Seal *Halichoerus grypus* [1364] • Submerged or partially submerged sea caves [8330]
Long Bank SAC (002161)	• Sandbanks which are slightly covered by sea water all the time[1110]
Blackwater Bank SAC (002953)	• Sandbanks which are slightly covered by sea water all the time[1110]

Designated Site	Qualifying features of conservation interest
Slaney River Valley SAC (000781)	• Freshwater Pearl Mussel *Margaritifera margaritifera* [1029] • Sea Lamprey *Petromyzon marinus*[1095] • Brook Lamprey *Lampetra planeri* [1096] • River Lamprey *Lampetra fluviatilis* [1099] • Twaite Shad *Alosa fallax* [1103] • Atlantic Salmon *Salmo salar* (only in fresh water) [1106] • Estuaries[1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Otter *Lutra lutra* [1355] • Harbour Seal *Phoca vitulina* [1365] • Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation [3260] • Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles [91A0] • * Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) [91E0]
The Raven SPA (004019)	• Red-throated Diver *Gavia stellata* [A001]wintering • Cormorant *Phalacrocorax carbo* [A017] wintering • Common Scoter *Melanitta nigra* [A065] wintering • Grey Plover *Pluvialis squatarola* [A141] wintering • Sanderling *Calidris alba* [A144] wintering • Greenland White-fronted goose *Anser albifrons flavirostris* [A395] wintering • Wetlands [A999]
The Raven RAMSAR Site (333)	• Sand-dune spit protecting Wexford Harbour from the sea. The tip is highly mobile, with constantly changing patterns of recurves, lagoons and sand bars. The unforested foredunes support a well-developed native vegetation, including various nationally rare species. The site provides important roosting sites for passage terns and supports a small nesting colony of the tern *Sterna albifrons*. Internationally important numbers of the globally vulnerable goose *Anser albifrons flavirostris* winter at the site and large numbers of waders roost at high tide. The site is managed for timber.
Saltee Islands SPA (004002)	• Fulmar *Fulmarus glacialis* breeding [A009] • Gannet *Morus bassanus* breeding [A016] • Shag *Phalacrocorax aristotelis* breeding [A018] • Kittiwake *Rissa tridactyla* breeding [A188] • Guillemot *Uria aalge* breeding [A199] • Razorbill *Alca torda* breeding [A200] • Puffin *Fratercula arctica* breeding [A204]
Ballyteige Burrow SAC (000696)	• Estuaries [1130] • Mudflats and sandflats not covered by seawater at low tide [1140] • Coastal lagoons* [1150] • Annual vegetation of drift lines [1210] • Perennial vegetation of stony banks [1220] • *Salicornia* and other annuals colonising mud and sand [1310] • *Spartina* swards (*Spartinion maritimae*) [1320] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330]

Designated Site	Qualifying features of conservation interest
	• Mediterranean salt meadows (*Juncetalia maritimi*) [1410] • Mediterranean and thermo-Atlantic *halophilous* scrubs (*Sarcocornetea fruticosi*) [1420] • Embryonic shifting dunes [2110] • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) [2120] Fixed coastal dunes with herbaceous vegetation (grey dunes)* [2130] Atlantic decalcified fixed dunes (*Calluno-Ulicetea*)* [2150]
Ballyteige Burrow SPA (004020)	• Light-bellied Brent Goose (*Branta bernicla hrota*) [A046] • Shelduck (*Tadorna tadorna*) [A048] • Golden Plover (*Pluvialis apricaria*) [A140] • Grey Plover (*Pluvialis squatarola*) [A141] • Lapwing (*Vanellus vanellus*) [A142] • Black-tailed Godwit (*Limosa limosa*) [A156] • Bar-tailed Godwit (*Limosa lapponica*) [A157] • Wetland and Waterbirds [A999]
Raven Point Nature Reserve SAC (000710)	• Mudflats and sandflats not covered by seawater at low tide[1140] • Annual vegetation of drift lines[1210] • Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) [1330] • Embryonic shifting dunes[2110] • Shifting dunes along the shoreline with *Ammophila arenaria* ('white dunes') [2120] • *Fixed coastal dunes with herbaceous vegetation ('grey dunes') [2130] • Dunes with *Salix repens* ssp. *argentea (Salicion arenariae*) [2170] • Humid dune slacks [2190]

* denotes a priority habitat under the Habitats Directive

4.4.3.1 Lady's Island SAC

Situated in the extreme south-east of Ireland, this site comprises a shallow coastal lagoon separated from the sea by a sandy-gravel barrier. Salinity of the lagoon is generally oligo-mesohaline but it is periodically tidal when the barrier is breached. Dune vegetation occurs over much of the barrier. Swamp and marsh vegetation is particularly well developed at Ring Marsh in the south-east of the site. Several small islands within the lagoon are included in the site. The surrounding land is low-lying agricultural land. Carnsore Point, formed by an intrusion of igneous granite, felsite and other intrusive rocks rich in silica, occurs near the south-eastern boundary of the site.

Lady's Island Lake is by far the largest and best example of a sedimentary lagoon in the country and one of the best in Europe. It is in a relatively natural condition, despite regular breaching of the barrier separating it from the sea. The flora is typically brackish and includes the Red Data Foxtail stonewort charophyte *Lamprothamnion papulosum*. The fauna of the lagoon is rich, with at least 13 lagoonal specialist species recorded. This coast comprises the best example in Ireland of a landward moving (transgressive) system of gravel-based barrier. The sequence of back barrier washover and seepage structures are among the best in Europe, and, indeed, Lady's Island remains the last intact example in Europe. The site supports typical vegetation of stony banks, including the Red Data Book species Cottonweed *Othanthus maritimum* total of six other Red Data Book plant species are present in the site. Carnsore Point has a good example of a littoral reef very exposed to wave action. The reef has wide and well-banded lichen communities that are typical of the supra littoral fringe on very

exposed shores. In the sublittoral fringe, the Dabberlocks *Alaria esculenta* community is also representative. The site supports breeding Arctic Tern *Sterna paradisaea*, and in the past Sandwich terns *S. sandvicensis*, Common Tern *S. hirundo* and Roseate tern *S. dougallii*. The site is important in supporting the internationally important tern colony (for Roseate tern *S. dougallii*, Sandwich terns *S. sandvicensis*) at Inish Island. It is of regional importance for wintering waterfowl, including European golden plover *Pluvialis apricaria* and has one of the highest numbers of breeding wildfowl species in the country, including Gadwall *Anas strepera* and Garganey *Anas querquedula*.

4.4.3.2 Lady's Island Lake SPA

Lady's Island Lake is by far the largest and best example of a sedimentary lagoon in the country and one of the best in Europe. It supports an excellent range of birds typical of lagoonal systems. In winter, there is a good diversity of waterfowl species, though most occur in relatively low numbers. The population of Gadwall *Anas strepera* is of national importance though part of the population is resident. There are regionally important populations of Greater Scaup *Aythya marila*, Whooper Swan *Cygnus cygnus* and Golden Plover *Pluvialis apricaria.* In summer, Western Marsh-harrier *Circus aeruginosus* is a regular visitor and nesting is a possibility. Lady's Island has an excellent diversity of breeding wildfowl and is one of the few sites in Ireland where Garganey *Anas querquedula* is considered to breed.

The very localised Northern Shoveler *Anas clypeata* also breeds and it is one of the principal sites in Ireland for breeding Gadwall *Anas strepera*. The site is an internationally important site for breeding terns and is the largest tern colony in the country, with four species of tern present. It has the largest colony of Sandwich terns *Sterna sandvicensis* in the country. The population of Roseate tern *Sterna dougallii* is the second largest after Rockabill. The Arctic Tern *Sterna paradisaea* and Common Tern *Sterna hirundo* populations are of national importance. It also supports one of the largest colonies of Black-headed Gull *Larus ridibundus* in the country. Mediterranean Gull *Larus melanocephalus* has bred at the site since the late 1990s, the only known breeding site in the country. The terns have been studied since the 1960s, and National Parks and Wildlife and BirdWatch Ireland have co managed the colonies since 1993 as part of a long-term conservation programme. This programme includes wardening, habitat management, thorough monitoring of breeding parameters and ringing of chicks. Lady's Island is an important site for passage waders, including Ruff *Philomachus pugnax*, Curlew Sandpiper *Calidris ferruginea*, Green sandpiper *Tringa ochropus* and the very scarce Wood sandpiper *Tringa glareola*. The lagoon supports two Red Data Book charophyte species, Foxtail stonewort *Lamprothamnion papulosum* and Bearded stonewort *Chara canescens*. The site includes a designated Refuge for Fauna.

4.4.3.3 Carnsore Point SAC

Carnsore Point is situated to the south of Co. Wexford in the south-east of Ireland. It is formed by an intrusion of Igneous Granite, Felsite and other intrusive rocks rich in silica. Both on the shore and under the surface of the water, the reef is typically strewn with boulders, cobbles and patches of sand. It is exposed to prevailing wind and swells from the west. Tidal streams tend to be moderate but are strong in some areas. Offshore, Barrel's Rocks are extremely exposed to the full force of Atlantic swells.

Carnsore Point has good examples of littoral reefs moderately exposed to wave action and sublittoral reef communities very exposed to moderately exposed to wave action in which a number

of rare species occur. The moderately exposed reef communities are distinguished by a luxuriant growth of the brown alga Knotted Wrack *Ascophyllum nodosum* in the midshore. Infralittoral reef areas have good, species-rich communities that are typical of exposed infralittoral reefs subject to moderate tidal streams. Conversely, the species poor community at Barrel Rocks is an extremely good example of a very exposed shallow reef community.

The following species were recorded for infralittoral areas that are notable: *Tethyspira spinosa*, Yellow feathers *Gymnangium montagui*, Latticed corklet *Cataphellia brodricii,* Orange Lights Seasquirt *Pycnoclavella aurilucens*, *Sidnyum elegans,* Lesser gooseberry sea squirt *Distomus variolosus* and Orange sea grapes *Stolonica socialis*. The circalittoral reefs have examples of several different community types that occur in tidal streams, and some are influenced by sand scour. The populations of the sponge *Tethyspira spinosa*, the *anthozoan* Latticed corklet *Cataphellia brodricii*, and the hydroids *Schizomavella sarniensis* and *Stolonica socialis*, are particularly important because they represent a substantial proportion of the entire populations that occur in Irish waters. The Green crenella *Musculus discors* beds are particularly noteworthy as they are the only beds in Ireland where the mussels are superabundant and species richness is high (63 species south of Carnsore Point and 79 species north-east of Terchen). The littoral sediment community that occurs at Carne Beach adds habitat diversity to the area and is a good example of a moderately exposed sand shore.

