# Greater Dublin Drainage Project

Uisce Éireann

## *Revised* Natura Impact Statement

October 2023

Page left intentionally blank

## Explanatory Note:

An Bord Pleanála (ABP) previously made a decision to grant planning permission by Order dated 11 November 2019 under reference number ABP-301908-18 for the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project). That decision was quashed by Order of the High Court and the case was remitted by that Court to the Board for a fresh determination.

Following the remittal Order, ABP decided that given the passage of time since the submission of the original planning application, and in accordance with section 37F(1)(c) of the Planning and Development Act 2000, Irish Water should have the opportunity to update, where appropriate, the Environmental Impact Assessment Report (EIAR) and Natura Impact Statement (NIS) and any other information submitted.

This revised NIS has been prepared in response to that request from ABP to provide a full update in an Addendum Report. In the preparation of this revised NIS, Irish Water and its technical advisors have considered the extent to which the NIS is required to be updated, having particular regard to:

- Any relevant changes to the baseline environment; and
- Any relevant changes in law, policy, or industry standards and guidance in the intervening period.

In so far as relevant to this revised NIS, Uisce Éireann has also had regard to the information presented at the Oral Hearing for application ABP-301908-18 and the High Court proceedings in respect of that application, including the addition of ultraviolet (UV) treatment such that the Proposed Project description has been updated.

This revised NIS presents any changes or updates to the NIS submitted with the original 2018 planning application. Changes in the main body of text to this revised NIS are identifiable as blue text with light grey background shading under each respective Section heading.

Page left intentionally blank

## Contents


**1. Introduction ........ 1**
1.1 Purpose of the Document ........ 1
1.2 Overview of Proposed Development ........ 1
1.3 Study Area and Zone of Influence ........ 2
1.4 Study Team ........ 2
**2. Appropriate Assessment Approach ........ 5**
2.1 Legislative Background for Appropriate Assessment ........ 5
2.2 Overview of Appropriate Assessment (AA) Stages ........ 5
**3. Description of the Proposed Project ........ 8**
3.1 Receiving Environment ........ 8
3.2 Description of Construction Stage including Techniques and Approaches ........ 10
3.2.1 Proposed WWTP and Sludge Hub Centre ........ 10
3.2.2 Proposed Pumping Station at Abbotstown ........ 11
3.2.3 Orbital Sewer Pipeline, North Fring Sewer and Outfall pipeline (land sections) ........ 11
3.2.4 Proposed Outfall Pipeline (marine section micro tunnelled) ........ 12
3.2.5 Proposed Outfall Pipeline (marine section sub-sea pipe laying) ........ 13
3.2.6 Proposed Diffuser ........ 15
3.2.7 Proposed Access and Construction Compounds ........ 15
3.2.8 Proposed Regional Biosolids Facility ........ 16
3.2.9 Programme ........ 16
3.3 Description of Operational Stage ........ 18
3.3.1 Proposed Treatment Standards ........ 18
3.3.2 Chambers ........ 19
3.3.3 Air Valves ........ 19
3.3.4 Maintenance during Operation ........ 19
**4. Screening for Appropriate Assessment ........ 20**
4.1 Methodology ........ 20
4.1.1 Published Guidance on Appropriate Assessment ........ 20
4.1.2 Likely Significant Effect ........ 21
4.1.3 Mitigation Measures at Screening Stage ........ 21
4.1.4 Consideration of *ex-situ* Effects ........ 22
4.1.5 Conservation Objectives ........ 23
4.1.6 In-combination Effects ........ 23
4.2 Elements of the Project with Potential for Likely Significant Effects ........ 24
4.2.1 Water Catchments traversed by the Proposed Project ........ 32
4.3 European Sites within the Study Area of the proposed Project ........ 32
4.3.1 Further Information in Relation to Ireland's Eye SAC ........ 34
4.3.2 Further Information in Relation to Ireland's Eye SAC and Howth Head SAC ........ 35
4.3.3 Further Information in Relation to the North-West Irish Sea candidate SPA ........ 37

4.4 Analysis of Potential for Likely Significant Effects ... 39
4.5 Screening Assessment Conclusions ... 50
**5. Scientific Investigations to Support Impact Assessment ... 51**
5.1 Field Surveys ... 51
5.1.1 Estuarine Ornithological Survey ... 51
5.1.2 Coastal and Marine Vantage Point (VP) Ornithological Surveys ... 57
5.1.3 Boat-based Assessment of Auk Fledging ... 62
5.1.4 Baldoyle Estuary Walkover ... 63
5.1.5 Surveys for Reefs (1170) on Ireland's Eye - Rockabill to Dalkey Island SAC ... 69
5.1.6 Surveys for the Harbour Porpoise - Rockabill to Dalkey Island SAC ... 77
5.2 Modelling ... 82
5.2.1 Airborne Noise Modelling at Microtunnelling Compounds ... 82
5.2.2 Water Quality Modelling ... 82
5.2.3 Underwater Noise Modelling ... 86
**6. Assessment of Implications for European sites ... 88**
6.1 Impact Pathway - Airborne noise and visual disturbance ... 88
6.1.1 Baldoyle Bay SPA ... 88
6.1.2 Ireland's Eye SPA and North-West Irish Sea cSPA ... 95
6.1.3 Other European Sites ... 123
6.2 Impact Pathway - Water quality and habitat deterioration ... 127
6.2.1 Baldoyle Bay SAC ... 127
6.2.2 Rockabill to Dalkey Island SAC ... 131
6.2.3 Lambay Island SAC ... 135
6.2.4 Other European Sites ... 137
6.3 Impact Pathway - Underwater Noise and Disturbance ... 144
6.3.1 Baldoyle Bay SAC ... 144
6.3.2 Rockabill to Dalkey SAC ... 145
6.3.3 Lambay Island SAC ... 146
6.4 Impact Pathway – Habitat Loss ... 148
6.4.1 Baldoyle Bay SAC ... 148
6.4.2 Rockabill to Dalkey Island SAC ... 149
6.4.3 Baldoyle Bay SPA ... 150
6.4.4 Irelands Eye SPA and the North-West Irish Sea cSPA ... 151
6.4.5 Other European Sites ... 152
6.5 ASSESSMENT OF IN COMBINATION EFFECTS WITH OTHER PLANS OR PROJECTS ... 155
**7. Mitigation Measures for the Protection of Natura 2000 sites ... 168**
7.1 Baldoyle Bay SPA ... 168
7.2 Ireland's Eye SPA and the North-West Irish Sea cSPA ... 168
7.3 Baldoyle Bay SAC ... 168
7.4 Rockabill to Dalkey Island SAC ... 169

7.5 Lambay Island SAC ..... 170
7.6 Other European Sites ..... 171
**8. Conclusions ..... 172**
8.1 Baldoyle Bay SPA ..... 172
8.2 Ireland's Eye SPA and the North-West Irish Sea cSPA ..... 173
8.3 Baldoyle Bay SAC ..... 173
8.4 Rockabill to Dalkey Island SAC ..... 174
8.5 Lambay Island SAC ..... 174
8.6 Other European Sites ..... 175
**9. REFERENCES ..... 176**

# Appendices

**Appendix A - RPS Ornithology Reports**

- Estuarine, Coastal and Marine Ornithology Technical Report 2018
- Estuarine, Coastal and Marine Ornithology Baseline Report 2023

**Appendix B - Benthic Solutions Ltd - Reef Assessment Reports**

- Phase II Ireland's Eye Reef Survey 2015,
- Marine Habitat Assessment Survey 2023
- Irelands Eye Sublittoral Biotope Surbey 2023

**Appendix C - IWDG Report on Marine Mammals**

**Appendix D - Quiet Oceans - Underwater Noise Modelling Report**

**Appendix E - Site-Specific Detailed Conservation Objectives List Links**

**Appendix F – RPS Revised Vessel Management Plan**

# 1. Introduction

RPS was commissioned by Uisce Éireann (formerly Irish Water) to provide information in support of Screening for Appropriate Assessment (AA) and, if necessary, prepare a Natura Impact Statement (NIS) containing an assessment of implications for European sites to inform the AA for the proposed Greater Dublin Drainage (GDD) project. Uisce Éireann is seeking consent for the GDD project from:

- An Bord Pleanála for planning permission as a Strategic Infrastructure Development application;
- The Environmental Protection Agency (EPA) for a Waste Water Discharge licence; and
- The Marine Planning and Foreshore Section of the Department of Housing, Local Government and Heritage for a Foreshore Licence.

## 1.1 Purpose of the Document

A screening for AA exercise described in Section 4 of this report has concluded that, on the basis of objective information, the Proposed Project either individually or in combination with other plans or projects is likely to have significant effects on European sites in view of their conservation objectives. As such, the Proposed Project must be subject to AA in accordance with Article 6(3) of the EU Habitats Directive (Directive 92/43/EEC) on the Conservation of Natural Habitats and of Wild Fauna and Flora; the Planning and Development Act 2000 (as amended); and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011) (as amended).

This revised NIS document comprises a two-stage evaluation and analysis exercise (Stage 1 – a screening appraisal to inform screening for appropriate assessment in Section 4; and Stage 2 – an assessment of implications for European sites in Sections 6-7) to inform the AA of the proposed GDD project by the competent authority for planning which is An Bord Pleanála and subsequently the competent authority for a Foreshore Licence application which is the Marine Planning and Foreshore Section of the Department of Housing, Local Government and Heritage and the competent authority for a Waste Water Discharge licence, which is the EPA Environmental Licensing Programme Office of Environmental Sustainability.

In their assessments, the competent and public authorities concerned must arrive at a definitive determination under Article 6(3) of the Habitats Directive and transposing domestic legislation applicable to the various consents as to whether or not the project, on its own or in combination with other plans and projects, will adversely affect the integrity of any European site.

## 1.2 Overview of Proposed Development

The land based elements of the GDD project are located along the southern fringe of Fingal in North County Dublin, between Blanchardstown and Baldoyle, and in the marine environment off North County Dublin between Baldoyle and Ireland's Eye (see Figure 1.1). The project comprises the following interlinked elements:

- Regional Wastewater Treatment Plant (WwTP) to be located on a 29.8ha site in the townland of Clonshagh in Fingal (see Section 3.2.1);
- Sludge Hub Centre to be co-located on the same site as the Regional WwTP (see Section 3.2.1);
- Abbotstown Pumping Station to be located in the grounds of the National Sports Campus (see Section 3.2.2);
- Orbital Drainage Sewers from Blanchardstown – Clonshagh (13,804m) (see Section 3.2.3);
- Connecting sewer from the North Fringe Sewer (NFS) to the WwTP (570m) (see Section 3.2.3);
- Outfall Pipeline from the WwTP to the outfall point approximately one kilometre north-east of Ireland's Eye. The total length of the Outfall pipeline is 11,313m with the land based section comprising 5,379m and the marine section, including the multiport diffuser comprising 5,934m. As the Outfall pipeline crosses

under the estuary habitats of Baldoyle Bay SAC, the tunnelled and the sub-sea pipeline sections will require connection approximately 700m offshore. This marine section will require the installation of works to protect an existing fibre optic cable approximately 4,200m offshore just northwest of Ireland's Eye (see Sections 3.2.4 and 3.2.5);

- Marine Diffuser Section (see Section 3.2.6); and
- Regional Biosolids Storage Facility to be located on a 11.4ha site at Newtown/Kilshane in Fingal (see Section 3.2.8).

A detailed description of the proposed development, including construction and operational phases is included in Chapter 3 of this NIS.

The need for the GDD project is derived from the key findings of the Greater Dublin Strategic Drainage Study (GDSDS) Final Strategy Report and its associated Strategic Environmental Assessment (SEA) which were prepared in 2005 - 2008 respectively on behalf of the seven local authorities that form the GDA. The policy basis for the need for the proposed GDD project is set out in more detail the Environmental Impact Assessment Report (EIAR).

## 1.3 Study Area and Zone of Influence

Determination of this Proposed Project's Zone of Influence (ZoI) was achieved by assessing all elements of the Proposed Project against the ecological receptors within the Proposed Project footprint, in addition to all ecological receptors that could be connected to and subsequently impacted by the Proposed Project through impact pathways. To this end, the ZoI extends outside of the Proposed Project infrastructure footprint to include ecological receptors connected to the Proposed Project through overlap / intersection, proximity and connectivity through features such as watercourses. The proposed GDD project is located within the following four European sites (see Figure 1-1 and Figure 1-2):

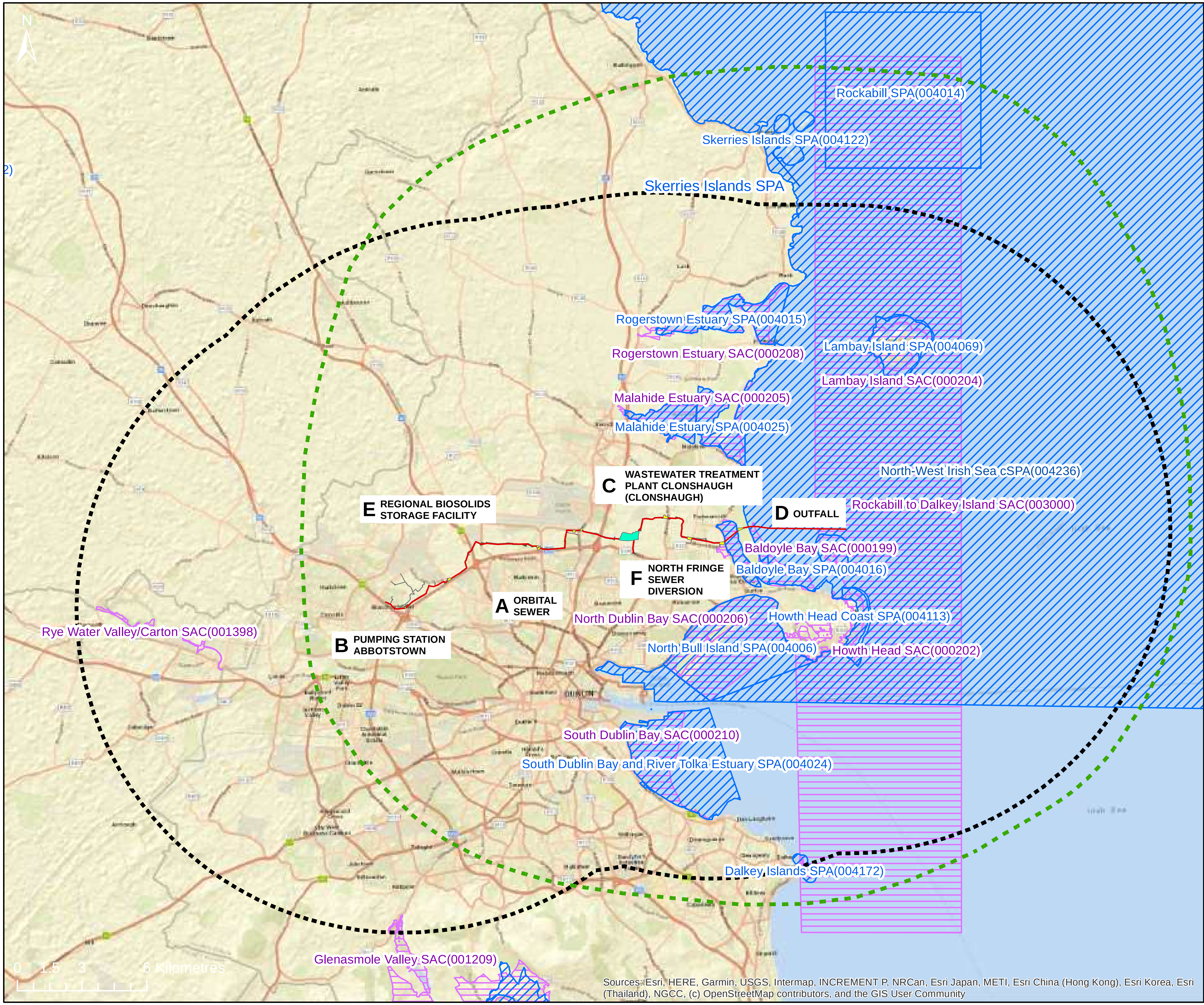
- Baldoyle Bay Special Areas of Conservation (SAC) (000199) – the proposed outfall pipeline will pass in a tunnel under Baldoyle Bay SAC. The two tunnelling compounds will be located either side of Baldoyle Bay but outside the SAC;
- Baldoyle Bay Special Protection Areas (SPA) (004016) – the outfall pipeline passes under Baldoyle Bay SPA. The two tunnelling compounds are located either side of Baldoyle Bay but outside the SPA;
- Rockabill to Dalkey Island (SAC) (003000) - the marine diffuser and approximately 1,300m of the outfall pipeline are located within the Rockabill to Dalkey Island SAC; and
- North-West Irish Sea candidate SPA (cSPA) (004236) - the length of the marine-based outfall pipeline beyond Velvet Strand to the terminal marine diffuser (4,800m) is located within the North-West Irish Sea cSPA. This comprises 108.5 ha of the red line boundary of the Proposed Project.

Other designated sites, habitats, flora and fauna protected under Irish statute e.g. (p)NHA, are assessed in full in Chapters 9-11 of the accompanying EIAR contained in Volume 2.

## 1.4 Study Team

The NIS has been compiled by RPS with input from a team of specialist ecologists covering the fields of terrestrial and aquatic ecology and ornithology. In addition the NIS also includes input from a specialist marine ecology company - Benthic Solutions Ltd (BSL). The ecology team has also worked closely with other inter-related disciplines and has had regard to outputs including noise modelling, sediment transport modelling and marine mammal surveys as part of their evaluation and analysis (see EIAR Volume 2 Part B Appendices ). The input from this team has been reviewed and updated, where required, to reflect the objective scientific data presented.

**Figure 1-1**




**Legend**

- Pipe Alignment
- Special Protection Area (SPA)
- Special Conservation Areas (SAC)
- Proposed WWTP
- Proposed Compounds
- Construction Wayleave
- Zone of Influence
- Buffer of Pipeline Corridor&Plant 15km

NOTE:
The SAC and SPA data is sourced from Natural Parks and Wildlife Service website. SPA dataset is last updated July 2023 ans SAC in October 2023


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure 1-1**
**Natura 2000 Sites and Zone of Influence**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

**Issue Details**

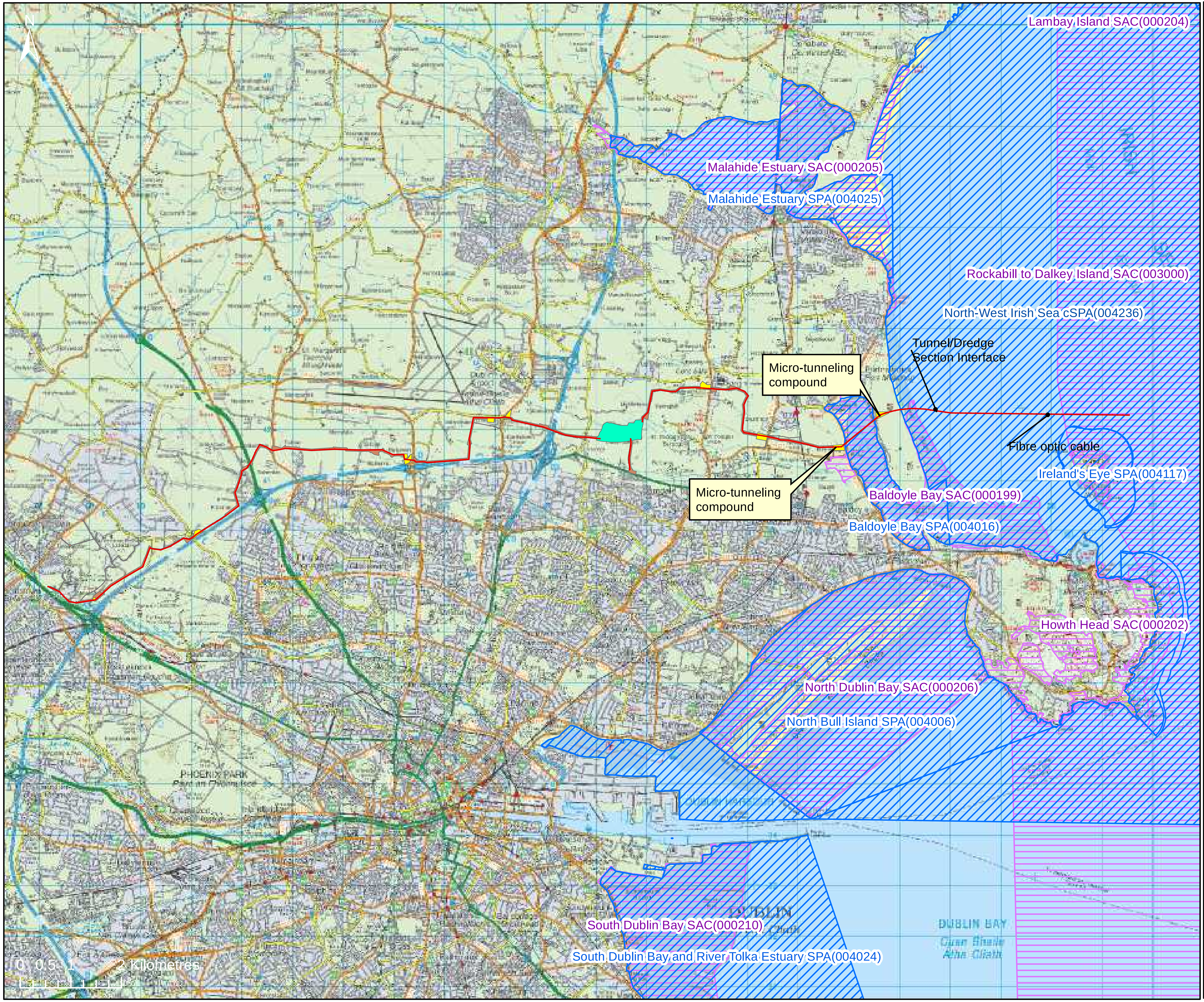
**File Identifier:** IE000258-RPS-AG-XX-D-Z-0025

| | | |
|---|---|---|
| **Status:** A1 | **Rev:** C01 | **Model File Identifier:** |
| **Drawn:** PK | | **Date:** 23/10/2023 |
| **Checked:** RR | | **Scale:** 1:165,000 @A3 |
| **Approved:** RR | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50319610 © Ordnance Survey Ireland/Government of Ireland.

**Figure 1-2**




## Legend

- Pipe Alignment
- Special Protection Area (SPA)
- Special Conservation Areas (SAC)
- Proposed WWTP
- Proposed Compounds
- Construction Wayleave

NOTE:
The SAC and SPA data is sourced from Natural Parks and Wildlife Service website. SPA dataset is last updated July 2023 ans SAC in October 2023.


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure 1-2**
**Location of Greater Dublin Drainage Project and SAC's & SPA's**


West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland


**Issue Details**

**File Identifier:**
IE000258-RPS-AG-XX-D-Z-0026

| | | |
|---|---|---|
| **Status:** A1 | **Rev:** C01 | **Model File Identifier:** |
| **Drawn:** PK | | **Date:** 23/10/2023 |
| **Checked:** RR | | **Scale:** 1:70,000 @A3 |
| **Approved:** RR | | **Projection:** ITM |

**NOTE:**

# 2. Appropriate Assessment Approach

## 2.1 Legislative Background for Appropriate Assessment

The Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora, better known as "The Habitats Directive", provides legal protection for habitats and species of European importance. Articles 3 to 9 provide the legislative means to protect habitats and species of Community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000. Natura 2000 is a European ecological network of special areas of conservation, composed of sites hosting the natural habitat types listed in Annex I and habitats of the species listed in Annex II, shall enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range.

In Ireland these sites are designated as European Sites and include SPAs, established under the EU Birds Directive (79/409/EEC, as codified by 2009/147/EC) for birds and SACs, established under the Habitats Directive 92/43/EEC for habitats and species.

The Habitats Directive has been transposed into Irish law by Part XAB of the Planning and Development Act, 2000 (as amended) and the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477/2011) as amended.

Articles 6(3) and 6(4) of the Habitats Directive sets out the decision-making tests for plans and projects likely to have a significant effect on or to adversely affect the integrity of European sites. Article 6(3) establishes the requirement for Appropriate Assessment (AA):

*Any plan or project not directly connected with or necessary to the management of the [Natura 2000] site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subjected to appropriate assessment of its implications for the site in view of the site's conservation objectives. In light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent national authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public.*

Both EU and national guidance exists in relation to Member States fulfilling their requirements under the EU Habitats Directive, with particular reference to Article 6(3) and 6(4) of that Directive. The methodology followed in this report to inform the assessment has had regard to the following legislation and guidance listed in Section 4.1.1:

- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (also known as the 'Habitats Directive');
- Council Directive 2009/147/EC on the conservation of wild birds, codified version, (also known as the 'Birds Directive');
- The European Communities (Birds and Natural Habitats) Regulations 2011 to 2021; and
- The Planning and Development Act 2000-2022.

## 2.2 Overview of Appropriate Assessment (AA) Stages

According to European Commission (EC) guidance documents 'Assessment of plans and projects in relation to Natura 2000 sites' (EC, 2021) and 'Managing Natura 2000 sites: The Provisions of Article 6 of the 'Habitats' Directive 92/43/EEC' (EC, 2019); the obligations arising under Article 6 establish a step-wise procedure as illustrated in Figure 2-1.

The first part of this procedure consists of a pre-assessment stage ('screening') to determine whether, firstly, a plan or project is directly connected with or necessary to the management of the site, and secondly, whether it is likely to have a significant effect on the site. It is governed by the first sentence of Article 6(3).

The second part of the procedure, governed by the second sentence of Article 6(3), relates to the appropriate assessment (AA) and the decision of the competent national authorities. The purpose of the AA is to assess the implications of the plan or project in respect of the site's conservation objectives, either individually or in combination with other plans or projects. The conclusions of the AA enable the competent authorities to ascertain whether the plan or project will adversely affect the integrity of the site concerned.

A third part of the procedure (governed by Article 6(4)) comes into play if, despite adverse effects on the integrity of the site concerned, it is proposed not to reject a plan or project but to give it further consideration. In this case, Article 6(4) allows for derogations from Article 6(3) under certain conditions.

The extent to which the sequential steps of Article 6(3) applies to a given plan or project depends on several factors, and in the sequence of steps, each step is influenced by the previous step. The order in which the steps are followed is therefore essential for the correct application of Article 6(3).

Each step determines whether a further step in the process is required. If, for example, the conclusion at the end of a Habitats Directive stage one screening appraisal is that significant effects on European sites can be excluded on the basis of objective information, there is no requirement to proceed to the next step.

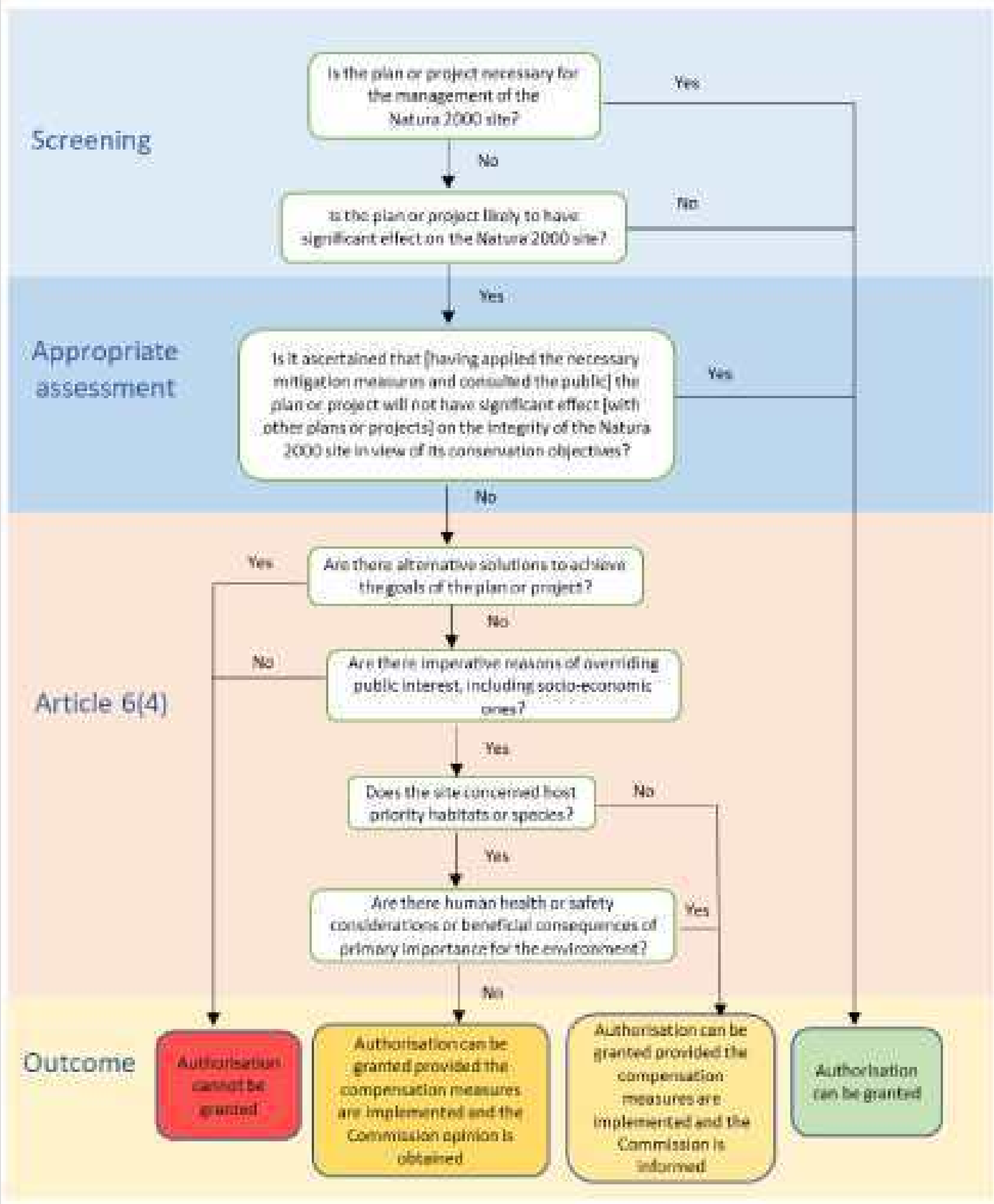



**Figure 2-1: Stages in Appropriate Assessment**

# 3. Description of the Proposed Project

## 3.1 Receiving Environment

The location of the Proposed Project is illustrated on Figure 1-1 and shown in detail on Planning Drawings Nrs. 32102902 – 2000 to 32102902 – 2014. The land based elements of the Proposed Project are located along the southern fringe of Fingal in North County Dublin, between Blanchardstown and Baldoyle, and in the marine environment off North County Dublin between Baldoyle Bay and Ireland's Eye.

The proposed site for the proposed **WwTP** is located in the townland of Clonshagh, in Fingal. It is situated in open agricultural land approximately 2.4km south east of Dublin Airport and approximately 500m north of the R139 Road. The Cuckoo Stream (a tributary of the Mayne River) lies immediately north, with the Mayne River itself approximately 400m south of the proposed WwTP site. The Proposed Project elements which were incorporated into the planning design for the Proposed Project following direction at the Oral Hearing in 2019 and the subsequent planning conditions applied to the 2018 planning application submission include :

- Ultraviolet (UV) Treatment
  - UV Treatment is to be included in the treatment process at the proposed wastewater treatment plant (WwTP) in the northern section of the WwTP site.
  - The UV treatment system will be designed for the expected flows at the plant and will be installed on the final effluent line. UV treatment will be in operation 24 hours a day, 365 days a year.
  - The UV system will consist of approximately two treatment channels located below or partially below ground level with above-ground Motor Control Centre (MCC) (in a kiosk) along with minor maintenance and control equipment (e.g. shut-off button, frame for supporting, retracting and cleaning of UV lamps etc.).
- River Mayne Culvert Extension
  - Extension of the River Mayne Culvert on the proposed access road to the WwTP by 4m (from 21m to 25m) to cater for the full width of the future north south link road.

The proposed **Sludge Hub Centre** is to be co-located with the WwTP on the site at Clonshagh.

The proposed site for the WwTP and Sludge Hub Centre has a total area of 29.8ha. There are no designated European sites within or adjacent to the proposed WwTP site.

The proposed **Regional Biosolids Facility (RBSF)** will be located in the townland of Newtown, Dublin 11. The proposed site is 11.0ha in area, situated adjacent to the R135 Finglas Road and north-east of Huntstown power station. Fingal County Council (FCC), who own the site has partially developed the proposed site (i.e. road infrastructure, drainage, power, boundary treatments, access/egress gates to the R135 Finglas Road and some administration buildings) for a waste recycling centre, in accordance with planning permission PLO6F.EL.2045.

The proposed **Orbital Sewer** will transfer flows from the existing Blanchardstown drainage catchment, which includes Blanchardstown and its environs and the Meath towns and villages of Ashbourne, Ratoath, Kilbride, Dunboyne & Clonee, to the proposed WwTP at Clonshagh (Clonshaugh). This orbital sewer will commence in the grounds of Waterville Park, Blanchardstown where it intercepts the existing Blanchardstown main sewer line, which is known as the 9C sewer. From this point it will be routed through the grounds of Connolly Hospital and the grounds of the National Sports Campus to the proposed **Abbotstown Pumping Station**, which will be located adjacent to the M50. From this pumping station the Orbital Sewer will be routed north of and generally parallel to the M50 to Clonshagh passing, en-route, south of the Dublin Airport complex. The lands along the length of the orbital sewer are generally open fields with agriculture being the main land use pattern. The total length of this Orbital Sewer will be approximately 13,700m. There are no designated European sites within the Orbital Sewer Route.

The proposed **NFS Diversion Sewer** will transfer flows in the NFS upstream of the point of interception to the proposed WwTP. It is proposed to intercept the NFS in the vicinity of the junction of the proposed access road to the WwTP with the R139. From this point the sewer will be routed to the proposed WwTP along the proposed access road. The total length of this diversion sewer is approximately 600m. There are no designated European sites within the corridor for the NFS diversion sewer corridor.

The proposed **Outfall Pipeline** route consists of a land based section (Clonshagh – Baldoyle), a marine section (Baldoyle – Ireland's Eye) and a multiport marine diffuser. The land based section commences at the proposed WwTP and is routed in an easterly direction towards the coast between Baldoyle and Portmarnock. The lands along the length of the proposed Outfall pipeline (land-based) are generally open fields with agriculture the main land use pattern. The land based section of the outfall pipeline terminates to the west of the Coast Road (R106). There are no environmentally designated sites within corridor of the proposed Outfall pipeline, however both tunnelling compounds are located directly adjacent to Baldoyle Bay SAC and SPA.

The proposed Outfall Pipeline Route commences at the tunnel launch shaft in the tunnelling compound located just off the R106 Coast Road, north of Baldoyle and is routed in a north easterly direction across the Baldoyle Estuary to the public car park immediately north of Portmarnock Golf Club where it turns in an easterly direction terminating approximately 1km north east of Ireland's Eye (approximately 1,400m into the Rockabill to Dalkey Island SAC).

The proposed Outfall Pipeline Route will cross under the estuary habitats of Baldoyle Bay SAC) and Baldoyle Bay SPA from the Coast Road to approximately 600m offshore, where it exits the tunnel. It will then continue in an easterly direction where it terminates just north of Ireland's Eye within the Rockabill to Dalkey Island SAC (site code: 003000) and North-West Irish Sea cSPA (004236). Ireland's Eye SAC (002193) & Ireland's Eye SPA (004117) lies approximately 700m and 200m respectively to the south of the outfall pipeline.

The total length of the proposed outfall pipeline route will be approximately 11,400m, with the land based section comprising 5,400m and the marine section, including the multiport diffuser comprising 5,900m.

The proposed multiport **marine diffuser** is located on the final section of the proposed Outfall pipeline and will consist of a number of vertical risers from the outfall pipeline to above sea-bed level onto which diffuser valves will be attached to allow the treated wastewater to achieve the required initial dilution on discharge to the marine environment. The proposed marine diffuser lies within the Rockabill to Dalkey Island SAC and within the North-West Irish Sea cSPA (004236), and lies approximately 700m and 200m respectively to the north east of Ireland's Eye SAC (002193) and Ireland's Eye SPA (004117).

The coast in the vicinity of the proposed Outfall Pipeline Route is characterised by sandy beaches. Water depths in this area range from 0m – 25m LAT (Lowest Astronomical Tide). The seabed is gradually sloping eastward and the bottom is sandy in nature with varying depth to bedrock.

The proposed Outfall Pipeline Route terminates within the Irish Sea Dublin (HA 09) Coastal Water Body as defined under the Water Framework Directive (WFD)

The proposed GDD Project will traverse the following Natura 2000 sites as illustrated on Figure 1-2:

- Baldoyle Bay SAC (000199) – the proposed Outfall Pipeline Route will pass under Baldoyle Bay SAC. The two tunnelling compounds will be located directly adjacent to Baldoyle Bay but outside the SAC;
- Baldoyle Bay SPA (004016) – the proposed Outfall Pipeline Route will pass under Baldoyle Bay SPA. The two tunnelling compounds will be located directly adjacent to Baldoyle Bay but outside the SPA;
- Rockabill to Dalkey Island SAC (003000) - the proposed marine diffuser and approximately 1,300m of the proposed Outfall Pipeline Route are located within the Rockabill to Dalkey Island SAC; and
- North-West Irish Sea cSPA (004236) – the length of the marine-based outfall pipeline beyond Velvet Strand to the terminal marine diffuser (4,800m) is located within the North-West Irish Sea cSPA. This comprises 108.5 ha of the red line boundary of the Proposed Project.

Ireland's Eye SAC (002193) and Ireland's Eye SPA (004117) lie approximately 700m and 200m respectively to the south of the proposed Outfall Pipeline Route and marine diffuser.

## 3.2 Description of Construction Stage including Techniques and Approaches

The following sections describe the construction methodology for each of the elements of the Proposed Project. However an outline Construction & Environmental Management Plan (CEMP) including a Surface Water Management Plan has been prepared for the Proposed Project and is included in Volume 2 Part B Appendices.

### 3.2.1 Proposed WWTP and Sludge Hub Centre

Construction of the proposed WwTP will involve:

- Excavation for building foundations and tanks;
- Reinforced concrete works;
- Erection of structural steel/concrete building frames;
- Erection of building walls (concrete/blockwork)
- Erection of prefabricated cladding panels to walls and roofs of buildings;
- Erection of prefabricated steel tanks;
- Mechanical and electrical fit out of buildings and tanks;
- Installation of below and above ground pipework;
- Construction of screening berms;
- Construction of access/egress roads to/from site (extension of culvert by 4m at the access road crossing of the River Mayne); and
- Internal circulation roads, car parks and footpaths, landscaping and final planting.

Over the three-year construction period, these activities will be sequentially scheduled by the appointed contractor to optimise resources and programme, moving various work crews from building to building in a sequential manner. A typical sequence of work is outlined below (refer to the Outline CEMP for further detail):

- Erect fencing to site and access roads;
- Strip topsoil from site and access roads, set aside for reuse;
- Grade site/access roads to finished profile. Excavated material deposited in screening berms;
- Establish appointed contractor's compound on-site;
- Construct access roads and site circulation roads to subbase level;
- Excavate foundations for first building/tank, move to next building/tank;
- Pour concrete foundations/base to first building tank, move to next structure;
- Erect structural steel/concrete building frame, or reinforced concrete walls of tanks, move to next structure;
- Erect inner/outer walls and roof of building (prefabricated panels), move to next building;
- Install doors/windows and make building weather proof, move to next building;
- Commence first fix mechanical/electrical fit out of structure (building/tank), move to next building;
- Commence second fix mechanical/electrical fit out of structures;
- Erect prefabricated steel tanks (e.g. mesophilic anaerobic digesters);
- Erect biogas holding tanks;
- Install below ground pipework;

- Install above ground pipework;
- Test tanks and pipework for watertightness;
- Commence commissioning work on wastewater and sludge treatment systems;
- Finish construction of access/egress roads and internal circulation roads, car parks and footpaths;
- Erect permanent site security fencing;
- Landscape and plant site;
- Remove temporary construction fencing;
- Remove/demobilise appointed contractor's compound; and
- Hand-over of site to Client/operator.

Excavated material will be reused on-site in construction of the screening berms and landscaping, where possible, such that quantities of excavated material will balance the fill material required in the screening berms and site landscaping.

### 3.2.2 Proposed Pumping Station at Abbotstown

The preliminary design of the proposed Abbotstown pumping station indicates that the invert level of the inlet sewer is approximately 17m deep, and as a result, the base slab for the wet well and dry well will be constructed significantly below the existing ground level.

Construction of the Abbotstown pumping station will be undertaken using conventional construction methodologies and will involve deep excavation for basement wet well/dry well, reinforced concrete works, erection of reinforced concrete building frame, erection/building walls (concrete/blockwork); erection of prefabricated cladding panels to walls and roofs of building, mechanical and electrical fit out of building, construction of access road car park and footpaths, landscaping and final planting.

Preliminary site investigation indicates rock at approximately 2.5m below ground level. The rock shall be excavated to the required invert level in such a manner as to minimise noise generation. Overburden above the rock will most likely be retained using a temporary concrete retaining wall. All excavated material will be removed off site to an appropriately licenced facility.

### 3.2.3 Orbital Sewer Pipeline, North Fring Sewer and Outfall pipeline (land sections)

An outline construction methodology is provided in the Outline CEMP (see Volume 2 Part B Appendices) for these elements and summarised in the following paragraphs.

The construction methodology for the proposed land based pipeline routes will be a combination of open cut and trenchless methods. A conventional open cut methodology will be employed for the majority of the proposed land based pipeline routes. A typical work sequence for a conventional open cut methodology is as follows:

- Fence pipeline construction corridor;
- Fence proposed temporary construction compound area;
- Establish the proposed temporary construction compounds;
- Strip topsoil carefully and store to one side of the proposed construction corridor for later reinstatement;
- Import pipes and string along the proposed construction corridor;
- Excavate pipeline trench and store to side of the proposed construction corridor (opposite side to topsoil storage) for later reinstatement;
- Import granular pipeline bedding material and place in excavated trench;

- Place pipeline on bedding material in excavated trench;
- Import granular pipeline surround material and place around pipeline in excavated trench;
- Test pipeline for watertightness;
- Backfill pipeline trench with suitable excavated material;
- Remove excess excavated material off site;
- Reinstate land drains; and
- Reinstatement of the proposed construction corridor to pre-construction condition (e.g. replacement of topsoil, seeding and replanting as appropriate) in accordance with the Outline CEMP for the Proposed Project.

Open cut methodology will not be suitable for all of the proposed pipeline routes, as a number of areas will require the use of trenchless techniques. In particular, the crossing of physical, natural and manmade obstructions, such as significant watercourses, significant topographical features, major roads, railways and major infrastructure, will necessitate the use of trenchless techniques.

Suitable trenchless techniques include pipe jacking and microtunnelling methods. Trenchless techniques require drive shafts to be constructed at the start of each trenchless section and reception shafts at the end of each section. These shafts will be constructed within the proposed temporary construction compounds located within the proposed construction corridor. At watercourse crossings, the drive and reception shafts will be located a minimum of 20m from the watercourse.

Locations where trenchless techniques will be employed are indicated on Planning Drawing nr. 32102902 – 2220.

The construction of the proposed orbital sewer and outfall pipeline (land based section) is estimated to take 18 months. Depending on the depth and size of the particular section of pipeline, it is envisaged that progress will be in the order of 15 to 30m per day. In advance of pipeline construction, a period will be required for the fencing of the construction corridor, topsoil stripping and archaeological monitoring of the excavations. Post pipeline construction, a period will be required for reinstatement and establishment, particularly where grass is to be planted.

#### 3.2.3.1 Testing & Commissioning

Upon installation of the pipelines and prior to backfilling operations a hydrostatic/water test will be carried out on complete sections of pipeline to ensure there are no leaks. The pipe will be tested in discrete lengths, the lengths of which will be decided based on operational constraints and the quantity of water available. Water for testing will be taken from the closest public water supply network in agreement with Irish Water. Water will be re-used in multiple test sections by over pumping as required and finally discharged through the proposed outfall pipeline.

### 3.2.4 Proposed Outfall Pipeline (marine section micro tunnelled)

The proposed outfall pipeline route (marine section) will be constructed using microtunnelling and subsea pipe laying (dredging) techniques.

Microtunnelling techniques will be used between section chainage 0,000m and chainage 2,000m, from the open fields immediately west of the R106 Coast Road to approximately 600m offshore terminating below the low tide water mark.

The microtunnelled section will have an internal diameter of 2m and will be constructed at depths between 15m and 20m below ground level using a microtunnelling machine, with pipe sections installed as the microtunnelling machine progresses.

The microtunnelled section will require two proposed temporary construction compounds onshore, in the open field immediately west of the R106 Coast Road (chainage 0,000m) (proposed temporary construction compound no. 9) and in the grassed space (chainage 1,000m) adjacent to the public car park off the Golf Links Road, immediately north of Portmarnock Golf Club (proposed temporary construction compound no. 10). At proposed temporary construction compounds no. 9 and no. 10, the drive/reception shafts will be constructed, tunnelling equipment will be located and the tunnel materials will be stored temporarily. Waste material from the tunnel will be removed and disposed of in accordance with waste management legislation. Preliminary analysis estimates that microtunnelling will progress at a rate of approximately 60m per week and that the tunnelling will take in the region of 12 months, which includes for site mobilisation.

On completion of the construction works, proposed temporary construction compounds no. 9 and no. 10 will be dismantled and the ground will be reinstated to its original condition.

The proposed area for temporary construction compounds no. 9 and no. 10 will require a plan area of approximate dimensions of 150m x 100m and will contain the following plant and facilities:

- Office area including car parking;
- Launch (Jacking) shaft with Jacking station;
- Tunnelling equipment including:
- Tunnel Boring Machine (TBM);
- Control unit;
- Hydraulic pump units;
- Generators;
- Bentonite mixing plant; and
- Water separation plant;
- Storage area for jacking pipes, fuel, bentonite;
- Crane; and
- Excavator.

Microtunnelling will operate on a continuous 24-hour/7-day basis for the duration of the tunnelling works.

#### 3.2.5 Proposed Outfall Pipeline (marine section sub-sea pipe laying)

Subsea pipe laying (dredging) techniques will be used between chainage 2,000m and the final outfall location (chainage 5,940m).

A 5m deep trench of trapezoidal section in the Seabed, will be excavated using a combination of backhoe dredger in the shallower areas and trailer suction hopper dredger (TSHD) where the water depths are beyond the limits of the backhoe dredger.

Excavated material from the backhoe dredger will be placed in a barge and subsequently deposited and stockpiled parallel to the proposed outfall pipeline route (marine section) trench, within the 250m wide proposed construction corridor. Where the TSHD is used it will deposit and stockpile the excavated material parallel to the proposed outfall pipeline route (marine section) trench, within the 250m wide proposed construction corridor. The stockpiled material will be subsequently reused to refill the trench over and around the pipe once it is installed in the trench.

Long length large diameter (LLLD) polyethylene pipe will be utilised on this dredged section of the proposed outfall pipeline route (marine section). These pipes will be constructed at the factory in the required diameter in continuously extruded strings up to 650m long. The pipe strings will then be towed to a pipe assembly/ballasting area in close proximity to the proposed outfall location.

Potential pipe assembly/ballasting areas identified include Dublin Port and adjacent to the pipeline trench. Pipe assembly will take place at Dublin Port (at quay wall or in sheltered waters) or in sheltered waters along the route of the outfall pipeline. At Dublin Port, mobile cranes would lift the concrete collars into place along a quay wall. Collars would be delivered by road to the port. In sheltered waters, a floating jack up platform supported by tugs and multicat vessels would be used to assemble the pipe strings and place the concrete collars. Collars would be delivered on a daily basis by ship to platform.

At the pipe assembly/ballasting areas, the pipe lengths will be joined together into longer pipeline strings and a concrete ballast will be placed over the pipe.

The typical method for connecting pipe strings is flanged connections. However, alternatives such as mechanical couplings or welding of sections may also be used.

It is noted that there are a number of alternatives for concrete ballast, and the concrete ballast design will be project specific depending on the installation scenario, pipeline parameters and contractor preferences. Options include rectangular, circular or starred ballast blocks or, alternatively, continuous concrete collars.

The assembled pipeline strings will then be towed to the proposed outfall pipeline route and surface positioned over the dredged trench. The pipeline will then be installed in the dredged trench in a continuous operation involving:

- Surface to seabed transfer utilising the polyethylene pipe's flexible properties (the 'S-bend' installation method); and
- Submersion by water filling/air evacuation.
- Connecting the pipeline strings together, using mechanical joints, as the installation progresses.

Once the pipe is confirmed to be in place at the bottom of the trench, the previously excavated material will be replaced around and over the pipe.

Preliminary analysis indicates that the construction period for the subsea pipe-laying element would take six months. However, it should be noted that all marine operations are weather dependent.

#### 3.2.5.1 Dredge / Tunnel Interface

The tunnelled section will terminate approximately 600m offshore and this will be the interface point between the two sections of the marine outfall, i.e. the tunnelled section and the section constructed by subsea pipe construction techniques.

To facilitate retrieval of the Tunnel Boring Machine (TBM) the tunnel section will terminate into a temporary structure, such as a cofferdam for a 'dry' retrieval of the TBM, or into a pre-excavated section of trench filled with loose sand/granular material sourced from elsewhere along the trench alignment.

Where a cofferdam will be used the TBM is removed from the cofferdam using a crane mounted on a jack-up platform and a bulkhead is installed in the tunnel. The cofferdam will then be removed and the dredged trench completed. This will take approximately 1 month.

Where a 'wet' retrieval is used, the TBM will be driven into the pre-excavated section of trench. A bulkhead will be installed in the tunnel. The loose material will be carefully excavated by dredger from around the TBM and the TBM lifted from the trench using a crane mounted on a jack-up platform. The pipe trench will then be completed. This will take approximately 2 weeks.

When the pipe strings are installed in the trench as close as possible to the tunnel end the connection between the tunnel section and the sub-sea pipeline is made. This connection can be made by a number of methods;

- Inserting the HDPE spool piece sufficiently into the tunnel and sealing the annulus between the tunnel and the HDPE marine outfall pipeline route (marine section) to form a water tight seal.
- Making a mechanical connection between the tunnel and the outfall pipeline, using a flanged spool piece or similar.

#### 3.2.5.2 Fibre optic cable protection

The proposed engineering solution is to install interlocking sheet piles to support the outfall pipeline trench in the vicinity of the fibre optic cable. This will reduce the width of the trench and allow the cable to be supported during the installation of the outfall pipeline route (marine section).

Once supported, the cable will be shielded with a suitable conduit to provide additional protection. This will allow the contractor to excavate below the supported cable. Following excavation of a suitable trench, the contractor will install a short length of PE pipeline, beneath the cable. This short length of PE pipeline will then be connected to the overall outfall, by means of subsea connections, in a similar manner to that described above.

The envisaged methodology for the outfall pipeline crossing of the fibre optic cable is provided hereunder;

- Sheet piles are driven to support the trench;
- The fibre optic cable is fitted with a Uraduct cable protection system, or similar;
- The cable is supported on either side of the trench using precast concrete structures. The trench is then excavated and the ballasted pipeline is laid; and
- After the pipe has been laid the previously excavated material shall be used as backfill around the new pipe and the cable protection system shall be removed.

#### 3.2.5.3 Testing & Commissioning

The outfall pipeline (marine section) will be tested prior to transportation to the proposed outfall pipeline route. Therefore no onsite hydrostatic/water testing is required.

### 3.2.6 Proposed Diffuser

The proposed multiport marine diffuser will be located on the final section of the proposed outfall pipeline route (marine section) and will consist of a number of vertical risers from the proposed outfall pipeline to above sea-bed level onto which diffuser valves will be attached to allow the treated wastewater to achieve the required initial dilution on discharge to the marine environment.

The pipeline will be supplied with pre-installed flanged openings (capped) for the diffusers. Once the pipeline is lowered into the trench divers will remove the flanged caps and attach the riser pipes via bolted connections. The trench will then be backfilled. Divers will then attach the diffuser valves, again using bolted connections, to the end of the riser pipes which are protruding above the reinstated sea bed. Protective covers – precast concrete or steel will then be placed over the diffuser valves.

### 3.2.7 Proposed Access and Construction Compounds

Access to the outfall pipeline route will be be via the public road network and also along the construction corridor, where practicable. However, in certain circumstances it will not be possible to access along the corridor and in these circumstances access will be along permanent wayleaves acquired through 3rd party lands. The proposed locations of such temporary access roads are identified on Figure 1-2.

To facilitate the construction of the Proposed Project, proposed temporary construction compounds will be required at various locations (e.g. at the proposed Abbotstown pumping station site, various locations along the proposed pipeline routes, trenchless crossing locations, etc.). The proposed temporary construction compounds will be in place for periods of one to 12 months, depending on their location and the construction activity taking place at that particular location. The proposed temporary construction compounds will have a site office, welfare facilities, parking and a materials storage area. The proposed locations of temporary compounds are identified on Figure 1-2.

### 3.2.8 Proposed Regional Biosolids Facility

The RBSF, which forms part of the Proposed Project, is an 11Ha site at Newtown, Dublin 11 and will include the following elements:

- Demolition of existing single storey structures on site comprising of a security kiosk (approx. 22 sq.m gfa), the weighbridge kiosk (approx. 19 sq.m gfa), an ESB Sub-Station (approx. 16 sq.m gfa) and an administration building (approx. 85 sq.m gfa), together with the partial removal of existing internal roads and partial removal / diversion of existing drainage infrastructure as appropriate to accommodate the development;
- Provision of 2no. biosolids storage buildings, each approximately 50m wide, 105m long and 15m in height, including solar panels on the roof of one building. These buildings have a combined capacity to store up to 48,000 cubic metres of biosolids waste at any one time;
- Provision of 4no. odour control units, each with 18.2m high discharge flues;
- Mechanical and electrical control building (approx. 35 sq.m gfa, 4 m high);
- Provision of a single storey site administration building for office, welfare facilities and meeting rooms (approx. 130 sq.m gfa) and associated staff car parking;
- Use of the existing vehicular access off the R135, including provision of new 2.7m high entrance gates to serve the Regional Biosolids Storage Facility;
- All ancillary landscape and site development works, including:
- Provision of 2no. new weighbridge facilities (1no. weighbridge on entry and exit of the Regional Biosolids Storage Facility).
- Provision of new ESB Sub-Station (approx. 40 sq.m gfa).
- Landscaping and boundary treatments, including new 2.7m high boundary to North Road/R135.
- Provision of fire protection holding tank (approx. 6.7m high).
- Provision of a HGV cleaning and set down area.
- Formation of new footpath and landscaped verge to R135 along site frontage.
- Provision of drainage, water, external lighting, and other utilities.
- Diversion of 450mm surface water pipe.
- 1no. signage structure, 5.2m in height erected on posts accommodating 2no. signage zones: 2.4m x 1.7 and 2.4m x 1.2m, located at the site entrance.

The Regional Biosolids Storage Facility will require a Certificate of Registration for the activity of storing biosolids (treated wastewater sludge).

These proposals are described in further detail in Volume 2 Part A, Section 4.

### 3.2.9 Programme

The revised proposed programme for Construction is presented in Figure 3-1.

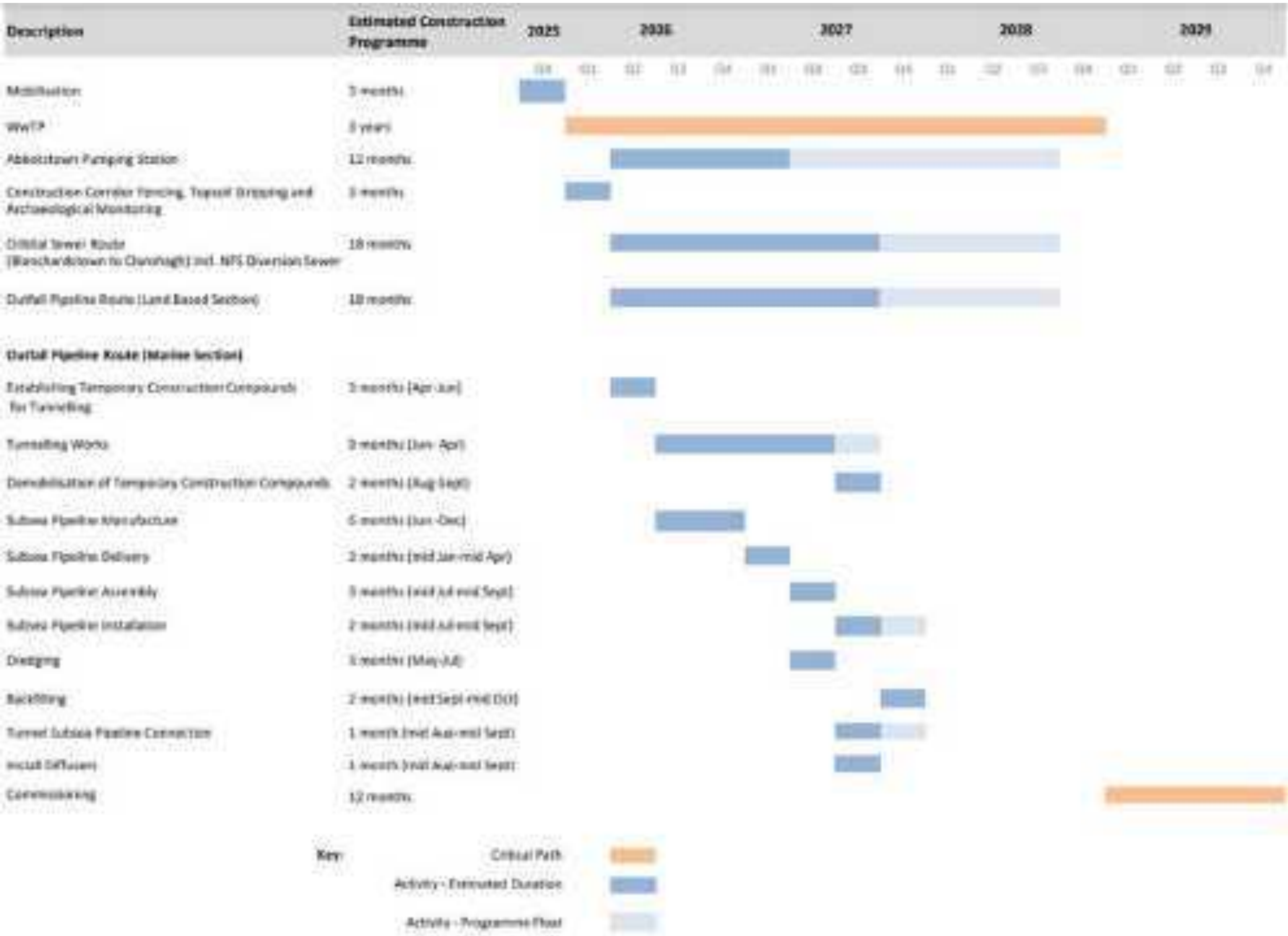



**Figure 3-1: Indicative Construction Phase Programme**

## 3.3 Description of Operational Stage

### 3.3.1 Proposed Treatment Standards

A system for the licensing or certification of waste water discharges from areas served by local authority sewer networks was brought into effect on 27th September 2007 with the introduction of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I No. 684 of 2007). This licensing and certification process gives effect to a number of EU Directives by the imposition of restrictions or prohibitions on the discharge of dangerous substances and the implementation of measures required under the Water Framework Directive (WFD) and thus preventing or reducing the pollution of waters by waste water discharges. All discharges to the aquatic environment from sewerage systems owned, managed and operated by water service authorities require a waste water discharge licence or certificate of authorisation from the EPA.

The authorisation process provides for the EPA to place conditions on the operation of such discharges to ensure that potential effects on the receiving water bodies are limited and controlled with the aim of achieving good surface water status and good groundwater status no later than December 2015. The proposed Regional WwTP will require a waste water discharge licence to be granted by the EPA under the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I No. 684 of 2007) prior to commissioning of the treatment plant.

Treatment standards for a treated wastewater from the proposed Regional WwTP to be discharged into the marine environment of the Irish Sea off the coast of North County Dublin were examined and reported on in the “Key Effluent Treatment Standards Report; December 2017”. This report proposed, subject to the granting of a Wastewater Discharge Licence by the EPA, that the final treated wastewater produced at the proposed Regional WwTP should conform to the standards outlined in Table 3-1.

**Table 3-1: Treated Wastewater Effluent Emission Limits for proposed Regional WwTP**

| Parameter | | Emission Limit |
|---|---|---|
| pH | | 6 - 9 |
| Toxicity | | 5 TU |
| Temperature | | 25°C (max) |
| $BOD_5$ | 95th Percentile | 25 mg/l $O_2$ |
| | Not to be exceeded | 50 mg/l $O_2$ |
| COD | 95th Percentile | 125 mg/l $O_2$ |
| | Not to be exceeded | 250 mg/l $O_2$ |
| TSS | 95th Percentile | 35 mg/l |
| | Not to be exceeded | 87.5 mg/l |

3-dimensional hydrodynamic modelling studies undertaken on the proposed discharge have confirmed that, for the identified outfall location and the emission limit values set out in Table 3-1 the receiving water (apart from the small mixing zone) will meet good status criteria and meet the environmental quality objectives for coastal water nutrients levels. The modelling studies have also confirmed that:

- The Proposed Project will have negligible impact on the water quality of the coastal waters off County Dublin;
- The Proposed Project will not impact achieving the goals of the WFD of reaching good status in all water bodies; and
- The proposed discharge location will not negatively influence any designated bathing waters.

### 3.3.2 Chambers

Access chambers, manholes, air valves, scour valves and vent stacks are required to be constructed for the proper functioning, maintenance and operation of the proposed orbital sewer route and the proposed outfall pipeline route (land based section and marine section).

### 3.3.3 Air Valves

Air valves in pumped rising main systems serve two primary functions; the regular release of accumulated air that comes out of solution within a pressurised system, and to discharge large volumes of air from the pumped rising system when the pipeline is initially filled. Air valves are generally located at high points along the pumped rising main length.

#### 3.3.3.1 Scour Valves

Scour valves are required at the low points on pumped rising main systems to facilitate the drain down of the pumped rising main system during maintenance.

#### 3.3.3.2 Manholes

Access to the gravity sections of the proposed orbital sewer route (Section 1; chainage 5,220m – 12,745m) for maintenance purposes will be facilitated by the construction of access manholes. Manholes will be located at bends, changes in gradient and at approximately 200m centres along the proposed orbital sewer route.

#### 3.3.3.3 Access Chambers

Access to the proposed outfall pipeline route (land based section) for maintenance purposes will be facilitated by the construction of access chambers.

### 3.3.4 Maintenance during Operation

The normal operation of the project and its constituent elements will be fully automated, which will be monitored, controlled and managed from a control centre located at the proposed Regional WwTP.

The automated control systems will report through supervisory control and data acquisition (SCADA) and telemetry systems to the control centre. The Regional WwTP and SHC will be manned 24 hours a day, 7 days a week. It is envisaged that between 30 – 40 operations staff will be employed, working in normal shift patterns, to ensure the continued and efficient operation of all elements of the project.

Maintenance activities would typically include the following;

- General maintenance (daily);
- Preventative maintenance (as scheduled by operator);
- Pumping Station Inspections (weekly visit);
- Inspection Chambers on pipelines (annual visit); and
- Inspection of multiport diffusers (annual dive survey).

# 4. Screening for Appropriate Assessment

## 4.1 Methodology

### 4.1.1 Published Guidance on Appropriate Assessment

Appropriate Assessment Guidelines for Planning Authorities have been published by the Department of the Environment Heritage and Local Government (DEHLG, 2010a). In addition to the advice available from the Department, the European Commission has published a number of documents which provide a significant body of guidance on the requirements of Appropriate Assessment, most notably including Commission Notice C(2021) 6913 '*Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC*' (EC, 2021), which sets out the principles of how to approach decision making during the process. These principal national and European guidelines have been followed in the preparation this report. The following list identifies these and other pertinent guidance documents:

- Communication from the Commission on the Precautionary Principle., Office for Official Publications of the European Communities, Luxembourg (EC, 2000a);
- Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg (EC, 2000b);
- Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels (EC, 2001);
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission; (EC, 2007);
- Estuaries and Coastal Zones within the Context of the Birds and Habitats Directives - Technical Supporting Document on their Dual Roles as Natura 2000 Sites and as Waterways and Locations for Ports. European Commission (EC, 2009);
- Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin (DEHLG, 2010a);
- Department of Environment Heritage and Local Government Circular NPW 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive – Guidance for Planning Authorities (DEHLG, 2010b);
- Guidance document on the implementation of the birds and habitats directive in estuaries and coastal zones with particular attention to port development and dredging. European Commission (EC, 2011a);
- European Commission Staff Working Document 'Integrating biodiversity and nature protection into port development' (EC, 2011b);
- Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document, National Parks and Wildlife Service, Dublin (NPWS, 2012);
- Interpretation Manual of European Union Habitats. Version EUR 28. European Commission (EC, 2013);
- European Commission Notice C(2018) 7621 'Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC' (EC, 2019);
- Institute of Air Quality Management 'A guide to the assessment of air quality impacts on designated nature conservation sites' (Version 1.1) (IAQM, 2020);
- Office of the Planning Regulator Practice Note (PN01) 'Appropriate Assessment Screening for Development Management' (OPR, 2021);

- European Commission Notice C(2021) 6913 'Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC' (EC, 2021); and
- European Commission Guidance document on Assessment of plans and projects in relation to Natura 2000 sites - A summary (EC, 2022).

#### 4.1.2 Likely Significant Effect

The European Commission's 2018 Notice (EC, 2019) advises that the appropriate assessment procedure under Article 6(3) is triggered, not by the certainty, but by the likelihood of significant effects, arising from plans or projects regardless of their location inside of or outside a protected site. Such likelihood exists if significant effects on the site cannot be excluded on the basis of objective information. Mitigation measures cannot be taken into account in this assessment. The significance of effects should be determined in relation to the specific features and environmental conditions of the site concerned by the plan or project, taking particular account of the site's conservation objectives and ecological characteristics. Significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned. The Commission's guidance acknowledges that against this background, what may be significant in relation to one site may not be in relation to another.

The threshold for a Likely Significant Effect (LSE) is treated in the screening exercise as being above a *de minimis* level. A *de minimis* effect is a level of risk that is too small to be concerned with when considering ecological requirements of an Annex I habitat or a population of Annex II species present on a European site necessary to ensure their favourable conservation condition. If low level effects on habitats or individuals of species are judged to be in this order of magnitude and that judgment has been made in the absence of reasonable scientific doubt, then those effects are not considered to be likely significant effects.

> *"the requirement that the effect in question be 'significant' exists in order to lay down a de minimis threshold. Plans or projects that have no appreciable effect on a European site are thereby excluded. If all plans or projects capable of having any effect whatsoever on the site were to be caught by Article 6(3), activities on or near the site would risk being impossible by reason of legislative overkill".*
>
> *[Paragraph 48 of the Judgment of the Court in CJEU case C-258/11]*

EC (2021) defines a LSE as being "*any effect that may reasonably be predicted as a consequence of a plan or project that would negatively and significantly affect the conservation objectives established for the habitats and species significantly present on the Natura 2000 site. This can result from either on-site or off-site activities, or through combinations with other plans or projects*". In this regard, the conservation objectives of a site as well as prior or baseline information about it can be very important in more precisely identifying conservation sensitivities.

The analysis involved in a Stage 1 screening appraisal for Appropriate Assessment is described in EC (2021) as comprising four steps:

- Ascertaining whether the plan or project is directly connected with or necessary to the management of a Natura 2000 site;
- Identifying the relevant elements of the plan or project and their likely impacts;
- Identifying which (if any) Natura 2000 sites may be affected, considering the potential effects of the plan or project alone or in combination with other plans or projects; and
- Assessing whether likely significant effects on the Natura 2000 site can be ruled out, in view of the site's conservation objectives.

#### 4.1.3 Mitigation Measures at Screening Stage

In determining whether or not likely significant effects will occur or can be excluded in the Stage 1 appraisal, measures intended to avoid or reduce the harmful effects of the proposed development on European sites, (i.e.

“mitigation measures”) or best practice measures have not been taken into account in this screening stage appraisal. This approach is consistent with up-to-date EU guidance (EU,2019; EC,2021; EC, 2022) and the case law of the Court of Justice of the European Union (CJEU).

In April 2018, the Court of Justice (CJEU) of the European Union issued a ruling in case C-323/17 People Over Wind & Peter Sweetman v Coillte Teoranta (“People Over Wind”) that Article 6(3) of Directive 92/43/EEC must be interpreted as meaning that, in order to determine whether it is necessary to carry out, subsequently, an appropriate assessment of the implications, for a site concerned, of a plan or project, it is not appropriate, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site. The CJEU found that taking account of mitigation measures at the screening stage could compromise the practical effect of the Habitats Directive in general, and the assessment stage in particular (since the assessment stage would be deprived of its purpose and there would be a risk of circumvention of that stage). In its judgment in Eco-Advocacy, the CJEU recently found that this does not preclude standard features, which are inherent to a project, and are incorporated into a project’s design, not with the aim of reducing its negative effects.

The judgment in People Over Wind is further emphasised in EC (2019) which refers to CJEU Case C-323/17, and also EC (2021) states specifically in Table 1 on p12 thereof that that mitigation measures cannot be considered at the screening stage of appropriate assessment, citing CJEU case C-323/17.

More recently, in June 2023, the CJEU issued a ruling in case C-721/21 Eco Advocacy CLG vs. An Bord Pleanála that Article 6(3) of Directive 92/43/EEC must be interpreted as meaning that, in order to determine whether it is necessary to carry out an appropriate assessment of the implications of a plan or project for a site, account may be taken of the features of that plan or project which involve the removal of contaminants and which therefore may have the effect of reducing the harmful effects of the plan or project on that site, where those features have been incorporated into that plan or project as standard features, inherent in such a plan or project, irrespective of any effect on the site. The referring court has yet to take this CJEU judgment into account in relation to the live Judicial Review proceedings in Ireland [2020 No. 1030 JR].

This revised NIS does not attempt to reformulate any measures previously described as mitigation measures in the original NIS in light of the emerging case law from the CJEU by now describing them as features that have been incorporated into the Proposed Project as ‘standard features’ for the purposes of screening for appropriate assessment.

#### 4.1.4 Consideration of *ex-situ* Effects

EC (2019) advises that Member States, both in their legislation and in their practice, allow for the Article 6(3) safeguards to be applied to any development pressures - including those which are external to European sites but which are likely to have significant effects on any of them.

The CJEU developed this point when it issued a ruling in case C-461/17 (“Brian Holohan and Others v An Bord Pleanála”) that determined inter alia that Article 6(3) of Directive 92/43/EEC must be interpreted as meaning that an appropriate assessment must on the one hand, catalogue the entirety of habitat types and species for which a site is protected, and, on the other, identify and examine both the implications of the proposed project for the species present on that site, and for which that site has not been listed, and the implications for habitat types and species to be found outside the boundaries of that site, provided that those implications are liable to affect the conservation objectives of the site.

In that regard, consideration has been given in this Habitats Directive appraisal to implications for habitats and species located outside of the European sites considered in the appraisal with reference to those sites’ Conservation Objectives where effects upon those habitats and/or species are liable to affect the conservation objectives of the sites concerned.

#### 4.1.5 Conservation Objectives

The conservation objectives for each European site are to maintain or restore the favourable conservation condition of the Annex I habitat(s) and/or the Annex II species for which the site has been selected.

The favourable conservation status of a habitat is achieved when:

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

The favourable conservation status (or condition, at a site level) of a species is achieved when:

- Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats;
- 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.

EC (2022) advises that an assessment should be done for all of the designating features (species, habitat types) that are significantly present on the site (habitats and species with A, B or C, but not D, site assessment in the Standard Data Form for the site) in view of their conservation objectives. EC (2022) additionally notes that "*the lack of site-specific conservation objectives or the establishment of conservation objectives, which are not in line with the required standard, as specified in the Commission note on "Setting conservation objectives of Natura 2000 sites" (EC, 2012), jeopardises compliance with the requirements of Article 6(3)*".

##### 4.1.5.1 Site-Specific Conservation Objectives

The NPWS began preparing and publishing detailed Site-Specific Conservation Objectives (SSCOs) for European sites in 2011, and continue to do so. All of the European sites considered in this report have had SSCOs set (refer Table 4-2).