4.4.3.4 Tacumshin Lake SAC

Situated on the south Wexford coast, site comprises a large, shallow (1-2 m) sedimentary lagoon separated from the sea by a long (5-6 km) gravel/sand barrier. At present there is no natural outlet to the sea and the lagoon drains through installed pipes. The pipes are not of sufficient capacity to prevent winter flooding. Salinity is generally low but rises as water levels fall in summer. The lagoon bed sediments are colonised by halophytic vegetation, especially *Salicornia spp*. Substantial areas of the lagoon are now dominated by swamp vegetation and there are also marginal areas of wet grassland. The gravel/sand barrier is mostly covered by a sand dune system. Surrounding land is low-lying and used for agriculture, both pasture and arable.

The site provides an excellent example of a shallow, generally oligohaline, percolation lagoon. One of the largest and best examples of its type in the country and one of the largest lagoonal habitat of any type in the country. Flora and fauna diverse and typically brackish. Has the Red Data Book *charophyte Chara canescens* and several rare lagoonal fauna specialists (*Notonecta viridis, Enochrus halophilus, Ochthebius marinus*). The gravel/sand barrier is an important geomorphological feature and has the very rare and Red Data Book species *Otanthus maritimus*. Dunes are of moderate quality. Important for waterfowl in autumn and winter. Has nationally important populations of eight species, and particularly important for *Anas strepera* and *Anas acuta* (11% and 14% of respective national totals). Used by the Annex I Bird Directive species *Cygnus cygnus* and *Pluvialis apricaria* and occasionally by *Cygnus columbianus bewickii*.

4.4.3.5 Tacumshin Lake SPA

This site comprises a large, shallow (1-2m) sedimentary lagoon, separated from the sea by a long (5-6 km) gravel/sand barrier. At present there is no natural outlet to the sea and the lagoon drains through installed pipes. Winter flooding is regular. Salinity is generally low but rises as water levels fall in summer. The lagoon bed sediments are colonised by halophytic vegetation, especially

Salicornia spp. Stands of *Ruppia spp*. and *Chara spp*. also occur. Substantial areas of the lagoon are now dominated by swamp vegetation and there are also marginal areas of wet grassland. The gravel/sand barrier is mostly covered by a sand dune system. Surrounding land is low-lying and used for agriculture, both pasture and arable.

Tacumshin Lake is one of the largest lagoons in the country and supports an excellent range of birds typical of lagoonal systems. In winter, it is a principal roost for internationally important populations of both *Cygnus cygnus* and *Cygnus columbarius bewickii*, the latter species now very localised in Ireland. Both of these swans feed mainly on improved grassland in the vicinity. There are a further 13 waterfowl species which occur in numbers of national importance, including *Anas penelope, Anas strepera, Anas acuta, Anas clypeata, Aythya fuligula, Fulica atra, Pluvialis apricaria, Vanellus vanellus* and *Limosa limosa*. The population of *Anas acuta* represents over 16% of the national total, whilst those of *Anas penelope, Anas strepera* and *Fulica atra* are just over 5% of the respective totals. In summer*, Circus aeruginosus* is a regular visitor and nesting is a possibility. Tacumshin Lake is one of the few sites in Ireland where *Anas querquedula* is considered to breed. The site has a good breeding population of the localised *Acrocephalus scirpaceus*. Tacumshin Lake is an important site for passage waders, including *Philomachus pugnax, Calidris minuta, Calidris ferruginea, Tringa ochropus* and the very scarce *Tringa glareola*. The lagoon supports the Red Data *charophyte* species *Chara canescens*, as well as populations of *Otanthus maritimus* and *Centaurium pulchellum*.

4.4.3.6 Wexford Harbour and Slobs SPA

Wexford Harbour is the lowermost part of the estuary of the River Slaney, a major river that drains much of the south-east region. The site is divided between the natural estuarine habitats of Wexford Harbour and the reclaimed polders known as the north and south 'slobs'. The seaward boundary extends from the Rosslare peninsula in the south to the area just west of The Raven Point in the north, while the inner boundaries of the site extend to Ferrycarrig bridge and towards Castlebridge. Shallow marine water is a principal habitat, but at low tide extensive areas of intertidal flats are exposed. These vary from rippled sands in exposed areas to sandy-muds in the more sheltered areas, especially at Hopeland and the inner estuary to the west of Wexford bridge. Salt marshes fringe the intertidal flats, especially in the sheltered areas. The slobs are two flat areas of farmland, mainly arable and pasture grassland, empoldered behind 19th century sea-walls. The lands are drained by a network of channels which flow into two central channels, in parts several hundred metres in width. Water from the channels is pumped into the sea with electric pumps. The channels often support swamp vegetation. Several conifer plantations are included, especially on the south slob.

This site is of international importance for several species of waterfowl but also because it regularly supports well in excess of 20,000 waterfowl. It is one of the top three sites in the country for numbers and diversity of wintering birds. Of particular importance is that it is one of the two most important sites in the world for *Anser albifrons flavirostris*. It also has internationally important populations *of Branta bernicla hrota, Cygnus columbarius bewickii* and *Limosa lapponica*, and is now one of the few sites in the country which supports a regular flock of *Cygnus columbarius bewickii*. There is at least a further 22 species of wintering waterfowl which occur in numbers of national importance. Several of these represent substantial proportions of the national totals, especially *Anas penelope* (3.1%), *Anas platyrhynchos* (3.6%), *Anas acuta* (3.3%), *Aythya marila* (4.9%), *Mergus serrator* (4.1%), *Pluvialis apricaria* (3.7%), *Pluvialis squatarola* (11.3%), *Vanellus vanellus* (5.1%) and

Limosa limosa (3.6%). Numbers of wintering birds are often swelled by hard-weather movements from Europe, notably *Pluvialis apricaria* and *Vanellus vanellus*. The site is a regular location for *Philomachus pugnax* during passage and in winter, and is regularly visited by a range of other passage waders, most notably *Tringa glareola, Tringa erythropus and Tringa ochropus. Asio flammeus* is a regular visitor in small numbers to the slobs during winter. A nesting colony of *Egretta garzetta* has recently become established within the site and birds are present in the area throughout the year. *Passer montanus*, a Red Data Book species, breeds. Part of the North Slob is a Nature Reserve and much of the slob is managed for the benefit of the wintering geese. Monitoring of the wintering birds of the slobs extends back to the 1960s and nowadays there is an ongoing monitoring and research programme. The North Slob has a wildfowl collection and an interpretative centre. The site supports *Puccinellia fasciculata,* a Red Data Book species, and has a good population of *Lepus timidus hibernicus.*

4.4.3.7 Saltee Islands SAC

The site comprises the Saltee Islands and a large area of the surrounding seas. There are two islands (Great Saltee and Little Saltee) and a constellation of islets and rocks. The islands are situated between 4 and 5 km off the south Wexford coast. As a group, they constitute a broken reef that protrudes from a seabed of sand and shell. The reef has a north-east/south-west orientation and is typically strewn with boulders, cobbles and patches of sand and gravel. Bedrock is metamorphic schist and gneiss. The islands are exposed to prevailing wind and swells from the west. Tidal streams tend to be moderate but are strong in some areas, particularly where the reef is shallow. The islands were inhabited and farmed in the past but are now abandoned, although some sheep grazing occurs on Little Saltee. A community dominated by *Pteridium aquilinum* is the main vegetation type on the islands. Dry grassland occurs within the old field boundaries. Habitats with a minor presence are springs, flushes and scrub. The shorelines vary from rocky cliffs of moderate height to shingle, sand and boulder shores. Small sections of boulder clay cliffs are exposed in places.

The exposed reef communities of the Saltee Islands are extremely species rich and contain rare or scarce species. In the shallow infralittoral zone, there are extremely species rich kelp parks (79-124 species) and tideswept *Halidrys siliquosa* and mixed kelp communities (78-100 species). The lower infralittoral communities dominated by red algae are also extremely species rich (79-117 species). Rare and notable species of sponge, anthozoan, brittlestar and hydroid live in these areas. *Circalittoral* communities are also distinguished by consistently extremely high species richness (average 76 species). There are four notable and scarce sponge species, 6 species of scarce or notable hydroid, a scarce anemone, two scarce *nudibranchs* and two scarce *ascidian* species. Perhaps more important than the high number of notable species in the Saltee Islands area is the fact that the populations of ten of those species have extremely high conservation value because they represent a high proportion of the total population in the national territory: these are the sponge *Tethyspira spinosa*; the hydroids *Halecium muricatum, Aglaophenia acacia* and *Gymnangium montagui;* the anemone *Cataphellia brodricii,* the *nudibranchs Okenia aspersa* and *Aeolidiella glauca*; and the *ascidians Pycnoclavella aurilucens, Distomus variolosus* and *Stolonica socialis*.

The sediment communities are also important. The littoral sediment communities present at Kilmore Quay are characteristic of many similar beaches around the coast. The sublittoral sediment characterized by the sea cucumber *Neopendactyla mixta* is one of only seven such communities recorded by Biomar. Good examples of vegetated cliff habitat on both islands with a typical south-

eastern flora. Has sea caves though marine communities not yet investigated. A long established breeding population of *Halichoerus grypus* and the only significant population in the south-east region. The Saltee Islands are amongst the most important seabird colonies in the country for populations and species diversity. Internationally important for *Uria aalge* and *Alca torda*, and nationally important for a further seven seabird species, including *Sula bassana, Phalacrocorax corax, Phalacrocorax aristotelis, Larus fuscus, Rissa tridactyla, and Fratercula arctica*. The islands have long-established seabird monitoring programmes. *Pyrrhocorax pyrrhocorax* occurs at the eastern edge of its Irish range and *Falco peregrinus* breeds. Great Saltee is a major site for spring and autumn landbird migration.

4.4.3.8 Long Bank SAC (002161)

Long Bank and Holdens Bed are situated several kilometres to the east of Rosslare and Wexford Harbour on the East coast. The site is at the southern end of a series of offshore sand banks that run from Arklow to the south of Rosslare. Long Bank is approximately 12 km in length and, at its widest, is approximately 1.4 km across, while Holdens Bed is approximately 3.7 km in length and 1.4 km wide. The two banks are separated by a channel and are separated from the Lucifer bank to the east by an area of deeper water.

Due to the lack of data it is not possible to determine the quality and importance of this site in comparison to the other offshore sand banks on the east coast. It is, however, likely to be an important south-eastern example of the habitat and of good quality.

4.4.3.9 Blackwater Bank SAC (002953)

This site exhibits typical species diversity for offshore sandbanks in this region.

4.4.3.10 Slaney River Valley SAC (000781)

This site comprises almost the entire Slaney system, from the headwater streams in the Wicklow Mountains to the extensive estuarine area of Wexford Harbour. The main river tributaries included are the Bann, Glasha, Clody, Derry, Derreen, Douglas and Carrigower Rivers. The tidal influence extends upriver as far as Enniscorthy. In the upper and central regions the geology consists of granite. Above Kilcarry Bridge, the Slaney has cut a gorge into the granite plain. The Derry and Bann Rivers are bounded by a narrow line of uplands which corresponds to schist outcrops. South of Kildavin the Slaney flows through an area of Ordovician slates and grits. The river is often fringed by woodland and/or swamp vegetation. Other habitats which occur alongside the river include wet grassland, scrub and, in higher areas, heath and bog. Improved grassland and arable land is included alongside the river for water quality reasons. Salt marshes are a feature of the lower estuarine area of the site.

Estuaries and intertidal sand and mud flats are particularly well represented in this site, with salinity ranging from full freshwater to full seawater. The quality of these habitats is generally good. The Slaney River and its tributaries display good examples of floating river vegetation. An important area of alluvial forest is found at Macmine, while old oak woodlands occur at Toomnafinnoge, the latter being a remnant of the ancient oak woods of Shillelagh. The site is of high importance for the conservation of fish species, *notably Salmo salar, Petromyzon marinus, Lampetra fluviatilis, L. planeri* and the very localised *Alosa fallax fallax. Lutra lutra* is well distributed throughout, while a significant population of *Margaritifera margaritifera* occurs on the Derreen River. The site provides year-round

haul-out habitat for the Annex II species *Phoca vitulina*, and includes regionally significant breeding and moulting sites. The site has high ornithological importance, especially for wintering waterfowl with internationally important populations of *Branta bernicla hrota, Cygnus olor, Limosa limosa* and *Limosa lapponica*.

There is at least a further 14 species of wintering waterfowl which occur in numbers of national importance. Wintering *Larus* gulls are well represented, especially *Larus ridibundus* and *Larus fuscus*. A nesting colony of *Egretta garzetta* has recently become established within the site and birds are present in the area throughout the year. The site supports one of the best breeding concentrations of *Acrocephalus scirpaeus* in the country. A range of flora and fauna species listed as Red Data Book species occur within the site.

4.4.3.11 The Raven SPA (004019)

Situated on the north side of Wexford Harbour, the site incorporates the dynamic sand system of the Raven Point and the coastal fringe running north to Blackwater Head (a distance of over 10 km). It also includes the adjacent shallow marine waters to a distance of approximately 2 km. The Raven is an important example of an extremely dynamic coastal sand system. It contains one of the few afforested sand dune systems in Ireland though the commercial plantings have compromised the structure of the natural dune vegetation. Outside the planted areas, there are good examples of a range of sand dune types, including embryo dunes, mobile marram dunes, fixed dunes and humid dune slacks. The site contains intertidal sand flats and some salt marsh. Sand bars and banks are a feature of the site though the configuration of these change regularly.

The Raven has important bird interests, being part of the Wexford Slobs and Harbour complex. Of critical significance is that it forms the principal night roost for the internationally important Wexford Harbour population of *Anser albifrons flavirostris*. The shallow waters provide optimum conditions for divers, grebes and seaduck, with nationally important populations of *Melanitta nigra* (supports 27% of national total), *Gavia stellata* (one of the top sites in the country), *Gavia immer, Mergus serrator* and *Phalacrocorax carbo.* It is one of the most regular sites in the country for *Podiceps auritus*. It also provides an important roost site, and to a lesser extent feeding area, for a range of other waterfowl species, with nationally important numbers of *Pluvialis squatarola* and *Calidris alba.* The Raven is a traditional breeding site for *Sterna albifrons*, with numbers of national importance in most years. Three Red Data Book plant species are known from the site, as well as a number of important insect species*. Bufo calamita*, a Red Data Book species, has been successfully introduced into the site. Part of the site is managed as a Nature Reserve.

4.4.3.12 Saltee Islands SPA

The site comprises the two Saltee Islands (Great Saltee and Little Saltee) which are situated between 4 and 5km off the south Wexford coast. The bedrock is metamorphic schist and gneiss. The islands are exposed to prevailing wind and swells from the west. The islands were inhabited and farmed in the past but are now abandoned, although some sheep grazing occurs on Little Saltee. A community dominated by *Pteridium aquilinum* is the main vegetation type on the islands. Dry grassland occurs within the old field boundaries. Good examples of vegetated cliff habitat with a typical south-eastern flora occur on both islands. The shorelines vary from rocky cliffs of moderate height to shingle, sand and boulder shores. Small sections of boulder clay cliffs are exposed in places. Sea caves are found in several parts of the site. Other habitats present include springs, flushes and scrub. The site includes

an area of the surrounding seas to a distance of 500 m from the shoreline where seabirds feed, bathe and socialise.

The Saltee Islands support one of the most important seabird colonies in the country (for populations and species diversity) and hold the most important colony in the south-east for populations and species diversity. The site is nationally important for eleven seabird species: *Fulmarus glacialis, Sula bassana, Phalacrocorax carbo, Phalacrocorax aristotelis, Larus fuscus, Larus marinus, Larus argentatus, Uria aalge, Alca torda, Rissa tridactyla* and *Fratercula arctica*. The islands, especially Great Saltee, have a long-established seabird monitoring programme, and in particular the growth of the *Sula bassana* colony since its establishment in the 1920s has been well documented. There is a long-term seabird ringing programme in operation. *Pyrrhocorax pyrrhocorax* occurs at the eastern edge of its Irish range and *Falco peregrinus* breeds. Great Saltee is a major site for spring and autumn landbird migration and the island formerly had a bird observatory. Ringing of migrants still takes place. The site has a long established breeding population of *Halichoerus grypus* which is the only significant population in the south-east region.

4.4.3.13 Ballyteige Burrow SAC

Site is located on the south coast of Co. Wexford between the towns of Kilmore Quay and Cullenstown. Comprised of a sand and shingle barrier beach, approximately 8 km in length, and the estuary of the River Duncormick. The extensive overlying sand spit is known as the Burrow, while the estuary that it encloses is known as the Cull. Site possesses a range of coastal habitats, including various types of dunes, salt meadows, and intertidal sand and mud flats. An interesting feature of the dunes is the occurrence of large dry hollows in which the sand has been almost completely stripped away to reveal the underlying shingle. These depressions contain unusual assemblages of plant species. The site has a series of drainage channels and a small pond which now have lagoonal characters. Most of site is a Statutory Nature Reserve and managed for conservation. Former estuarine areas adjacent to the site have been reclaimed as polders and are intensively managed for agriculture.

The Burrow sand spit contains an excellent range of dune habitats, of which the fixed dunes and eu-Atlantic decalcified dunes are of particular note for their extent and quality. The fixed dunes are particularly species-rich and contain a flora characteristic of the south-east coast of Ireland. Salt marsh habitats are also particularly well developed, with very good examples of both Atlantic and Mediterranean salt meadows, and one of only two extant sites in Ireland which has halophilous scrub vegetation characterised by *Arthrocnemum perenne*. Although the lagoon habitat within the site is largely artificial, the biological community is notably rich and characteristically lagoonal, with at least 11 lagoonal fauna specialists and several rare species. Site has 6 Red Data Book plant species and is the only Irish site for the lichen *Fulgensia subbracteata*. Site supports important concentrations of waterfowl in autumn and winter, including *Pluvialis apricaria* and *Limosa lapponica* and an internationally important population of *Branta bernicla hrota*. Has a small colony of breeding *Sterna albifrons*.

Ballyteige Burrow SPA

The site is located on the south coast of Co. Wexford between the towns of Kilmore Quay and Cullenstown. It is comprised of a sand and shingle barrier beach, approximately 8 km in length, and the estuary of the River Duncormick. The extensive overlying sand spit is known as the Burrow, while

the estuary that it encloses is known as the Cull. The site possesses a range of coastal habitats, including various types of dunes, salt meadows, and intertidal sand and mud flats. Former estuarine areas adjacent to the site have been reclaimed.

The site has an internationally important population of *Branta bernicila hrota,* and supports nationally important numbers of *Tadorna tadorna, Pluvialis apricaria, Charadrius hiaticula, Vanellus vanellus, Limosa limosa* and *Limosa lapponica*. The estuarine habitats provide feeding and roosting areas for the waterfowl species, though a lot of the birds also feed on the intensively managed lands of the adjacent polders. There is a small colony of breeding *Sterna albifrons* in the site, though nesting may not occur every year. Salt marsh habitats are particularly well represented, with one of only two extant sites in Ireland which has halophilous scrub vegetation characterised by *Arthrocnemum perenne*. Within the site are 6 Red Data Book plant species and the only Irish site for the lichen *Fulgensia subbracteata*. The site is a Statutory Nature Reserve and managed for conservation.

4.4.3.14 Raven Point Nature Reserve SAC

Situated on the north side of Wexford Harbour, the site incorporates the dynamic sand system of the Raven Point and the coastal stretch running north to Curracloe House. The main part of the dune system was planted with coniferous species in the 1930s and 1950s, mainly as a coastal defence measure. Other than the sand dune habitats, the site also contains sand flats, salt marsh and lagoons. There has been heavy erosion along the eastern site of the site in recent years, but the dunes are building westwards along the southern boundary of the adjacent Wexford Slobs. The sediment source is siliceous in nature. The main land uses of the site are nature conservation and commercial forestry. Future plans include replacement of the conifers with hardwood species.