The published SSCO documents note that an appropriate assessment based on the most up to date conservation objectives will remain valid even if the targets are subsequently updated, providing they were the most recent objectives available when the assessment was carried out.

The most up-to-date Conservation Objectives for the European sites being considered have been used in this appraisal. Details in relation to the Qualifying Interests and Special Conservation Interests of these European sites is based on publicly available data sourced from the NPWS website in October 2023.

#### 4.1.6 In-combination Effects

Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are also considered. As set out in EC (2019), significance will vary depending on factors such as magnitude of impact, type, extent, duration, intensity, timing, probability, cumulative effects and the vulnerability of the habitats and species concerned.

EC (2020) notes that cumulative environmental effects can be defined as effects on the environment caused by the combined action of past, current and future activities. Although the effects of one development may not be significant, the combined effects of several developments together can be significant.

EC (2020) also notes that the 'in combination' provision applies to plans or projects that are completed, approved but uncompleted, or proposed. In addition to the effects of the plans or projects that are the main subject of the assessment, it may be appropriate to consider the effects of already completed plans and projects. Although already completed plans and projects are themselves excluded from the assessment requirements of Article 6(3), it is still important to take them into consideration when assessing the effects of the current plan or project in order to determine whether there are any potential cumulative effects arising from the current project in combination with other completed plans and projects. The effects of completed plans and projects would typically form part of the site's baseline conditions at this stage. Plans and projects that have been approved in the past but have not yet been implemented or completed should be included in the in-combination provision. As regards other proposed plans or projects, on grounds of legal certainty it would seem appropriate to restrict the 'in combination' provision to plans that have been proposed, i.e. for which an application for approval or consent has been submitted.

This mirrors the advice contained in EC (2019) which advises that other plans or projects which are completed, approved but uncompleted, or proposed have been considered. EC (2019) specifically advises that "*as regards other proposed plans or projects (i.e. other projects not proposed by the Applicant), on grounds of legal certainty it would seem appropriate to restrict the in-combination provision to those which have been actually proposed, i.e. for which an application for approval or consent has been introduced*".

EC (2021) additionally advises that:

- All types of plans or projects that could, in combination with the plan or project under consideration, have a significant effect, should be taken into account during the assessment;
- An in-combination assessment is often less detailed at the screening stage than in the appropriate assessment;
- There is still a need to identify all other plans or projects that could give rise to cumulative impacts with the plan or project in question and
- If this analysis cannot reach definitive conclusions, it should at least identify any other relevant plans and projects that should be scrutinised in more detail during the appropriate assessment.

## 4.2 Elements of the Project with Potential for Likely Significant Effects

There is a significant number of designated sites at and close to the marine aspects of the Proposed Project (see Figure 1-1). This screening stage of the assessment considers European sites designated under European Council Directives 92/43/EEC and 2009/147/EC. The proposed Project will be screened against those European sites for which a pathway of effect can be reasonably established between a receptor and the source of effect.

The possibility of significant effects is considered in this report using the source-pathway-receptor model. 'Source' is defined as the individual elements of the proposed works that have the potential to affect the identified ecological receptors. 'Pathway' is defined as the means or route by which a source can affect the ecological receptor. 'Ecological receptor' is defined as the Special Conservation Interests (SCIs) for SPAs or Qualifying Interests (QIs) for SACs, and for which Conservation Objectives (COs) have been set for the European sites being considered. Each element can exist independently however an effect is created when there is a linkage between the source, pathway and receptor.

Elements of the Proposed Project with the potential for LSEs are discussed in Table 4-1 with the possibility of impact pathways noted under one of four effect themes:

- Water quality and habitat deterioration;
- Airborne noise and visual disturbance;
- Underwater noise and disturbance; and
- Habitat Loss.

**Table 4-1: Project Elements that can give rise to Likely Significant Effects (LSEs)**

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| Clonshaugh Regional WWTP and Sludge Hub Centre including Access Road to WwTP, including extension of the River Mayne Culvert on the proposed access road to the WwTP by 4m (from 21m to 25m) to cater for the full width of the future north south link road. | Enabling Works – Excavations, earthworks, construction traffic. | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as this element of the proposed Project is located >3.5km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this element of the project to those marine receptor species.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off during construction stage and a possibility of release of polluting emissions as a result of leaks or spillages from the WWTP at operational stage, as the Cuckoo Stream lies directly north of this element of the proposed Project and is located within the River Mayne Catchment, which flows into Baldoyle Bay. |
| | Construction Works – Excavations, earthworks, concrete works, construction traffic, surface water management.<br>Instream works for culvert along access access road. | | |
| | Commissioning | Release of test water (potable water) into outfall pipeline. No effects predicted. | |
| | Operational Stage (including proposed UV treatment system) | Water quality and habitat deterioration. | |
| Pumping Station at Abbotstown including Access Road | Enabling Works – Excavations, earthworks | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as this element of the proposed Project is located >9km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this element of the project to those marine receptor species.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off during construction stage and a possibility of release of polluting emissions as a result of leaks from the pumping station at operational stage, as this element of the proposed Project is located within the Tolka River Catchment, which flows into the Tolka Estuary. |
| | Construction Works – Excavations, earthworks, concrete works, construction traffic, surface water management. | | |
| | Commissioning | Release of test water (potable water) into outfall pipeline. No effects predicted. | |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| | Operational Stage - | Water quality and habitat deterioration. | |
| Orbital Sewer Pipeline | Enabling/Advance Works - surveys, hedgerow removal, trenchless crossing advance works<br>Construction – Earthworks, surface water management, trenching, pipeline deliveries and installation, backfilling, resinstatement | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as this element of the proposed Project is located >4.5km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater or airborne noise, vibration or other visual stimuli cannot occur at this distance.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off within the wayleave at construction stage and a possibility of release of polluting emissions as a result of leaks from the pipeline at operational stage, as this element of the proposed Project is located within the Santry, Mayne and Tolka River catchments which flow to Dublin Bay and Baldoyle Bay. |
| | Commissioning/Testing - | Release of test water (potable water) into ourfall pipeline. No effects predicted. | |
| | Operation | Water quality and habitat deterioration | |
| Orbital Sewer Pipeline - Trenchless Crossings (local roads, rail, water courses, etc.) | Earthworks, excavations, pumping, drilling, management of drilling fluid, reinstatement | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as this element of the proposed Project is located >4.5km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater or airborne noise, vibration or other visual stimuli cannot occur at this distance.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off within the wayleave at construction stage, as this element of the proposed Project is located within the Santry, Mayne and Tolka River catchments which flow to Dublin Bay and Baldoyle Bay. |
| North Fringe Sewer (see also WWtP access road) | Enabling/Advance Works surveys, hedgerow removal, trenchless crossing advance works<br>Construction – Earthworks, trenching, pipeline deliveries and installation, backfilling, resinstatement | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as this element of the proposed Project is located >4.5km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater or airborne noise, vibration or other visual stimuli cannot occur at this distance.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off within the wayleave at construction stage and a possibility of release of polluting emissions as a result of leaks from the pipeline at operational stage, as this element of the proposed Project is located within the River Mayne Catchment, which flows into Baldoyle Bay.  The route crosses the River Mayne. |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| | Commissioning/Testing - | Release of test water (potable water) into ourfall pipeline. No effects predicted. | |
| | Operation | Water quality and habitat deterioration | |
| Outfall pipeline (land section) | Enabling/Advance Works - surveys, hedgerow removal, trenchless crossing advance works | Water quality and habitat deterioration<br><br>Airborne noise and visual disturbance.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater noise cannot occur as this element of the proposed Project is terrestrial.<br><br>Habitat loss cannot occur as this element of the proposed Project is not located within or adjacent to a European site. | There is a possibility of release of suspended sediment or contaminated run off within the wayleave at construction stage and a possibility of release of polluting emissions as a result of leaks from the pipeline at operational stage, as the proposed Project corridor crosses the Cuckoo Stream and is located within the River Mayne Catchment, which flows into Baldoyle Bay.<br><br>There is a possibility of disturbance and/or displacement by habitat loss, visual stimuli, general construction noise, piling noise, vibration or the presence of construction plant, machinery and operatives at the eastward terminal of the Outfall pipeline (land-based section) directly on qualifying species (outside the SPA boundary) and in proximity to lands used by SCI species of Euopean sites. |
| | Construction – Earthworks, surface water management, trenching, pipeline deliveries and installation, backfilling, resinstatement | | |
| | Commissioning/Testing | Release of test water (potable water) into ourfall pipeline. No effects predicted. | |
| | Operation | Water quality and habitat deterioration | |
| Outfall pipeline marine sections – micro tunnelling & tunnelling compounds (compounds 9 & 10) | Enabling/Advance Works – Eathworks | Water quality and habitat deterioration<br><br>Airborne noise and visual disturbance<br><br>Habitat loss.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater noise will not occur as this element of the proposed Project comprises terrestrial excavations each side of a shallow estuary and marine feature species do not occur in the estuary.<br><br>Construction traffic associated with the microtunnelling compounds will utilise existing roads (R106) and will therefore not result in displacement or disturbance to feature species of European sites. | There is a possibility of release of suspended sediment or contaminated run off at construction stage, as this element of the proposed Project is located within the North-West Irish Sea candidate SPA and directly adjacent to Baldoyle Bay and surface water will flow into Baldoyle Bay.<br><br>There is a possibility of habitat loss by direct land take within the North-West Irish Sea candidate SPA boundary, disturbance to SPA-qualifying features through visual disturbance, vibration or construction noise due to the presence of construction plant, machinery and operatives at the micro tunnelling compounds adjacent to lands used by overwintering birds at Baldoyle Bay.<br><br>There is a possibility of habitat loss at construction phase as this element of the proposed Project is located within one European site (North-West Irish Sea candidate SPA) and immediately adjacent to other European sites (Baldoyle Bay SPA, Baldoyle Bay SAC and Ireland's Eye SPA). |
| | Construction – Earthworks, excavations, pumping, piling, management of drilling fluid, reinstatement, night time working (including lighting), construction traffic | | |
| | Commissioning/Testing | Release of test water (potable water) into ourfall pipeline. No effects predicted. | |
| | Operation | None (no operational stage activity). | |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| Outfall pipeline (Marine section – sub sea pipe laying) | Construction – Dredging along a 250m wide working corridor, stringing in pipelines, return of excavated material to sea bed, marine vessel traffic . | Water quality and habitat deterioration.<br>Underwater noise and disturbance.<br>Airborne noise, vibration and visual disturbance.<br>Habitat loss | There is a possibility of suspended sediment plumes or contaminated run off from marine vessels at construction stage affecting European sites, or the SCIs of European sites utilising habitats outwith their boundaries.<br><br>There is a possibility of release of polluting emissions as a result of leaks from the pipeline at operational stage.<br><br>There is a possibility of general construction noise or the presence of construction vessels, construction plant, machinery and operatives along the working corridor of the marine outfall pipeline corridor affecting habitats outwith European sites being used by their SCI species. This could result in disturbance and/or displacement.<br><br>There is a possibility of construction noise emissions in the water column of the working corridor of the marine outfall pipeline corridor which could disturb or injure mobile marine mammal feature species of Rockabill to Dalkey Island SAC or Lambay Island SAC.<br><br>There is a possibility of habitat loss occurring where this element of the proposed Project passes through a European site. |
| | Construction - Ballasting and pipe assembly operation may be carried out at a quay side location or in sheltered water. | Airborne noise, vibration and visual disturbance (see Section 4.4.1) | |
| | Testing and Commissioning of marine pipeline | No testing required after installation. | |
| | Operation | Water quality and habitat deterioration | |
| Interface option 1 (dredged pit) | Enabling Works – mobilisation of vessels | Water quality and habitat deterioration<br><br>Underwater noise and disturbance<br><br>Airborne noise and visual disturbance<br><br>Habitat loss | There is a possibility of suspended sediment plumes or contaminated run off from marine vessels at construction stage, as this element of the proposed Project is located in the nearshore waters of Velvet Strand within Baldoyle Bay SAC and within the North-West Irish Sea candidate SPA.<br><br>The piling noise, vibration and the presence of vessels, construction plant, machinery and operatives at the interface between the land-based and marine-based outfall pipeline could impact areas of habitat used by SCI species both within the North-West Irish Sea candidate SPA, and close to the boundaries of proximate European sites such as Baldoyle Bay SPA and Ireland's Eye SPA. This could result in disturbance and displacement.<br><br>There is a possibility of construction noise emissions in the water column at the interface between the land-based and marine-based outfall pipeline which could disturb or injure mobile marine |
| | Construction – Dredging | | |
| Interface option 2 (cofferdam) | Enabling Works - set up jack-up platform | | |
| | Cofferdam construction, Removal of TBM, connection of pipelines, removal of cofferdam | | |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| | | | mammal feature species of Rockabill to Dalkey Island SAC or Lambay Island SAC.<br><br>There is a possibility of habitat loss occurring as this element of the proposed Project is located both within the North-West Irish Sea candidate SPA and in proximity to nearshore waters of Velvet Strand within Baldoyle Bay SAC. |
| Fibre Optic cable | Construction - install sheet piles, excavate, place precast concrete structure, remove sheet piles and precast concrete structures | Water quality and habitat deterioration<br><br>Underwater noise and disturbance<br><br>Airborne noise and visual disturbance | There is a possibility of suspended sediment or contaminated run off from marine vessels at construction stage, as this element of the proposed Project is located in the marine waters of the North-West Irish Sea candidate SPA and between Baldoyle Bay SAC and Rockabill to Dalkey Island SAC.<br><br>There is a possibility of construction noise or the presence of marine vessels, construction plant, machinery and operatives at the FO cable in areas used by breeding seabirds of nearby SPAs.<br><br>There is a possibility of construction noise emissions in the water column at the FO cable which could disturb or injure mobile marine mammal feature species of Rockabill to Dalkey Island SAC or Lambay Island SAC.<br><br>There is a possibility of habitat loss occurring as this element of the proposed Project is located both within the North-West Irish Sea candidate SPA and in proximity to nearshore waters of Velvet Strand within Baldoyle Bay SAC. |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| Diffuser | Construction – installation, backfilled, divers attach diffuser valves, precast concrete or steel are then placed over the diffuser valves. | Water quality and habitat deterioration<br><br>Underwater noise and disturbance<br><br>Airborne noise and visual disturbance<br><br>Habitat loss | There is a possibility of suspended sediment plumes or contaminated run off from marine vessels at construction stage, or release of elevated levels of pollutants as a result of operational emissions, as this element of the proposed Project is located within Rockabill to Dalkey Island SAC and the North-West Irish Sea candidate SPA and and in proximity to Ireland's Eye SPA.<br><br>The construction noise, vibration and the presence of marine vessels, construction plant, machinery and operatives at the marine diffuser could impact areas of habitat used by SCI species within and beyond the boundaries of European sites . This could result in disturbance and displacement.<br><br>There is a possibility of construction noise emissions in the water column at the diffuser which could disturb or injure mobile marine mammal feature species of Rockabill to Dalkey Island SAC or Lambay Island SAC.<br><br>There is a possibility of habitat loss occurring as this element of the proposed Project is located in Rockabill to Dalkey Island SAC |
| Regional Biosolids Storage Facility (RBSF) | Construction Works – Excavations, earthworks, concrete works | Water quality and habitat deterioration | There is a potential pathway between the RBSF Component of the Proposed Project and the Malahide Estuary SAC via the surface water network. However no significant effects are predicted,due to the absence of discharge/emissions from the proposed site, other than the collection of rainfall and surface water runoff (see Ringend Wastewater Treatment Plant Upgrade - Stage 1 Screening & Stage 2 NIS Report, May 2018).<br><br>Other effect themes are not applicable as this element of the Proposed Project is located >8km from any European site.<br>Disturbance or displacement of feature species of European sites as a result of underwater or aerial noise, or other visual stimuli cannot occur at this distance.<br><br>Habitat loss cannot occur at this distance. |
| | Commissioning - | n/a | |
| | Operational Stage - collection of rainfall and surface water management. | Water quality and habitat deterioration | |
| Access Roads | Construction - Earthworks, reinstatement | Water quality and habitat deterioration | There is a possibility of release of contaminated run off from spillages during construction stage as construction plant moves |

| Project Element | Stages of Development | Type of Effects | Impact Pathways |
|---|---|---|---|
| | | Airborne noise and visual disturbance.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater noise will not occur as this element of the proposed Project is terrestrial with no impact pathway to marine feature species.<br><br>There is no possibility of disturbance to SCIs of European sites as construction plant moves along the R106 regional road, as this is an existing major traffic route.<br>There is no possibility of habitat loss in a European site as this element of the proposed Project is terrestrial and not located within a European site. | along access roads; as this element of the proposed Project is located generally within the Santry, Mayne and Tolka River catchments which flow to Dublin Bay and Baldoyle Bay, and in particular includes use of the R106 regional road which runs along the boundary of Baldoyle Bay SAC and SPA.<br><br>There is a possibility of construction noise from the presence of construction plant, machinery and operatives during construction of 125m of access track to the south of the western microtunnelling compound. This could result in disturbance to SCIs of European sites using habitats outwith their boundaries. |
| Satellite Compounds | Construction - Earthworks, reinstatement | Water quality and habitat deterioration | There is a possibility of release of contaminated run off from spillages at construction compounds (excluding microtunnelling compounds at Baldoyle Bay); as this element of the proposed Project is located within the Santry, Mayne and Tolka River catchments which flow to Dublin Bay and Baldoyle Bay, |
| Utility Connections (gas & electricity) at Clonshaugh and Abbottstown Pumping Station | Construction – earthworks along access & egress roads to WWTP to install underground cables to connect gas and esb. All works to be undertaken within the proposed wayleave. | Water quality and habitat deterioration.<br><br>Other effect themes are not applicable as these elements of the Proposed Project are located >3.5km from any European site.<br><br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br><br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this element of the project to those marine receptor species.<br><br>Habitat loss cannot occur at this distance. | There is a possibility of release of suspended sediment or contaminated run off during construction into the River Mayne Catchment, which flows into Baldoyle Bay and the Tolka River Catchment, which flows into the Tolka Estuary. |

#### 4.2.1 Water Catchments traversed by the Proposed Project

The Tolka River rises near Dunshaughlin in Co. Meath and flows in a south-easterly direction where it crosses through the north of Dublin city before entering the sea at Clontarf through South Dublin Bay and the River Tolka Estuary SPA (004024) and North Dublin Bay pNHA (000206). The Tolka River has a length of approximately 20km from source to the sea, nearly half of which is located within the urban sprawl of Dublin City. The Tolka River will not be crossed by the orbital pipeline, however the Abbotstown Pumping station and associated compound, will be located approximately 130m from this river. The course of the river has been altered in this location and flows in a straight line under the M50 within an artificial channel with concrete banks.

The Santry River rises near Harristown, in Co. Dublin, and flows east via Santry, Kilmore, Edenmore and Raheny, through several designated nature conservation areas, before entering the sea at Dublin Bay. The Santry River flows through the Santry Demesne pNHA (00178) and discharges through North Bull Island SPA (004006) and North Dublin Bay SAC and pNHA (000206). The Santry River will be crossed once by the orbital sewer at Silloge. A satellite compound will be located at the M50 Interchange No. 4, and will be located approximately 100m from this river.

The Mayne River rises near Harristown, in Co. Dublin, and flows east entering the sea via Portmarnock Estuary at Mayne Bridge. The Cuckoo Stream, a tributary of the Mayne River, rises near Huntstown, in Co. Dublin, and flows east merging with the Mayne River at Balgriffin. The Mayne River discharges through Baldoyle Bay SAC and pNHA (000199) and Baldoyle Bay SPA (004016). The Mayne River will be crossed once by the orbital sewer just north of the M50 and south of Ballystruan. A satellite compound will be located at the Old Airport Road / R132 Swords Road junction (the Collinstown Crossroads) and will be located approximately 650m from the Mayne River, and approximately 235m from the Cuckoo Stream. The Mayne River will also be crossed by a new culvert system which will be constructed to provide access to Craobh Chiaráin Gaelic Athletic Association (GAA) Pitches and the new WwTP at Clonshaugh. The Cuckoo Stream will be crossed once by the orbital sewer directly downstream of the new WwTP which will be constructed at Clonshagh. The Cuckoo Stream also lies immediately north of the WwTP site, while the Mayne River lies approximately 400m to the south. The site of the WwTP will also constitute a compound for the duration of the works.

##### 4.2.1.1 Surface Water Management Plan

An outline Surface Water Management Plan (see EIAR Volume 2 Part B Appendices) has been prepared for the Proposed Project. It includes details of the proposed discharge locations where treated surface water will be discharged to the aforementioned water catchments during the construction of the project. It includes a number of measures to ensure there is no direct discharge of surface water from any element of the works without proper attenuation and treatment. As per that completed for the NIS associated with the 2018 planning application, for clarity, this outline Surface Water Management Plan has not been taken in to consideration in the screening appraisal, and should not be taken into consideration as part of the screening for appropriate assessment to be undertaken by the competent authority (refer to Section 4.1.3).

### 4.3 European Sites within the Study Area of the proposed Project

Table 4-2 lists the European Sites potentially affected by the proposed Project as shown in Figure 1-1 and summarises the potential pathways for Likely Significant Effects as identified in Table 4-1.

Table 4-2: European Sites potentially affected by the proposed Project

| Ref No. | Site Name | Date of publication of SSCOs | Site Code | Approximate Location Relative to Proposed Works | Potential Pathways for LSEs |
|---|---|---|---|---|---|
| 1 | Baldoyle Bay SAC | Nov 2012 | 000119 | Marine outfall passes through this SAC | • Hydrological (water quality and habitat deterioration)<br>• Underwater noise and disturbance<br>• Habitat loss |
| 2 | Baldoyle Bay SPA | Feb 2013 | 004016 | Marine outfall passes through this SPA | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 3 | Rockabill to Dalkey Island SAC | May 2013 | 003000 | A 1,300m section of the marine outfall and diffuser are located in this SAC | • Hydrological (water quality and habitat deterioration)<br>• Underwater noise and disturbance<br>• Habitat loss |
| 4 | Ireland's Eye SAC | Jan 2017 | 002193 | 1.0km south of the marine outfall | Designated for coastal and not marine habitats. There is no hydrological link and no open pathway of effect, thus there is no real possibility of LSEs. Further clarifications made to the An Bord Pleanála Inspector at the Oral Hearing in 2019 confirmed that Ireland's Eye SAC was screened out in relation to LSE (see Section 4.3.1 and Section 4.3.2 below). |
| 5 | Ireland's Eye SPA | Oct 2022 | 004117 | 0.4km southwest of the marine outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 6 | North Dublin Bay SAC | Nov 2013 | 000206 | 2.3km to the south of the marine outfall | • Hydrological (water quality and habitat deterioration) |
| 7 | North Bull Island SPA | Mar 2015 | 004006 | 2.3km to the south of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 8 | Malahide Estuary SPA[1] | Aug 2013 | 004025 | 2.5km to the north of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 9 | Malahide Estuary SAC | May 2013 | 000205 | 2.5km north of the marine outfall | • Hydrological (water quality and habitat deterioration) |
| 10 | Howth Head Coast SPA | Oct 2022 | 004113 | 2.6km to the south of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 11 | Howth Head SAC | Dec 2016 | 000202 | 2.6km to the south of the marine outfall | Designated for coastal terrestrial habitats. There is no hydrological link and no open pathway of effect, thus there is no likelihood of significant effects. Further clarifications made to the An Bord Pleanála Inspector at oral hearing in 2019 confirmed that Howth Head SAC was screened out in relation to LSE (see Section 4.3.2 below). |
| 12 | South Dublin Bay and River Tolka Estuary SPA | Mar 2015 | 004024 | 7.6km south of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |

[1] NPWS also refer to this as Broadmeadows / Swords Estuary SPA.

| Ref No. | Site Name | Date of publication of SSCOs | Site Code | Approximate Location Relative to Proposed Works | Potential Pathways for LSEs |
|---|---|---|---|---|---|
| 13 | Rogerstown Estuary SAC | Aug 2013 | 000208 | 8.5km north of the marine outfall | Hydrological<br>(water quality and habitat deterioration) |
| 14 | Rogerstown Estuary SPA | May 2013 | 004015 | 8.5km north of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 15 | South Dublin Bay SAC | Aug 2013 | 000210 | 9.1km to the south of the Marine Outfall | • Hydrological<br>(water quality and habitat deterioration) |
| 16 | Lambay Island SAC | Jul 2013 | 000204 | 9.3km north-east of the marine outfall | • Hydrological<br>(water quality and habitat deterioration)<br>• Underwater noise and disturbance |
| 17 | Lambay Island SPA | Oct 2022 | 004069 | 9.3km north-east of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 18 | Dalkey Island SPA | Oct 2022 | 004172 | 14.9km south of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 19 | Skerries Islands SPA | Oct 2022 | 004122 | 16.7km to the north of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 20 | Rockabill SPA | May 2013 | 004014 | 16.9km to the north of the Marine Outfall | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |
| 21 | Glenasmole Valley SAC | Dec 2021 | 001209 | 14.8km south of the project | This SAC is situated 14.8km south of the Orbital Sewer. It is considered that there is no potential for effects on this site as no connecting pathways, e.g. streams or rivers) potentially lie within the zone of influence |
| 22 | Rye Water Valley/Carton SAC | Dec 2021 | 001398 | 8.7km to the west of the project | This SAC is situated 8.7km to the west of the Orbital Sewer. It is considered that there is no potential for effects on this site as no connecting pathways, e.g. streams or rivers) potentially lie within the zone of influence |
| 23 | North-West Irish Sea candidate SPA | Sep 2023 | 004236 | Marine outfall passes through this cSPA | • Hydrological (water quality and habitat deterioration)<br>• Airborne noise and visual disturbance<br>• Habitat Loss |

The sites shaded in grey in Table 4-2 above above have no potential pathway for impact and as such are not considered further in the screening assessment.

### 4.3.1 Further Information in Relation to Ireland's Eye SAC

At the oral hearing convened by An Bord Pleanala in March 2019, further explanation in relation to why likely significant effects would not occur on Ireland's Eye SAC was submitted to the An Bord Pleanala Inspector, as follows –

“Irelands Eye cSAC was included in Section 4.3 of the NIS which listed the European Sites within the Study Area of the Proposed Project. Table 4-2 listed the European Sites potentially affected by the Proposed Project and summarised the potential pathways for Likely Significant Effects (LSE).

It was noted in the table that Irelands Eye SAC is designated for terrestrial habitats, specifically vegetated sea cliffs [‘Perennial vegetation of stony banks [1220] habitat’]. No marine habitats are included in the Qualifying Interests. As the island is fundamentally based on a bedrock outcrop, the aquifer that supports surface soils will be isolated from the marine section of the works by this underlying formation. No construction operations are proposed for the island and therefore there is no potential pathway for LSE.

Consideration has been given to the possible interface with the coastline via sea spray particularly on the designated habitat ‘Perennial vegetation of stony banks [1220] habitat’. The NPWS (2017) Conservation Objectives: Ireland's Eye SAC 002193 states that the full distribution of the 1220 habitat on the island has not been fully mapped although the habitat was recorded by Moore and Wilson (1999) and by Ryle et al. (2009). This remains the case. Shingle occurs on the western shore between sand hills and a sandy beach. Map 3 of the document, indicates the plotted habitat on the southern tip of the main island (see Figure 1 reproduced below). The document also states that the shingle beach at Ireland’s Eye SAC has poor vegetation, mainly limited to some marram (Ammophila arenaria) at the back of the beach. Curled dock (Rumex crispus), silverweed (Potentilla anserina) with spear-leaved orache (Atriplex prostrata) was also recorded.

The Perennial vegetation of stony banks habitat is recorded on the south and possibly western side of the island, at a distance of 1.5km from and on the opposite side of Island to the proposed project and plume trajectories. All locations where perennial vegetation of stony banks habitat is recorded within the SAC are in a sheltered part of the island where the likelihood of significant seawater spray is reduced. Furthermore, should it occur, the impact from seawater spray would not cause any impact to this habitat as elevations in suspended sediments or other elevated nutrients from a project would be imperceptible.

In the context of the above, Ireland’s Eye SAC was screened out in relation to LSE on the following basis:

Construction Stage:

- The hydrodynamic model indicated that plume effects during construction dredging on the adjacent north face of Irelands Eye were negligible. A maximum possible predicted elevation, of between 5 and 10mg/l for suspended solids was predicted. This is well below the natural variability of the waters surrounding the island throughout the year (which varied from 15-162mg/l and a median of 23mg/l). The Perennial vegetation of stony banks habitat for which the SAC is designated, is recorded on the south and possibly western side of the island. This is the opposite side of island to the proposed project and plume trajectories.

Operational Phase

- The hydrodynamic model indicated that the operational plume did not impact waters
- immediately adjacent to the Ireland’s Eye SAC.
- All locations where Perennial vegetation of stony banks habitat is recorded within the SAC are in a sheltered part of the island where the likelihood of significant seawater spray is reduced.

Furthermore the impact from seawater spray which ‘might’ contain imperceptible elevations in suspended sediments or other elevated nutrients from a project-related plume would not cause any impact to this habitat, should it occur.”

### 4.3.2 Further Information in Relation to Ireland’s Eye SAC and Howth Head SAC

As regards Ireland’s Eye SAC, the ABP Inspector’s Report of 2019 notes that –

*"this site is designated for coastal and not marine habitats. There is no hydrological link and no open pathway of effect, thus there is no real possibility of LSE's.*

*At the oral hearing this matter was further considered. Ms Cawley attending in an advisory capacity for FCC stated that further clarification was required in relation to the ruling out of potential significant effects on Ireland's Eye SAC. Mr Wilson addressed the matter (OH-64). He reiterated that the site is designated for terrestrial habitats. There is no connection between the aquifer that supports the soils on the island and the marine works. There is no work on the island. The plume effects are shown to be negligible in terms of construction phase water quality impacts. The vegetation is on the opposite side of the works to the project / plume trajectory and in sheltered areas where there is no likelihood of significant sea spray. In the operational phase the plume has been shown not to impact the waters immediately adjacent the SAC. There would be no impact from the imperceptible elevations in suspended sediments or nutrients in the unlikely event that sea water spray did contact the habitat. Based on this statement and the available information presented in the EIAR, the NIS and the background studies and the oral hearing discussion I am satisfied that the evidence firmly discounts any likely significant effect on the habitats which are qualifying interests. I consider that there is sufficient objective information to enable the Board to conclude that Ireland's Eye SAC can be screened out from further consideration."*

As regards Howth Head SAC, the ABP Inspector's Report of 2019 notes that this site –

*"is designated for Vegetated sea cliffs of the Atlantic and Baltic Coasts and European dry heaths. The applicant's submission is that there is no hydrological link and no open pathway of effect, thus there is no likelihood of significant effects.*

*The conservation objectives for this European site are vegetated sea cliffs and dry heaths. These coastal terrestrial habitats are a considerable distance from the project in terms of any pathways which might give rise to significant effects. In relation to the construction and operational plumes the site is to the south and therefore away from and in the opposite direction to the area which might be affected. In any case at that distance there would be no discernible changes in water quality in the construction or operational phases. I consider that there is sufficient objective information to enable the Board to conclude that Howth Head SAC can be screened out from further consideration".*

Following the original grant of planning permission in 2019, Judicial Review proceedings were determined by the High Court (Joyce-Kemper v. An Bord Pleanála (No. 2) [2020] IEHC 601, [2020] 11 JIC 2402 (Unreported, High Court, 24th November 2020). The Court addressed the issue of screening out likely significant effects on both Ireland's Eye SAC and Howth Head SAC as this had been raised as one of the grounds of challenge by the Applicant in those proceedings.

At paragraphs 284-296 of the Judgment of Mr. Justice Allen, the Court found –

*284. "The challenge to the screening out of Ireland's Eye SAC was based on the proposition that it is an island surrounded by the sea and that as a matter of common sense in rough sea conditions there was bound to be spray all over the island. The determination was said to be based entirely on the premise that there would not be any sea spray on Ireland's Eye.*

*285. The challenge to the screening out of Howth Head SAC was based on the same argument: that anyone who has walked the hill of Howth would know that when the sea was rough the spray could reach the top of the hill. So, it was said, it was just an unsustainable proposition to say that the sea was not going to reach the habitats and that seems to be the sole basis on which the sites were screened out. The test, it was said, failed to identify any of the actual likely risks and so failed the test in Eamon (Ted) Kelly.*

*286. In my clear view the argument that Ireland's Eye SAC and Howth Head SAC were screened out solely on the basis that they would not be exposed to sea spray cannot withstand even superficial scrutiny. The Inspector's conclusion, based on the evidence, was that the effects in the short term of the tunnelling*

> *plume and in the long term of the operational plume on water quality would be negligible and would have no impact on the conservation objectives of the sites. It is clear from the passages in the Inspector's report relied upon in support of the argument, that the likelihood or unlikelihood of sea spray was entirely secondary. If the sea water quality would not be affected by the plumes, it would make no difference whether any spray reached the qualifying interests. There was no challenge to the conclusion that the water quality of the sea would not be affected."*

And at paragraph 292 of that Judgment, the Court concluded that "*The applicant has not established any substantial ground on which the screening out of Ireland's Eye SAC or Howth Head SAC might be challenged*".

Nothing about the updated baseline environment or the Proposed Project has changed to invalidate these previous conclusions in relation to AA screening.

#### 4.3.3 Further Information in Relation to the North-West Irish Sea candidate SPA

The North-West Irish Sea candidate SPA (cSPA) (site code IE004236) was notified to the public by the Department of Housing, Local Government and Heritage in July 2023 following selection by the Minister under Regulation 15 of the European Communities (Birds and Natural Habitats) Regulations 2011, as amended, as a site to be considered for consideration for classification as a SPA.

The Regulation 15 notification which was issued on 13 July 2023 is the first stage in the designation of the North-West Irish Sea candidate SPA under the Birds and Habitats Regulations, and allows for a three-month period during which observations may be submitted in relation to the proposed designation. A second public notification, known as a Regulation 16 notification, will be issued once the statutory three-month period for the Regulation 15 notification has elapsed, and a further three-month period will then begin, during which observations and objections to the proposed designation, on scientific, ornithological grounds, may be submitted by interested parties. The earliest possible date for the publication of the Regulation 16 notification is therefore 14 October 2023. In the interim, a site synopsis has been published by NPWS, noting inter alia that:

- The North-West Irish Sea cSPA constitutes an important resource for marine birds;
- The estuaries and bays that open into it along with connecting coastal stretches of intertidal and shallow subtidal habitats, provide safe feeding and roosting habitats for waterbirds throughout the winter and migration periods;
- These areas, along with more pelagic marine waters further offshore, provide additional supporting habitats (for foraging and other maintenance behaviours) for those seabirds that breed at colonies on the north-west Irish Sea's islands and coastal headlands;
- These marine areas are also important for seabirds outside the breeding period;
- This cSPA extends offshore along the coasts of counties Louth, Meath and Dublin, and is approximately 2,333 km$^2$ in area;
- This cSPA is ecologically connected to and adjoins twelve existing SPAs already designated for the protection of birds along the coast;
- The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species:
    - Common Scoter
    - Red-throated Diver
    - Great Northern Diver
    - Fulmar
    - Manx Shearwater
    - Shag, Cormorant

- o Little Gull
- o Kittiwake
- o Black-headed Gull
- o Common Gull
- o Lesser Black-backed Gull
- o Herring Gull
- o Great Black-backed Gull
- o Little Tern
- o Roseate Tern
- o Common Tern
- o Arctic Tern
- o Puffin
- o Razorbill, and
- o Guillemot.

The breeding seabird species listed for those SPAs, which abut the North-West Irish Sea cSPA are:

- Fulmar (Lambay Island SPA);
- Cormorant (Skerries Island SPA; Ireland's Eye SPA; Lambay Island SPA);
- Shag (Skerries Island SPA; Lambay Island SPA);
- Lesser Black-backed Gull (Lambay Island SPA);
- Herring Gull (Skerries Island SPA; Ireland's Eye SPA; Lambay Island SPA);
- Kittiwake (Lambay Island SPA; Ireland's Eye SPA; Howth Head SPA);
- Roseate Tern (Rockabill SPA);
- Common Tern (Rockabill SPA;);
- Arctic Tern (Rockabill SPA);
- Little Tern (Boyne Estuary SPA);
- Guillemot (Lambay Island SPA, Ireland's Eye SPA);
- Razorbill (Lambay Island SPA, Ireland's Eye SPA); and
- Puffin (Lambay Island SPA).

The Common Tern population that is listed for the nearby South Dublin Bay and River Tolka Estuary SPA is also likely to use this cSPA as a foraging resource.

NPWS advise that the Department has been informed by two surveys of the western Irish Sea region in 2016, showing that an estimated 120,232 and 34,626 individual marine birds occurred in this cSPA during autumn and winter respectively. Those marine bird species whose estimated abundances equalled or exceeded 1% of the total estimated size of the winter assemblage are:

- Red-throated Diver (538),
- Fulmar (506),
- Little Gull (391),

- Kittiwake (944),
- Black-headed Gull (508),
- Common Gull (2,866),
- Herring Gull (6,893),
- Great Black-backed Gull (2,096),
- Razorbill (4,638) and
- Guillemot (13,914).

The estimated 2016 summer abundance of Manx Shearwater in the North-West Irish Sea cSPA is 13,010 and is of international importance. The estimated 2016 autumn and winter abundances of Great Northern Diver in the North West Irish Sea cSPA is 248 and 230 respectively and are of international importance. The estimated abundances of Common Scoter over parts of this cSPA can reach significant numbers (e.g. 14,567 in December 2018) which is also of international importance.

NPWS published detailed Site Specific Conservation Objectives for the North-West Irish Sea cSPA in September 2023 (NPWS, 2023) which have been fully considered in this assessment. Details of the site, including a Natura 2000 Standard Data Form, will be transmitted to the European Commission when the above statutory processes have been completed. At the time of writing, this has not yet occurred. Conservation objectives have been set to maintain three categories of populations of waterbirds and seabirds, as follows:

| Breeding Populations | Non-breeding populations | Populations |
|---|---|---|
| • Manx Shearwater | • Red-throated Diver | • Fulmar |
| • Cormorant | • Great Northern Diver | • Herring Gull |
| • Shag | • Common Scoter | • Kittiwake |
| • Lesser Black-backed Gull | • Black-headed Gull | • Guillemot |
| • Roseate Tern | • Common Gull | • Razorbill |
| • Common Tern | • Great Black-backed Gull | |
| • Arctic Tern | • Little Gull | |
| • Little Tern | | |
| • Puffin | | |

## 4.4 Analysis of Potential for Likely Significant Effects

Table 4-3 identifies the potential for likely significant effects on the Qualifying Interests (QIs) or Special Conservation Interests (SCIs) of the European sites as a result of construction, commissioning or operation of the proposed Project.

Table 4-3: Potential for Likely Significant Effects on European Sites

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| 1 | Baldoyle Bay SAC 000199 | Marine outfall pipeline will be installed in a tunnel that passes below the SAC. | Mudflats and sandflats not covered by seawater at low tide; *Salicornia* and other annuals colonizing mud and sand; Atlantic salt meadows (Glauco-*Puccinellietalia maritimae*); and Mediterranean salt meadows (*Juncetalia maritimi*). | • Possible deterioration of water quality of estuarine habitats due to pollution events or elevated suspended solids during construction of all project elements upstream of this site that could lead to runoff into the Mayne River which flows into the SAC.<br>• Possible deterioration of water quality of estuarine habitats due to pollution events or suspended sediment plumes during construction of marine project elements including bentonite blowout or surface venting.<br>• Possible deterioration of water quality of estuarine habitats due to plume arising from operation of project.<br>• No direct habitat loss will occur within the SAC as the marine pipeline will be installed in a tunnel that passes below the SAC; tunnelling compounds on the surface are to be located outside the boundary of the SAC, and the interface of the tunnelled section and seabed section of the marine pipeline will be located outside of the SAC. However, there is the potential for bentonite release or surface venting during the tunnelling operations that could lead to habitat loss. | LSEs upon estuarine habitats as a result of polluting events upstream of the SAC cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon estuarine habitats as a result of constrution (including dredging plumes or bentonite release/surface venting during tunnelling) and operational phases cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 2 | Baldoyle Bay SPA 004016 | Marine outfall pipeline will be installed in a tunnel that passes below the SPA. | Light-bellied Brent Goose; Shelduck; Ringed Plover; Golden Plover; Grey Plover; Bar-tailed Godwit; and Wetland and Waterbirds. | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or elevated suspended solids during construction of all project elements upstream that could lead to runoff into the Mayne River which flows into the SPA.<br>• Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or suspended sediment plumes during construction of marine project elements, including dredging, bentonite blowout or surface venting. | LSEs upon intertidal wetland habitats in the SPA as a result of polluting events upstream of the SPA cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon intertidal wetland habitats in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to plume arising from operation of project.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities causing birds to change their behaviour.<br>No direct habitat loss will occur within the SPA as the marine pipeline will be installed in a tunnel that passes below the SPA, and tunnelling compounds on the surface are to be located outside the boundary of the SPA. However, habitat loss outwith the SPA boundary during construction is possible and as a result of surface venting/bentonite release. | sediments or polluting substances, and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary. |
| 3 | Rockabill to Dalkey Island SAC 003000 | A 1,300m section of the marine outfall and diffuser are located in this SAC | *Phocoena phocoena* (Harbour porpoise); Reefs. | • Possible deterioration of water quality of reef habitats due to pollution events or elevated suspended solids during dredging of marine outfall pipeline, diffuser, FO cable protection works, interface works.<br>• Possible deterioration of water quality for reef habitats due to treated wastewater discharge during operation.<br>• Possiblen noise disturbance of mobile cetacean species during construction of marine outfall and diffuser, FO cable protection works, interface works..<br>• Possible deterioration of water quality leading to reduction in prey of mobile cetacean species during operation.<br>• Habitat Loss associated with 1,300m of marine outfall and diffuser. | LSEs upon reef habitats as a result of polluting events from marine plant cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon reef habitats as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary.<br><br>LSEs upon Harbour porpoise as a result of underwater noise and disturbance cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon Harbour porpoise as a result of habitat loss cannot be excluded without further analysis and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| 4 | Ireland's Eye SPA 004117 | 0.4km southwest of the marine outfall | Cormorant (*Phalacrocorax carbo*);<br>Herring Gull (*Larus argentatus*);<br>Kittiwake (*Rissa tridactyla*);<br>Guillemot (*Uria aalge*); and Razorbill (*Alca torda*). | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the microtunnelling/subsea interface, causing birds to change their behaviour.<br>It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first. | LSEs upon SCI species as a result of airborne noise and visual disturbance (both inside and outside the SPA boundary) cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary. |
| 5 | North Dublin Bay SAC 000206 | 2.3km to the south of the marine outfall | *Petalophyllum ralfsii* (Petalwort);<br>Mudflats and sandflats not covered by seawater at low tide;<br>*Salicornia* and other annuals colonizing mud and sand;<br>Atlantic salt meadows (Glauco-*Puccinellietalia maritimae*);<br>Mediterranean salt meadows (*Juncetalia maritimi*);<br>Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes);<br>Fixed coastal dunes with herbaceous vegetation (grey dunes);<br>Annual vegetation of drift lines; | • Possible deterioration of water quality of estuarine habitats due to pollution events or elevated suspended solids during construction of all project elements upstream of this site that could lead to runoff into the Santry River, which flows into the SAC.<br>• Possible deterioration of water quality of estuarine habitats due to pollution events or suspended sediment plumes during construction of marine project elements..<br>• Possible deterioration of water quality of estuarine habitats due to plume arising from operation of project. | LSEs upon estuarine habitats as a result of polluting events upstream of the SAC or from marine plant cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon estuarine habitats as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | Embryonic shifting dunes; and<br>Humid dune slacks. | | |
| 6 | North Bull Island SPA 004006 | 2.3km to the south of the Marine Outfall | Light-bellied Brent Goose (*Branta bernicla* hrota);<br>Shelduck (*Tadorna tadorna*);<br>Teal (*Anas crecca*);<br>Pintail (*Anas acuta*);<br>Shoveler (*Anas clypeata*);<br>Oystercatcher (*Haematopus ostralegus*);<br>Golden Plover (*Pluvialis apricaria*);<br>Grey Plover (*Pluvialis squatarola*);<br>Knot (*Calidris canutus*);<br>Sanderling (*Calidris alba*);<br>Dunlin (*Calidris alpina*);<br>Black-tailed Godwit (*Limosa limosa*);<br>Bar-tailed Godwit (*Limosa lapponica*);<br>Curlew (*Numenius arquata*);<br>Redshank (*Tringa totanus*);<br>Turnstone (*Arenaria interpres*);<br>Black-headed gull (*Chriocecephalus ridibundus*); and<br>Wetland and Waterbirds | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or suspended sediment plumes during construction of marine project element.<br>• Possible deterioration of water quality of intertidal wetland habitats in the SPA due to plume arising from operation of project.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities causing birds to change their behaviour. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 7 | Malahide Estuary SPA 004025 | 2.5km to the north of the Marine Outfall | Great Crested Grebe (*Podiceps cristatus*);<br>Light-bellied Brent Goose;<br>Shelduck;<br>Pintail;<br>Goldeneye (*Bucephala clangula*); | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or suspended sediment plumes during construction of marine project elements.<br>• Possible deterioration of water quality of intertidal wetland habitats in the SPA due to plume arising from operation of project. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | Red-breasted Merganser (*Mergus serrator*);<br>Oystercatcher;<br>Golden Plover;<br>Grey Plover;<br>Knot;<br>Dunlin;<br>Black-tailed Godwit;<br>Bar-tailed Godwit;<br>Redshank; and<br>Wetland and Waterbirds. | • Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities causing birds to change their behaviour. | excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 8 | Malahide Estuary SAC 000205 | 2.5km north of the marine outfall | Mudflats and sandflats not covered by seawater at low tide;<br>*Salicornia* and other annuals colonizing mud and sand;<br>Atlantic salt meadows (Glauco-*Puccinellietalia maritimae*);<br>Mediterranean salt meadows (*Juncetalia maritimi*);<br>Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes); and<br>*Fixed coastal dunes with herbaceous vegetation (grey dunes). | • Possible deterioration of water quality of estuarine habitats due to pollution events or suspended sediment plumes during construction of marine project elements..<br>• Possible deterioration of water quality of estuarine habitats due to plume arising from operation of project. | LSEs upon estuarine habitats as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 9 | Howth Head Coast SPA 004113 | 2.6km to the south of the Marine Outfall | Kittiwake. | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | | microtunnelling/subsea interface, causing birds to change their behaviour.<br>It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first. | LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 10 | South Dublin Bay and River Tolka Estuary SPA 004024 | 7.6km south of the Marine Outfall | Light-bellied Brent Goose;<br>Oystercatcher;<br>Ringed Plover;<br>Grey Plover;<br>Knot;<br>Sanderling;<br>Dunlin;<br>Bar-tailed Godwit;<br>Redshank;<br>Black-headed Gull;<br>Roseate Tern (*Sterna dougallii*);<br>Common Tern (*Sterna hirundo*);<br>Arctic Tern (*Sterna paradisaea*); and<br>Wetland and Waterbirds. | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or suspended sediment plumes during construction.<br>• Possible deterioration of water quality of intertidal wetland habitats in the SPA due to plume arising from operation of project.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities causing birds to change their behaviour. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 11 | Rogerstown Estuary SAC 000208 | 8.5km north of the marine outfall | Estuaries;<br>Mudflats and sandflats not covered by seawater at low tide;<br>*Salicornia* and other annuals colonizing mud and sand;<br>Atlantic salt meadows (Glauco-*Puccinellietalia maritimae*);<br>Mediterranean salt meadows (*Juncetalia maritimi*); | • Possible deterioration of water quality of estuarine habitats due to pollution events or suspended sediment plumes during construction of marine project elements..<br>• Possible deterioration of water quality of estuarine habitats due to plume arising from operation of project. | LSEs upon estuarine habitats as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes); and Fixed coastal dunes with herbaceous vegetation (grey dunes). | | |
| 12 | Rogerstown Estuary SPA 004015 | 8.5km north of the marine outfall | Greylag Goose (*Anser anser*);<br>Light-bellied Brent Goose;<br>Shelduck;<br>Shoveler;<br>Oystercatcher;<br>Ringed Plover (*Charadrius hiaticula*);<br>Grey Plover;<br>Knot<br>Dunlin;<br>Black-tailed Godwit;<br>Redshank; and<br>Wetland and Waterbirds | • Possible deterioration of water quality of intertidal wetland habitats in the SPA due to pollution events or suspended sediment plumes during construction of marine project elements.<br>• Possible deterioration of water quality of intertidal wetland habitats in the SPA due to plume arising from operation of project.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities causing birds to change their behaviour. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 13 | South Dublin Bay SAC 000210 | 9.1km to the south of the Marine Outfall | Mudflats and sandflats not covered by seawater at low tide. | • Possible deterioration of water quality of estuarine habitats due to pollution events or suspended sediment plumes during construction of marine project elements..<br>• Possible deterioration of water quality of estuarine habitats due to plume arising from operation of project. | LSEs upon estuarine habitats as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 14 | Lambay Island SAC & 000204 | 9.3km north-east of the marine outfall | *Halichoerus grypus* (Grey Seal);<br>*Phoca vitulina* (Harbour Seal);<br>Reefs; and | • Possible disturbance of mobile cetacean species during construction of marine outfall and diffuser, FO cable protection works, interface works.. | LSEs upon Harbour seal as a result of underwater noise and disturbance cannot be excluded without further analysis and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | Vegetated sea cliffs of the Atlantic and Baltic coasts. | • Possible deterioration of water quality leading to reduction in prey of mobile pinniped species during construction.<br>• Possible deterioration of water quality leading to reduction in prey of mobile pinniped species during operation. | LSEs upon water quality in the SAC as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 15 | Lambay Island SPA 004069 | 9.3km north-east of the Marine Outfall | Fulmar (*Fulmarus glacialis*); Cormorant (*Phalacrocorax carbo*); Shag (*Phalacrocorax aristotelis*); Greylag Goose; Lesser Black-backed Gull (*Larus fuscus*); Herring Gull (*Larus argentatus*); Kittiwake (*Rissa tridactyla*); Guillemot (*Uria aalge*); Razorbill (*Alca torda*); and Puffin (*Fratercula arctica*). | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the microtunnelling/subsea interface, causing birds to change their behaviour.<br>It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 16 | Dalkey Island SPA 004172 | 14.9km south of the Marine Outfall | Roseate Tern; Common Tern; and Arctic Tern. | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | | microtunnelling/subsea interface, causing birds to change their behaviour.<br>• It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first.on food resource abundance. | LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 17 | Skerries Islands SPA 004122 | The SPA is situated 16.7km north of the proposed project. | Cormorant;<br>Shag;<br>Light-bellied Brent Goose;<br>Purple Sandpiper (*Calidris maritima*);<br>Turnstone; and<br>Herring Gull. | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the microtunnelling/subsea interface, causing birds to change their behaviour.<br>It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first. | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 18 | Rockabill SPA 004014 | The SPA is situated 16.9km north of the proposed project. | Purple Sandpiper;<br>Roseate Tern;<br>Common Tern; and<br>Arctic Tern. | • Possible deterioration of water quality from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species inside and outside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the | LSEs upon SCI species as a result of airborne noise, vibration and visual disturbance within and in proximity to the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss outwith the SPA boundary cannot be excluded without further analysis and the application of mitigation as necessary. |

| Ref. | Site name & Code | Approximate Location Relative to Proposed Works | Qualifying interests (or) Special Conservation Interests | Potential for Likely Significant Effects (LSEs) | LSEs |
|---|---|---|---|---|---|
| | | | | microtunnelling/subsea interface, causing birds to change their behaviour.<br>It is considered that underwater noise will not result in LSE as birds will likely be disturbed or displaced by the presence of vessels (i.e. visual disturbance) first. | LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary. |
| 19 | North-West Irish Sea candidate SPA 004236 | Marine outfall pipeline will be installed in a tunnel that passes below the cSPA immediately off the beach at Velvet Strand and then on the seabed of the cSPA until the terminal diffuser | Red-throated Diver<br>Great Northern Diver<br>Fulmar<br>Manx Shearwater<br>Shag, Cormorant<br>Little Gull<br>Kittiwake<br>Black-headed Gull<br>Common Gull<br>Lesser Black-backed Gull<br>Herring Gull<br>Great Black-backed Gull<br>Little Tern<br>Roseate Tern<br>Common Tern<br>Arctic Tern<br>Puffin<br>Razorbill, and<br>Guillemot. | • Possible deterioration of water quality in the marine environment within the SPA arising from construction and operational sediment/pollution plumes resulting in change in foraging potential as a result of changes in water quality impacting on food resource abundance.<br>• Possible disturbance or displacement of SCI species using marine waters inside the SPA as a result of noise or visual stimuli of construction stage activities for the marine outfall pipeline, marine diffuser, FO protection cable works and the microtunnelling/subsea interface, causing birds to change their behaviour.<br>• It is considered that underwater noise may result in LSEs upon some species of diving seabirds as a result of e.g. sheet piling for the FO protection. | LSEs upon SCI species as a result of airborne noise and visual disturbance within the SPA cannot be excluded without further analysis and the application of mitigation as necessary.<br><br>LSEs upon water quality in the SPA as a result of plumes at construction or operational phase cannot be excluded without further analysis of the extent of predicted plumes and their concentration of suspended sediments or polluting substances, and the application of mitigation as necessary.<br><br>LSEs upon SCI species as a result of habitat loss within the SPA boundary as a result of excavation of seabed material by backhoe dredger or trailer suction hopper dredger to create a 5m deep trench for a length of 3,940m; deposition and stockpiling of excavated material parallel to the proposed outfall pipeline route (marine section) trench within a 250m wide proposed construction corridor; and pipe laying operations cannot be excluded without further analysis and the application of mitigation as necessary. |

## 4.5 Screening Assessment Conclusions

A screening exercise was completed in compliance with the relevant European Commission and national guidelines to determine whether or not LSEs on any European site could be discounted as a result of the construction or operation of the proposed development.

From the findings of the Screening for Appropriate Assessment, it was concluded that the Proposed Project (as described in Section 3):

- Is not directly connected with or necessary to the management of any European site;
- Has the potential to give rise to significant effects on the qualifying interests of seven SACs and twelve SPAs as outlined in Table 4-3; and
- Does not have the potential to affect the remaining SAC and SPA sites identified in the wider study area. These sites have therefore been screened out as discussed in Section 4.3.

Having regard to the methodology employed and the findings of the screening stage exercise, it is concluded that an appropriate assessment of the implications of the Proposed Project on European sites is required, in view of their conservation objectives and in combination with any other relevant plans or projects.

# 5. Scientific Investigations to Support Impact Assessment

The following field surveys, assessments and modelling were undertaken to assess and examine the potential for the proposed project to impact on the conservation objectives.

## 5.1 Field Surveys

### 5.1.1 Estuarine Ornithological Survey

A wetland bird survey was undertaken during 2014/2015, 2015/2016, and 2017 to characterise the ornithological interests of Baldoyle Bay and surrounding areas, particularly with respect to spatial and temporal distribution of key SPA species. Surveys were carried out twice per month between December 2014 and May 2016, and an up to date survey campaign was restarted in 2017 with surveys again being conducted twice per month between March 2017 and May 2017.

Surveys re-commenced in 2020 and a wetland bird survey was undertaken monthly between September 2020 and August 2021. Another overwintering survey campaign commenced in November 2021 and surveys were undertaken monthly until March 2022. Wetland bird surveys were most recently undertaken monthly between October 2022 and June 2023.

The survey methodology was based on the British Trust for Ornithology (BTO) Wetland Bird Survey (WeBS) and Irish WeBS (I-WeBS) methodology as outlined in Gilbert *et al.* (1998) and BTO (2016a and 2016b). The survey method included both high tide and low tide waterbird counts. Surveys were conducted throughout a range of weather conditions and times of the day where good visibility prevailed.

Full details of the methodologies and survey effort employed during these surveys is provided in Appendix C.

#### 5.1.1.1 Results Summary

Appendix C presents the peak monthly counts and the mean of these counts (peak mean) of the estuarine walkover surveys. Table A10.2 of Appendix C contains peak mean data for the Baldoyle Bay SPA species of conservation interest (SCIs) and Table A10.3 contains data for the other named qualifying features.

For bird species that are not qualifying species of the Baldoyle Bay SPA, peak counts by month for the entire estuarine survey programme are presented in Table A10.4 of Appendix C. Table A10.4 ranks these species by peak count.

Figure A10.1 to Figure A10.74C in Appendix C show the distribution of various species of birds across the Baldoyle Bay estuarine survey area recorded during the estuarine walkover surveys, including SCIs of the Baldoyle Bay SPA and other species included on the Natura 2000 data form. The figures are ordered alphabetically. Figures were produced for species that are named on citations of Ireland's Eye SPA, Howth Head Coast SPA or the North-West Irish Sea cSPA, or for other species if more than 10 records of the species were made during the surveys.

##### 5.1.1.1.1 Special Conservation Interests of the Baldoyle Bay Special Protection Area

Light-bellied brent geese were present in peak numbers during the wintering and passage periods, and were generally absent during the breeding season (May to September each year) (refer to Table A10.2 in Appendix C), which is broadly consistent with the findings of the data presented in the 2018 NIS. The peak count was 321 birds (previously recorded peak count of 816 birds in 2018), which did not exceed the 1% national threshold of 350 birds. The drop in peak count could be attributed to avian flu or changes in wintering and migratory patterns. Brent geese were observed across the surveyed section of the SPA and on both the seaward and landward sides of the estuary. Within the SPA, birds were frequently seen in association with wetted channels, where they were observed feeding, loafing and bathing. Birds were observed roosting in the north, west and east of the section of the SPA that was surveyed.

Shelduck were present in the estuarine survey area all year round (refer to Table A10.2 in Appendix C). Peaks in the population size occurred over winter during both the baseline and updated surveys, but birds were also present in reasonable numbers during the breeding season. This suggests a small resident population which is swelled by additional wintering birds. The three-year peak count of 305 birds recorded in the updated surveys exceeds the 1% national threshold of 100 birds, but not the 1% international threshold of 2,500 birds. Previously a peak count of 138 birds was recorded during the baseline surveys. Shelduck were distributed relatively evenly throughout the wetted portion of the SPA covered by the surveys and were infrequently recorded in association with habitats beyond the SPA (refer to Figure A10.64 in Appendix C). They were frequently seen individually or in small groups.

Ringed plover numbers peaked during the autumn passage and winter periods in 2020, and were also regularly recorded during the breeding season in 2021 (refer to Table A10.2 in Appendix C). The peak count of 86 birds recorded during the updated surveys did not exceed the 1% national threshold of 120 birds. Previously a peak count of 204 birds was recorded during the baseline surveys. This species showed a preference for the habitats associated with the eastern side of Baldoyle Bay SPA (refer to Figure A10.57 in Appendix C). As well as being recorded within the SPA, relatively substantial numbers of records were made on the land to the western side of the Portmarnock Golf Course. A handful of records were also made in the Velvet Strand Beach intertidal area to the east of the SPA. These findings are consistent with those presented in the 2018 NIS.

Grey plover were present in peak numbers during the passage periods, and were generally absent during the breeding season (April to August 2021). In the winter, the species was only present in low numbers (refer to Table A10.2 in Appendix C). The peak count of 31 birds recorded during the updated surveys exceeded the 1% national threshold of 30 birds, but not the 1% international threshold of 2,000 birds. Previously a peak count of 487 was recorded during the baseline surveys, which is more than five times higher than the most recent peak. During the updated surveys, grey plover were observed within the estuarine survey area almost exclusively within the Baldoyle Bay SPA (refer to Figure A10.27 in Appendix C). Records were made across the estuary of birds feeding, roosting and loafing.

Golden plover, like grey plover, were present in peak numbers during the wintering and passage periods and were generally absent during the breeding season (April to July 2021). The peak count of 945 birds exceeded the 1% national threshold of 920 birds, but not the 1% international threshold of 9,300 birds. A peak count of 3,061 birds had previously been recorded in the same area during the baseline surveys. There were comparatively few records of golden plover during the estuarine surveys, though when recorded, birds were present in large groups of up to 800 birds (refer to Figure A10.21 in Appendix C). Most observations of this species were made within the Baldoyle Bay SPA boundary, though some groups of birds were recorded in the field to the west. Several groups of roosting birds were recorded towards the north of the estuary.

Bar-tailed godwits were present in peak numbers during the wintering and passage periods each year, and in low numbers during the breeding season. The peak count during the update surveys was 205 birds, exceeding the 1% national threshold of 170 birds, but not the 1% international threshold of 1,500 birds. Previously a peak count of 275 birds was recorded during the 2018 NIS baseline surveys. Bar-tailed godwit records were predominantly located within the intertidal area of Baldoyle Bay SPA (refer to Figure A10.2 in Appendix C). Small numbers of birds were recorded in the intertidal area of Velvet Strand Beach to the east of the SPA. Over two-thirds of records were feeding birds, with roosting on the estuary fringes the next most commonly recorded behaviour. The main roosting locations were areas in the north and north-west of the SPA, with some roosting birds recorded at the western shoreline of the SPA.

##### 5.1.1.1.2 Other Named Qualifying Species of the Baldoyle Bay SPA

The other qualifying species listed in the Natura 2000 data form for the Baldoyle Bay SPA can be grouped into three broad categories of temporal distribution.

1. Species that were absent during the breeding season, with peaks in the population occurring in the winter or passage seasons: great crested grebe, knot, pintail, red-breasted merganser and sanderling.

Great crested grebes were recorded on 15 occasions with a peak count of 25 birds within the Baldoyle Bay SPA during the update surveys, compared to 44 birds recorded during the 2018 NIS baseline surveys. All other records were made in the intertidal area to the east of the SPA at Velvet Strand, where birds were recorded feeding and loafing (refer to Figure A10.24 in Appendix C). The peak count of 25 birds did not exceed the 1% national threshold of 30 birds.

Knot were recorded in moderate numbers during the update surveys and favoured the area of Baldoyle Bay several hundred metres to the south of the microtunnelled section of the proposed outfall pipeline route (marine section), where they were recorded feeding and roosting (Figure A10.34, Appendix C). The peak count of 267 birds exceeded the 1% national threshold of 160 birds, but not the 1% international threshold of 5,300 birds. Only 126 birds had previously been recorded during the 2018 NIS baseline surveys.

Only three records of pintail were made during the estuarine surveys in November and December 2020 and January 2021 (refer to Figure A10.49 in Appendix C), compared to two records during the baseline surveys presented in the original NIS. All three records were within the Baldoyle Bay SPA boundary, just to the south of the proposed microtunnelled section of the proposed outfall pipeline route (marine section). The 1% national threshold of 20 birds was not exceeded.

Red-breasted merganser were observed feeding within the SPA boundary, with the majority of records made in the southern portion of the estuarine survey area (refer to Figure A10.53 in Appendix C). There were greater numbers of records of this species in the sea off Velvet Strand to the east of the Baldoyle Bay SPA, than in the SPA itself. The peak count was 26 birds, which exceeded the 1% national threshold of 25 birds. The 1% international threshold of 800 birds was not exceeded.

Sanderling were recorded frequently during the estuarine surveys, with the majority of records in the south of the SPA (refer to Figure A10.61 in Appendix C). Records for this species were also made in the intertidal area of Velvet Strand to the east of the Baldoyle Bay SPA. The peak count of 76 birds did not exceed the 1% national threshold of 85 birds. A peak count of 50 birds had previously been recorded during the 2018 EIAR baseline surveys.

2. Species that were present in low / very low numbers of non-breeding / early returning birds during the breeding season, with peaks in the population occurring in the winter or passage seasons: black-tailed godwit, dunlin, greenshank, lapwing, redshank, teal and turnstone were present.

Black-tailed godwit were recorded in relatively modest numbers during the estuarine surveys and were located outside of the Baldoyle Bay SPA (refer to Figure A10.5 in Appendix C). The peak count was 250 birds, which exceeded the 1% national threshold of 200 birds. The 1% international threshold of 1,100 birds was not exceeded. A peak count of 166 birds had previously been recorded during the baseline surveys presented in the original NIS.

Dunlin were frequently recorded throughout the Baldoyle Bay SPA (refer to Figure A10.18 in Appendix C). Small numbers of birds were also observed to the west and the south of the SPA and in the intertidal area to the east. The peak count of 1,006 birds was above the 1% national threshold of 460 birds but below the 1% international threshold of 13,300 birds. Around half the number of dunlin were recorded during the baseline surveys presented in the original NIS, with a peak count of 525 birds.

Greenshank were recorded feeding and roosting predominantly in the Baldoyle Bay SPA to the north and south of the microtunnelled section of the proposed outfall pipeline route (marine section) (refer to Figure A10.25 in Appendix C). Records for greenshank were also observed in the fields to the north of the SPA and in the intertidal area to the east and west, whereas no birds were recorded in terrestrial habitats during the baseline surveys presented in the original NIS. The peak count for greenshank was 54 birds, which is above the 1% national threshold of 20 birds, but below the 1% international threshold of 3,300 birds.

Lapwing were recorded in the Baldoyle Bay SPA and terrestrial habitats to the west (refer to Figure A10.35 in Appendix C). Within the SPA close to the mouth of the River Mayne, there were numerous records of this species. Birds recorded in the fields to the north and west of the estuary feeding and roosting. The peak count of 263 birds was lower than the 1% national threshold of 850 birds. A peak count of 534 birds had previously been recorded during the baseline surveys presented in the original NIS.

Redshank were recorded across the estuarine section of the survey utilising numerous areas for feeding, loafing and roosting (refer to Figure A10.54 in Appendix C). Most observations throughout the SPA were associated with river channels or the saltmarsh areas at the fringe of the intertidal flats. To the south of the proposed microtunnelled section of the proposed outfall pipeline route (marine section), records were concentrated to the eastern and western margins of the Baldoyle Bay SPA. Small numbers of records were made in the sea off Velvet Strand and to the south of the SPA. The peak count of 197 birds was lower than the 1% national threshold of 240 birds. A peak count of 294 birds had previously been recorded during the baseline surveys presented in the original NIS.

Teal were most frequently associated with river channels in both the estuary itself, but also upstream (refer to Figure A10.70 in Appendix C). There was a concentration of records within Baldoyle Bay SPA towards the western edge. The peak count of 266 birds was lower than the 1% national threshold of 360 birds. A peak count of 328 birds had previously been recorded during the baseline surveys presented in the original NIS.

Turnstone were recorded infrequently, with records distributed across the Baldoyle Bay SPA section of the estuarine survey area (refer to Figure A10.71 in Appendix C). A small number of records were also made on the intertidal area to the east of the SPA. The peak count of 29 birds was lower than the 1% national threshold of 95 birds. A peak count of 74 birds had previously been recorded during the baseline surveys presented in the original NIS.

3. Species that are present in larger numbers throughout the year, with peaks in the population occurring in the winter or passage seasons: curlew, grey heron, mallard and oystercatcher. There may be small resident populations of these species, which increase in the winter as birds which have spent the breeding seasons elsewhere arrive to Baldoyle Bay.

Curlew were distributed evenly throughout Baldoyle Bay SPA, with birds recorded feeding and roosting across the SPA habitat (refer to Figure A10.16 in Appendix C). There were small numbers of birds recorded in the fields to the west of the SPA, on Portmarnock Golf Course to the east, and in the intertidal area to the east of the SPA. The peak count of 115 birds was lower than the 1% national threshold of 350 birds. A peak count of 164 birds had previously been recorded during the baseline surveys presented in the original NIS.

Grey heron was recorded primarily in association with the River Mayne and other watercourses to the west of Baldoyle Bay SPA. They were also recorded frequently in the north-west corner of Baldoyle Bay SPA (refer to Figure A10.26 in Appendix C), and in modest numbers across Baldoyle Bay SPA itself, particularly on the western and eastern fringes of the SPA. The peak count of 17 birds was lower than the 1% national threshold of 25 birds. A peak count of 15 birds had previously been recorded during the baseline surveys presented in the original NIS.

Mallard were recorded across Baldoyle Bay Estuary and surrounding habitats, with several ‘hotspots’ where numbers of records were much higher (refer to Figure A10.41 in Appendix C). These hotspots were used for feeding and roosting, and were generally located close to the estuary and SPA edges where rivers flow into it. They were also seen regularly on the River Mayne to the west of the SPA. Substantial numbers were recorded on Portmarnock Golf Course to the east of the SPA in association with water bodies. The peak count of 131 birds was lower than the 1% national threshold of 290 birds. A peak count of 185 birds had previously been recorded during the baseline surveys presented in the original NIS.

Oystercatcher were most frequently recorded within the SPA boundary to the south of the microtunnelled section of the proposed outfall pipeline route (marine section) (refer to Figure A10.46 in Appendix C). In addition, birds were recorded frequently on Portmarnock Golf Course feeding and roosting, and also in the intertidal zone to the east of Portmarnock Golf Course and the SPA at Velvet Strand. The peak count of 348 birds was lower than the 1% national threshold of 610 birds. A peak count of 739 birds had previously been recorded during the baseline surveys presented in the original NIS.

#### 5.1.1.1.3 Other Bird Species

Auk species, which are SCIs and / or qualifying species of the North-West Irish Sea cSPA, Ireland's Eye SPA and Howth Head Coast SPA, were recorded in very low numbers within Baldoyle Bay. Birds were recorded during the winter / passage period and the late summer in each year following either failed breeding or fledging (refer to Table A10.4 in Appendix C). The peak count was seven each for common guillemot and black guillemot, and three for razorbill. Records of auks within Baldoyle Bay SPA were very infrequent, with 17 guillemot observations recorded (refer to Figure A10.28 in Appendix C). Black guillemot (refer to Figure A10.3 in Appendix C) and razorbill (refer to Figure A10.52 in Appendix C) were only recorded in the sea off the Velvet Strand Beach within the North-West Irish Sea cSPA. Given that these groups of birds are seabirds and are not primarily associated with estuaries, it is not considered that Baldoyle Bay is a habitat of great importance to auks. This is consistent with the findings presented in the original NIS.

Divers were recorded in relatively low numbers during the wintering and passage periods (September to March in each year) (refer to Table A10.4 in Appendix C). There were single individuals present during the breeding season. The single great northern diver record (refer to Figure A10.74B in Appendix C) and majority of red-throated diver records (refer to Figure A10.55 in Appendix C) were recorded in the sea off Velvet Strand Beach within the North-West Irish Sea cSPA. The peak counts were 11 for red-throated diver (recorded on a single occasion close to the mouth of the River Sluice in the north of Baldoyle Bay SPA) and one great northern diver, and did not exceed the 1% national thresholds for these species (20 and 25 respectively). This is consistent with the findings presented in the 2018 NIS. Given that these species typically inhabit nearshore or more marine environments (other than when at their freshwater breeding grounds), they are not primarily associated with small enclosed estuaries like Baldoyle Bay SPA and so this is not a habitat of significant importance to them.

Dark-bellied brent geese were only observed during passage periods, distributed within and adjacent to the estuary (refer to Figure A10.17 in Appendix C).

Mute swans were present at Baldoyle Bay in low numbers throughout each year 2020 to 2023, suggesting a small resident population. They were recorded in association with river channels (refer to Figure A10.45 in Appendix C), with records more frequent at the mouths of the River Sluice in the north of Baldoyle Bay, and the River Mayne. This is consistent with the findings presented in the original NIS.

Wigeon were regularly recorded in relatively moderate numbers during the winter and passage periods each year. Records were confined to within the Baldoyle Bay SPA boundary (refer to Figure A10.73 in Appendix C). The peak of 247 birds did not exceed the 1% national threshold of 560 birds. The species was largely absent from the estuarine survey area in May, June, July and August (2020 and 2021), but present in more substantial numbers in passage and winter months in each year. A peak count of 257 birds had previously been recorded during the baseline surveys presented in the original NIS.

Of the more infrequently recorded species, eider ducks were recorded on a single occasion in September 2020. Goldeneye, shoveler and common scoter were present slightly more regularly, but only in small numbers with peak counts of two birds respectively. A peak count of 27 pochard was recorded on a single survey in January

2022, however were not recorded on any other survey. Common scoter (an SCI of the North-West Irish Sea cSPA) were recorded in relatively low numbers during the spring and autumn passage periods with a peak count of 30 birds. Coot, moorhen, little grebe and water rail were recorded in low numbers throughout each year between 2020 and 2023, suggesting the presence of small resident populations (refer to Table A10.4 in Appendix C). Coots were only observed in association with freshwater habitats (refer to Figure A10.14 in Appendix C), and little grebes were located predominantly in association with water features on the Portmarnock Golf Course (refer to Figure A10.39 in Appendix C). The distribution of moorhen (refer to Figure A10.44 in Appendix C) and water rail was similar.