The site is an important example of an extremely dynamic coastal sand system. It contains one of the few afforested sand dune systems in Ireland though the commercial plantings have compromised the structure of the natural dune vegetation. Outside the planted areas, there are good examples of a range of sand dune types, including embryo dunes, mobile marram dunes, fixed dunes, dunes with *Salix repens* and humid dune slacks. A small though significant area of Atlantic salt meadow occurs below the fixed dunes. The site also has a good example of intertidal flats, which are predominantly sandy owing to exposure. Three Red Data Book plant species are known from the site, as well as a number of locally important species. Natterjack toad a Red Data Book species, has been successfully introduced into the site. Site provides principal roost site for the Internationally Important Wexford Slobs and Harbour population of *Anser albifrons flavirostris*. Seven further bird species occur at the Raven in nationally important concentrations, notably *Pluvialis squatarola* and *Calidris alba*, and there are populations of *Pluvialis apricaria* and *Limosa lapponica*. *Sterna albifrons* breeds in some years though recently conditions have been less suitable. Most of site is a statutory nature reserve.

4.4.4 Conservation Objectives

According to the Habitat's Directive, the *conservation status of a natural habitat* will be taken as 'favourable' within its biogeographic range when:

- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and

- the conservation status of its typical species is favourable as defined below.

According to the Habitat's Directive, the conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' within its biogeographic range when:

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

The specific conservation objectives for each site are available on www.npws.ie. These have been accessed for the sites listed in the tables above on the [23/04/18]. Generic conservation objectives were available for the following sites:

- Lady's Island Lake SAC [000704]. Version 6.0. produced in February 2018
- Lady's Island Lake SPA [004009]. Version 6.0 produced in February 2018
- Tacumshin Lake SPA [004009]. Version 6.0 produced in February 2018

Site specific and more detailed conservation objectives were available for the following sites:

- Carnsore Point SAC [002269]. Version 1.0 produced in October 2011.
- Wexford Harbour and Slobs SPA [004076]. Version 1.0 produced in March 2012.
- Saltee Islands SAC [000707]. Version 1.0 produced in October 2011.
- Long Bank SAC [002161]. Version 1 produced in April 2013.
- Blackwater Bank SAC [002953]. Version 1 produced in April 2013.
- Slaney River Valley SAC [000781]. Version 1 produced in October 2011.
- The Raven SPA [004019]. Version 1 produced in March 2012.
- Saltee Islands SPA [004002]. Version 1.0 produced in October 2011.
- Ballyteige Burrow SAC [000696]. Version 1 produced in July 2014.
- Ballyteige Burrow SPA [004020]. Version 1 produced in June 2014.
- Raven Point Nature Reserve SAC [000710]. Version 1.0 produced in December 2011

All conservation objectives together with other designated site information are available on http://www.npws.ie/protectedsites/.

4.5 IDENTIFICATION OF POTENTIAL IMPACTS

Potential likely ecological impacts arising from the project are identified in this section.

Description of elements of the project likely to give rise to potential ecological impacts on Natura 2000 sites.	• Works will be conducted adjacent to and within designated areas so there will be direct impacts on lagoon, dune and marine habitats within the Natura 2000 network • The risk of a fuel, oil or concrete spillage into lagoonal/transitional waters within Lady's Island SAC/SPA and marine waters of Carnsore Point SAC due to the use of plant and construction works. • Dredging of substrates at the flow control structure could potentially affect water quality. • There is potential for direct impacts on dune habitats and rare plants during construction through accessing the proposed development site. • Salinity changes brought about by the proposed development could interfere with lagoon ecology, affecting aquatic biotic composition and birds supported by the lake.

Describe any likely direct, indirect or secondary ecological impacts of the project (either alone or in combination with other plans or projects) by virtue of:
 	
• *Size and scale;*
• *Land-take;*
• *Distance from Natura 2000 Site or key features of the Site;*
• *Resource requirements;*
• *Emissions;*
• *Excavation requirements;*
• *Transportation requirements;*
• *Duration of construction, operation etc.; and*
• *Other.*
	• Works conducted within SACs and an SPA
	• Works duration of ca. 9 months
	• Large scale excavation will be required
	• Resources required include:
	  ○ plant machinery
	  ○ transport vehicles
	  ○ fuels and oils
	  ○ cement
	  ○ piping
	• Potential emissions include:
	  ○ water borne sediment
	  ○ fuel or oil spill
	  ○ concrete

Describe any likely changes to the site arising as a result of: • *Reduction of habitat area;* • *Disturbance of key species;* • *Habitat or species fragmentation;* • *Reduction in species density;* • *Changes in key indicators of conservation value; and* • *Climate change.*	• The proposed development is located largely within the Lady's Island Lake SAC and SPA. The southern extent of the proposed pipeline (seaward end) is located outside of these designated sites, within the Carnsore Point SAC. • As the proposed development is located on the shoreline of Lady's Island Lake, the construction works will impact directly on the Annex I habitat type 'Coastal lagoons'. • Maintenance dredging could constitute a loss of lagoonal habitat during operation stage, if spoil was placed in an area that reduced the wetted lake area. • There is potential for lagoon habitat loss through pollution, eutrophication and salinity changes. Depletion of plant and benthic communities could occur through toxicity or deoxygenation due to pollution or eutrophication, or due to rapid salinity changes.
Describe any likely impacts on the Natura 2000 site as a whole in terms of: • *Interference with the Key relationships that define the structure of the site; and* • *Interference with key relationships*	• The proposed development has the potential to alter the water chemistry/salinity of the Lady's Island Lake SPA and SAC, thus affecting the functioning of the ecosystem and the conservation of a rare habitat and its typical species. • Biological features of lagoons, which may potentially be affected by changes in water quality include the charophytes, other lagoonal aquatic plants (tasselweed,

that define the function of the site.	pondweed), lagoonal invertebrates, fish and birds. The following water quality (other than salinity) issues are identified: nutrient enrichment, toxic contamination and Turbidity.
Describe from the above those elements of the project, or combination of elements, where the above impacts are likely to be significant or where the scale of magnitude of impacts is not known.	• Any impacts on water quantity or quality could impact on flora and fauna in the lagoon, and therefore on the birds dependent on these for sustenance, especially for Tern during the breeding season. • Pile driving associated with pipeline construction is identified as a potential concern as vibration/sound can be propagated indefinitely through the medium of water. Sound energy can have harmful effects on aquatic and marine fauna, as well as avoidance impacts.

4.6 ASSESSMENT OF SIGNIFICANCE OF POTENTIAL IMPACTS

This section considers the list of sites identified in **Section 4.4.2** above together with the potential ecological impacts identified in the previous section and determines whether the proposed construction works and management of Lady's Island Lake are likely to have significant effects on Natura 2000 sites.

The likelihood of significant effects to Natura 2000 sites from the proposal was determined based on a number of indicators including:

- Habitat loss
- Habitat alteration
- Habitat or species fragmentation
- Disturbance and/or displacement of species
- Water quality and resource

The likelihood of significant cumulative/in-combination effects is assessed in Section 4.6.4.

4.6.1 Habitat Loss and Alteration

4.6.1.1 Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC

The proposed development is located largely within the Lady's Island Lake SAC and SPA. The southern extent of the proposed pipeline (seaward end) is located outside of these designated sites, within the Carnsore Point SAC. As the proposed development is located on the shoreline of Lady's Island Lake, the construction works will impact directly on the Annex I habitat type 'Coastal lagoons'. The installation of the flow control structure pipe and associated dredged drainage channel will result in a temporary direct impact on the lagoon habitat. The area of lagoonal substrate requiring removal will be the proposed development footprint, and any additional area required to lower the bed of the lagoon for pipeline installation. The footprint of the pipeline and drainage channel within the lagoon represents an area of ca. 3000m^2.

There is potential for lagoon habitat loss through pollution, eutrophication and salinity changes. For example, nutrient mobilisation and dispersal in the water, even at low levels could also shift communities within the lake, especially considering that nutrients locked in organic substrates in the system may be at a critically high level and cause an ecosystem collapse in part of the lake. The affected lagoonal area overlaps with the Special Conservation Interest 'Wetland & Waterbirds' of

Lady's Island SPA. The loss of this wetland habitat corresponds to the lagoon habitat discussed above. Alteration of habitat may also occur via the introduction and spread of non-native plant species.

4.6.1.2 Other Natura 2000 sites within 15km

The other sites within 15km of the proposed development are Tacumshin Lake SAC (000709), Tacumshin Lake SPA (004009), Wexford Harbour and Slobs SPA (004076), Saltee Islands SAC (000707), Long Bank SAC (002161), Blackwater Bank SAC (002953), Slaney River Valley SAC (000781), Raven SPA (004019), Raven RAMSAR Site (333), Saltee Islands SPA (004002), Ballyteige Burrow SAC (000696), Ballyteige Burrow SPA (004020) and Raven Point Nature Reserve SAC (000710).

With regard to the significant separation distances that intervene between the proposed development and each of the above Natura 2000 sites, no direct habitat loss or alteration impacts will ensue. The closest of these Natura 2000 sites for example are Tacumshin Lake SAC and SPA, located ca. 2.2km to the west. Given the geographical separation from the proposed development and Tacumshin Lake, there would be no loss or alteration of habitats for which these sites have been selected.

4.6.2 Disturbance and/or Displacement of Species

4.6.2.1 Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC

Adverse water quality impacts could affect bird feeding and breeding habitats by impacting lagoon ecology and therefore affecting prey items. Elevated suspended solids in the sea adjacent to the proposed works location could impact on the feeding efficiency of terns hunting. Disturbance caused by the works could displace birds from preferred feeding areas. Disturbance impacts could reduce feeding efficiency and increase energy demands on birds of special conservation interest in Lady's Island SPA.

Pile driving associated with pipeline construction is identified as a potential concern as vibration/sound can be propagated indefinitely through the medium of water. Sound energy can have harmful effects on aquatic and marine fauna, as well as avoidance impacts. The occurrence of shallow areas in the environs of the proposed development and the option of piling out of water will reduce propagation of energy to sensitive fauna.

4.6.2.2 Other Natura 2000 sites within 15km

The potential for disturbance and displacement of fauna of conservation interest in other designated areas must also be considered. The most likely site where such impacts could take place is at Tacumshin Lake, due to its proximity with birds of special conservation interest (SCI) in the SPA ca. 2.2km west. Generic conservation objectives have been prepared for this site (NPWS, 2020) so more detail on SCIs was obtained from alternative sources as indicated hereunder upon as a basis upon which to assess disturbance and displacement impacts. In addition, the Scottish Natural Heritage (SNH, 2016) guidance *'Assessing Connectivity with Special Protection Areas (SPA)'* was used to ascertain core foraging distances of relevant SCIs, where available.