Seven species of gull were recorded throughout each year during the updated surveys: black-headed gull (refer to Figure A10.4 in Appendix C), common gull (refer to Figure A10.10 in Appendix C), great black-backed gull (refer to Figure A10.23 in Appendix C), herring gull (refer to Figure A10.29 in Appendix C), kittiwake, lesser black-backed gull (refer to Figure A10.36 in Appendix C) and Mediterranean gull. Of these, black-headed gull, common gull, great black-backed gull, herring gull, kittiwake, and lesser black-backed gull are all SCIs of the North-West Irish Sea cSPA. In addition, herring gull is an SCI of Ireland's Eye SPA, with great black-backed gull a named qualifying species. These commonly encountered gull species were recorded across many habitats found within the estuarine survey area. They are highly adaptable birds and will utilise a range of coastal, inland and offshore habitats. Kittiwake and Mediterranean gulls were very occasional visitors and were recorded in low numbers.

Cormorant (an SCI of Ireland's Eye SPA and the North-West Irish Sea cSPA) and shag (an SCI of the North-West Irish Sea cSPA) were recorded regularly, but in low numbers throughout most of each year between 2020 and 2023, with cormorants being the more commonly encountered of the two species (refer to Table A10.4 in Appendix C). The presence of these species is common in coastal locations. Whilst shags (refer to Figure A10.63 in Appendix C) were recorded only in the sea off Velvet Strand, cormorants (refer to Figure A10.15 in Appendix C) were recorded both off Velvet Strand and in Baldoyle Bay SPA. The 1% national threshold was not exceeded for either species.

Three species of raptor were occasionally observed during the estuarine surveys undertaken between September 2020 and June 2023 (refer to Table A10.4 in Appendix C). Buzzards and kestrels were the most frequent and numerous raptors recorded. Buzzard records were confined to the open fields to the west of Baldoyle Bay SPA, with a small number of individuals flying over the estuary (refer to Figure A10.7 in Appendix C). Kestrels were also observed in similar areas, with a further three records over Portmarnock Golf Course (refer to Figure A10.33 in Appendix C). Three records for peregrine (which is an SCI of Howth Head Coast SPA) were observed over Portmarnock Golf Course in September 2020 and January 2023.

Four species of tern were recorded within Baldoyle Bay SPA during the breeding season (i.e. between March and August each year) (refer to Table A10.4 in Appendix A10.1). Of these, common and Sandwich tern were the most abundant, with Arctic and roseate terns (both SCIs of the North-West Irish Sea cSPA) only recorded in low numbers. It is likely that these were either foraging birds from local breeding colonies or birds on passage. The two most frequently recorded tern species (i.e. common tern (refer to Figure A10.13 in Appendix C) and Sandwich tern (refer to Figure A10.62 in Appendix C), together with Arctic tern (refer to Figure A10.74A in Appendix C) and roseate tern (refer to Figure A10.74C) were recorded almost exclusively off the coast of Velvet Strand in the North-West Irish Sea cSPA. Common tern is a SCI species of the North-West Irish Sea cSPA. Only three records for sandwich tern were made within the Baldoyle Bay SPA.

Four other species of wader were recorded during the surveys: common sandpiper, common snipe, ruff and whimbrel. They were usually recorded in small numbers (<10) (refer to Table A10.4 in Appendix C), with the exception of ruff which recorded a peak count of 36 birds in January 2021 (refer to Figure A10.59 in Appendix C) and whimbrel which recorded a peak count of 29 birds in April 2023 (refer to Figure A10.72 in Appendix C). Records for both species were distributed across Baldoyle Bay SPA with a higher concentration of whimbrel in the north of the SPA. Common snipe were recorded in the north and around the fringes of Baldoyle Bay SPA, and on the fields to the west of the SPA boundary (refer to Figure A10.66 in Appendix C). Common sandpiper was most numerous at the mouth of the River Sluice (refer to Figure A10.11 in Appendix C) in the north of the SPA.

Little egrets were recorded throughout the intertidal area during the update estuarine surveys undertaken between September 2020 and June 2023 (refer to Figure A10.38 in Appendix C). The peak count for this species was 21 birds during June 2023, but smaller numbers were recorded throughout all other years.

A single individual of the following species was seen only once: corn bunting, grasshopper warbler, house sparrow, long-tailed tit, magpie, red-legged partridge and sedge warbler.

Full details of the estuarine baseline survey results are available in Appendix C.

### 5.1.2 Coastal and Marine Vantage Point (VP) Ornithological Surveys

VP surveys were carried out from December 2014, with six hours of surveys carried out monthly per VP to July 2017. Surveys were carried out twice per month between December 2014 to July 2016, and March 2017 to July 2017.

Two VPs were utilised; one on the mainland ("Velvet Strand, VP1" (IO250423, Lat. 53.41631, Long. -6.11966, mean viewing angle 70°)), and one on Ireland's Eye ("Ireland's Eye, VP2" (IO287415, Lat. 53.40792, Long. -6.06387, mean viewing angle 0°). The Velvet Strand VP covered the area of the outfall pipeline corridor out to sea using a 2km viewing arc, and the Ireland's Eye VP covered the remaining outfall pipeline corridor using a 2km viewing arc. In this way, the proposed outfall pipeline and a large buffer was covered by the surveys.

Surveys re-commenced in 2020. Six hours of survey effort per month was carried out from August 2020 to July 2021 and from January to June 2023. A reduced effort was undertaken between October and December 2022 comprising three hours in October, nine hours in November and three hours in December. Surveys were not undertaken at VP2 in February or April 2023 due to poor weather conditions. Survey protocol was designed to count birds on the water (primary focus) and in flight (through snapshot recording).

Surveys were timed to give coverage over a range of tidal states, and to ensure that both spring and neap tides were covered. Key species / species groups for the VP surveys were primarily seabirds which utilise the marine environment for foraging and roosting/loafing and social interaction, particularly during the breeding season when nests are established on cliffs or offshore islands such as the Ireland's Eye SPA.

Full details of the methodologies employed during these surveys, along with a priority species list and detailed records of survey timings is provided in Appendix C.

#### 5.1.2.1 Results Summary

Table A10.6 and Table A10.10 in Appendix C provide information on the bird species of Ireland's Eye SPA and Howth Head Coast SPA recorded during VP surveys for the breeding season (April to August) (refer to Table A10.10 in Appendix C) and wintering season (October to December) across all surveyed years (refer to Table A10.6 in Appendix C), respectively. Presented is the number of observations of each species (i.e. a measure of how often a species was recorded), the total number of each species recorded in flight and on the sea, the peak count of each species recorded in flight and on the sea during a single survey, and an overall peak count (i.e. the maximum number of individuals seen during a single survey). In addition, graphs are presented in Appendix C, to illustrate the numbers recorded over time for each key species.

The distribution of SPA qualifying marine bird species from the Ireland's Eye VP during the breeding season is presented in Figure A10.75 to Figure A10.86 of Appendix C. The figures focus on birds recorded on the water within Ireland's Eye SPA marine waters and the North-West Irish Sea cSPA marine waters. Findings are discussed by species below.

Table A10.7 and Table A10.11 in Appendix C provide information on Baldoyle Bay SPA qualifying species recorded during VP surveys for the breeding season (April to August) (refer to Table A10.11 in Appendix C) and wintering season (October to December) across all surveyed years (refer to Table A10.7 in Appendix C), respectively. Presented is the number of observations of each species (i.e. a measure of how often a species was recorded), the total number of each species recorded in flight and on the sea, the peak count of each species recorded in flight and on the sea during a single survey, and an overall peak count (i.e. the maximum number of individuals seen during a single survey). In addition, graphs are presented in Appendix C which show the timing of occurrence for key species. The graphs have been produced for species where greater than 50 birds were observed on the sea during either the breeding or the wintering season.

Appendix C provides information on non-designated marine bird species recorded during VP surveys for the breeding (April to August 2021) (refer to Table A10.12 in Appendix C) and wintering (October to December 2022) (refer to Table A10.8 and Table A10.9 in Appendix C) seasons, respectively. Presented is the number of observations of each species (i.e. a measure of how often a species was recorded), the total number of each species recorded in flight and on the sea, the peak count of each species recorded in flight and on the sea during a single survey, and an overall peak count (i.e. the maximum number of individuals seen during a single survey). In addition, graphs are presented in Appendix C showing the timing of occurrence for key species. .

Table A10.13 to Table A10.49 in Appendix C provide details on the distribution of birds recorded during VP surveys between August 2020 and June 2023. Records are split by VP, distance from the observer, and the behaviour code assigned to each record.

##### 5.1.2.1.1 Special Conservation Interests of the North-West Irish Sea cSPA, Ireland's Eye SPA and Howth Head Coast SPA

Kittiwake is a SCI at the North-West Irish Sea cSPA, Ireland's Eye SPA and Howth Head Coast SPA. Kittiwakes were observed throughout the breeding and wintering/passage seasons, but in highest numbers in March 2023 (refer to Table A10.6 in Appendix C). The peak single survey count was 783 birds (refer to Table A10.10 in Appendix C). Across all survey years, a substantial decrease in numbers of birds was observed in June (Graph A10.2, Appendix C). Numbers then remained low until around February, before increasing again in March. All of the 2,135 kittiwakes observed on the sea between March and October were recorded from VP2 on Ireland's Eye (Table A10.32, Appendix C). Of these, 1,574 birds (73.7%) were recorded loafing. Records of kittiwakes on the water were distributed more to the northeast of the Ireland's Eye VP viewing arc, and in general, the sectors in which most birds were recorded were situated further away from Ireland's Eye within the marine waters of the North-West Irish Sea cSPA (refer to Figure A10.83 in Appendix C).

During the breeding season, the species that were recorded in the highest numbers were guillemot and razorbill. Both species are SCIs of the North-West Irish Sea cSPA and Ireland's Eye SPA. Peak numbers of both species were observed in May 2023. The peak single survey count was 1,572 for guillemot and 2,626 for razorbill (refer to Table A10.10 in Appendix C). In total, around 80% of birds from both species that were recorded during VP surveys were observed between May and June each year (refer to Graph A10.1 in Appendix C). No observations were noted for either species in February in any year, with numbers remaining low between August and December; and a slight increase in guillemot observations in January (refer to Graph A10.1 in Appendix C). Numbers began to increase in March and April. In addition, substantial numbers of guillemots or razorbills that were not identified to species level were also recorded (refer to Table A10.10 in Appendix C) in May, June and July each year. This is because birds were routinely detected, but identification to species level can be more difficult depending on sea state, lighting conditions or distance (or a combination of these) (refer to Figure A10.81 in Appendix C).

The great majority of guillemots (Table A10.29, Appendix C) and razorbills (Table A10.39, Appendix C) were recorded on sea between March and October from VP2 on Ireland's Eye (6,314 of 6,374 (99.1%) guillemots and 6,403 of 6,477 (98.9%) razorbills). Of these observations, 96.1% of guillemots and 95.5% of razorbills were observed loafing. Feeding behaviour accounted for only 0.03% of guillemots and 0.04% of razorbills recorded on the sea from the Ireland's Eye VP. Both guillemots (refer to Figure A10.80 in Appendix C) and razorbills (refer to Figure A10.85 in Appendix C) were recorded within 500m of the Ireland's Eye VP in the marine waters of Ireland's Eye SPA, but also in relatively large numbers between 500m and 1km away from the VP in the marine waters of the North-West Irish Sea cSPA. The most frequently recorded behaviour of both species were non-feeding (generally loafing) birds most often recorded within 500m of the Ireland's Eye VP.

Herring gulls are an SCI of Ireland's Eye SPA and the North-West Irish Sea cSPA. They were observed throughout the breeding season, with numbers peaking in June (refer to Graph A10.2 in Appendix C), though numbers in January and May were also high. Lower numbers of birds were present in the area for the second half of the year between July and December (refer to Graph A10.2 in Appendix C). The peak single monthly count was 1,693 birds during the breeding season (refer to Table A10.10 in Appendix C), and 1,108 birds in the winter season (refer to Table A10.6 in Appendix C). A greater number of birds on the water were recorded at VP1 between March and October, with majority of birds recorded either feeding or loafing (refer to Table A10.31 in Appendix C). Birds on the water were distributed quite evenly throughout the VP viewing arcs, though the most birds occurred within 0m to 500m of Ireland's Eye. Records on the water from VP2 (Ireland's Eye) were quite heavily restricted to western VP sectors (refer to Figure A10.82 in Appendix C), which is where the majority of nest sites have previously been recorded.

Cormorants are an SCI of the Ireland's Eye SPA and the North-West Irish Sea cSPA and were recorded most frequently during the breeding season (refer to Graph A10.4 in Appendix C). Cormorant records during the breeding season were the most numerous in May, with a single monthly peak of 21 birds (refer to Table A10.10 in Appendix C). The maximum winter peak was 55 birds (refer to Table A10.6 in Appendix C). Between March and October, birds were recorded on the water most frequently in distance bands 3 and 4 for VP1 (Velvet Strand), and 1 and 2 for VP2 (Ireland's Eye) (refer to Table A10.20 in Appendix C). Birds were recorded behaving in a variety of ways (feeding, preening, loafing and roosting) across the entire VP survey area. Birds were observed most frequently between the inshore areas between Ireland's Eye and Velvet Strand in the inshore marine waters of the North-West Irish Sea cSPA (refer to Figure A10.76 in Appendix C).

Great black-backed gull is a SCI species of the North-West Irish Sea cSPA. This species was present for the majority of the year, with a peak in numbers during the winter / passage season observed between October and December 2022 (refer to Graph A10.2 and Table A10.10 in Appendix C). Great black-backed gulls on the water were evenly distributed across most of the sectors in the Ireland's Eye VP viewing arc (refer to Figure A10.79 in Appendix C). Birds on the sea were recorded more frequently loafing in distance bands closer to the VPs (refer to Table A10.25 in Appendix C). Of all birds recorded on the sea, 45.2% were either loafing or roosting.

Fulmar, a SCI species of the North-West Irish Sea cSPA, were observed in relatively small and consistent numbers for much of the year (refer to Graph A10.3 in Appendix C). The breeding season peak was 45 birds in June (refer to Table A10.10 in Appendix C), and the winter peak was 166 birds in January (refer to Table A10.6 in Appendix C). Fulmar observations were quite heavily restricted to the eastern sectors of the VP viewing arc (VP2, Ireland's Eye). Between March and October, most fulmars observed on the water (102 birds, 98.1%) were recorded at VP2 on Ireland's Eye (Table A10.23, Appendix C). Of these observations, 94 birds (92.2%) were recorded either loafing, feeding or roosting.

Shag are a SCI species of the North-West Irish Sea cSPA. This species was recorded most frequently during the breeding season (refer to Graph A10.4 in Appendix C), with a single monthly peak of 45 birds (refer to Table A10.10 in Appendix C) and 104 birds during the winter season (refer to Table A10.6 in Appendix C). Of the 725 birds recorded on the water between March and October of all survey years, 549 birds (75.7%) were seen from VP2. Of these, 220 birds (40.7%) were feeding, most frequently between the shoreline and 1km from the VP in the inshore marine waters of the North-West Irish Sea cSPA and the marine waters of Ireland's Eye SPA. Feeding behaviour was also the most commonly encountered activity for this species from VP1. From VP2, shags showed a preference for inshore waters between Ireland's Eye and Velvet Strand (Figure A10.86, Appendix C).

Gannet (not a SCI but cited on the Natura 2000 form for Ireland's Eye SPA) had a peak single survey count of 379 birds in June (refer to Table A10.10 in Appendix C). Of the 713 gannets recorded on the sea between March and October, 614 birds were observed from VP2 (86.1%) (Table A10.24, Appendix C). Around two-thirds of these birds were recorded either loafing or preening, and 63 birds (10.2%) were recorded plunge diving. Most of these records were located between the shoreline and 1km from the VP in the marine waters of both Ireland's Eye Spa and the North-West Irish Sea cSPA. Gannet observations were almost entirely to the east of Ireland's Eye SPA (refer to Figure A10.78 in Appendix C). In winter, the peak count was 42 birds (refer to Table A10.6 in Appendix C).

Puffin is a species listed as a SCI species of the North-West Irish Sea cSPA. Puffins were only recorded between May and July, with the majority of records in June (refer to Graph A10.6 in Appendix C), with a peak count of 103 birds (refer to Table A10.10 in Appendix C). Puffins were predominantly recorded within 500m of Ireland's Eye in the marine waters of Ireland's Eye SPA (61.6% of records), and in smaller numbers between 500m and 1km from Ireland's Eye in the marine waters of the North-West Irish Sea cSPA (refer to Figure A10.84 in Appendix C). In total, 245 of 268 records on the water (91.4%) were recorded from VP2 (Table A10.38, Appendix C). Of these birds, 240 were recorded loafing or preening (98.0%) and only five feeding.

Black guillemots (not a SCI but cited on the Natura 2000 form for Ireland's Eye SPA) were present throughout much of the year in low numbers (refer to Graph A10.6 in Appendix C). Records were more numerous between March and July. The peak single monthly breeding season count was 14 in May (refer to Table A10.10 in Appendix C), with the corresponding winter count being 34 (refer to Table A10.6 in Appendix C). Black guillemots were most frequently recorded in the western count sectors of the Ireland's Eye VP (refer to Figure A10.75 in Appendix C). They were recorded in similar numbers across both VPs, favouring the more distant areas of the VP1 viewing arc from the VP, and areas of sea within 1km of the Ireland's Eye VP (Table A10.13, Appendix C). The most common behaviour recorded was feeding, accounting for 47.3% of records at VP1 and 64.5% of records at VP2.

Black-headed gulls are a SCI species of the North-West Irish Sea cSPA. They were recorded throughout the year between 2020 and 2023 (refer to Graph A10.12 in Appendix C). The month in which the most gull records were made was October 2022, whilst during the breeding season birds were present in relatively consistent numbers, with August having slightly more records than other months. The peak count was 299 birds (Table A10.6, Appendix C) and 27 during the breeding season (Table A10.10, Appendix C). In total, 549 black-headed gulls were recorded on the water between March and October, of which 547 (99.6%) were observed from VP1 (Table A10.14, Appendix C). Of these, 235 birds (43.0%) were recorded roosting or loafing on water.

Common gulls are a SCI species of the North-West Irish Sea cSPA. They were recorded throughout the year (refer to Graph A10.12 in Appendix C), but in much lower numbers than black-headed gulls. In winter, the peak count was 72 (refer to Table A10.6, in Appendix C) and six birds in the breeding season (Table A10.10, Appendix C). Between March and October, most records of birds on the water (95.5%) were made at VP1 (Table A10.17, Appendix C). Feeding was the most frequently recorded behaviour, followed by roosting and loafing. The most commonly recorded behaviour from VP2 was roosting.

Common scoters were present during the winter months (refer to Table A10.6 in Appendix C) with a peak count of 151 birds in November 2022. Common scoter were completely absent between April and August and present in relatively low numbers during other months (refer to Graph A10.14 in Appendix C). Of the 95 common scoters recorded on the water during VP surveys between March and October, 77 (81.2%) were recorded loafing, whilst 13 birds (13.7%) were recorded feeding (Table A10.18, Appendix C). Records were the most numerous in bands and sectors away from coastlines and in open water.

Lesser black-backed gulls are a SCI species of the North-West Irish Sea cSPA. They were similar to common gulls, in their temporal distribution and observed during the VP surveys only in low numbers (refer to Graph A10.12 in Appendix C). As with common gull, the wintering/passage season saw the highest number of individuals recorded, with a peak of 11 (Table A10.6, Appendix C). In the breeding season, the peak was seven (Table A10.10, Appendix C). Spatial distribution of records on the sea between March and October was quite equal over the entire VP survey area, though numbers recorded from VP1 were greater (Table A10.34, Appendix C). Overall numbers were low, and the majority of birds were recorded roosting or loafing.

Red-throated divers are a SCI species of the North-West Irish Sea cSPA. They were present throughout the winter and passage periods, being present between August to April (refer to Graph A10.13 in Appendix C). Between May and July, birds were absent. The peak survey count was 62 birds in November (Table A10.6, Appendix C) and two birds in the breeding season (Table A10.10, Appendix C). Birds observed on the water were predominantly recorded from VP1, with 195 of 262 birds (74.4%) (Table A10.42, Appendix C). Most records were located in distance bands 3 and 4 from both VPs (i.e between 1km and 2km from the VP in the marine waters of the North-West Irish Sea cSPA), with the most common behaviours being feeding and loafing.

Great northern divers are a SCI species of the North-West Irish Sea cSPA. They were recorded in small numbers (Graph A10.13, Appendix C) during the winter period, with a peak count of two birds (Table A10.6, Appendix C). All of the 11 birds recorded during the VP surveys were recorded in distance bands 3 and 4 (i.e between 1km and 2km from the VP in the marine waters of the North-West Irish Sea cSPA) (Table A10.28, Appendix C).

Common tern, Arctic tern and roseate tern are SCI species of the North-West Irish Sea cSPA. Several tern species were relatively abundant in the marine environment during the breeding season (Graph A10.15, Appendix ). The most commonly occurring species was common tern. The peak count was 122 birds recorded during the breeding season (Table A10.10, Appendix C), of which 79.2% were recorded on the sea. The majority of common tern observations (97.9%) were recorded from VP1. Birds were most frequently seen plunge diving in distance band 4 (1.5km-2.0km from the VP in the marine waters of the North-West Irish Sea cSPA). Common terns were less likely to be observed within 500m of VPs compared with the rest of the VPs. The next most commonly recorded tern was a roseate tern which was recorded plunge feeding on a small number of occasions from both VPs (Table A10.10, Appendix C). Roseate terns were only recorded in May and June (Graph A10.15, Appendix C). Arctic terns were only recorded in very low numbers, off the Velvet Strand, with peaks of 3 birds in June and July (Table A10.4, Appendix C).

Manx shearwater is a SCI species of the North-West Irish Sea cSPA. This species was recorded in low numbers during June and September only (Graph A10.16, Appendix C). The peak count was nine birds in June (Table A10.10, Appendix C), all of which were recorded as either flying or plunge feeding in distance bands 3 and 4 (i.e. 1.5km-2.0km from the VP in the marine waters of the North-West Irish Sea cSPA).

Although not a marine species, peregrine is a SCI species of Ireland's Eye SPA and Howth Head Coast SPA. Birds were observed in very low numbers throughout the year (refer to Graph A10.7 in Appendix C). The peak single monthly count was two birds during April 2021 (refer to Table A10.10 in Appendix C), and three during the wintering period (refer to Table A10.6 in Appendix C).

#### 5.1.2.2 Other Bird Species

Great-crested grebes were regularly recorded in the marine environment between October and March (refer to Graph A10.8 in Appendix C). The peak single survey count was 1,648 birds in December 2022 (refer to Table A10.7 in Appendix C). In general, numbers of this species recorded were much lower than the occasional peaks that were observed. Birds recorded from the VP were located mainly within distance bands 3 and 4 for both VPs (3,654 of 4,286, 85.2%) (Table A10.26, Appendix C). Of these, 2,477 (67.8%) were recorded either feeding or loafing between 1.5km and 2km of the VPs. Much lower peaks (255 birds) were recorded during the baseline surveys for the original NIS.

Oystercatchers were present in fairly consistent numbers during the VP surveys for the majority of the year (refer to Graph A10.8 in Appendix C), and the most frequently recorded species of the Baldoyle Bay SPA citation during VP surveys (refer to Tables A10.7 and A10.11 in Appendix C). The peak single survey count was 4,139 birds during the winter 2022 (refer to Table A10.7 in Appendix C), and 945 birds during the breeding season (refer to Table A10.11 in Appendix C). Peak counts of 210 and 145 birds were recorded during the baseline surveys for the original NIS. Most commonly, birds were recorded within 500m of both VPs (refer to Table A10.32 in Appendix C).

Both sanderlings and dunlin were recorded in the marine environment between September and April (Graph A10.9, Appendix C). All observations of both species were made from VP1. The peak single monthly count was 65 birds for sanderling (Table A10.7, Appendix C) and 85 birds for dunlin (Table A10.22, Appendix C), with birds most frequently recorded in distance bands 3 and 4 (Table A10.45 and A10.22, Appendix C).

Red-breasted mergansers were present in the marine environment in low numbers throughout much of the year (Graph A10.9, Appendix C). Peak numbers were recorded in November, with much lower numbers recorded during the breeding season. The peak single survey count was 32 birds (Table A10.7, Appendix C), and two birds during the breeding season (Table A10.11, Appendix C). Of the 54 birds recorded between March and October during VP surveys, 50 were from VP1 (Table A10.41, Appendix C). Birds were most frequently recorded feeding in distance band 2.

The temporal pattern of turnstone presence in the marine environment was relatively similar to dunlin and red-breasted merganser, but with lower overall abundance and a more obvious absence during most of the breeding season (Graph A10.10, Appendix C). The peak single survey count was 43 birds during the winter (Table A10.7, Appendix C), and 17 birds during the breeding season (Table A10.11, Appendix C). All 64 birds recorded between March and October were from VP1 (Table A10.49, Appendix C).

Ringed plover were recorded throughout the majority of the year, with a peak single count of 31 birds (Table A10.11, Appendix C). Ringed plovers were only recorded from VP1 with 73 out of 107 observations (68.2%) made within distance band 4.

Sandwich tern, which was recorded between March and September across all survey years, was recorded on the water, with 114 records between March and October in all survey years (Table A10.46, Appendix C). The highest numbers were recorded in September (peak count of 40; Table A10.8, Appendix A10.1). Sandwich terns were evenly distributed throughout the viewing arcs of both VPs, though the highest number of birds occurred in distance band 4 of both VPs.

Additional birds listed in Table A10.7 and Table A10.11 of Appendix C can be grouped into the following broad category of temporal distribution in the area covered by the marine VP surveys:

- Species that were recorded in the wintering and breeding periods in the marine environment, in low or very low numbers, or predominantly in flight: brent goose, curlew, grey heron, redshank and shelduck;
- Species that were not recorded in the marine environment: golden plover, grey plover, greenshank, knot, pintail and teal;
- Species that were recorded in the wintering period only in the marine environment, in low or very low numbers, or predominantly in flight: hooded crow, linnet, meadow pipit, purple sandpiper, black-throated diver, wren, eider, little grebe and buzzard; and
- Species that were recorded in the breeding period only in the marine environment, in low or very low numbers, or predominantly in flight: blackcap, greenfinch, sand martin, Canada goose, whimbrel and lapwing.

Full details of the results are available in Appendix C.

#### 5.1.3 Boat-based Assessment of Auk Fledging

Ireland's Eye hosts breeding auk species, namely 4,410 guillemot (individuals) and 1,600 razorbill (individuals) (Cummins *et al.* 2019 citing 1999-2015 data). When fledging, chicks and one or both parents tend to depart nests and disperse from breeding colonies to offshore areas to moult, and avoid predation of chicks by other seabirds. This can result in a situation where many birds are in the water at once, where they could potentially be susceptible to disturbance or displacement. The aim of the surveys was therefore to supplement VP information on the use of waters surrounding Ireland's Eye by auks during this leaving event, specifically to check whether adults or fledged birds remained in the area or if they dispersed relatively rapidly.

Surveys were conducted in July 2016 and July 2017 and consisted of a single surveyor on a boat travelling round Ireland's Eye and noting numbers of auk chicks in nests on the cliffs, and any birds in the water. Visits occurred approximately twice weekly and were supplemented by additional observations from the boatman, who was present in the area almost daily. Given the findings of the two years of data, and the previous and up-dated VP survey results [July 2021], it was not considered necessary to repeat the boat-based surveys in light of the original findings and the comparable findings on auk distribution from the VP surveys.

#### 5.1.3.1 Results Summary

Boat-based surveys in July of 2016 and 2017 revealed that fledged chicks were present on cliffs and not in the water until mid-July. At this point, numbers of guillemots and razorbills on nests on the cliffs rapidly declined; however, no rafts of fledged chicks (or adults) were observed on the water around Ireland's Eye at any time. By the final week of July, the majority of guillemots and razorbills had left the area without massing of large numbers of birds in the water being recorded. Survey observations suggest that rather than spending time on the water around the island, guillemots and razorbills leave the nest only when they intend to leave the area,and then leave in small groups. Based on the lack of movements of large rafts of birds recorded it is possible that some movements may occur at night.

### 5.1.4 Baldoyle Estuary Walkover

This survey was undertaken to support the earlier coastal and intertidal habitat mapping carried out by Ecoserve in 2005, and a more detailed assessment undertaken for the NPWS on the saltmarsh community in Baldoyle estuary SAC (site code 00199) in 2006 (Mc Corry and Ryle 2009). The site was visited on 13th November 2013 by a Benthic Solutions Limited (BSL) botanist, and the habitat mapping prepared by Mc Corry and Ryle (2009) reviewed in the field in relation to the current conditions at the site and the proposed Outfall Pipeline. Geographic Information Systems (GIS) shapefiles, prepared by Mc Corry and Ryle (2009), were loaded onto electronic media and underlain by aerial photographs (Google Maps) to allow for an accurate assessment in the field of the extent of habitat types as previously described and mapped and to document any changes.

On 14th November 2022, a walkover survey of the estuarine section of the Proposed Project was undertaken during daylight hours. The aim of the survey was to identify any changes to the distribution or description of the habitats within and immediately adjacent to the Proposed Project boundary since the original surveys associated with Chapter 9 (Biodiversity (Marine)) in Volume 3 Part A of the EIAR in the 2018 planning application. The mapping and description of the habitats was completed with reference to A Guide to Habitats in Ireland (hereafter referred to Fossitt, 2000) (Heritage Council, 2000); consistent with the habitat classification system used in Chapter 9 (Biodiversity (Marine)) in Volume 3 Part A of the EIAR in the 2018 planning application. The results of the survey were digitally mapped in Geographical Information System (GIS). The weather conditions during the survey were mild (c.10-15°C (degrees Celsius)) and mostly dry with occasional showers.

#### 5.1.4.1 Results Summary

In the original 2018 NIS, the habitat map showing the distribution and extent of Annex I habitats produced by Mc Corry and Ryle and deemed to be of favourable conservation status, was reviewed, visited and confirmed in 2013 and the habitat mapping and descriptions presented below on Figure 5-1.

The Outfall Pipeline will be tunnelled underneath Baldoyle Bay SAC. The tunnelled section will cross under an area of the estuary near the public car park related to the Portmarnock beach and dune system/entrance to Portmarnock Golf Club. At this side of the estuary the tunnelled section will cross under a grassy embankment adjoining the public road, which is mown and maintained by FCC. It then reaches under a band of a mosaic of Atlantic salt-meadow (ASM) and Mediterranean salt-meadow (MSM) 20 to 30m wide in places. To the north of the proposed Outfall Pipeline is an area of Atlantic salt-meadow (ASM). These areas grade into extensive swards of *Spartina,* which extend towards the centre of the estuary where they become broken up forming a mosaic of clumps of *Spartina* and mudflats.

At the upper extent of the saltmarsh the vegetation is dominated by Creeping Bent Grass (*Agrostis stolonifera*), with occasional Sea Beet (*Beta maritima*), Sea Rush (*Juncus maritimus*), Red Fescue (*Festuca rubra*), Sea Purslane (*Halimione portulacoides*), Common Scurvy Grass (*Cochlearia officinalis*) and Sea Pink (*Armeria maritima*).

These grade into an area of middle marsh with occasional pans and creeks which are dominated by Sea Pink, Sea Plantain (*Plantago maritima*), Lax-flowered Sea Lavender (*Limonium humile*) and Sea Aster (*Aster tripolium*) with occasional stands of Saltmeadow Rush (*Juncus gerardii*) and Sea Rush, whilst areas with higher inundation of the tide (lower marsh) contain Sea Arrow Grass (*Triglochin maritima*), Common Scurvy Grass and Sea Purslane. This then grades into areas of dense stands of Common Cord-grass (*Spartina anglica*) which dominate the mudflats and creeks with occasional Enteromorpha.

North of the main crossing point for the Outfall Pipeline is an area with better defined pans and creeks that more closely approximates pure Atlantic Salt Meadows and a stand of Common Reed (*Phragmites australis*) is present near where the road turns back to the west.

The band of saltmarsh vegetation tapers off to the south towards the Mayne River and occasional sparse patches of Sea Aster, Common Scurvy Grass, Glasswort (*Salicornia sp*.) and Common Cord-grass are present on the open muds. Backing this is a stone wall with scattered Sea Aster, Lax-flowered Sea Lavender, Sea Arrowgrass and Sea Beet.

The central part of the estuary, including the entrance to the Bay the and the intertidal zone along Velvet Strand, are consistent with the Mudflats and sandflats not covered by seawater at low tide (1140), with a grading of sediments from a sandy silt within the main part of the bay to a slightly silty sand in the entrance and sand along the foreshore along the eastern shore of the Portmarnock peninsula and along Velvet Strand.

The habitats at Baldoyle Estuary do not appear to have undergone any significant changes in quality or extent at the proposed location of the outfall since the 2006 surveys conducted by NPWS. The boundaries of the Annex I habitats as mapped by Mc Corry and Ryle have not changed significantly since that time and the vegetation composition at the proposed marine route appears to have remained broadly similar.

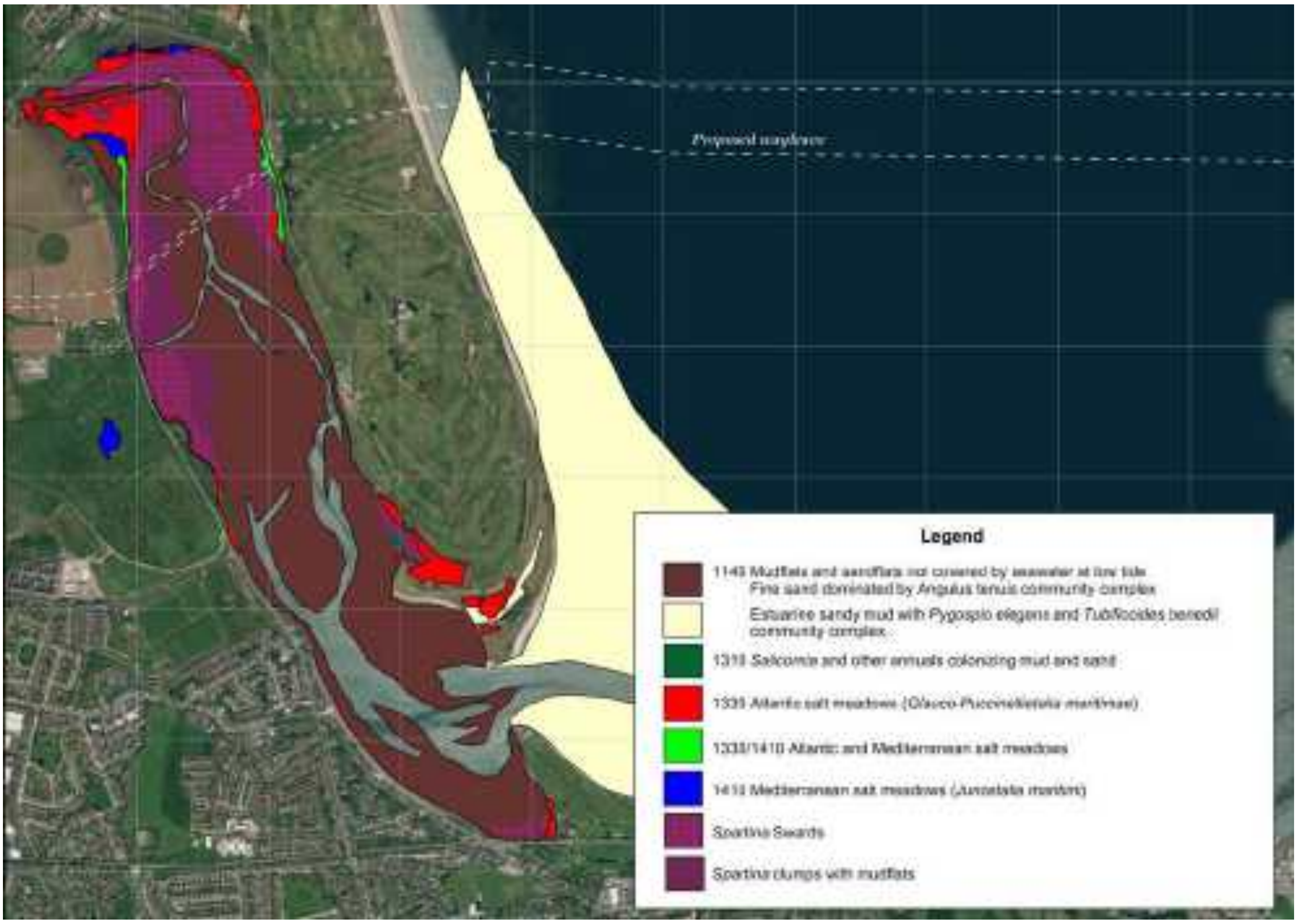



**Figure 5-1: Habitat Map of the Annex I Habitats of Baldoyle Estuary prepared by Mc Corry and Ryle (2009).**

The proposed pipeline route crosses beneath the estuary and adjacent coastline eastern coastline (including the Velvet Strand) and therefore avoids direct impact with the designated habitats of mudflats and sandflats not covered by seawater at low tide (1140), bordered by mixed Atlantic and Mediterranean salt meadows (1330/1140) on the eastern and western margins of the marine section.

Overall, the habitats at Baldoyle Estuary do not appear to have undergone any significant changes in quality or extent at the proposed location of the outfall since the 2006 surveys conducted by NPWS. The boundaries of the Annex I habitats as mapped by Mc Corry and Ryle have not changed significantly since that time and the vegetation composition at the proposed marine route appears to have remained broadly similar. The proposed pipeline route crosses beneath the estuary designated as mudflats and sandflats not covered by seawater at low tide (1140), but bordered by mixed Atlantic and mediterranean salt meadows (1330/1140) on the eastern and western margins of the marine section.

Following the updated survey in Autumn 2022, the following observations were made in relation to estuarine habitats of Baldoyle Estuary. This section should be read with reference to Figure 5-2 Habitat Map of the Fossitt Habitats of Baldoyle Estuary, Figure 5-3 Habitat Map of Annex I habitats of Baldoyle Estuary and review notes from 2013 revisit survey (Taken from the original 2018 NIS).

**North of Proposed Outfall Pipeline Route – Eastern Side**

The previous survey as presented above from the original 2018 NIS described a similar habitat to that surveyed in the 2022 survey; with the upper vegetation dominated by Spartina swards, creeping bent grass (Agrostis stolonifera), sea beet (Beta vulgaris), rushes (Juncus sp.), sea aster (Aster tripolium) and sea purslane (Halimione portulacoides).

The previous study reported a wider extent of Atlantic salt meadow directly above the outfall pipeline route, which in the 2022 survey was dominated by Spartina swards and only extended into Atlantic salt meadow at the uppermost section of the marsh. Overall, the extent of Mediterranean salt meadow remained broadly unchanged since the previous survey. Some of the species recorded in the previous survey, such as common scurvy grass (Cochlearia officinalis) and sea pink (Armeria maritima) were not encountered in the 2022 survey.

**South of Proposed Outfall Pipeline Route – Eastern Side**

The previous survey reported a similar extent of Spartina swards along the western side of the golf course to that recorded in the 2022 survey, however, there were patches of Mediterranean and Atlantic salt meadows Annex I habitat south of Portmarnock golf course which were not noted in the 2022 survey. In the 2022 survey, this area was identified as a broadly Marram grass dune habitat. A distinct cluster of sea buckthorn (Hippophae rhamnoidesi), associated with Dune Scrub and Woodland habitat (CD4) was observed to the south of the golf course in 2022, which was not previously recorded in the previous survey.

**North of Proposed Outfall Pipeline Route – Western Side**

Overall, in 2022, the western section of the proposed outfall pipeline route was similar to the previous survey. The scrub vegetation, and mosaic of Mediterranean and Atlantic salt meadow marsh was also documented, although this represented a smaller area in the 2022 survey.

The previous survey recorded species such as bush vetch (Vicia sepium), common comfrey (Symphytum officinale), tall fescue (Festuca aruninacea), common scurvy grass (Cochlearia officinalis) and glasswort (Salicornia sp.), which were not encountered in the 2022 survey.

**South of Proposed Outfall Pipeline Route – Western Side**

The previous study documented Spartina swards at the lowermost sections of estuary, however, the extent of this habitat was greater in the 2022 survey. The previous study reports an Annex I Atlantic salt meadow habitat, which was not identified in the 2022 study. There was no mention of Marram grass dune habitat in the previous study.

In 2022, the Sand shore (LS2) and Mud shore (LS4) habitats occupied a similar extent to that described in the previous survey. The previous survey in 2013 excluded sections of the mudflats within the centre of the estuary which were likely covered by channels of seawater at the time of the survey. In the 2022 survey, due to tidal conditions and health and safety constraints, this area in the centre of the estuary was not surveyed, however, based on previous survey results and desktop review using aerial photography, it was mapped as LS4 Mud shore.


**Figure 5-2: Habitat Map of the Fossitt Habitats of Baldoyle Estuary (Based on 2022 Update Survey).**


**Figure 5-3: Habitat Map of the Annex I habitats of Baldoyle Estuary (Based on 2022 Update Survey).**

### 5.1.5 Surveys for Reefs (1170) on Ireland's Eye - Rockabill to Dalkey Island SAC

The Rockabill to Dalkey Island SAC (site code 3000) was established in April 2013 and designated for the marine Annex I qualifying interest Reefs and the Annex II species harbour porpoise (*Phocoena phocoena*). As the proposed Outfall Pipeline (including the proposed marine diffuser) is located within this SAC, additional surveys were carried out to cover both qualifying interests.

i. Within the Rockabill to Dalkey Island SAC, two community types are recorded within the Annex I habitat, namely intertidal reef community complex and subtidal reef community complex (Reefs 1170). Intertidal and subtidal surveys were undertaken in 2010 and 2011 (MERC 2010; 2012a; 2012b). These data were used to determine the physical and biological nature of the Annex I habitat. The area and quality of these qualifying features were based on broad interpolations from only limited drop-down video. Therefore, two additional survey campaigns were carried out to establish a greater understanding of these features within the vicinity of the proposed Outfall Pipeline. The surveys were undertaken in two phases. The initial phase of the investigation was based on a detailed video inspection of features identified in the bathymetry by BSL in May 2015 (BSL 2015a). During this survey additional bathymetry was carried out using a precision echo sounder to infill deficiencies in existing data close to the island's cliffs and rock outcrops. Detailed photography was also carried out using a high resolution camera on 9 drop-down video locations taken along the subtidal reefs around the island and at the proposed Outfall Pipeline. The results of this survey were used to identify key areas for the second phase of operations using an intertidal walk-over (three sites) and detailed subtidal transects using scientific divers (four sites) and presented in Figure **5-5**. This later phase was carried out by BSL and Aquatic Survey and Monitoring Limited in July 2015. Details of the survey are supplied in the Appendix D.

In January 2023, camera transects were carried out along the proposed outfall pipeline route (marine section), along sublittoral reef transects surrounding Ireland's Eye and at a historic environmental sampling station between Ireland's Eye and Howth harbour in which maerl was previously found to be present. Actual sampling locations are presented in Figure 5-4.

The aim of these surveys was to update our understanding of these dynamic environments and identify any material changes to the distribution or description of the habitats within close vicinity of the Proposed Outfall Route (marine section) or proposed diffuser location. The survey was consistent with previous surveys carried out at the site using drop-down camera equipment, however, an additional 'freshwater lens' adaptation was required to allow for the high turbidity in the waters in the region and during the winter months. The weather conditions during the survey were marginal with slight to moderate seas of around 1m wave height.

Seabed video footage and stills were acquired along predetermined transects in line with survey requirements. A total of six camera transects were carried out using both the BSL MOD4.0 and Kongsberg 408 camera systems. One transect was positioned along the length of the proposed outfall pipeline route (marine section), with a further four transects positioned around Ireland's Eye and one between Ireland's Eye and Howth harbour (~400m NNE Howth harbour).

Video footage and stills were acquired along the proposed outfall pipeline route using a MOD4.0 camera system mounted within a BSL 'freshwater lens' drop-down frame, equipped with separate strobes and LED lamps. Footage and stills from the transects surrounding and immediately south of Ireland's Eye were acquired using a Kongsberg 14-408 underwater camera system also mounted within a 'freshwater lens' drop-down frame equipped with separate LED lamps. Once at the seabed, the camera was moved along the length of the transect at an approximate speed of 0.8 knots. Still photographs were captured remotely using a surface control unit via a towed umbilical cable. The stills were uploaded in real-time and saved to the camera and a laptop via specialist software. Live video footage, overlaid with the date, time, position and site details were viewed in real-time; however, due to technical issues, no overlay was displayed on the footage acquired using the Kongsberg 14-408 camera system. The live video stream was used to assist with targeting of the stills camera and to facilitate a habitat assessment. Footage was saved internally by the video camera and data was downloaded after approximately six hours of camera operations and backed-up onto a hard drive.

In addition to the above video assessment, a further detailed sublittoral habitat survey was carried out on the 31 March and the 1 April 2023 at the four sublittoral sites originally assessed in the 2018 planning application. These were similarly undertaken using a scientific SCUBA diving protocol by the same scientists that carried out the original surveys (MERC assisted by ASML). The results of this survey have been combined and interpreted with those of the original assessment, updated to current habitat nomenclature and are presented in Appendix A9.2 in Volume 3A Part B of the EIAR Addendum.

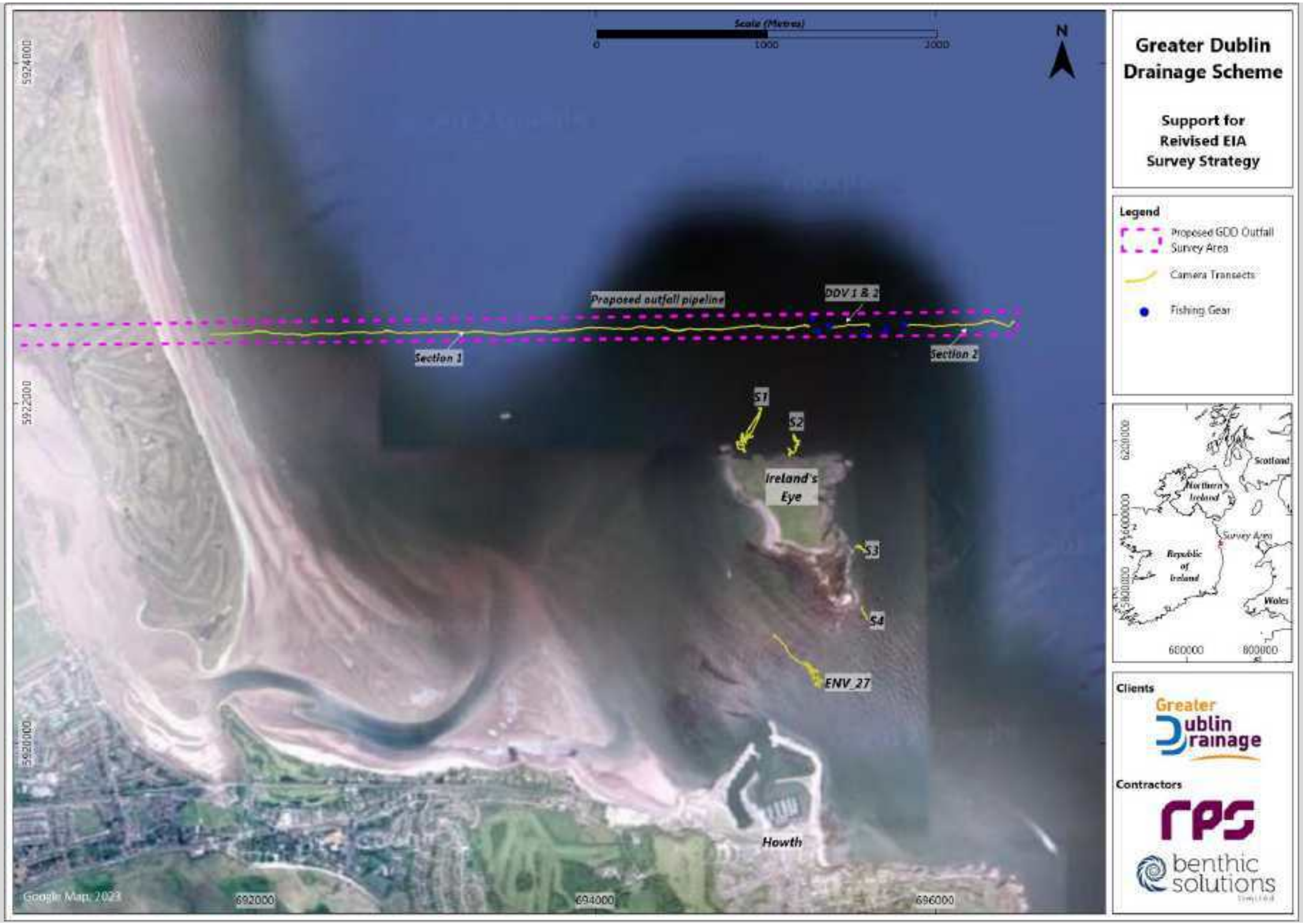



**Figure 5-4: Benthic Sampling Strategy Overview.**

A total of six camera transects were conducted over the survey area (one along the proposed outfall pipeline route, four surrounding Ireland's Eye and one between Ireland's Eye and Howth harbour). Due to the presence of fishing gear over the proposed outfall pipeline transect approximately 1km to the west of the proposed diffuser location, a continuous transect was not achievable. Consequently, the transect was therefore split into two sections running from the shore up to the fishing gear (west to east, Section 1) and from the diffuser location to the fishing gear (east to west, Section 2) with two further drop-down video (DVV) deployments undertaken within the area between the fishing gear to achieve as much coverage as possible (Figure 5-4).

#### 5.1.5.1 Results Summary

**Intertidal Reef Community Complex Surveys**

This reef community complex is recorded on the eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and Marine Diffuser location. The exposure regime of the complex ranges from exposed to moderately exposed reef for Ireland's Eye. The substrate here is that of flat and sloping bedrock, cobbles and boulders. Vertical cliff faces are found on the north and northeast shores of the island.

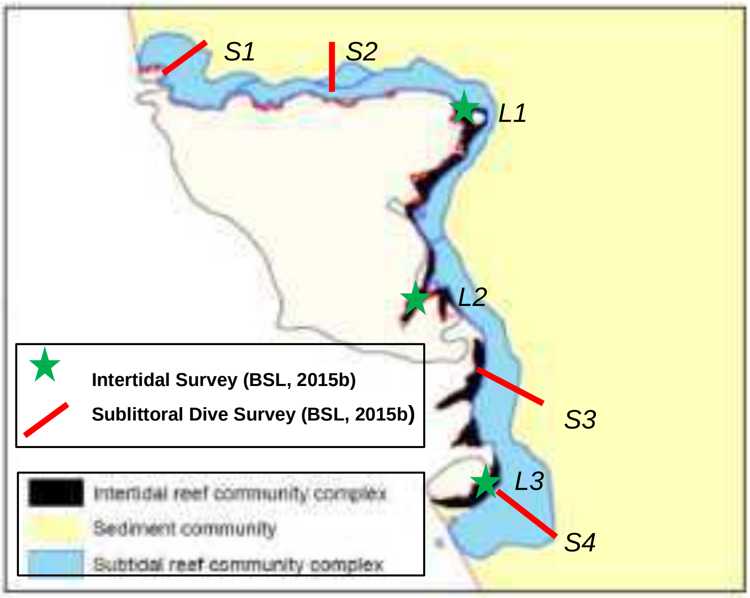



**Figure 5-5: Ireland Eye Marine Community Types designated by Rockabill to Dalkey Island SAC**

A detailed walkover survey was carried out in 2015 at three locations (see Figure **5-5**) along the eastern edge of the Island, relating to the northern, central and southern extreme of the eastern shoreline (BSL 2015b). Survey operations were conducted in June/July. Sites were selected from aerial photography to present different exposures and the vertical profiles completed along all of the lower, middle and upper shorelines at these locations. Details of the survey are supplied in the Appendix D.

**Table 5-1: Ireland Eye Marine Community Types designated by Rockabill to Dalkey Island SAC and locations of detailed Intertidal and Subtidal Surveys (BSL, 2015b).**

| | L1 | L2 | L3 |
|---|---|---|---|
| **General Description** | Gully sheltered by northeast stack. Typical exposed shore to wave action amplified by the effect of surge through the gully. Shading with reduced algal component. | Sheltered inlet protected from wave action. | Southeast tip of the island partially separated from the main island by a connecting intertidal reef |
| **Zone (i) supralittoral** | Nitrate enriched LR.FLR.Lic.Pra | A typical lichen zone dominated by the nitrophilous yellow lichen *Xanthoria parietina* and the green algae *Pasiola stipitata* LR.FLR.Lic.Pra | nitrate enriched LR.FLR.Lic.Pra *Prasiola stipitata* |
| **Zone (ii) Upper shore** | LR.HLR.MusB | Limpets, barnacles and littorinids found amongst the algae Spiral wrack and channel wrack mixed to form an LR.MLR.BF.FspiB | Limpets, and *Semibalanus balanoides* barnacles. LR.HLR.MusB |
| **Zone (iii) Middle upper shore (barnacle zone)** | Barnacles LR.HLR.MusB.Cht | *Ascophyllum nodosum* and *Fucus vesiculosus* LR.LLR.F.Asc.FS | Patchy canopy of the bladderless 'Bladder wrack' *Fucus evesiculosus*. LR.HLR.MusB.Cht |
| **Zone (iv) upper middle shore** | faunally dominated LR.HLR.MusB.Sem | Typical *Fucus serratus* and red seaweeds LR.MLR.BF.Fser.R | Faunally dominated LR.HLR.MusB.Sem |
| **Zone (v) lower middle shore** | LR.HLR.FR.Mas | | *Laminaria hyperborea* forest (with occasional *L. hyperborea*) with frequent patches of red algae dominated by coralline crusts. *Fucus serratus*, *Osmundea pinnatifida* and *Mastocarpus stellatus* LR.HLR.FR.Mas (v) |
| **Zone (iv) Lower shore** | Algae dominated LR.HLR.FR.Coff/IR.MIR.KR.Ldi g | Algae dominated LR.HLR.FR.Coff/IR.MIR.KR.Ldig | Algae dominated LR.HLR.FR.Coff/IR.MIR.KR.Ldig |

This survey has collected semi-quantitative data from two moderately exposed littoral stations (L1 and L3) and a sheltered station (L2). L1 was slightly modified by shading, wave surge and nitrogenous enrichment and the L3 upper shore biotope was similarly enriched by roosting seabirds. In the littoral zone, the biotopes '*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock/*Laminaria digitata* on moderately exposed sublittoral fringe rock (LR.HLR.FR.Coff/ IR.MIR.KR.Ldig) usually emerged from the sublittoral, followed by a zone covered by seaweeds to a faunally dominated shore consisting of limpets, barnacles and littorinids. The littoral zone was separated into vertical zones up the shoreline, with six bands recorded at L1 and L3 (exposed shorelines) and five at L2 (within a sheltered gulley). Whilst slight community variations were recorded within the communities relating to site exposure of three different transects L1 to L3, all indicated a well-defined biological zonation. The supralittoral upper zone was dominated by the green algae *Pasiola stipitata* (LR.FLR.Lic.Pra complex) with all areas typically showing lichen and/or being nitrate rich from seabird activity. A further 5 zones were recorded with the upper and middle shores dominated by limpets, and barnacles *Semibalanus balanoides* (LR.HLR.MusB) along with brown algaes (littorinids and wracks), giving way to *Ascophyllum nodosum* and the fucoids *Fucus vesiculosus* *F.evesiculosus*a and *F.serratus* along with red seaweeds. The communities became faunally dominated in the upper middle shore with the LR.HLR.MusB.Sem complex. Lower middle shores showed occasional *Laminaria hyperborea* forest with frequent patches of red algae dominated by coralline crusts. *F.serratus*, *Osmundea pinnatifida* and *Mastocarpus stellatus* (LR.HLR.FR.Mas complex). The lower shore was algae dominated by LR.HLR.FR.Coff/IR.MIR.KR.Ldig

Overall, intertidal habitat indicated faunal populations that were well represented and moderately diverse habitats containing many of the common species found along the Irish Sea coastline.

Table 5-2: Summary of Intertidal Reef Community Complex (L3, BSL, 2015b)

| Littoral Zonation | Example image |
|---|---|
| **Southeast tip of the island partially separated from the main island by a connecting intertidal reef** | |
| **Zone (i) Supralittoral Upper shore**<br><br>**LR.FLR.Lic.Pra**<br>*Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock. |  |
| **Zone (ii) Eulittoral Upper shore**<br><br>**LR.HLR.MusB**<br>Mussel and/or barnacle communities. |  |
| **Zone (iii) Eulittoral Middle upper shore (barnacle zone)**<br><br>**LR.HLR.MusB.Cht**<br>*Chthamalus* spp. on exposed upper eulittoral rock.<br>Patchy canopy of the bladderless 'Bladder wrack' *Fucus evesiculosus*. |  |
| **Zone (iv) Eulittoral Upper middle shore**<br><br>**LR.HLR.MusB.Sem**<br>*Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock<br>Faunally dominated. |  |
| **Zone (v) Eulittoral lower shore**<br><br>**LR.HLR.FR.Mas**<br>*Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock<br>. *Fucus serratus*, *Osmundea pinnatifida* and *Mastocarpus stellatus* |  |
| **Zone (iv) Sublittoral fringe**<br><br>**LR.HLR.FR.Coff/IR.MIR.KR.Ldig**<br>*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock/<br>*Laminaria digitata* on moderately exposed sublittoral fringe bedrock<br><br>Algae dominated *Laminaria digitator* forest (with occasional *L. hyperborea*) with frequent patches of red algae dominated by coralline crusts |  |

Subtidal Reef Community Complex Surveys

This reef community complex is recorded off the northern, eastern and southern shores of Ireland’s Eye immediately south of the proposed outfall route and Marine Diffuser location. The substrate ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland’s Eye, whilst the northern reaches of the island show both sediment scouring and a thin veneer of silt covering the reef. In general, previous surveys (MERC 2010,MERC 2012a and MERC, 2012b) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals occurred.The detailed assessment of the subtidal reefs carried out in 2015 using drop-down camera system (BSL 2015a) and latera  more detailed assessment using a scientific dive team at four locations on the northern and eastern sides of the island in June/July (BSL 2015b).  Details of the survey are supplied in the Appendix D.

Dive surveys collected semi-quantitative data from four locations, with two sites located beneath the steep cliff face of the northern coast (S1 and S2), and two located adjacent to the rocky shorelines in the southeast of the island (S3 and S4). The positions of these sites are shown in Figure 5-5. and a  summary of results for tranect S2 shown in Table 5-3.  The sublittoral stations were characterised by *Laminaria digitata* forests in the shallower part (IR.MIR.KR.Ldig.Ldig) and were usually replaced by the biotope ‘Foliose red seaweeds with dense Dictyota *dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock’ (IR.HIR.KFaR.FoR.Dic). The deeper extend was dominated by a ‘Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock’ (CR.HCR.XFa.ByErSp.Sag) or in the case of Sublittoral S2 ‘*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock’ (CR.HCR.XFa.FluCoAs). The deeper biotope at Sublittoral S4 was categorised as a possible ‘*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock’ (HCR.XFa.FluCoAs.Paur). Increased sedimentation was noted at these stations. The maximum depths surveyed for each site was between 10.5m and 14m below mean sea level.

Univariate analyses of the results of both reef assessments surface showed clear differences between the littoral and sublittoral stations in terms of species richness with twice as many species recorded from the sublittoral area (ca. 88.3as opposed to ca. 44.7). Both littoral and sublittoral environments indicated moderately high species diversity. Multivariate analyses revealed statistical separation of biotopes with the vertical zonation of the fauna (by water depth or height on the foreshore) constituting the dominant community patterns observed and being generally consistent at the different survey sites visited on Ireland’s Eye. No species of particular nature conservation interest were noted during any of the surveys and no rare or particularly fragile biotopes recorded. Naturally high levels of siltation were recorded in the sublittoral environment; a fact that has not appeared to have had a significant impact on the biological diversity in this area.

**Table 5-3: Summary of Subtidal Reef Community Complex (S2, BSL, 2015b)**

| Sublittoral Zonation | Example image | |
|---|---|---|
| **This stations were situated along the north coast of the island and showed significant evidence of a heavy silt burden. The deeper sediment plains gave way to a steeply inclined reef at a depth of circa 15.5m ODM. The reef was initially broken, with deposits of muddy gravel lying between boulders and outcrops of sloping bedrock.** | | |
| **Zone (i) Infralittoral Upper shore**<br><br>**IR.MIR.KR.Ldig.Ldig**<br>*Laminaria digitata* on moderately exposed sublittoral fringe bedrock Stunted *Laminaria digitata* kelp plants, with several other foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea*. Beneath these algae, crusts of mussels and barnacles predated by the common starfish *Asterias rubens*. |  |  |

| Sublittoral Zonation | Example image | |
|---|---|---|
| **Zone (ii) Infralittoral rock ca. 6-8.5m**<br><br>**IR.HIR.KFaR.FoR.Dic**<br>Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock<br><br>Add. algal species were *Rhodymenia holmesii, Sphondylothamnion multifidum* and *Apoglossum ruscifolium* amongst the sward. Fish observed were ling (*Molva molva*), the black goby (*Gobius niger*) and Greater pipefish (*Syngnathus acus*).. |  |  |
| **Zone (iii) Circalittoral ca 10-15.,5m**<br><br>**CR.HCR.XFa.FluCoAs**<br>Flustra foliacea and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock**.** The biotope on these outcrops was dominated by the bryozoans *Flustra foliacea, Scupocellaria sp*. and *Bugulina flabellate and*<br><br>**CR.HCR.XFa.ByErSp.Sag**<br>Mixed turf of bryozoans and erect sponges with Sagartia elegans on tide-swept circalittoral rock<br><br>Other sub-dominant taxa were feather-star *Antedon bifida*, plumose anemone *Metridium dianthus* and *Sagartia elegans* and *Urticina felina*, barnacle *Balanus crenatus*, soft coral *Alcyonium digitatum*, frequent erect sponges *Hymeniacidon perlevis, Amphilectus fucorum* and *Haliclona simulans*, the hydroids *Nemertesia antennina* and *Obelia dichotoma* as well as the tunicate *Clavelina lepadiformis*. | <br> | <br> |

**2023 Survey**

Areas of flat and sloping bedrock were observed to the north (S1) and south-east of Ireland's Eye (S3 and S4) as well as immediately to the south (ENV_27), with boulders typically in close proximity. Exposed rock was often heavily encrusted with sessile epifauna including barnacles (*Cirripedia* sp.), encrusting bryozoans, anemones (*Actinaria* sp.), encrusting and erect sponges (*Porifera* sp.), dead man's fingers coral (*Alcyonium digitatum*), red seaweeds (*Rhodophyta* sp.) and kelp (*Laminaria* sp.); however in some areas, notably transect S3, high levels of siltation were apparent which led to an obvious reduction in the quantity and range of sessile epifauna.

Mobile epifauna observed across the areas of bedrock and boulders consisted predominantly of the velvet crab (*Necora puber*) and the common starfish (*Asterias rubens*), with aggregations of feather stars (*Crinoidea* sp.) observed in some instances. Areas of fine sand featuring varying levels of shell fragments were found to the north of Ireland's Eye and were characterised by sparse conspicuous fauna with the occasional common starfish

(*Asterias rubens*) and encrusting sessile epifauna such as calcareous tube dwelling worms (*Serpulidae* sp.) and encrusting bryozoans in areas featuring higher concentrations of shell fragments.

Finally, a mixed mosaic of fine sands, shell fragments and rock fragments interspersed between areas of boulders and bedrock was apparent across transect ENV_27. Exposed rock fragments were often heavily encrusted with barnacles (*Cirripedia* sp.) and calcareous tube dwelling worms (*Serpulidae* sp.) as well as encrusting bryozoans; whilst areas of coarse shell fragments were typically associated with the presence of anemones (*Actinaria* sp.).

This updated survey provided observations at the deeper parts of each of the sublittoral transects and intermittent results close to the shoreline and cliffs. Similar habitats and biotopes to those reported in the 2018 planning application were recorded, confirming *Laminaria digitata* forests in the shallower part and replaced by the biotope 'Foliose red seaweeds with dense *Dictyota dichotoma* and / or *Dictyopteris membranacea* on exposed lower infralittoral rock'. The deeper extent was also dominated by a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock' or in the case of Sublittoral S2, '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock'. The deeper biotope at Sublittoral S4 was categorised as a possible '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock'. The 2023 survey confirmed a high level of suspended sediment within the water column and areas on the rocky reef substrate also showed high levels of sedimentation and silt burden both on open rocky surfaces as well as within the faunal swards.

#### 5.1.6 Surveys for the Harbour Porpoise - Rockabill to Dalkey Island SAC

A considerable number of surveys and sightings of the harbour porpoise have been gathered along the Irish east coast, including the area between Ireland's Eye and Skerries to the north (e.g. Pollock *et al*. 1997; Reid *et al*. 2003; Ó Cadhla *et al*. 2004; SCANS-II, 2008; Berrow *et al.* 2010; Berrow *et al*. 2011; Baines & Evans, 2012; Wall *et al*. 2012). The boundary of the SAC was supported by targeted surveys of the harbour porpoise community conducted in 2008 (Berrow *et al.* 2008). Recent, site specific information of cetacean activity in the vicinity of the proposed Outfall Pipeline and this section of the SAC were undertaken over a two year program based on three integrated methods in line with best practice; these were land-based vantage point surveys, boat-based transects and static acoustic monitoring. Visual surveys were only carried out in favourable weather conditions (Beaufort sea-state <2 and visibility >6km). Monthly land-based surveys were conducted from sites at Loughshinny for 6 months and Howth Head for 24 months. Single platform line-transect boat surveys were also conducted bi-monthly following a pre-determined route and standardised design. Finally, static acoustic monitoring using C-PODs was conducted for 6 months at a single site off Loughshinny and for 24 months at three locations off Portmarnock. Full details of these surveys are reported in Appendix E.

Passive acoustic monitoring recorders were deployed at three mooring sites along the proposed Outfall Pipeline between March 2015 and March 2017. An additional site was located east of Loughshinny in March 2015 for 6 months. Each mooring was fitted with a C-POD self-contained click detector which logs the echolocation clicks of porpoises and dolphins. The recovered data was interpreted by the IWDG. All C-POD data were analysed using only high probability clicks, which reduced the possibility of false positives (i.e. recorded as present when there were in fact no dolphins or porpoise present). Harbour porpoise detections were extracted as detection positive minutes per day and were analysed statistically for temporal and geographical trends. Porpoise detections were analysed with respect to season (spring, summer, autumn and winter), diel cycle (day and night-time), tidal state (ebb, flood, slack high, slack low) and tidal phase (spring, neap) at a resolution of one hour.

IWDG further supported the project by providing regular observations from both sea and land based surveys for cetaceans over the same survey period. Land-based observation sites were located on the cliffs at Howth Head, looking directly over the proposed Outfall Pipeline for a 24 month period, as well as the Loughshinny Martello Tower, for a six month period which recorded twenty hours of land-based monitoring conducted over six survey days. The weather was favourable throughout with no swell; sea state of Beaufort wind force of 2 or below and visibility of 6-20km. Marine mammals were sighted on 86% of survey days. The survey effort conducted from Howth Head amounted to around 144 hours (23 surveys) between 18 March 2015 and 11 March 2017.

Environmental conditions were favourable with no swell, sea-state of Beaufort wind force of 2 or below for 99% and visibility >6km for 97% of survey effort. Marine mammals were sighted on 100% of survey days.

Eleven independent boat-based surveys were carried out from April 2015 to January 2017 over a total of 897km of track-lines. Environmental conditions were favourable with visibility of >6km for 91% of the time and swell of <1m for 100% of survey effort. Sea-state of Beaufort wind force of 2 or below was recorded for eight of the eleven surveys however sea-state of Beaufort wind force of 2 or below was recorded for 8% of the survey carried out in April 2015, 36% in June 2015 and 46% during December 2016. Marine mammals were sighted on all survey days.

The software programme DISTANCE was used for calculating detection functions, which is the probability of detecting an object a certain distance from the track-line and used to calculate the density of animals on the track-line of the vessel. A detection function was calculated from each boat survey, providing sufficient number of sightings were made to provide a robust estimate.

All of these datasets have been integrated and are reported in Appendix E.

#### 5.1.6.1 Results Summary

Annex II Marine Mammal (harbour porpoise *Phocoena phocoena*) Surveys

This small toothed cetacean species occurs throughout Irish continental shelf waters including estuarine, coastal and offshore environments in which it carries out breeding, foraging, resting, social activity and other life history functions. Individual porpoises of all ages use sound as their primary sensory tool in order to navigate, communicate, avoid predators, or locate and facilitate the capture of prey under water. Group sizes tend to be small (i.e. in single figures, more commonly 2 to 3 individuals) although larger aggregations may occasionally be recorded, particularly in the summer months. The species breed annually in Ireland, predominantly during the months of May to September. The principal calving period in Irish waters is thought to occur in the months of May and June, although it may extend throughout the summer months and into early autumn. Newborn calves are weaned before they are one year old. Mating commonly occurs several weeks after the calving season.

The Rockabill to Dalkey Island SAC Code: 3000 was designated in April 2013. The occurrence of harbour porpoises within the SAC was estimated using visual observation and passive acoustic methods in order to deliver an assessment of community or population size (i.e. relative abundance or absolute abundance), density and distribution, although the size, community structure and distribution or habitat use of harbour porpoise inhabiting Rockabill to Dalkey Island SAC is not fully understood. In acknowledging limitations in the understanding of aquatic habitat use by the species within the site, it should be noted that all suitable aquatic habitat is considered relevant to the species range and ecological requirements at the site and is therefore of potential use by harbour porpoises. Initial survey estimates of individuals undertaken in 2008 indicated estimates of 0.54-6.93 animals per $km^2$ (and an overall estimate of 2.03 individuals per $km^2$ for the survey) within the northern half of the site and 0.48-2.05 animals per $km^2$ (and an overall estimate of 1.19 individuals per $km^2$), within the southern half of the site, including outer Dublin. Additional acoustic data plus casual and effort-related sighting rates from coastal observation stations are significant for the east coast of Ireland and, comparatively high group sizes (>5 individuals) have been recorded from this area. The species is present at the site in all seasons, while important cohorts within the harbour porpoise community such as adults, juveniles and new-born calves have also been recorded within the site, including during the calving/breeding season.

A visual and Passive Acoustic Monitoring (PAM) survey of harbour porpoises was carried out in the summer of 2013 at the Rockabill to Dalkey Island SAC by Berrow and O'Brien (2013) in order to derive local density and abundance estimates. The study concluded a population estimated to be between around 400 individuals within the SAC with average density varying from 1.13 to 2.61 $km^2$, with an overall average density of 1.44±0.09 porpoises per $km^2$. Observations included the sightings of juveniles and calves combined, making up approximately 7% of observations. up to sea state 2.

A comprehensive range of long–term land-based, vessel-based, and acoustic observations were carried out for marine mammals in the survey area by the Irish Whale and Dolphin Group (IIWDB) between March 2015 and March 2017. A summary of results, along with previous survey effort are summarised in

Figure 5-6.

Land-based monitoring was carried out monthly from 18 March 2015 until 11 March 2017. Just under 144 hours of monitoring was conducted over 23 independent surveys. Marine mammals were sighted on 100% of survey days with harbour porpoise present on 83% of occasions with 167 sightings recorded made up of 293 animals. These were made up of approximately 80% adults with the remainder juveniles and calves. The calves were only recorded between September 2015 and November 2015, and in August 2016. Sighting rate were calculated based on sightings and number of animals per hour of effort with porpoise sighting rates consistently higher during late summer and autumn, between August 2015 and January 2015, and August 2016 and October 2016.