In assessing impacts including disturbance and displacement, it is important to recognise that different species vary considerably in aspects of their ecology due to many evolutionary adaptations and specialisations to their wetland habitats. Different species or groups of species may therefore

utilise wetland habitats in very different ways which relates to how species are distributed across a site as a whole (NPWS, 2011). Species vary considerably in different aspects of their ecology with regards to trophic (foraging) guild, food/prey requirements, principal supporting habitat within the site, ability to use alternative habitats within the site and site fidelity/faithfulness (NPWS, 2012). Bird species will vary in this use of habitats within a site. This may vary between times of day, seasons and between different sites. **Table 3** outlines the ecological characteristics, requirements and specialities for non-breeding waterbird SCIs within Tacumshin lake SPA.

Table 3 Ecological Characteristics, requirements and specialities of non-breeding waterbird SCI species for Tacumshin Lake SPA (adapted from NPWS, 2011 and 2012).

Species	Distribution[A]	Trophic Guild[B]	Food Prey Requirements[C]	Principal Habitat within site[D]	Ability to use alternative habitats[E]
Little Grebe	Widespread	1,2	Wide	Lagoon and associated habitats, intertidal mudflats and shallow subtidal	3
Bewick's Swan	Restricted	1,7	Wide	Lagoon and associated habitats, intertidal mudflats and shallow subtidal	2
Whooper Swan	Widespread	1,7	Wide	Lagoon and associated habitats, intertidal mudflats and shallow subtidal	2
Wigeon	Widespread	1,5	Narrower	Intertidal mud/sand flats, sheltered and shallow subtidal lagoons	2
Gadwall	Not supplied	1	Invertebrates, vegetation & seeds	Intertidal mud/sand flats, sheltered and shallow subtidal lagoons	Not supplied
Teal	Widespread	1	Wide	Intertidal mud/sand flats, shallow subtidal and lagoons	3
Pintail	Localised	1	Wide	Intertidal mud/sand flats, sheltered and shallow subtidal	2
Shoveler	Localised	1	Wide	Lagoon, brackish and freshwater lakes, plus intertidal sand and mud flats	3
Tufted Duck	Not supplied	2	Fish & Invertebrates	Lagoon, brackish and freshwater lakes	Not supplied
Coot	Widespread	1, 2, 7	Wide	Lagoon, brackish and freshwater lakes	Not supplied
Grey plover	Localised	4	Wide	Intertidal mud/sand flats	3
Golden plover	Intermediate	4	Wide	Intertidal mud/sand flats	2
Lapwing	Very Widespread	4	Wide	Lagoon, brackish and freshwater lakes	2
Black-tailed godwit	Localised	4	Wide	Intertidal mud/sand flats	2

A: Distribution – Very Widespread (>300 sites), Widespread (200-300 sites), Intermediate (100-200 sites), Localised (50-100 sites), Highly Restricted (<50 sites) (based on Boland & Crowe, 2012).

B: Trophic Guild – 1= surface swimmer, 2= water column diver (Shallow), 3= water column diver (deeper), 4/5= Intertidal walker (out of water), 6= Intertidal walker (in water), 7= terrestrial walker

C: Food/Prey Requirements – species with a wide prey/food range, a narrow prey range (e.g. a species that forage upon a few species/taxa only), and species with highly specialised foraging requirements (e.g. piscivores).

D: Principal Supporting Habitat present within the SPA (Note that this is the main habitat used when foraging with the exception of Whooper Swan that utilise wetland habitats for roosting and forage within terrestrial grasslands outside of the SPA), where not supplied in either NPWS (2011) and NPWS (2012), habitat(s) selected on basis of feeding guild

E: Ability to Use Alternative Habitat – refers to the species ability to utilise other habitats adjacent to the site: 1= wide-ranging species, 2= reliant on site but highly likely to use alternative habitat at certain times (e.g. high tide), 3= considered totally reliant on wetland habitats due to unsuitable surrounding habitats and/or species limited by habitat requirements.

F: Site fidelity on non-breeding grounds: Unknown; Weak; Moderate; or High.Water Quality

Most of the birds of SCI that occur in Tacumshin Lake SPA (migratory and non-migratory) have fidelity to this site and most species and do not need to travel beyond the site as it provides adequate foraging. Tacumshin Lake SPA is a large site and its western limit (including lagoon habitat used by birds) is greater than 6.5km from the proposed development. Based on the geographical separation of Tacumshin Lake SPA the proposed development, it is considered that the conservation objectives for the site's qualifying interests will not be undermined despite their co-occurrence adjacent to the same stretch of shoreline along the south Wexford coast. This statement acknowledges the fact that core the core foraging ranges of breeding Golden plover and wintering Whooper swan are 3km and 5km respectively, these distances potentially within the range of proposed works at Lady's Island, and that the works would take place over a 9 month period, but is justified by adaptability (trophic guilds and ability to use alternative habitat at certain times). It is highly likely that other species will not depend on habitats where they could be subject to disturbance from the proposed works, or be affected by lake management levels during operation stage.

Beyond Tacumshin Lake SPA, the Wexford Harbour and Slobs SPA are next in closest proximity to the proposed development, located ca. 8.7km to the north. Analogous to reasons outlined for Tacumshin Lake SPA, the conservation objectives of any other SPA site would not be adversely affected by the proposed development.

With the exception of Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC, there exists no plausible pathway or links between the proposed development site and the Natura 2000 network due to separation distances. Therefore, no disturbance or displacement of species are expected regarding pollution and associated impacts on habitats or species.

4.6.3 Water quality

4.6.3.1 Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC

The proposed development has the potential to alter the water chemistry/salinity of the Lady's Island Lake SPA and SAC, thus affecting the functioning of the ecosystem and the conservation of a rare habitat and its typical species. Depletion of plant and benthic communities could occur through rapid salinity changes. The salinity "shock" effect within the lagoon, especially the southern end of the lake, near the flow control structure, could potentially cause mortalities of freshwater and oligohaline species.

Impacts on the plant life and macroinvertebrates due to water quality changes could alter the feeding patterns of birds using Lady's Island lagoon. The magnitude of impact is dependent on the level of ecological change and is not expected to show greater variance than the existing regime i.e. annual breaching of the barrier beach.

Potentially when the proposed works take place, contaminated surface water runoff may enter Lady's Island Lake cSAC. Contaminants from the construction site may contain hydrocarbons such as hydraulic oils and diesel, cement/concrete-based compounds and wastewater discharges from welfare facilities. These impacts can be mitigated however.

The various works carried out can result in re-suspension of materials in sections of the water column. Most re-suspended sediments should settle in the general vicinity of the works, however

with a strong current they may be carried to neighbouring areas, particularly in the case of the lighter materials. Either way this can result in a silt layer falling on benthic species, impairing breathing/feeding in any species sensitive to such changes.

Contaminants associated with sea-bed sediments may be released during the installation of the drainage pipeline; this can occur in particulate, dissolved, or volatile fractions. It is not clear if the sediment re-settling and potential water quality changes will have a significant impact on the features of qualifying interest of Lady's Island Lake cSAC / SPA and Carnsore Point cSAC.

4.6.3.2 Other Natura 2000 sites within 15km

The proposed development is highly unlikely to have an impact on any other Natura site taking account of the lack of pathways and geographical separation.

4.6.4 Habitat or Species Fragmentation

Habitat fragmentation has been defined as 'reduction and isolation of patches of natural environment' (Hall *et al*., 1997 cited in Franklin *et al*., 2002) usually due to an external disturbance such that an alteration of the spatial composition of a habitat occurs that alters the habitat and 'create[s] isolated or tenuously connected patches of the original habitat' (Wiens, 1989 cited in Franklin *et al*., 2002). This results in spatial separation of habitat units which had previously been in a state of greater continuity. Adverse effects of habitat fragmentation on species/populations can include increased isolation of species / populations which can detrimentally impact on the resilience or robustness of the species / populations, potentially altering species abundance and leading to a reduction in overall species diversity.

4.6.4.1 Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC

Lady's Island Lake is a heterogeneous waterbody with regard to its salinity and therefore the biological communities it supports can vary according to location within the lake. The proposed development will allow sea water into Lady's Island Lake and bring about salinity changes. The proposed management could bring about changes to the plant, macroinvertebrate, fish and avifaunal communities of Lady's Island Lake.

4.6.4.2 Other Natura 2000 sites within 15km

The preceding sections have concluded that significant water quality and habitat loss or alteration effects would not occur and that significant disturbance of displacement can also be ruled out. Therefore, the potential for significant habitat or species fragmentation effects to occur as a result of the proposed development is highly unlikely.

4.6.5 Cumulative/In-combination Impacts

4.6.5.1 Lady's Island Lake SAC, Lady's Island Lake SPA and Carnsore Point SAC

The effects of the water level and salinity changes resulting from water level management practices at lady's Island may be combining with other impacts on the site, most notably eutrophication, compounding potential damage to the site and its species. Non-native species, climate change, modification of hydrographic functioning, silting up and drying out, as well as circuits/tracks all represent potentially significant cumulative effects on the Natura 2000 Sites at and adjacent to Lady's Island.

4.6.5.2 Other Natura 2000 sites within 15km

It is objectively concluded that significant cumulative/in-combination impacts to other SACs or SPAs within the zone of influence of the proposed development will not occur. This has been demonstrated above with reference to geographical separation and absence of / weak pathways.

4.7 CONCLUSION OF SCREENING STAGE

In conclusion, to determine the potential impacts, if any, of the project on nearby Natura 2000 sites, a screening process for Appropriate Assessment was undertaken. The proposed development is within 15km of fifteen Natura 2000 sites and one Ramsar Site.

It has been objectively concluded during the screening process that thirteen sites within 15km of the project are unlikely to be significantly impacted:

- Tacumshin Lake SAC (000709)
- Tacumshin Lake SPA (004092)
- Wexford Harbour and Slobs SPA (004076)
- Saltee Islands SAC (000707)
- Long Bank SAC (002161)
- Blackwater Bank SAC (002953)
- Slaney River Valley SAC (000781)
- The Raven SPA (004019)
- The Raven Ramsar Site (No. 333)
- Saltee Islands SPA (004002)
- Ballyteige Burrow SAC (000696)
- Ballyteige Burrow SPA (004020)
- Raven Point Nature Reserve SAC (000710)

It has been concluded with regard to the proposed water level management project that significant effects cannot be ruled out at this stage on the following Natura 2000 site:

- Lady's Island Lake SAC (000704)
- Lady's Island Lake SPA (004009)
- Carnsore Point SAC (002269)

Further assessment is required to determine whether the project is likely to adversely affect the integrity of these Natura 2000 sites. An Appropriate Assessment of the project is required and a Natura Impact Statement (NIS) will need to be prepared to inform the Appropriate Assessment.