Eleven boat-based marine mammal surveys were conducted from April 2015 to January 2017. Track-lines were staggered to provide good coverage of the site and to ensure all habitats were surveyed. Harbour porpoise were recorded on 100% of survey days with the greatest number of sightings recorded in November 2015 and August 2016. Group sizes also increased between August 2015 and November in 2015, and in August 2016. The lowest numbers of sightings were recorded in June 2015, June 2016 and December 2016 however sea-state was higher during these surveys which would increase the likelihood of missed sightings, therefore these results must be treated with caution. Calves were only recorded in August 2015, November 2015 and August 2016. Harbour porpoise sightings were regularly distributed across the study area. The average density of animals was greatest in the summer with both August 2015 and August 2016 recording the highest numbers at 1.91ind/km$^2$ and 2.29ind/km$^2$. This fell to between 0.61ind/km$^2$ and 0.89ind/km$^2$ between January and April (2015-2017).

Static acoustic monitoring was carried out at three sites close to the proposed outfall pipeline using C-PODs for a duration of 750 days (between March 2015 and March 2017). Detections were recorded 96-99% of days on average at each site with the daily detection positive minutes ranging between 41.3 DPM/day to 94.3 DPM/day. Detections were categorised into the following categories:

- Season (spring, summer, autumn and winter);
- Diel cycle (day and night-time);
- Tidal state (ebb, flood, slack high, slack low) and;
- Tidal phase (spring, neap).

The acoustic data demonstrated that all three sites monitored along the proposed outfall pipeline off Portmarnock are used consistently by harbour porpoise on a daily basis. However, presence was greater during autumn and winter, during hours of darkness and at slack high tides. When the data from Portmarnock are compared to Loughshinny data collected in 2015 (Meade *et al*. 2015) results were similar with autumn having the highest detections, however, only six months were monitored. Tidal cycle was not significant at Loughshinny in contrast to Portmarnock, where more detections were recorded during spring tidal phase. Monitoring index at Loughshinny was high at 9.8%, while at Portmarnock values ranged between 2.8% and 6.6% across sites, suggesting Loughshinny is the most important site for harbour porpoise to be monitored during the proposed Project.

Trends in the presence of harbour porpoise with diel cycle on the east coast of Ireland have been found to differ geographically, but they are consistently more active at night. The reasons for increased nocturnal activity are uncertain but could be linked to an increase in prey abundance or activity in the absence of light, as suggested by Todd *et al.* (2009).

Overall, observations through all survey methods showed that harbour porpoise numbers increased in late summer during both 2015 and 2016 which coincided with the presence of calves and may be due to seasonally abundant food sources such as sprat, herring and *Trisopterus* and gadoid species. Reduced numbers were recorded during late spring/early summer which may be associated with an offshore movement of this species before calving. The density estimate of harbour porpoise was high and emphasizes the importance of this site for this species as these are some of the highest densities recorded in Ireland to date (Berrow *et al*. 2008, 2013 and 2015).

Information previously presented in this Section of the NIS in the 2018 planning application, has been augmented with recent data and additional surveys and studies for this project, in addition to those derived from other projects within the vicinity of the Proposed Project.

Estimates of overall harbour porpoise populations within the Rockabill to Dalkey Island SAC (Site Code: 003000) have been undertaken using a variety of both visual and passive acoustic monitoring techniques to estimate population size, density and distribution. A visual and passive acoustic monitoring survey of harbour porpoise previously carried out in the summer of 2013 by Berrow and O'Brien in order to derive local density and abundance estimates was repeated in 2016 and again in 2021. These were based on line-transect surveys over selected days in the summer. These update surveys confirmed that this area remains important for this species, although the mean density changed from 1.44 individuals per $km^2$, in 2013, to 1.55 individuals per $km^2$ (ind/$km^2$) in 2016 and only 0.83 ind/$km^2$ in 2021, indicating significant variability between surveys. This recent density estimate is around 44% of that reported in 2013 and 2016. The number of sightings per survey were down by around 17% on the mean of the previous surveys. This appears to reveal a real decrease in the density of harbour porpoises recorded in the Rockabill to Dalkey Island SAC during 2021, a decline that has similarly been reported in other Special Areas of Conservation designated for harbour porpoises off Ireland's east coast. Using the same methodology, the other SACs with harbour porpoise as qualifying interests were located at Roaringwater Bay and Islands SAC and Blasket Islands SAC, both reporting significant declines over a similar period for harbour porpoise of 70% and 53%, respectively (O'Brien & Berrow 2018; 2020 and 2018, respectively). This suggests that the driver of this decline is widespread throughout Irish waters.

With respect to understanding changes in seasonality around the proposed outfall pipeline route (marine section), recent data is not as comprehensive as records previously taken at the proposed marine diffuser location. These data showed that harbour porpoise numbers increased in late summer, coincidental with the presence of calves, whilst reduced numbers were recorded during late spring / early summer, which may be associated with an offshore movement of this species before calving. A separate additional study undertaken as part of the nearby Dublin Port redevelopment at the Alexandra Basin project, also carried out long-term passive acoustic monitoring within Dublin Bay, south of Howth Head, over two survey years (2020 and 2021). These data similarly confirmed the presence of harbour porpoises every day, with the greatest concentration during the summer months of July and August, with half to a quarter of detections recorded later in the year The lowest numbers were recorded in early summer when adults are expected to be further offshore whilst calving.

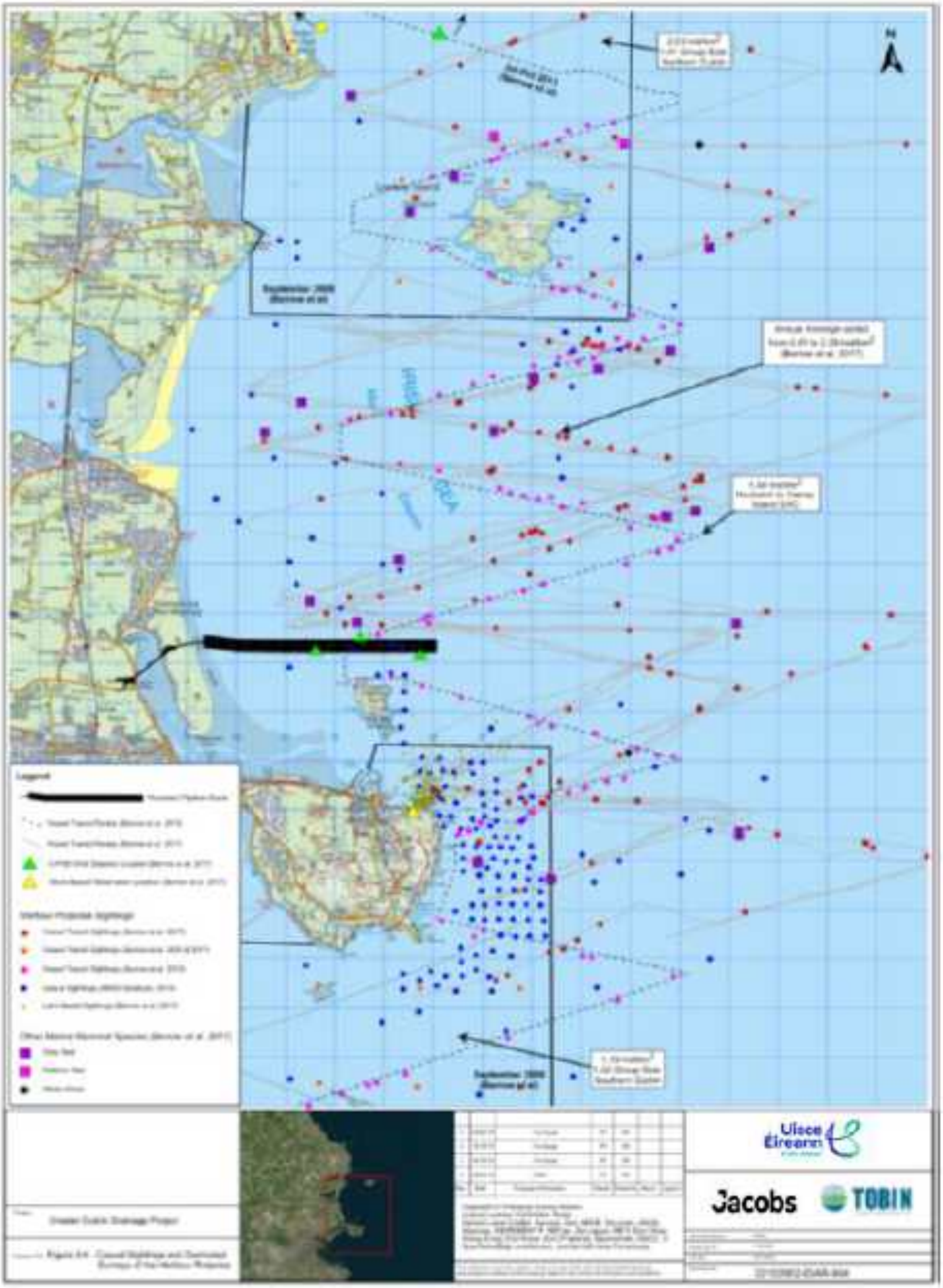


**Figure 5-6: Casual and Survey Sightings of the Harbour Porpoise in the Vacinity of the Proposed Marine Outfall.**

## 5.2 Modelling

### 5.2.1 Airborne Noise Modelling at Microtunnelling Compounds

The potential for Likely Significant Effect as a result of piling noise during the construction of jacking shafts in the microtunnelling compounds has been considered further in the assessment by a noise specialist.

The maximum noise levels associated with the proposed works in each of the Marine Compounds will arise as a result of the proposed piling activities in each of the compounds. These noise emissions have been considered in more detail in order to assess the potential noise impact on the bird population of the Baldoyle Estuary. It is anticipated that sheet piling or secant piling will be will be undertaken at the launch and reception shafts at each microtunnelling compound. Typical noise levels associated with these works have been considered in this assessment. The piling works at both compounds are anticipated to be completed in less than two weeks.

#### 5.2.1.1 Results Summary

With regard to the eastern microtunnelling compound, maximum noise levels as a result of the launch and reception shaft piling works are anticipated to be ≤65dB $LA_{max}$ in all sections of the Baldoyle Bay SPA. An area of largely undesignated land approximately 100m in radius around the launch and reception shaft piling will be exposed to noise levels of between >65 and ≤75 dB $LA_{max}$. Approximately 0.21 hectares of the Baldoyle Bay SPA falls within this area. This was calculated by overlaying a circle of 100m radius in GIS software and assessing the area overlapping the Baldoyle Bay SPA

With regard to the western microtunnelling compound, a small area (approximately 1.79 hectares) within the Baldoyle Bay SPA will be subject to noise between >65 and ≤75 dB $LA_{max}$. This was calculated by overlaying a circle of 100m radius in GIS software and assessing the area overlapping the Baldoyle Bay SPA. An area of non-designated land approximately 100m in radius around the launch and reception shaft piling will be exposed to noise levels of between >65 and ≤75 dB $LA_{max}$.

Airborne noise impacts in the subsea environment (where activities will result in a sound power level of >65 dB $LA_{max}$) are restricted to the areas where piling will be carried out at the microtunnelling/subsea interface and fibre optic cable crossing. Noise levels with the potential to impact birds are predicted to propagate up to 100m from the piling source at both the microtunnelling/subsea interface (located approximately 2,600m from the Ireland's Eye SPA) and the fibre optic cable crossing (located approximately 500m from the Ireland's Eye SPA), and are expected to last for a maximum of two weeks. They will likely be sequential in nature rather than simultaneous. The result of these works would result in the loss of approximately three hectares of subtidal habitat within the North-West Irish Sea cSPA for a period not exceeding four weeks during the construction phase of the proposed GDD project.

### 5.2.2 Water Quality Modelling

#### 5.2.2.1 Suspended Sediment Plume Analysis

Marcon Computations International was commissioned to inform the potential spread and extent of suspended sediment plumes arising from dredging works associated with the construction of the proposed Marine Outfall Pipeline. The computational models used in this study were based on the MIKE3 coastal process software using the 3D hydrodynamic flow model and a particle tracking (MIKE PT) modules. The model consisted of a regular 50m grid encompassing the general area of the proposed Marine Outfall Pipeline and expanded out into a flexible mesh model of varying grid sizes. This particle tracking model used the hydraulic flow regime from the MIKE3 hydrodynamic model to simulate the transport and fate of material discharged to the water column. The model included variable graded material along with temporally and spatially varying discharges.

For the 2023 EIAR Addendum, Marcon Computations International updated a number of model input parameters, including updated hydraulic flows for the River Dodder, and updated pollutant load inputs for the following river systems were inputted:

- Dodder
- Camac
- Liffey
- Tolka
- Mayne
- Sluice
- Ward
- Broadmeadow
- Turvey
- Ballyboghill
- Ballough
- Mill
- Santry
- Elm Park
- Trimlestown

Updated pollutant loads for the following Wastewater Treatment Plants were also inputted:

- Portrane
- Malahide
- Swords
- Shanganagh
- Ringsend (average)
- Ringsend (FFT)
- Ringsend
- (future average)
- Ringsend
- (future FFT)
- Proposed Project (average)
- Proposed Project (FFT)

Water quality standards and decay coefficients were also updated to reflect both the updated legislation and the inclusion of Intestinal Enterococci.

Having re-run the models, Marcon Computations International has confirmed that there are no changes to the predicted dredge plumes at construction phase.

The outfall will be constructed using a combination of a backhoe dredger, in shallower areas, and a trailer suction hopper dredger (TSHD) where the water depths are beyond the limits of the backhoe dredger. The back-hoe dredger or similar will be used for the dredging activity during 12 hour and daylight operations which gives a maximum dredging quantity of about 78 $m^3$ per hour while the dredger is working. It is estimated that the total volume of material to be excavated ranges between 200,000 to 400,000 $m^3$ and that the dredging operation will take approximately 130 days.

Details of the sediment characteristics were obtained from the surface and sub-surface sediments along the route from the vibrocoring and borehole data with calculations based on their proposed excavation locations along the outfall route (i.e. BH03, BH05, and BH08). These samples showed that sediments ranged from grey silty sand to grey sandy gravel. Whilst grey silty sand predominates along the entire route, the increase in gravel fraction over depth and towards the offshore end of the trench have largely been ignored for suspended sediment dispersion purposes as the heavier fractions settle out within a few metres of the dredger.

Material losses through suspension in the water column were assumed to be conservative. A 10% of total dredged volume, representing a 7.5% source at 1m above the seabed and a 2.5% source at the 1m below the surface were used. The MIKE model simulates the fate of the loss of material from the dredgers by releasing particles into the water column and tracking each particle throughout the simulation process. A range of grain sizes was used in order to cater for the variation in sediment grading of the bed sediment material. Assuming a density of 2000 kg/$m^3$ for in-site consolidated sand/gravel mix, the extraction rate equates approximately 1,852 kg/s and a 10% loss of 185.2kg/s occurring through sediment suspension. A dredging simulation was then run over the full

130 excavation period with the origin for dispersion and the source of the material moved to keep track with the dredgers simulated progress along the route.

The results of the dredging simulations were shown graphically by a series of model output diagrams based on operations from different borehole locations or different states of the tide. These have been summarised into a single chart (Figure 5-7). At almost all locations, snapshots of suspended sediment concentrations were taken over the course of spring or neap tides with the majority observed within the 0-100 mg/l range. In only two of the snapshots were the suspended sediment concentrations predicted to be greater than 100 mg/l. The deposition depth of dredged material is greatest in the immediate vicinity (within 8m) of the trench (>300 mm) with deposition depths reducing to less than 3mm within a few hundred meters of the trench route.

The Construction Plume

The spread of the sediment plume (Figure 5-7) shows the controlled release of spoil material by hopper barge every 7 hours producing a northerly plume drifting away from Ireland Eye with the greatest plume concentration recorded in the shallower first 2km of the route from landfall. The highest concentrations of suspended sediments >10 g/l were recorded at bed level within 50-100m from the discharge point. The granular nature of these sediments results in a fast settlement of material to the bottom with seabed and mid-depth concentrations generally falling to below 1 g/l within 200m from the discharge. Lower levels of sediment fines (silts and clays), recorded in the sub-surface layers of the corridor are modelled to travel further on discharge, and with concentration of between 10 and 100 mg/l recorded out to a maximum distance of around 1400m north of the route. Most suspended material would be recorded just above bed level concentrations in the surface waters generally limited to discharges made only in the offshore half of the proposed route. Here, low level concentrations of between 5 and 10mg/l were recorded out to 1500m from the corridor or remained just detectable out to 2600m. With the exception of the a small surface plume of 1-5 mg/l and 200-300m across caught in a small back-eddy 350m North of the Irelands Eye north coast, all of the plume discharge are predicted to disperse to the North of the proposed route based following a controlled discharge. None of the discharged sediment is predicted to impact the qualifying Annex I habitats of littoral and sublittoral reef features of the Rockabill to Dalkey Island SAC along the north and eastern coastline of Irelands Eye. Suspended sediments throughout the remainder of the SAC were limited to near bed impacts in the main part of the SAC area.

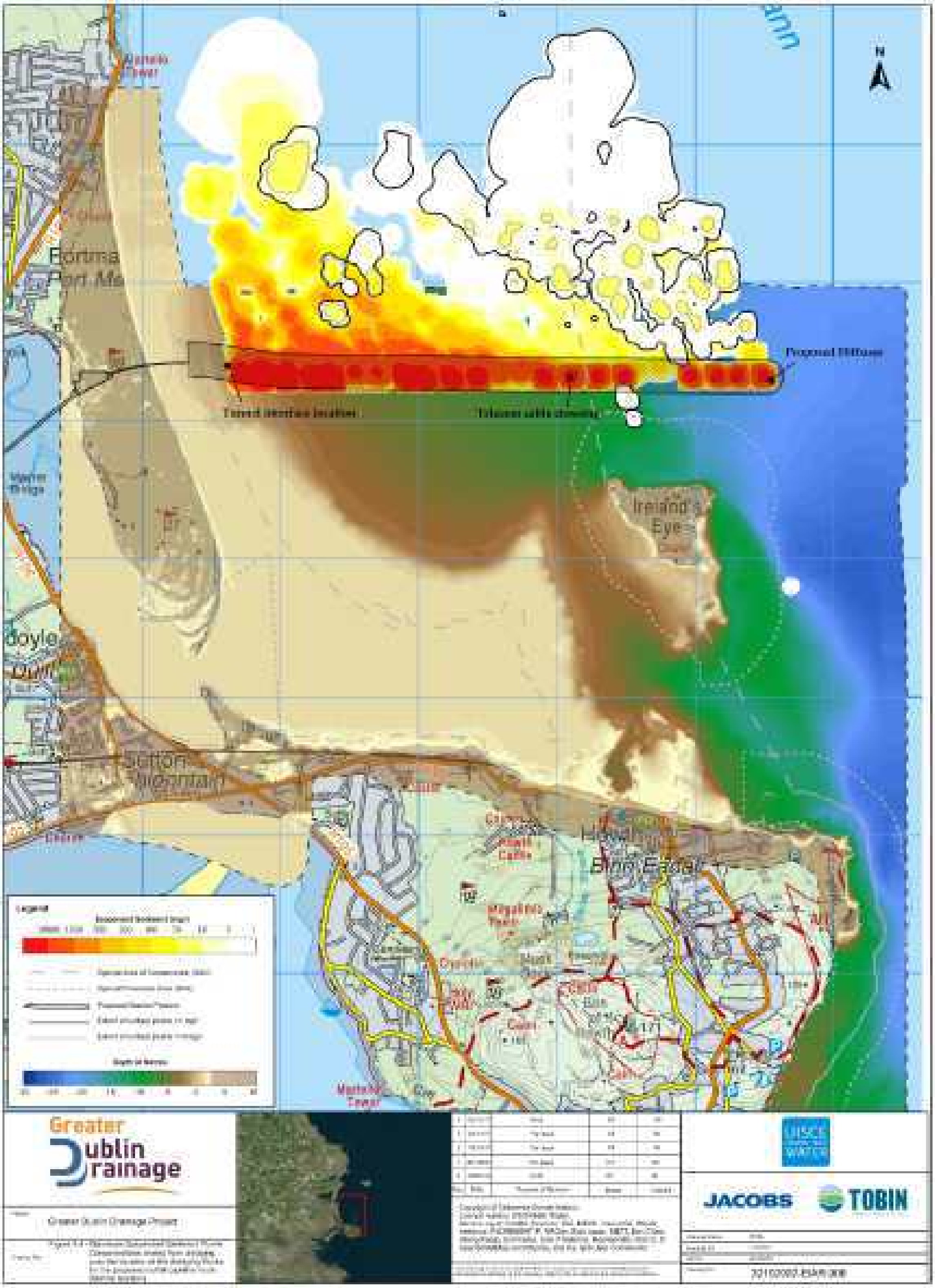



**Figure 5-7: Combined Suspended Sediment Concentrations Arising from Dredging Operations Over the Duration of the dredging works for the Outfall Location**

<u>The Operational Plume</u>

Details of the plume discharged into the Irish Sea by the outfall are discussed in chapter 8 of the EIAR and the standards of the treated effluent summarised in section 3.3.1 and characterised in Table 3.1. The diffuser constructed for the end of the outfall is designed to enhance the dilution of the treated effluent into the receiving waters on discharge. A numerical model of the expected dilution was produced based on the Cornell Mixing Zone Expert System (CORMIX) to predict the near-field dilution characteristics of a proposed outfall discharging to the receiving waters. The CORMIX model predicted the plume development, dilution and effluent concentrations within the plume. Near the discharge port, the plume tends to behave as a coherent jet, dominated by its initial momentum and buoyancy. Eventually, these are dissipated by interaction with the surrounding medium, and the plume becomes a diffuse mass carried along by the ambient current. Mixing initially occurs by turbulent flows at the boundaries of the plume, and later primarily by pure diffusion processes.

Simulations were run using the CORMIX using hydrodynamic data applied for the tidal cycle, ambient water quality and structure and profiled currents recorded during an earlier survey campaign at the proposed outfall location. Hourly simulations were carried out over the full tidal cycle for both neap and spring tidal scenarios with results indicating a consistent 20 fold dilution recorded within the near field (50m) from the discharge point on both neap and spring tidal streams. Far field dilutions (500m) showed greater variability based on the tides but generally varied from a 33 fold dilution during slack events, to 100 fold dilution during mid flood or ebb tidal streams. Therefore, for total suspended solids, a 35 mg/l (95$^{th}$ percentile) discharge would therefore dissipate to an increased back ground of 1.75 mg/l within 50m at all states of the tide, but vary from 1.06 to 0.35 mg/l at 500m, subject to tidal stream.

#### 5.2.2.2 Turbidity Monitoring

Suspended Sediments and Water quality results

Long term observations of turbidity recorded at the proposed outfall location throughout 2015 and 2016 (TML 2016) indicated a variable ambient suspended sediment load ranging from 4 to 120mg/l calculated from converted turbidity measurements (using Guillen *et al.,* 2000) or 15 to 160mg/l from sampled water quality measurements taken throughout the same survey period. The longer term observations in turbidity revealed significant variability in water clarity by season as well as by tidal state, with a regular semi-diurnal pattern recorded over a slow seasonal decreasing in turbidity (i.e. increased water clarity) recorded during the summer months. Spring and neap tidal cycles had a marked effect on the suspended sediment load, increasing ambient levels by between 7 and 25mg/l during the stronger spring tidal flows. Ambient suspended sediments were also affected by strong winds and poor weather periods.

### 5.2.3 Underwater Noise Modelling

#### 5.2.3.1 Noise from Dredging and Piling

The noise created by backhoe dredgers is produced from a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying (Dickerson et al. 2001; Robinson et al. 2012). Grab and backhoe dredgers are also characterised by sharp transients from operation of the mechanical parts. Suction dredgers produce a combination of sounds from relatively continuous sources including material passing through the suction pipe and the drag head moving across the substrate. However, it is the noise of the support vessel (engine and propeller noise) along with supporting vessels that can often be the most significant source of noise.

Noise levels produced by backhoe dredger operating around the Shetland Islands, UK, were recorded by Nedwell *et al.* (2008). He recorded a calculated source level of 163 dB re 1 µPa at 1 m (bandwidth = 20 Hz–100 kHz) although, Reine *et al.* (2012) calculated source levels of 179 dB re 1 µPa at 1 m (bandwidth = 3 Hz–20 kHz).

Noise produced by suction dredgers has been measured on a number of occasions. Robinson *et al.* (2011) measured six TSHDs, stating that sound the levels below 500 Hz were in line with those expected for a cargo ship travelling at modest speeds (8–16 kn). The maximum broadband source was 189.9 dB re 1 µPa at 1 metre (calculated based bandwidth 31.6 Hz to 39.8 kHz). Estimated source levels above 1 kHz were relatively high, probably a result of the coarse aggregate pumped through the dredge pipe. Using an identical approach, de Jong *et al.* (2010) found very similar results to Robinson *et al.* (2011), the source levels recorded a decline beyond 1 kHz when working sand rather than gravels. Consequently, the variation is sediment types from sands to mixed gravels encountered along the proposed route is expected to alter the source levels during dredging, particular at the higher frequencies.

A collation of dredger related noise profiles has previously been carried out by Subacoustech Environmental using their SPEAR model based on measured recording retained within their database. The SPEAR model gives unweighted source levels of 186 dB re 1 µPa for suction dredgers and 165 dB re 1 µPa for backhoe dredgers. Therefore the predicted noise from suction dredgers is expected to be approximately 20 dB above that of backhoe dredgers, this is due largely to the typical size difference between the two types of vessel as well as the increased size of plant necessary for suction dredging. A model of expected underwater noise created during the dredging exercise (see Appendix F) was based on Parvin (2008) and Robinson *et al* (2011) and estimated at 188 dB ref 1µPa in the 50Hz to 89 kHz range. The output using third octive bands of 125Hz, 1kHz and 8kHz were calculated to range between 172 and 176 dB ref 1µPa. The contouring of sound exposure levels (SEL) from a source along the proposed route at these three frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 1km at 125Hz, around 30km for 1kHz and 12km for 8 kHz.

The same model was used to assess the noise impact from an impact hammer source that might be used at the tunnel interface or at a telecom cable crossing, midway along the proposed corridor. The source was based on a piling of 600mm with the sounds generated impulsively. In order to translate the potential impacts more accurately, the SEL expressed is as dB 1µPa²@1m which corresponds to the acoustic energy received integrated over a given frequency band and over the significant duration of the sound pulse (100ms in this study; De Jong, *et al*., 2008). At two of the same lower third octive bands used for the dredging assessments, the sound pressure level of the piling was estimated to be 186 dB 1µPa²@1m at 125Hz dropping to 172 dB 1µPa²@1m at 1kHz. Contouring of sound exposure levels (SEL) from a source along the proposed route at these two frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 2km at 250Hz, around 12km for 1kHz.

All of these noise impacts will travel well within the Rockabill to Dalkey Island SAC where they have the potential to impact the Annex II species *Phocoena phocoena* (harbour porpoise).

# 6. Assessment of Implications for European sites

The findings of the Screening for Appropriate Assessment identified likely significant effects could not be excluded from 18 sites (7 SACs and 11 SPAs) as outlined in Table 4-2 and Table 4-3. The potential impacts and key best practice and mitigation measures for these European sites, their qualifying interest, special conservation interests and conservation objectives are assessed in greater detail in this NIS.

The following sections discuss each of the 18 sites under one or more of the following impact pathways as identified in the screening assessment (see Section 4):

- Water quality and habitat deterioration;
- Airborne noise and visual disturbance;
- Underwater noise and disturbance; and
- Habitat Loss.

As Baldoyle Bay SPA and Baldoyle Bay SAC, Rockabill to Dalkey Island SAC, North-West Irish Sea cSPA and Ireland's Eye SPA and are located immediately next to or overlapping with the proposed project, these are discussed first under each theme heading where relevant. The links to the site specific conservation objective lists used in the assessment for all 18 European sites are provided in Appendix F. Site-specific conservation objectives assigned to this cSPA have recently been published (NPWS, 2023) and as anticipated, are similar to objectives from the existing marine SPAs. In compliance with its legal obligations, Uisce Éireann has treated the candidate SPA as a fully designated SPA in this assessment and has worked with its newly published conservation objectives.

It should be noted that the land elements of the project i.e. WWtP, pumping station, orbital sewer pipeline, north fringe sewer pipeline and marine outfall pipeline (land section), access roads and compounds 1-8 as listed in Table 4-1 have the potential to give rise to Likely Significant Effects only on impact pathway theme 'water quality and habitat deterioration' in the event of a release of of contaminated run off from spillages during construction stage. All other elements of the project can give rise to two or more impact pathways.

## 6.1 Impact Pathway - Airborne noise and visual disturbance

### 6.1.1 Baldoyle Bay SPA

Based on the information contained in Setion 4 there are two potential pathways for LSEs to occur on this SPA; airborne noise and visual disturbance which is discussed here in Section 6.1.1 and water quality and habitat deterioration, information on which is provided in Section 6.2.4.1.

#### 6.1.1.1 Conservation Objectives

Baldoyle Bay SPA has seven SCIs, as described in Table 6-1, which also sets out the conservation objectives for each SCI.

Table 6-1: Conservation objectives for waterbird Special Conservation Interest species and wetland habitat at Baldoyle Bay SPA

| Species | A046 | Light-bellied brent Goose *Branta bernicla hrota* |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of Light-bellied Brent Goose in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by light-bellied brent goose, other than that occurring from natural patterns of variation |
| **Species** | **A048** | **Shelduck *Tadorna tadorna*** |
| **Conservation objective** | To maintain the favourable conservation condition of Shelduck in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by Shelduck, other than that occurring from natural patterns of variation |
| **Species** | **A137** | **Ringed Plover *Charadrius hiaticula*** |
| **Conservation objective** | To maintain the favourable conservation condition of Ringed Plover in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by Ringed Plover, other than that occurring from natural patterns of variation |
| **Species** | **A140** | **Golden Plover *Pluvialis apricaria*** |
| **Conservation objective** | To maintain the favourable conservation condition of Golden Plover in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by Golden Plover, other than that occurring from natural patterns of variation |
| **Species** | **A141** | **Grey Plover *Pluvialis squatarola*** |
| **Conservation objective** | To maintain the favourable conservation condition of Grey Plover in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by Grey Plover, other than that occurring from natural patterns of variation |

| Species | A157 | Bar-tailed Godwit *Limosa lapponica* |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of Bar-tailed Godwit in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population trend** | % change | Long term population trend stable or increasing |
| **Distribution** | Range, timing and intensity of use of areas | No significant decrease in the range, timing and intensity of use of areas by Bar-tailed Godwit, other than that occurring from natural patterns of variation |
| **Species** | **A999** | **Wetlands** |
| **Conservation objective** | To maintain the favourable conservation condition of wetland habitat in Baldoyle Bay SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Habitat area** | Hectares | The permanent area occupied by the wetland habitat should be stable and not significantly less than the area of 263ha, other than that occurring from natural patterns of variation |

#### 6.1.1.2 Relevant Baseline Information

See Section 5.1.1 for relevant baseline information.

Noise impacts will occur within an area of habitat within the Baldoyle Bay SPA of approximately 1.79 hectares due to piling occurring at the western microtunnelling compound. Table 6-2 provides details on the SCIs of the Baldoyle Bay SPA recorded using the habitat within this area during the baseline surveys.

**Table 6-2: Assessment of Baldoyle Bay SCIs present within predicted noise disturbance impact zone within the Baldoyle Bay SPA resulting from piling at the western microtunnelling compound during baseline surveys (frequency of observation, numbers, and predominant behaviour)**

| Species | Total Number of Records Within Impacted Habitat | Total Number of Birds Recorded Within Impacted Habitat | Maximum Number of Birds Recorded Within Impacted Habitat at Once | Predominant Behaviour Recorded Within Impacted Habitat |
|---|---|---|---|---|
| Shelduck | 3 | 18 | 16 | Feeding |
| Grey Plover | 1 | 3 | 3 | Loafing |

No SCIs of the Baldoyle Bay SPA were recorded in the habitats within 100m of the western microtunnelling compound jacking shaft, and outside the Baldoyle Bay SPA boundary during the baseline surveys.

Noise impacts will occur within an area of habitat within the Baldoyle Bay SPA of approximately 0.21 hectares due to piling occurring at the eastern microtunnelling compound. No SCIs of the Baldoyle Bay SPA were recorded in this area during the estuarine baseline surveys. A small number of SCI’s of the Baldoyle Bay SPA were recorded within habitat in the area likely to be impacted by noise disturbance outside the Baldoyle Bay SPA boundary. These are presented in Table 6-3.

**Table 6-3: Assessment of Baldoyle Bay SPA SCIs present within predicted noise disturbance impact zone outside the Baldoyle Bay SPA resulting from piling at the eastern microtunnelling compound during baseline surveys (frequency of observation, numbers, and predominant behaviour)**

| Species | Total Number of Records Within Impacted Habitat | Total Number of Birds Recorded Within Impacted Habitat | Maximum Number of Birds Recorded Within Impacted Habitat at Once | Predominant Behaviour Recorded Within Impacted Habitat |
|---|---|---|---|---|
| Ringed Plover | 2 | 10 | 9 | Feeding, Roosting |

The number of SCI observations recorded in habitat within published visual disturbance distances of both microtunnelling compounds (Cutts et al. 2013) was assessed. This is presented in Table 6-4.

**Table 6-4: Assessment of Baldoyle Bay SPA SCIs present within predicted visual disturbance impact zone resulting from presence of eastern and western microtunnelling compound during baseline surveys (frequency of observation and numbers)**

| Species | Published Disturbance Distance (Cutts et al. 2013) (metres) | Number of Records Within Published Disturbance Distance to Microtunnelling Compounds | Number of Birds Within Published Disturbance Distance to Microtunnelling Compounds |
|---|---|---|---|
| Light-bellied brent Goose | 205 | 17 | 475 |
| Shelduck | 500 | 338 | 1,506 |
| Ringed Plover | 50 | 0 | 0 |
| Golden Plover | 200 | 1 | 1,800 |
| Grey Plover | 200 | 7 | 17 |
| Bar-tailed Godwit | 200 | 4 | 27 |

In the subtidal environment, a number of SCI species were recorded, as reported in Section 5.4. The exact position of these birds is not considered to be a useful parameter in assessing any possible effects on them because they are mobile, but they are considered in the assessment below.

#### 6.1.1.3 Assessment

The baseline environment around the Baldoyle Bay SPA contains numerous sources of potential disturbance stimuli for birds. The Baldoyle Bay estuary lies on the approach to Dublin Airport's main runway. Observations made during ornithological surveys revealed that aircraft overfly the northern section of the Baldoyle Bay SPA very frequently. The R106 Coast Road, running down the western side of the bay, passes between the SPA boundary and the proposed temporary western construction for microtunnelling. A cycle path runs parallel to the road. The Baldoyle residential area to the south-west of Baldoyle Bay, and the Portmarnock and Sutton Golf Clubs on the eastern and southeastern sides of the bay are other sources of disturbance. Velvet Strand to the east is also frequented by a range of recreational users. This recreational and amenity disturbance stimulus is not likely to have decreased in the intervening years between the original NIS and now. In general, this suggests that many of the birds using the Baldoyle Bay SPA and surrounding area are habituated to a degree of a range of general visual and/or noise stimuli, including the presence of vehicles.

In order for the construction or operation of the proposed GDD project to result in disturbance to the birds in the area (including SPA qualifying species), the noise/visual stimuli would have to substantially exceed those that are already present in some way. Having regard to published advice on the typical types and magnitudes of visual and noise sources associated with general construction activities (Cutts et al. 2013), it is considered that general construction activities, the presence of a crane, and the presence of vehicle traffic associated with the microtunnelling compounds will not result in a Likely Significant Effect on the Baldoyle Bay SPA.

Only one noise source will propagate into the Baldoyle Bay SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This is noise produced during piling of the jacking shaft at the microtunnelling compounds. This is a reversible impact that will occur for a maximum time period of two weeks, and could result in an impact on 1.79 hectares (see Section 5.1.4) of habitat within the SPA boundary on the western side of the SPA, and 0.21 hectares on the eastern side of the SPA . It is estimated that the sound power level reaching the Baldoyle Bay SPA boundary will be in the region of 75 dB $LA_{max}$.

Noise disturbance during the construction of the jacking shaft at both the microtunnelling compounds could impact terrestrial habitats outside the Baldoyle Bay SPA boundary used by SCI species. Piling will occur for a period of two weeks during the construction period and the resulting impact is reversible.

There is also potential for connectivity between the Baldoyle Bay SPA and the subtidal habitats in and adjacent to the outfall pipeline corridor, which baseline data showed were being used by low numbers of some SCI species.