5 REFERENCES

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Franklin, Alan B., Noon, Barry R. & Luke George T., (2002) What is Habitat Fragmentation?, Studies in Avian Biology No. 25: 20-29.

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NPWS (2011) Wexford Harbour and Slobs Special Protection Area (Site Code 4076) & The Raven Special Protection Area (Site Code 4019) Conservation Objectives Supporting Document. (Version 1).

NPWS (2012) River Shannon and River Fergus Estuaries SPA (004077) Conservation Objectives Supporting Document (Version 1).

NPWS (2020) Conservation objectives for Tacumshin Lake SPA [004092]. Generic Version 7.0. Department of Culture, Heritage and the Gaeltacht.

Appendix 1

Stages of Appropriate Assessment

Stage 1 - Screening

This is the first stage of the Appropriate Assessment process and that undertaken to determine the likelihood of significant impacts as a result of a proposed project or plan. It determines need for a full Appropriate Assessment.

If it can be concluded that no significant impacts to Natura 2000 sites are likely then the assessment can stop here. If not, it must proceed to Stage 2 for further more detailed assessment.

Stage 2 - Natura Impact Statement (NIS)

The second stage of the Appropriate Assessment process assesses the impact of the proposal (either alone or in combination with other projects or plans) on the integrity of the Natura 2000 site with respect to the conservation objectives of the site and its ecological structure and function. This is a much more detailed assessment that Stage 1. A Natura Impact Statement containing a professional scientific examination of the proposal is required and includes any mitigation measure to avoid, reduce or offset negative impacts.

If the outcome of Stage 2 is negative i.e. adverse impacts to the sites cannot be scientifically ruled out, despite mitigation, the plan or project should proceed to Stage 3 or be abandoned.

Stage 3 - Assessment of alternative solutions

A detailed assessment must be undertaken to determine whether alternative ways of achieving the objective of the project/plan exists.

Where no alternatives exist the project/plan must proceed to Stage 4.

Stage 4 - Assessment where no alternative solutions exist and where adverse impacts remain

The final stage is the main derogation process examining whether there are imperative reasons of overriding public interest (IROPI) for allowing a plan or project to adversely affect a Natura 2000 site where no less damaging solution exists.

Appendix 2
Stages of Appropriate Assessment

Stage 1 – Screening

This is the first stage of the Appropriate Assessment process and that undertaken to determine the likelihood of significant impacts as a result of a proposed project or plan. It determines need for a full Appropriate Assessment.
If it can be concluded that no significant impacts to Natura 2000 sites are likely then the assessment can stop here. If not, it must proceed to Stage 2 for further more detailed assessment.

Stage 2 - Natura Impact Statement (NIS)

The second stage of the Appropriate Assessment process assesses the impact of the proposal (either alone or in combination with other projects or plans) on the integrity of the Natura 2000 site with respect to the Conservation Objectives of the site and its ecological structure and function. This is a much more detailed assessment that Stage 1. A Natura Impact Statement containing a professional scientific examination of the proposal is required and includes any mitigation measure to avoid, reduce or offset negative impacts.

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Appendix 3
Lady's Island Lake Drainage Solutions Previously Considered

Introduction

A report by Hurley (1997) details engineering solutions that were considered for drainage of Lady's Island Lake in the late 80's. It was stated that, in a report by the OPW, engineering works of any kind were ruled out at the barrier because of the high probability of total failure within a short time due to the unstable and uncertain ground conditions and the nature of the sea forces and speed of natural accretion. Two preferred options were considered at the time:

Construct a pumping scheme to bring lake water via a newly-constructed canal through Ring Marsh to a pumping station at Clougheast and discharging it into the existing land drain system to run to the sea at Carne.
Continue the traditional breaching with modifications:

2a: Open the breach more regularly (the lesser head of water the breach in the barrier would not be as wide or as deep and would therefore close more quickly).
2b: That an attempt be made to close the breach with a machine when the water level had fallen sufficiently.

In 1990 it was decided in favour of option 2b (due to costs of option 1) and the lake drainage committee was established to deal with this. As noted however attempts to close the breach have been tried and abandoned due to health and safety risks. With regard to Option 2a, this would not eliminate the potential negative effects on the Site. In addition, the barrier itself has been lowered through years of breaching, as during each cut a large amount of sand and gravel gets washed out to sea. It must be considered that that continued breaching of the barrier will eventually result in damage to the structural integrity of the barrier. If the height of the barrier continues to lower then flooding may become more frequent as overtopping becomes more regular, particularly if climate change has an impact.

The option of a culvert to drain the lake was also investigated. In February 1998, Malachy Walsh & Partners, Cork, Consulting Engineers, in association with Posford Duvivier, Peterborough, UK, were commissioned by the Department of Arts, Heritage, Gaeltacht and the Islands to carry out a study of methods of draining Lady's Island and Tacumshin Lakes. Fieldwork was conducted in the period February-May and a report was finalised on 8 July 1998. In regard to Lady's Island Lake, the result of the study of drainage options was that the preferred option was to install a pipeline at The Cut. The 250m-long pipeline would consist of a line of 1.2m internal diameter Class H concrete pipes extending from the lagoon bed to the beach face. The lagoon end of the pipeline would incorporate a flow control structure. The outlet of the sea-end of the pipeline would be constructed of concrete lined ductile spun iron and would exit on the beach at a level of 3.09m AOD (Poolbeg). The discharge capacity of the pipeline would be variable in the range 2.5-3.0m^3/s depending on the driving head generated by water level in the lagoon. The estimated capital cost of the pipeline at July 1998 prices was IR£170,000. Funding has not been provided to date due to the outcome of similar drainage works at Tacumshin.

A number of alternatives to the current management practice were outlined in '*A working document based on the Appropriate Assessment model into the cutting of the sand barrier at Our Ladys Island Lake, Wexford*' (Golder Associates, 2010). These alternatives are listed below.

'Do Nothing' Scenario

Coastal lagoons are naturally ephemeral habitats, being part of an ecological succession including salinity, sedimentation and vegetation changes. The area of a lagoon has a natural tendency to reduce with the encroachment of vegetation which will ultimately diminish the lagoon area.

If breaching of the marine barrier was halted, the effects would be eliminated, with the probable extinction of the marine component of the fauna as salinity levels drop, and a corresponding reduction in species richness. The water level in the lagoon usually remains above mean tide level, even in summer, so the amount of landward percolation of seawater is probably always small. Without the physical impact of the breach on the barrier it is likely to increase in height and revegetate over time, and overtopping during storm/high tide events is likely to become less frequent unless sea level rise or increased storm events provide for a continued strong saline influence. The lagoon would therefore follow a natural succession towards a predominately freshwater system with saline influences in the south, and marginal vegetation is likely to increase due to the absence of changes in water level and salinity. It is probable that the lagoonal specialists would become restricted to the south of the Site. Without management to control vegetation encroachment succession to a marsh will eventually occur.

If Lady's Island Lake is to be managed as a totally natural system, then in theory it should be allowed to flood and follow its natural succession. The lagoon barrier has been managed for almost 2 centuries however, and in the interests of maintaining the coastal lagoon habitat for which the lagoon is designated, as well as incorporating the needs of flood relief for local people, it would seem necessary that the site is managed as a 'semi-natural' system, requiring a solution that enables some level of controlled tidal flushing.

Engineering solutions

A short-term solution

An interlocking barrier on the lake side of the barrier has been proposed which could have the effect of keeping the lake level at a particular height (4m) while the breach is made. Sluice pipes (e.g. large corrugated rubber pipes) could be installed within the sand barrier, sitting at the 4 - 4.5m level, buried into the system so they are not damaged by the sea. The pipes could be capped at the seaward side of the barrier to prevent them becoming filled with sand. The caps could then be dug out/removed each spring and the sand cleared from the front of them to allow the water above the level of the artificial barrier to flow into the sea. Apart from the disturbance to the front of the pipes, the barrier would not be disturbed enabling it to build up again.

The excavation required in the barrier to clear sand from the front of the pipes would result in a lot less destruction than that currently undertaken by excavation of the cut. The advantages of this solution are that it would be cheaper than a 'sophisticated' engineering option. It would maintain a minimum stable water level that suits interested parties and would allow the barrier to build up again.

This should be considered as a short-term intermediate measure to reduce the potential catastrophic impacts and allow the barrier to build up again. In the meantime a more sophisticated solution could be investigated.

In order to avoid the problems that have occurred at some Sites due to incorrect placement of sluice pipes, and/or damage to sluice pipes requiring maintenance resulting in excessive drainage, the level of the pipe should be carefully selected. At present it appears that a height of 4-4.5m is appropriate for the Conservation Objectives of the SPA and SAC, as well as other interested parties. In the interest of the Sites flora and fauna the pipe should therefore be set in this height range.

A possible long-term solution

If the Site is to be managed to maintain tidal flushing at least intermittently then a 'two-way' pipe or culvert system would be required. While an engineer's investigation in 1990 revealed that the barrier could not support any sort of engineering structure, this should be re-examined, and international best-practice considered.

Cemlyn Bay SAC on Anglesey is impounded by a shingle bank with a narrow channel across which a sluice system was built in the 1930's. Seawater exchange occurs through the sluice and by percolation through the shingle bank. Some barrier beach lagoons in England also have sluices or culverts.

Ideally the structure could be designed to allow tidal incursion during spring tide and storm periods, however in order to stop lagoon levels dropping too low it would need to be combined with some sort of protection/barrier system as described in the above section to prevent water levels from decreasing below the optimal range.

The design of the structure will need to take into account the physical properties of the barrier (sediment type, height, width etc) and prevalent coastal geomorphological processes. There are historical cases where such structures have actually acted as coastal anchors, interrupting coastal geomorphological processes, resulting in increased storm damage, erosion etc. This appears to be one solution that may enable the Site to meet its Conservation Objectives with respect to the Annex I coastal lagoon habitat and associated species, however other alternatives should also be examined. Golder Associates (2010) deemed that a comprehensive engineering study was required.

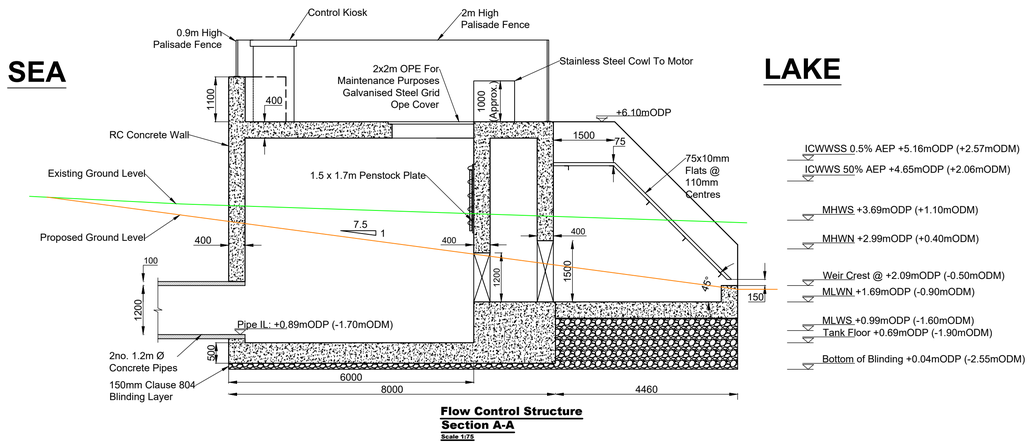
According to a report prepared by Parle (2012), the best that can be achieved is to maintain as high a level as possible over the winter /spring period commensurate with maximum level requirements. This means that the preferred drainage option should be capable of relatively close control on water level management and have a high drainage capacity at high water levels. Better management of lake levels will also require more information on lake levels, on salinity levels and the impacts of lake levels on environmental designations. The summary of Lady's Island Lake drainage options, as outlined in Parle (2012) are given in **Table A3.1** below.

Table A3.1 Summary of Lady's Island Lake drainage options (from Parle 2012).

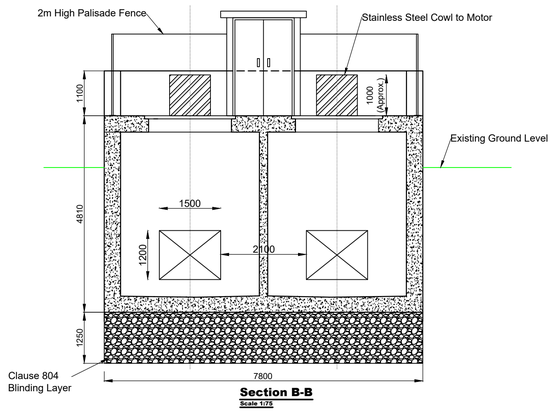
Drainage Options	Evaluation of Drainage Options
A. Pumped flow option 1: This involves intaking water from the east side of the lake and pumping to a land drain to the east of the lake where the outflow would drain to the sea.	Pumped flow options are unlikely to be a cost-effective means of controlling water levels in Lady's Island Lake. The running costs are high, limiting their usefulness in drawing down large lake inflows at high lake levels. The options examined were capable of dealing with yearly average inflows but would take too long to reduce lake levels

Drainage Options	Evaluation of Drainage Options
	to prevent excessively high lake levels. The costs of increasing pumping capacity are approximately pro rata to the increase in capacity.
B. Pump flow option 2: Involves intaking water from the lake just behind the barrier beach and pumping through the barrier to a buried outfall within the beach.	Same as above (Option A.)
C. Gravity flow, pipeline option: This is similar to the option presently used to drain Tacumshin Lake. A lakeside intake – flow control structure, concrete pipes buried under the sand dunes leading to a manhole under the beach and ductile iron pipes, supported on piles, outfalling on the front face of the beach between mid tide level and MLWS.	Although it appears to be one of the more expensive options (estimated capital cost of €970k, including allowances for VAT, design and construction supervision fees), satisfies to the greatest overall degree the environmental and land and cultural use requirements of Lady's Island Lake. Also allows the greatest scope for water level management of all the options considered. It does however include for the laying of a ductile iron pipeline supported on piles on a mobile beach. This is a more difficult construction option than the others examined – but is feasible. It is also important that the design of the flow control system for such an option addresses security issues in relation to flow control. This and Option E can be designed to manage salinity levels in the lake, either by lowering lake levels to allow landwards seepage through the barrier beach or flow of seawater through the pipeline. Can be designed to have minimal effect on the adjacent coastal processes. It has low maintenance requirements and is recommended. Lake and salinity levels should be monitored continuously as part of a water level management plan for the lake.
D. Gravity flow, Modified Cut Option: This involves the placing of a structure (most likely of rock armour) under the seaward face of the beach. This structure would act in conjunction with the existing cutting mechanism but would be designed to limit the width and depth of the cut.	Has the potential to fully satisfy lake level reduction requirements at high lake levels, it would be less effective at lower lake levels and the cut in the barrier beach, while smaller than the present cut size, remains large, and would be an impediment to the status of the barrier beach.
E. Gravity flow, Modified Cut Option with Pipeline: This is similar to Option D but would involve a lake intake and pipes to under the beach front slope where the pipes would discharge as required onto a rock armour structure that would constrain the size of the cut or eroded area on the beach.	Less costly, and has less construction risks than Option C. However there are uncertainties regarding flow capacity. A cut in the beach face will be required for drainage, and it may be necessary to reinstate the cut after each tide in order to maintain the drainage capacity. The cut would be much smaller than that undertaken at present or that of Option D but it would nonetheless result in a reduced barrier crest in its vicinity which would be an impediment to the status of the barrier beach. Can be designed to manage salinity levels in the lake, either by lowering lake levels to allow landwards seepage through the barrier beach or flow of seawater through the pipeline.

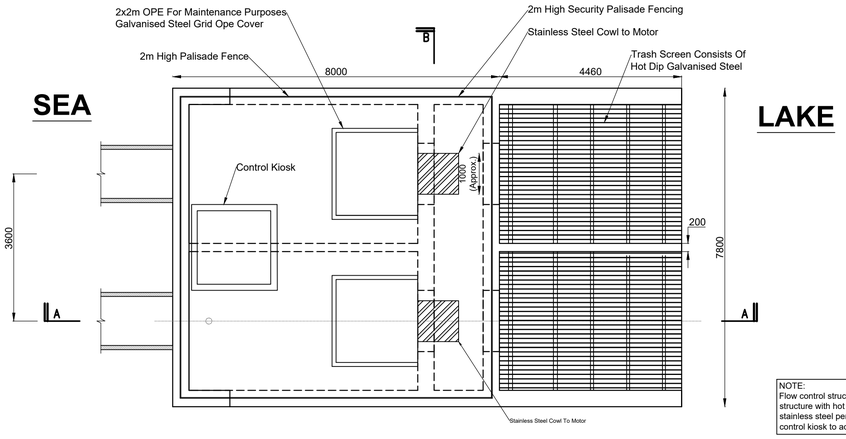
Appendix 4
Proposed Development Drawings



Flow Control Structure
Section A-A
Scale 1:75

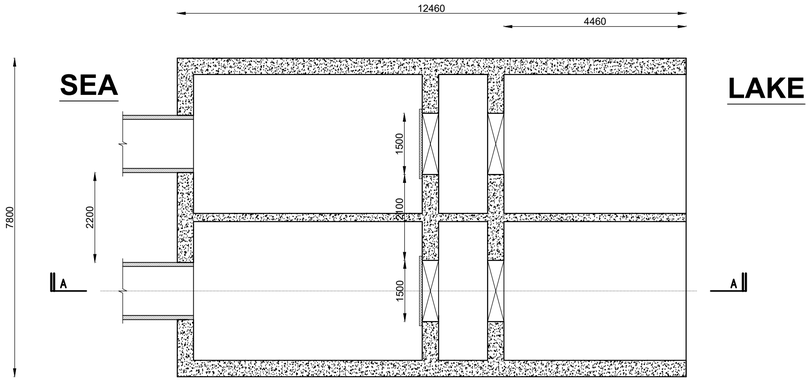


Section B-B
Scale 1:75



NOTE:
Flow control structure is a reinforced concrete structure with hot dip galvanised trash screen, stainless steel penstocks to control and a control kiosk to activate the penstocks.

Roof Plan
Scale 1:75



Floor Plan
Scale 1:75

SAMPLE KIOSK

Notes

1. All drawings are to be read in conjunction with all relevant Specifications, Bills of Quantities, Architectural, Services and Engineering drawings.
2. Any discrepancies between these documents shall be brought to the attention of the Engineer.
3. All dimensions are in millimetres unless noted otherwise.
4. Topographic levels shown in ODMalin.
5. ODM = Ordnance Datum Malin
   ODP = Ordnance Datum Poolbeg
   0.0mODMalin = +2.59m ODPoolbeg

Legend

RC Concrete

Clause 804

Rev.	Date	Description	by	ch'd	app
B	06.04.2021	ISSUED FOR PLANNING	JRC	PP	PP
A	16.06.2020	ISSUED FOR PLANNING	JRC	PP	PP

Project: LADY'S ISLAND LAKE
WATER LEVEL MANAGEMENT SYSTEM

Title: PROPOSED WORKS
FLOW CONTROL STRUCTURE

Client: WEXFORD COUNTY COUCIL

Malachy Walsh and Partners
Engineering and Environmental Consultants
Cork | Tralee | London | Limerick

Park House
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Bessboro Road
Blackrock
Cork.

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E-mail : drawing@mwp.ie

Scales (A1)	1:75	
Drawn	JRC	JUNE 2020
Ch'd(D.O.)		
Ch'd(Eng.)	PP	JUNE 2020
Approved	PP	JUNE 2020

Drg. No. 17821 - 5006

Rev. B

Notes

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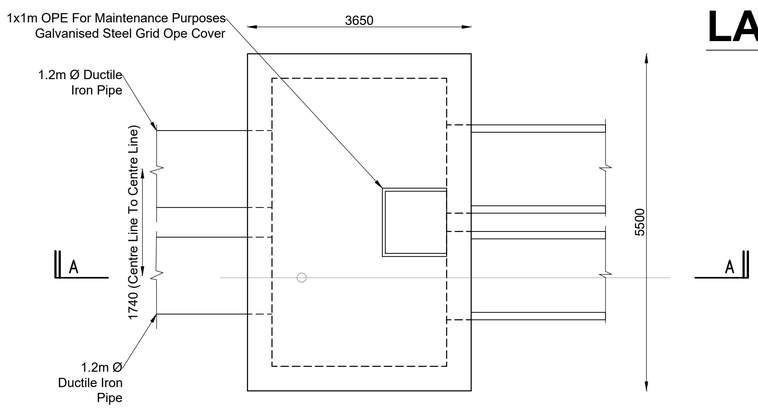
   ODP = Ordnance Datum Poolbeg
   0.0mODMalin = +2.59m ODPoolbeg

SEA

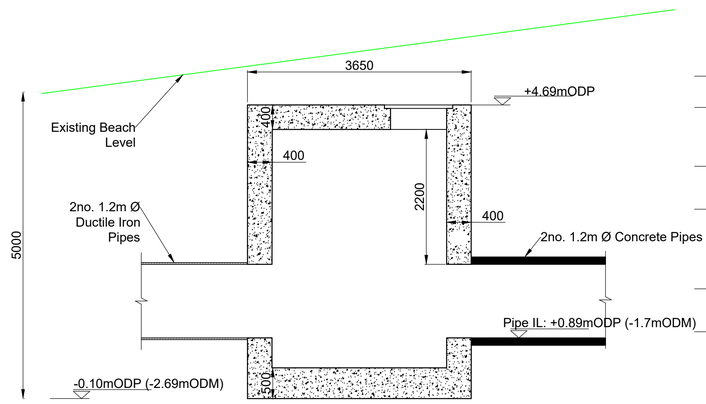


Roof Plan

LAKE

NOTE:
Junction box is a manhole to connect the ductile iron and concrete pipes. It consists of reinforced concrete with an access ope in the top covered with a steel cover.
It has a secondary function in that it provides stability to the ductile iron section of the pipeline against wave forces.
The junction box will be buried under the existing beach.

SEA



Section A-A

LAKE

ICWWS 0.5% AEP +5.16mODP (+2.57mODM)
ICWWS 50% AEP +4.65mODP (+2.06mODM)
MHWS +3.69mODP (+1.10mODM)
MHWN +2.99mODP (+0.40mODM)
MLWN +1.69mODP (-0.90mODM)
MLWS +0.99mODP (-1.60mODM)

Max Lake Level +5.10mODP (+2.51mODM)
Min Lake Level +4.50mODP (+1.91mODM)

Rev.	Date	Description	by	ch'd	app
B	06.04.2021	ISSUED FOR PLANNING	JRC	PP	PP
A	16.06.2020	ISSUED FOR PLANNING	JRC	PP	PP

Project: LADY'S ISLAND LAKE
WATER LEVEL MANAGEMENT SYSTEM

Title: PROPOSED WORKS
JUNCTION BOX

Client: WEXFORD COUNTY COUCIL

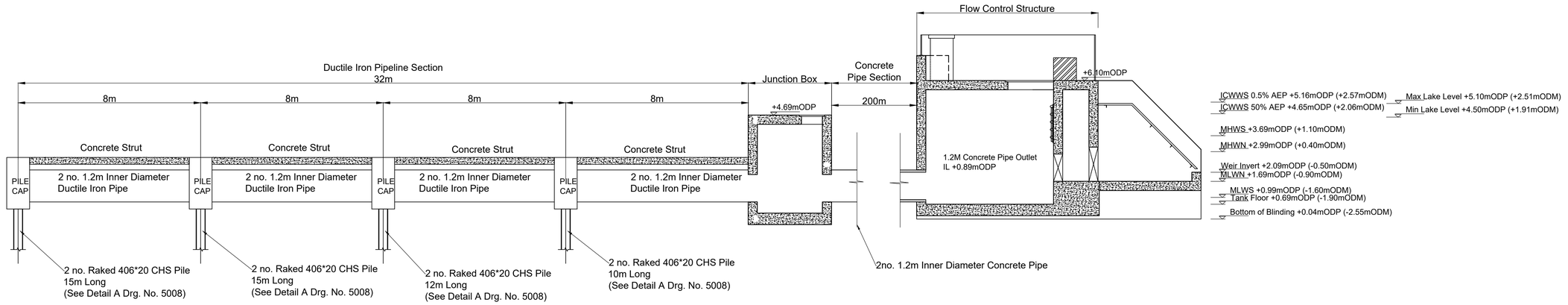
Malachy Walsh and Partners
Engineering and Environmental Consultants
Cork | Tralee | London | Limerick

Park House
Mahon Technology Park
Bessboro Road
Blackrock
Cork.

Tel : +353 (0)21 4536400
fax. : +353 (0)21 4536450
E-mail : drawing@mwp.ie

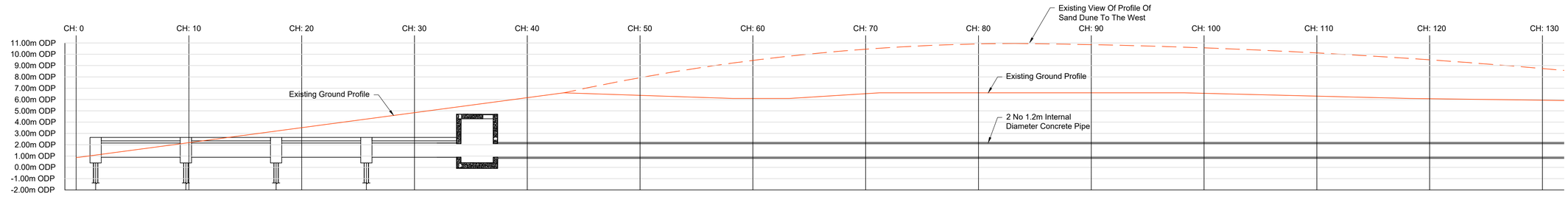
Scales (A1)	1:50	
Drawn	JRC	JUNE 2020
Ch'd(D.O.)		
Ch'd(Eng.)	PP	JUNE 2020
Approved	PP	JUNE 2020

Drg. No. 17821 - 5007
Rev. B



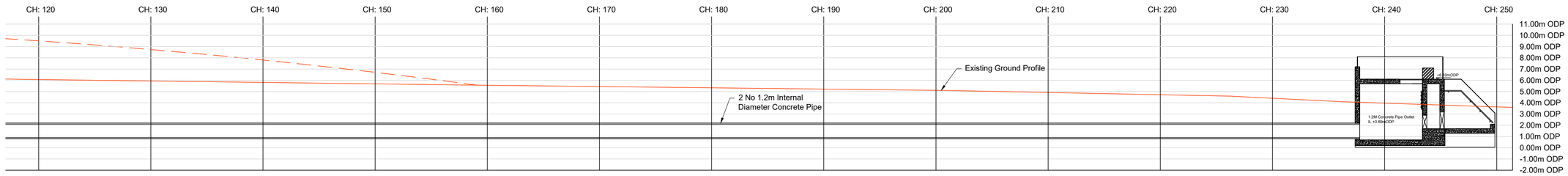
LONG SECTION - SCHEMATIC

SCALE: 1:100



LONG SECTION (B-B) - Part 1

SCALE: 1:200



LONG SECTION (B-B) - Part 2

SCALE: 1:200

Notes

1. All drawings are to be read in conjunction with all relevant Specifications, Bills of Quantities, Architectural, Services and Engineering drawings.
2. Any discrepancies between these documents shall be brought to the attention of the Engineer.
3. All dimensions are in millimetres unless noted otherwise.
4. Topographic levels shown in ODMalin.
5. ODM = Ordnance Datum Malin
   ODP = Ordnance Datum Poolbeg
   0.0mODMalin = +2.59m ODPoolbeg

Rev.	Date	Description	by	ch'd	app
B	06.04.2021	ISSUED FOR PLANNING	JRC	PP	PP
A	16.06.2020	ISSUED FOR PLANNING	JRC	PP	PP

Project: LADY'S ISLAND LAKE
WATER LEVEL MANAGEMENT SYSTEM

Title: PROPOSED WORKS
PIPE ELEVATION

Client: WEXFORD COUNTY COUCIL

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Scales (A1)	1:100	
Drawn	JRC	JUNE 2020
Ch'd(D.O.)		
Ch'd(Eng.)	PP	JUNE 2020
Approved	PP	JUNE 2020

Drg. No. 17821 – 5005

Rev. B

Appendix 5
Environmental Commitments

Note: To be read in conjunction with the full suite of mitigation in Section 10.1

1. Method Statements will be prepared by the appointed contractor. These will be submitted to Wexford County Council and National Parks and Wildlife Service (NPWS) for approval in advance of works commencing. Method Statements will be used to translate the project requirements into planned systems of work instructions to the site staff and operatives involved. They will define the proposed method of working for an element or section of work taking into account the particular requirements of the project including site conditions, safety hazards, the contract drawings, specification or code of practice and ecological requirements (highlighted by site ecologist). They define the proposed use of plant, labour and materials, any hold points or permits and may be supplemented by drawings, sketches and produce data as necessary.

2. The works site boundaries including site access will be marked by secure posts and robust high visibility tape before any works or excavations will start, to minimise the effects on the lakeshore, sub-littoral habitats and beach area. These areas will be agreed with the site ecologist. Machinery and personnel will not be permitted breach these agreed boundaries during the work.

3. The contractor will adhere to the following environmental commitments: sediment and erosion control; excavated materials and spoil management, commencement of works during August/September with a duration of 9 months, concrete and hydrocarbon control emergency response plan, site training and environmental awareness, non-native and invasive species control, waste management and minimising construction noise.

4. Substances that can cause water quality problems will need to be controlled adequately at all times during the works. Refuelling of machinery will be in designated refuelling areas. Spill kits and personnel practised in their use will be required in case of an oil spillage.

5. All construction equipment/gear will be stored at a site compound. Wastes generated on-site (construction and waste water) will be managed properly and taken to a licensed waste management company.

6. The timing of construction in the intertidal area will be influenced by the tide. There are tide timetables available online e.g. http://www.ukho.gov.uk/easytide/EasyTide/index.aspx. The meteorological forecasting service from Met Éireann will be used to avoid large excavations in advance of heavy rainfall.

7. A project ecologist (environmental clerk of works) will be appointed to monitor the works on a weekly basis for the full duration of the project. The contractor will work with the ecologist to deliver environmental compliance on site, as set out in the mitigation in the NIS. The ecologist will audit the construction works from an environmental viewpoint.

8. At post construction stage, compensation measures (e.g water level and salinity control) and monitoring will be the responsibility of Wexford County Council.