Airborne noise impacts in the subsea environment (where activities will result in a sound power level of >65 dB $LA_{max}$) are restricted to the areas where piling will be carried out at the microtunnelling/subsea interface and fibre optic cable crossing. Noise levels with the potential to impact birds are predicted to propagate up to 100m from the piling source at both the microtunnelling/subsea interface (located approximately 1,100m from the Baldoyle Bay SPA) and the fibre optic cable crossing (located approximately 3,600m from the Baldoyle Bay SPA), and are expected to last for a maximum of two weeks. They will likely be sequential in nature rather than simultaneous. The result of these works would result in the loss of approximately 3 hectares of subtidal habitat for a period not exceeding four weeks during the construction phase of the proposed GDD project.

Visual disturbance resulting from the construction and presence of the microtunnelling compounds along with the activities associated with them could result in impacts within the Baldoyle Bay SPA. In addition, similar impacts to habitats outside the boundary which may have connectivity to the Baldoyle Bay SPA is possible. This is a reversible impact that would occur for the duration of the construction period. Visual disturbance can occur up to a distance of 205m from source for light-bellied brent goose, 500m for shelduck, 200m for golden plover, grey plover and bar-tailed godwit, and 50m for ringed plover (Cutts et al. 2013). This level of disturbance applies to work during daylight and darkness. Working at night would require artificial lighting, which has been shown to benefit estuarine birds by increasing foraging opportunity (Santos et al. 2010).

Vessel disturbance impacts are restricted to the subsea environment, beginning from the micro-tunnelling/subsea interface, located approximately 600m offshore from Velvet Strand beach, and terminating at the marine diffuser. Piling works at the micro-tunnelling/subsea interface are situated approximately 1km from the Baldoyle Bay SPA, and 600m offshore from the Velvet Strand beach. Two groups of vessels will be present between April and October moving along the outfall pipeline corridor, with any disturbance impacts being restricted to an area around each group of vessels. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity.

**Light-bellied Brent Goose**

The up to date baseline survey data show that light-bellied brent geese do not regularly utilise habitats which fall within the zone of impact for the airborne noise disturbance impact pathway identified for the Baldoyle Bay SPA. Birds in flight are not predicted to be affected by this impact pathway because they are using the airspace and not the habitat, and are passing through the zone of impact rather than remaining within it. Small numbers of this species present in certain areas of highly restricted spatial extent could be subject to disturbance and displacement by the airborne piling noise, which would be temporary, reversible, and not result in any birds being lost from the Baldoyle Bay SPA population.

Larger numbers of birds were recorded using habitats which fall within the zone of impact for the visual disturbance impact pathway identified for the Baldoyle Bay SPA. This usage was recorded on 17 occasions by a total of 475 birds. Substantial numbers of this species present in habitats within 205m of the microtunnelling compounds could be subject to disturbance and displacement by visual disturbance, which would last for the duration of construction (approximately 18 months) and be reversible. The displacement of this number of birds could create knock on effects relating to competition and habitat availability, and could result in any birds being lost from the Baldoyle

Bay SPA population. As a result, it is considered that the airborne noise impact pathway of the proposed GDD project during construction and operation could compromise the targets of the conservation objective for this species.

The construction of the proposed GDD project therefore could result in an adverse effect on site integrity for this species. Mitigation is required, which is discussed in Section 7.1.

**Shelduck**

The up to date baseline survey data show that shelduck do not regularly utilise habitats which fall within the zones of impact for the airborne noise disturbance impact pathway for the Baldoyle Bay SPA. This species was not recorded in these areas during the estuarine survey programme. Small numbers of this species present in certain areas of highly restricted spatial extent could be subject to disturbance and displacement by the airborne piling noise, which would be temporary, reversible, and not result in any birds being lost from the Baldoyle Bay SPA population. As a result, it is considered that the airborne noise impact pathway of the proposed GDD project during construction and operation will not compromise the targets of the conservation objective for this species.

Shelduck was recorded in small numbers in the subsea environment, whilst larger numbers of birds were recorded using habitats which fall within the zone of impact for the visual disturbance impact pathway identified for the Baldoyle Bay SPA. This usage was recorded on 338 occasions by a total of 1,506 birds. Substantial numbers of this species present in habitats within 500m of the microtunnelling compounds could be subject to disturbance and displacement by visual disturbance, which would last for the duration of construction (approximately 18 months) and be reversible. The displacement of this number of birds could create knock on effects relating to competition and habitat availability, and could result in any birds being lost from the Baldoyle Bay SPA population. As a result, it is considered that the airborne noise impact pathway of the proposed GDD project during construction and operation could compromise the targets of the conservation objective for this species.

The construction of the proposed GDD project therefore could result in an adverse effect on site integrity for this species. Mitigation is required, which is discussed in Section 7.1.

**Ringed Plover**

The up to date baseline survey data show that ringed plover do not regularly utilise habitats which fall within the zones of impact for the airborne noise and visual disturbance impact pathway identified for the Baldoyle Bay SPA, being recorded only on a small number of occasions in these habitats during the estuarine survey programme (two observations, ten birds in total, within 100m of the eastern microtunnelling compound, which could be subject to noise disturbance). It was also recorded in the subsea environment in small numbers. Whilst small numbers of this species could be subject to disturbance and displacement, this effect would be restricted to a small spatial extent, temporary and reversible.

As a result, it is considered that the airborne noise and visual disturbance impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objective for this species. The construction of the proposed GDD project will therefore not cause an adverse effect on site integrity for this species.

**Golden Plover**

The up to date baseline survey data show that golden plover do not regularly utilise habitats which fall within the zones of impact for the airborne noise and visual disturbance impact pathway identified for the Baldoyle Bay SPA. This species was observed on a single occasion in the noise disturbance impact zone, and was recorded once during the estuarine survey programme in the area predicted to be impacted by visual disturbance (within 200m of the microtunnelling compounds). This observation consisted of 1,800 birds. This data shows that if birds of this species do happen to be present in these areas during the construction phase, they can be present in large numbers. Any effects would be temporary and reversible, with visual disturbance effects lasting for the duration of the construction period (approximately 18 months).

Whilst golden plover usage of these areas is infrequent, this species can occur in large flocks which would represent a large proportion of the Baldoyle Bay SPA population. The displacement of this number of birds could create knock on effects relating to competition and habitat availability, and could result in any birds being lost from the Baldoyle Bay SPA population. For this reason, it is considered that the airborne noise and visual disturbance impact pathway of the proposed GDD project during construction could compromise the targets of the conservation objective for this species.

The construction of the proposed GDD project therefore could result in an adverse effect on site integrity for this species. Mitigation is required, which is discussed in Section 7.1.

**Grey Plover**

The up to date baseline survey data show that grey plover do not regularly utilise habitats which fall within the zones of impact for the airborne noise and visual disturbance impact pathway identified for the Baldoyle Bay SPA. This species was not recorded at all in the noise impact zones during the estuarine survey programme, with seven observations consisting of 17 birds in the visual impact zone (within 200m of the microtunnelling compounds). If birds of this species do happen to be present in these areas during the construction phase, it is likely they would be present in low numbers, and any effect would be temporary and reversible.

As a result, it is considered that the airborne noise and visual disturbance impact pathway of the proposed GDD project during construction and operation will not compromise the targets of the conservation objective for this species. The construction and operation of the proposed project will not cause an adverse effect on site integrity for this species.

**Bar-tailed Godwit**

The up to date baseline survey data show that bar-tailed godwit do not regularly utilise habitats which fall within the zones of impact for the airborne noise and visual disturbance impact pathway identified for the Baldoyle Bay SPA. This species was not recorded at all in the noise impact zones, and only in small numbers (four records consisting of 27 birds) in the visual impact disturbance zone during the estuarine survey programme. This species was also observed on a single occasion in the subtidal environment. Whilst small numbers of this species could be subject to disturbance and displacement, this effect would be restricted to a small spatial extent, temporary and reversible.

As a result, it is considered that the airborne noise and visual disturbance impact pathway of the proposed GDD project during construction will not compromise the targets of the conservation objective for this species.

**Wetlands**

Due to the airborne noise and visual disturbance impact pathway, approximately 1.79 hectares of wetland habitat within the SPA boundary will be impacted due to piling noise from the jacking shaft of the western microtunnelling compound, and 0.21 hectares due to the same impact from the eastern microtunnelling compound, giving a total impact zone of 2 hectares. As a worst case scenario, it is considered that this habitat will be lost to birds for the duration of this activity, which is a maximum time period of two weeks. This impact is fully reversible.

Because no permanent loss of wetland habitat will occur during construction and operation of the proposed project by this impact pathway, it is considered that the airborne noise and visual disturbance impact pathway of the proposed project will not cause an adverse effect on site integrity for the wetland habitat of the Baldoyle Bay SPA.

#### 6.1.2 Ireland's Eye SPA and North-West Irish Sea cSPA

Based on the information contained in Section 4 there are two potential pathways for LSEs to occur on these SPAs; airborne noise and visual disturbance which is discussed here in Section 6.1.2 and water quality and habitat deterioration, information on which is provided in Section 6.2.4.2.

##### 6.1.2.1 Conservation Objectives

Table 6-5 sets out the five SCIs of the Ireland's Eye SPA and their conservation objectives. Table 6-6 sets out the twenty one SCIs of the North-West Irish Sea cSPA.

**Table 6-5: Conservation objectives for Special Conservation Interest species at Ireland's Eye SPA**

| Species | A017 | Cormorant *Phalacrocorax carbo* |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of Cormorant (currently excellent conservation status) in Ireland's Eye SPA. | |
| **The favourable conservation status of a species is achieved when:** | | |
| Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats | | |
| 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 | | |
| **Species** | **A184** | **Herring Gull *Larus argentatus*** |
| **Conservation objective** | To maintain the favourable conservation condition of Herring Gull (currently unknown conservation status) in Ireland's Eye SPA. | |
| **The favourable conservation status of a species is achieved when:** | | |
| Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats | | |
| 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 | | |
| **Species** | **A188** | **Kittiwake *Rissa tridactyla*** |
| **Conservation objective** | To maintain the favourable conservation condition of Kittiwake (currently excellent conservation status) in Ireland's Eye SPA. | |
| **The favourable conservation status of a species is achieved when:** | | |
| Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats | | |
| 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 | | |
| **Species** | **A199** | **Guillemot *Uria aalge*** |
| **Conservation objective** | To maintain the favourable conservation condition of Guillemot (currently excellent conservation status) in Ireland's Eye SPA. | |
| **The favourable conservation status of a species is achieved when:** | | |
| Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats | | |
| 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 | | |
| **Species** | **A200** | **Razorbill *Alca torda*** |
| **Conservation objective** | To maintain the favourable conservation condition of Razorbill (currently excellent conservation status) in Ireland's Eye SPA. | |
| **The favourable conservation status of a species is achieved when:** | | |
| Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats | | |
| 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 | | |

Table 6-6: Conservation objectives for Special Conservation Interest species of the North-West Irish Sea cSPA

| Species | A013 | Manx shearwater *Puffinus puffinus* |
|---|---|---|
| Conservation objective | To maintain the favourable conservation condition of manx shearwater in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| Attribute | Measure | Target |
| Breeding population size | Number | No significant decline |
| Spatial distribution | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| Forage spatial distribution, extent, abundance and availability | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| Disturbance across the site | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| Barriers to connectivity | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A017** | **Cormorant *Phalacrocorax carbo*** |
| Conservation objective | To maintain the favourable conservation condition of cormorant in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| Attribute | Measure | Target |
| Breeding population size | Number | Long term population trend within the SPA is stable or increasing |
| Spatial distribution | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| Forage spatial distribution, extent, abundance and availability | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| Disturbance across the site | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| Barriers to connectivity | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A018** | **Shag *Phalacrocorax aristotelis*** |
| Conservation objective | To maintain the favourable conservation condition of shag in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| Breeding population size | Number | Long term population trend within the SPA is stable or increasing |
| Spatial distribution | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| Forage spatial distribution, extent, abundance and availability | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| Disturbance across the site | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |

| | | |
|---|---|---|
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A183** | **Lesser Black-backed Gull *Larus fuscus*** |
| **Conservation objective** | To maintain the favourable conservation condition of lesser black-backed gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A192** | **Roseate Tern *Sterna dougallii*** |
| **Conservation objective** | To maintain the favourable conservation condition of roseate tern in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A193** | **Common Tern *Sterna hirundo*** |
| **Conservation objective** | To maintain the favourable conservation condition of common tern in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |

| | | |
|---|---|---|
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A194** | **Arctic Tern *Sterna paradisaea*** |
| **Conservation objective** | To maintain the favourable conservation condition of arctic tern in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A195** | **Little Tern *Sterna albifrons*** |
| **Conservation objective** | To maintain the favourable conservation condition of little tern in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A204** | **Puffin *Fratercula arctica*** |
| **Conservation objective** | To maintain the favourable conservation condition of puffin in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Breeding population size** | Number | Long term population trend within the SPA is stable or increasing |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |

| | | |
|---|---|---|
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A001** | **Red-throated Diver *Gavia stellata*** |
| **Conservation objective** | To maintain the favourable conservation condition of red-throated diver in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A003** | **Great Northern Diver *Gavia immer*** |
| **Conservation objective** | To maintain the favourable conservation condition of great northern diver in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A065** | **Common Scoter *Melanitta nigra*** |
| **Conservation objective** | To maintain the favourable conservation condition of common scoter in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |

| | | |
|---|---|---|
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A179** | **Black-headed Gull *Chroicocephalus ridibundus*** |
| **Conservation objective** | To maintain the favourable conservation condition of black-headed gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A182** | **Common Gull *Larus canus*** |
| **Conservation objective** | To maintain the favourable conservation condition of common gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A187** | **Great Black-backed Gull *Larus marinus*** |
| **Conservation objective** | To maintain the favourable conservation condition of great black-backed gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |

| | | |
|---|---|---|
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity and site use** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A862** | **Little Gull *Hydrocoloeus minutus*** |
| **Conservation objective** | To maintain the favourable conservation condition of little gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Non-breeding population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A009** | **Fulmar *Fulmarus glacialis*** |
| **Conservation objective** | To maintain the favourable conservation condition of fulmar in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population size** | Number | Long term SPA population trend is stable or increasing |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | A184 | Herring Gull *Larus argentatus* |
| **Conservation objective** | To maintain the favourable conservation condition of herring gull in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |

| Attribute | Measure | Target |
|---|---|---|
| **Population size** | Number | Long term SPA population trend is stable or increasing |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | **A188** | **Kittiwake *Rissa tridactyla*** |
| **Conservation objective** | To maintain the favourable conservation condition of kittiwake in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population size** | Number | Long term SPA population trend is stable or increasing |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | A199 | Guillemot *Uria aalge* |
| **Conservation objective** | To maintain the favourable conservation condition of guillemot in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Population size** | Number | No significant decline |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |
| **Species** | A200 | Razorbill *Alca torda* |
| **Conservation objective** | To maintain the favourable conservation condition of razorbill in North-west Irish Sea SPA, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |

| | | |
|---|---|---|
| **Population size** | Number | Long term SPA population trend is stable or increasing |
| **Spatial distribution** | Hectares, timing and intensity of use | Sufficient number of locations, area, and availability (in terms of timing and intensity of use) of suitable habitat to support the population |
| **Forage spatial distribution, extent, abundance and availability** | Location and hectares, and forage biomass | Sufficient number of locations, area of suitable habitat and available forage biomass to support the population target |
| **Disturbance across the site** | Intensity, frequency, timing and duration | The intensity, frequency, timing and duration of disturbance occurs at levels that do not significantly impact the achievement of targets for population size and spatial distribution |
| **Barriers to connectivity** | Number; location; shape; area (hectares) | The number, location, shape and area of barriers do not significantly impact the site population's access to the SPA or other ecologically important sites outside the SPA |

#### 6.1.2.2 Relevant Baseline Information

See Section 5.1.2 and Section 5.1.3 for relevant baseline information.

#### 6.1.2.3 Assessment

Due to the highly localised airborne noise impacts that are predicted (Section 5.2.1) there are no airborne noise impacts as a result of works in the subsea environment that will result in effects to SCI species inside the Ireland's Eye SPA. Noise from vessels involved in the construction of the outfall pipeline in the marine waters of the North-West Irish Sea cSPA will contribute to the potential for disturbance of birds on the water, in addition to visual disturbance.

With regard to visual disturbance, it is possible that vessels operating all along the route of the outfall pipeline corridor and marine diffuser have the potential to cause disturbance to the SCI species of the North-West Irish Sea cSPA, and vessels operating along the final 1km section of the outfall pipeline corridor have the potential to cause disturbance to the SCI species using the marine waters of Ireland's Eye SPA within its boundary. Vessels will be present in this area for up to three months. The will occur between April and October (see Section 3.2.8).

The Ireland's Eye SPA encompasses a large expanse of designated waters (approximately 182 hectares) and the North-West Irish Sea cSPA encompasses a comparatively much larger expanse of designated waters (232,300 hectares) stretching from Dublin Bay to Dundalk Bay and for 40km out to sea. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity, as described by current NatureScot guidance[2] on disturbance distances to bird species. It is judged that a worst case scenario would be two sets of vessels being present at the same time with one group working at or near the marine diffuser, and another group being present approximately 1km landward (to the west of this location). If a theoretical 500m disturbance distance from the working area of the outfall pipeline corridor is applied, which is considered highly conservative based on the findings of Garthe and Hüppop (2004) and Furness and Wade (2012), the marine diffuser vessel group would result in approximately 0.45 hectares of designated subtidal habitat of Ireland's Eye SPA being subject to possible visual disturbance and up to 78.54 hectares of designated subtidal habitat of the North-West Irish Sea cSPA being subject to possible visual disturbance; whilst the second vessel group would result in approximately 21.05 hectares of designated subtidal habitat of Ireland's Eye SPA being subject to possible visual disturbance and another 78.54 hectares of designated subtidal habitat of the North-West Irish Sea cSPA being subject to possible visual disturbance. This represents 11.8% of the total subtidal habitat of the Ireland's Eye SPA and 0.07% of the total subtidal habitat of the North-West Irish Sea cSPA. This level of disturbance actually occurring is unlikely, but if it did occur this would be for a period of no more than several days. More realistic disturbance levels, based on possible vessel positions within the outfall pipeline

[2] https://www.nature.scot/doc/disturbance-distances-selected-scottish-bird-species-naturescot-guidance

corridor, will be approximately half of the worst case based on the possible vessel positions in the outfall pipeline corridor.

There is connectivity between the Ireland's Eye SPA and the surrounding subtidal habitats of the North-West Irish Sea cSPA. Activities in the outfall pipeline corridor could result in disturbance effects on the SCI species of Ireland's Eye SPA or the North-West Irish Sea cSPA using subtidal habitats in the North-West Irish Sea cSPA. Each element of this impact pathway will be considered in turn.

Vessel disturbance impacts could occur in the North-West Irish Sea cSPA from the micro-tunnelling/subsea interface, located approximately 600m offshore from Velvet Strand beach, and terminating at the marine diffuser. Two groups of vessels will be present between April and October moving along the outfall pipeline corridor, with any disturbance impacts being restricted to an area around each group of vessels where their presence could be a stimulus of visual disturbance. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity.

There is also potential for connectivity between the Ireland's Eye SPA and the terrestrial and intertidal habitats in the vicinity of Baldoyle Bay, resulting in potential disturbance effects on SCI species using habitats beyond the Ireland's Eye Spa and North-West Irish Sea cSPA boundaries. The pathways through which an effect can occur during the construction phase is through airborne noise disturbance during the construction of the jacking shaft at both the microtunnelling compounds, and visual disturbance from the microtunnelling compounds. Piling will occur for a period of two weeks during the construction period and the resulting impact is reversible. Visual disturbance will occur in the vicinity of both microtunnelling compounds for the duration of construction. The exact distance is dependent on the species of bird in question.

The SCIs of Ireland's Eye SPA and the North-West Irish Sea cSPA are considered in turn below.

**Cormorant**

Cormorant is considered to be of above average sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). Despite this, evidence from Burbo Bank (CMACS, 2008) and Robin Rigg (E.ON / Natural Power, 2012) offshore wind farms has shown that densities of cormorant increased during the construction phase. Cormorant is relatively flexible with respect to habitat use (Garthe and Hüppop, 2004; Furness and Wade, 2012).

Usage of the subsea habitat in the vicinity of the proposed GDD project regularly by cormorant suggests that disturbance and displacement will occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of subtidal and coastal habitat means there is likely to be substantial alternative habitat within the marine waters of the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area no birds were recorded within the zone of influence of the impact pathways identified.

No birds would be lost from the Ireland's Eye SPA population as a result of the above impacts.

On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

It is considered that the breeding population size of cormorant in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of cormorant.

**Herring Gull**

Herring gull is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is considered that herring gull will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subtidal habitat in the vicinity of the proposed GDD project suggests that disturbance and displacement of herring gull could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. The total area of subtidal habitat affected is approximately 3 hectares.

The flexible habitat usage and highly mobile nature means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to these areas. For any birds that are displaced, the high local availability of subtidal habitat within the marine waters of the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction. No birds would be lost from the Ireland's Eye SPA or North-West Irish Sea cSPA population as a result of the above impacts.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of a these birds, none of which would be lost from the SPA population. Indeed, it is highly likely that many of these birds will not belong to the Ireland's Eye SPA population in any case but they will be a part of the North-West Irish Sea cSPA population.

On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

It is considered that the breeding and non-breeding population size of herring gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding and non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of herring gull.

**Kittiwake**

Kittiwake is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is considered that kittiwake will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subsea habitat in the vicinity of the proposed GDD project suggests that disturbance and displacement of kittiwake could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. For any birds that are displaced, the high local availability of subtidal habitat within the marine waters of the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction. The total area of subtidal habitat affected is approximately 3 hectares.

No birds would be lost from the Ireland's Eye SPA population as a result of the above impacts.

No birds were recorded within the Baldoyle Bay study area within the zone of influence of these impact pathways. No birds would be lost from the Ireland's Eye SPA population.

On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

It is considered that the breeding and non-breeding population size of kittiwake in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding and non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of kittiwake.

**Guillemot**

Guillemot is a species of medium vulnerability to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). They were the most frequently recorded bird species on the sea during the time of the year where construction vessels will be active in the outfall pipeline corridor and marine diffuser (April to October). Birds were most commonly recorded within 500m of Ireland's Eye and much less so in the outfall pipeline corridor (see Figures 6.1 and 6.2).

Usage of the subsea habitat in the vicinity of the proposed GDD project regularly by guillemot means that disturbance and displacement will occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance), and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). Based on the lower numbers of birds observed in the majority of the outfall pipeline corridor, these areas of subtidal habitat are not considered to be critical to the population of this species, and there are substantial areas of alternative subtidal habitat within the marine waters of the North-West Irish Sea cSPA in the local area beyond the zone of influence of these impact pathways of the proposed GDD project which birds can continue to utilise throughout the construction phase.

Survey data suggests that guillemots feed in areas beyond the zone of the influence of the proposed project. This is supported by the published mean foraging distance of 37.8km from colonies (Woodward *et al.*, 2019). Outwith the time period where guillemots leave the breeding colony (July to mid-August) no birds would be lost from the SPA population as a result of this impact pathway. However, within this time period birds are potentially more sensitive to disturbance and displacement impacts, and if vessel activity is not appropriately managed in this time period birds could be lost from the SPA population.

Within the Baldoyle Bay study area no birds were recorded within the zone of influence of the impact pathways identified. No birds would be lost from the Ireland's Eye SPA population. On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site outwith the time period of July to mid-August. During this time, mitigation is required and is discussed in Section 7.2. It is considered that at a population level, the North-West Irish Sea cSPA Guillemot population will not be susceptible to significant visual vessel disturbance impacts except for the July to mid-August period. During this time, mitigation is required and is discussed in Section 7.2.

It is considered that the breeding and non-breeding population size of guillemot in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding and non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of guillemot.

**Razorbill**

Razorbill is a species of medium vulnerability to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012). They were the most frequently recorded birds on the sea during the time of the year where vessels are likely to be active in the outfall pipeline corridor and marine diffuser (April to October). Birds were most commonly recorded within 500m of Ireland's Eye and much less so in the outfall pipeline corridor (Figures 6.3 and 6.4).

Usage of the subsea habitat in the vicinity of the proposed GDD project regularly by razorbill means that disturbance and displacement will occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). Based on the lower numbers of birds observed in the majority of the outfall pipeline corridor, these areas of subtidal habitat are not considered to be critical to the population of this species, and there are substantial areas of alternative subtidal habitat within the marine waters of the North-West Irish Sea cSPA in the local area beyond the zone of influence of these impact pathways of the proposed GDD project which birds can continue to utilise throughout the construction phase.

Survey data suggests that razorbills feed in areas beyond the zone of the influence of the proposed project. This is supported by the published mean foraging distance of 23.7km from colonies (Woodward *et al.*, 2019). Outwith the time period where razorbills leave the breeding colony (July to mid-August) no birds would be lost from the

SPA population as a result of this impact pathway. However, within this time period birds are potentially more sensitive to disturbance and displacement impacts, and if vessel activity is not appropriately managed in this time period birds could be lost from the SPA population.

Within the Baldoyle Bay study area no birds were recorded within the zone of influence of the impact pathways identified. No birds would be lost from the Ireland's Eye SPA population.

On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site outwith the time period of July to mid-August. During this time, mitigation is required and is discussed in Section 7.2.

It is considered that at a population level, the North-West Irish Sea cSPA Razorbill population will not be susceptible to significant visual vessel disturbance impacts except for the July to the mid-August period. During this time, mitigation is required and is discussed in Section 7.2.

It is considered that the breeding and non-breeding population size of razorbill in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding and non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of razorbill.

**Red-throated Diver**

Red-throated diver is a species with high sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012; Mendel, *et al.*, 2019; Dierschke, *et al.*, 2016) and small foraging range (Woodward *et al.*, 2019). However, as for other diver species, the response to human disturbance may vary between individuals (Gittings *et al.* 2015). They were the most frequently recorded on the sea during the winter and passage periods (August to April), which partially overlaps with the time when construction vessels will be active in the outfall pipeline corridor and marine diffuser (April to October). Most records of birds were between 1.5 and 2km of Ireland's Eye in the marine waters of the North-West Irish Sea cSPA, with less than 30 records in the outfall pipeline corridor.

Due to the very limited use of the subsea habitat in the vicinity of the proposed GDD project by red-throated diver, there will be minimal impacts resulting from disturbance and displacement in the vicinity of the outfall pipeline corridor and marine diffuser during construction. Any disturbance/displacement effects that do occur in the North-West Irish Sea cSPA will be on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea within the very large expanse of marine waters of the North-West Irish Sea cSPA that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of adjacent marine habitat within the marine waters of the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population. It is considered that the non-breeding population size of red-throated diver in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of red-throated diver.

**Great Northern Diver**

Great northern diver is a species with high sensitivity to vessel traffic (Furness *et al.,* 2013, Furness and Wade, 2012, Jarrett *et al.,* 2018). However, as for other diver species, the response to human disturbance may vary between individuals (Gittings *et al.* 2015). Great northern diver were recorded in very low numbers during the winter period (November and March); no birds were recorded during the breeding season. All observations of great northern diver were recorded between 1.5 and 2km of Ireland's Eye in the North-West Irish Sea cSPA.

A single individual was recorded within the Baldoyle Bay study area during November, which was recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population.

Due to the very limited use of the subsea habitat in the vicinity of the proposed GDD project by Great northern diver, there will be minimal impacts resulting from disturbance and displacement in the vicinity of the outfall pipeline corridor and marine diffuser during construction. Any disturbance/displacement effects that do occur will be on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of adjacent habitat within the marine waters of the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat in the marine waters of the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

It is considered that the non-breeding population size of great northern diver in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of great northern diver.

**Fulmar**

Fulmar is a highly pelagic, mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). Usage of the subsea habitat in the vicinity of the proposed GDD project suggests that disturbance and displacement of fulmar could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. For any birds that are displaced, there is high local availability of subtidal habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

It is considered that the breeding and non-breeding population size of fulmar in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding and non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of fulmar.

**Manx Shearwater**

Manx shearwater is a highly pelagic, mobile species that spend a significant amount of time at sea. They have a very low sensitivity to vessel traffic (Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). A total of 26 observations of Manx shearwater were recorded. The very low usage of the subsea habitat in the vicinity of the proposed GDD project suggests that disturbance and displacement of Manx shearwater could occur in the North-West Irish Sea cSPA from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. For any birds that are displaced, the high local availability of subtidal habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

It is considered that the breeding population size of Manx shearwater in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of Manx shearwater.

**Shag**

Shag is considered to be of medium sensitivity to vessel traffic (Furness and Wade, 2012). Similar to cormorant, shag is relatively flexible with respect to habitat use (Furness and Wade, 2012). They were most frequently recorded during the time of the year where vessels are likely to be active in the outfall pipeline corridor and marine diffuser (April to October). Birds were most commonly recorded within 500m of Ireland's Eye and much less so in the outfall pipeline corridor in the North-West Irish Sea cSPA.

Usage of the subsea habitat in the vicinity of the proposed GDD project regularly by shag suggests that disturbance and displacement may occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of subtidal and coastal habitat means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study small numbers of birds were recorded each month within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population.

No birds would be lost from the Ireland's Eye SPA population as a result of the above impacts. On this basis, it is considered the conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

It is considered that the breeding population size of shag in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of shag.

**Little Gull**

There is limited research on the sensitivity of little gull to vessel traffic, however their response is likely to be similar to other gull species which is considered to be very low (Garthe and Hüppop, 2004; Furness and Wade, 2012). There were no observations for little gull recorded during any of the surveys undertaken between 2018 and 2023.

It is considered that the non-breeding population size of little gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of little gull.

**Black-headed Gull**

Black-headed gull is a highly mobile species that spends a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and has large foraging ranges (Woodward *et al.*, 2019). It is considered that black-headed gull will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subtidal habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project suggests that disturbance and displacement of black-headed gull could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. The total area of subtidal habitat potentially affected is approximately 3 hectares.

The flexible habitat usage and highly mobile nature means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to these areas. For any birds that are displaced, the high local availability of subtidal habitat in the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of a these birds, none of which would be lost from the SPA population.

It is considered that the non-breeding population size of black-headed gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of black-headed gull.

**Common Gull**

Common gull is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is considered that common gull will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subtidal habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project suggests that disturbance and displacement of common gull could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. The total area of subtidal habitat potentially affected is approximately 3 hectares.

The flexible habitat usage and highly mobile nature means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to these areas. For any birds that are displaced, the high local availability of subtidal habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of a these birds, none of which would be lost from the SPA population.

It is considered that the non-breeding population size of common gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of common gull.

**Lesser Black-backed Gull**

Lesser black-backed gull is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have very large foraging ranges (Woodward *et al.*, 2019). It is considered that lesser black-backed gull will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subtidal habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project suggests that disturbance and displacement of lesser black-backed gull could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. The total area of subtidal habitat potentially affected is approximately 3 hectares.

The flexible habitat usage and highly mobile nature means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to these areas. For any birds that are displaced, the high local availability of subtidal habitat in the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of a these birds, none of which would be lost from the SPA population. Indeed, it is highly likely that many of these birds will not belong to the Ireland's Eye SPA population in any case.

It is considered that the breeding population size of lesser black-backed gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of lesser black-backed gull.

**Great Black-backed Gull**

Great black-backed gull is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is considered that great black-backed gull will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subtidal habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project suggests that disturbance and displacement of great black-backed gull could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks), localised (within 100m of each location, occurring sequentially) and reversible basis. The total area of subtidal habitat affected is approximately 3 hectares.

The flexible habitat usage and highly mobile nature means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to these areas. For any birds that are displaced, the high local availability of subtidal habitat in the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population. Indeed, it is highly likely that many of these birds will not belong to the Ireland's Eye SPA population in any case.

It is considered that the non-breeding population size of great black-backed gull in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of great black-backed gull.

**Little Tern**

Little tern is assessed to have a medium sensitivity to human disturbance at breeding colonies, although away from breeding grounds, sensitivity is considered to be low (Garthe and Hüppop, 2004, Perrow *et al.* 2006, 2011a,b). There were no observations for little tern recorded during any of the surveys undertaken between 2018 and 2023.

It is considered that at a population level, the North-West Irish Sea cSPA Little tern population will not be affected. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur.

**Roseate Tern**

Roseate tern is a species with medium sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012) and small foraging range (Woodward *et al.*, 2019). Only three records of roseate terns were made during the surveys undertaken between 2018 and 2023. All observations of roseate tern were recorded between 1.5 and 2km of Ireland's Eye.

Due to the very limited use of the subsea habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project by roseate tern, there will be minimal impacts resulting from disturbance and displacement in the vicinity of the outfall pipeline corridor and marine diffuser during construction. Any disturbance/displacement effects that do occur will be on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of adjacent habitat in the North-West Irish Sea cSPA means there is likely to be substantial alternative habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study area birds were recorded within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population.

It is considered that the breeding population size of roseate tern in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of roseate tern.

**Common Tern**

Common tern is a species with low sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012) and small foraging range (Woodward *et al.*, 2019). The majority of records for common tern were between 1.5 and 2km from Ireland's Eye and much less so in the outfall pipeline corridor. They were most frequently recorded during the time of the year where vessels are likely to be active in the outfall pipeline corridor and marine diffuser (April to October) in the North-West Irish Sea cSPA.

Usage of the subsea habitat in the North-West Irish Sea cSPA in the vicinity of the proposed GDD project regularly by common tern suggests that disturbance and displacement will occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of subtidal and coastal habitat means there is likely to be substantial alternative habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study, small numbers of birds were recorded during the summer period (May to August) within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population. Indeed, it is highly likely that these birds will not belong to the Ireland's Eye SPA population in any case.

It is considered that the breeding population size of common tern in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of common tern.

**Arctic Tern**

Arctic tern is a species with low sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012) and small foraging range (Woodward *et al.*, 2019). The majority of records for Arctic tern were between 1.5 and 2km from Ireland's Eye in theNorth-West Irish Sea cSPA but much less so in the outfall pipeline corridor. They were most frequently recorded during the time of the year where vessels are likely to be active in the outfall pipeline corridor and marine diffuser (April to October).

Therefore it is possible that a very limited amount of disturbance and displacement will occur from waters in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of subtidal and coastal habitat means there is likely to be substantial alternative habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

Within the Baldoyle Bay study, very small numbers of birds were recorded during the summer period (June to August) within the zone of influence of the airborne noise and visual disturbance impact pathway. For the same reasons described above, the highly localised, temporary and reversible nature of the impact pathway could result in a temporary redistribution of these birds, none of which would be lost from the SPA population. Indeed, it is highly likely that these birds will not belong to the Ireland's Eye SPA population in any case.

It is considered that the breeding population size of Arctic tern in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of Arctic tern.

**Puffin**

Puffin is a species with medium sensitivity to vessel traffic (Garthe and Hüppop, 2004; Furness and Wade, 2012) and a large foraging range (Woodward *et al.*, 2019). The majority of records for puffin were within 500m and between 1.5 and 2km from Ireland's Eye in the North-West Irish Sea cSPA. They were most frequently recorded during the time of the year where vessels are likely to be active in the outfall pipeline corridor and marine diffuser (April to October).

Usage of the subsea habitat in the vicinity of the proposed GDD project regularly by puffin suggests that disturbance and displacement will occur from marine waters in the North-West Irish Sea cSPA in the vicinity of the outfall pipeline corridor and marine diffuser during construction. This will occur on a short term, localised and reversible basis due to the presence of two groups of vessels, (visual disturbance) and piling at the microtunnelling/subsea interface and fibre optic cable crossing (noise disturbance occurring sequentially at each location). The flexible habitat usage of this species means that birds are capable of utilising areas of sea that will be beyond the zone of influence of the (visual) vessel disturbance and (noise) piling disturbance impact pathways, and that they are not heavily dependent on the area directly within or adjacent to the outfall pipeline corridor or the marine diffuser. For any birds that are displaced, the high local availability of subtidal and coastal habitat means there is likely to be substantial alternative habitat in the North-West Irish Sea cSPA beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

It is considered that the breeding population size of puffin in the North-West Irish Sea cSPA will remain stable. The spatial distribution of the population across the site, as regards to area, timing and intensity of use shall not be diminished. Sufficient locations, areas and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency, timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the breeding populations' access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of puffin.

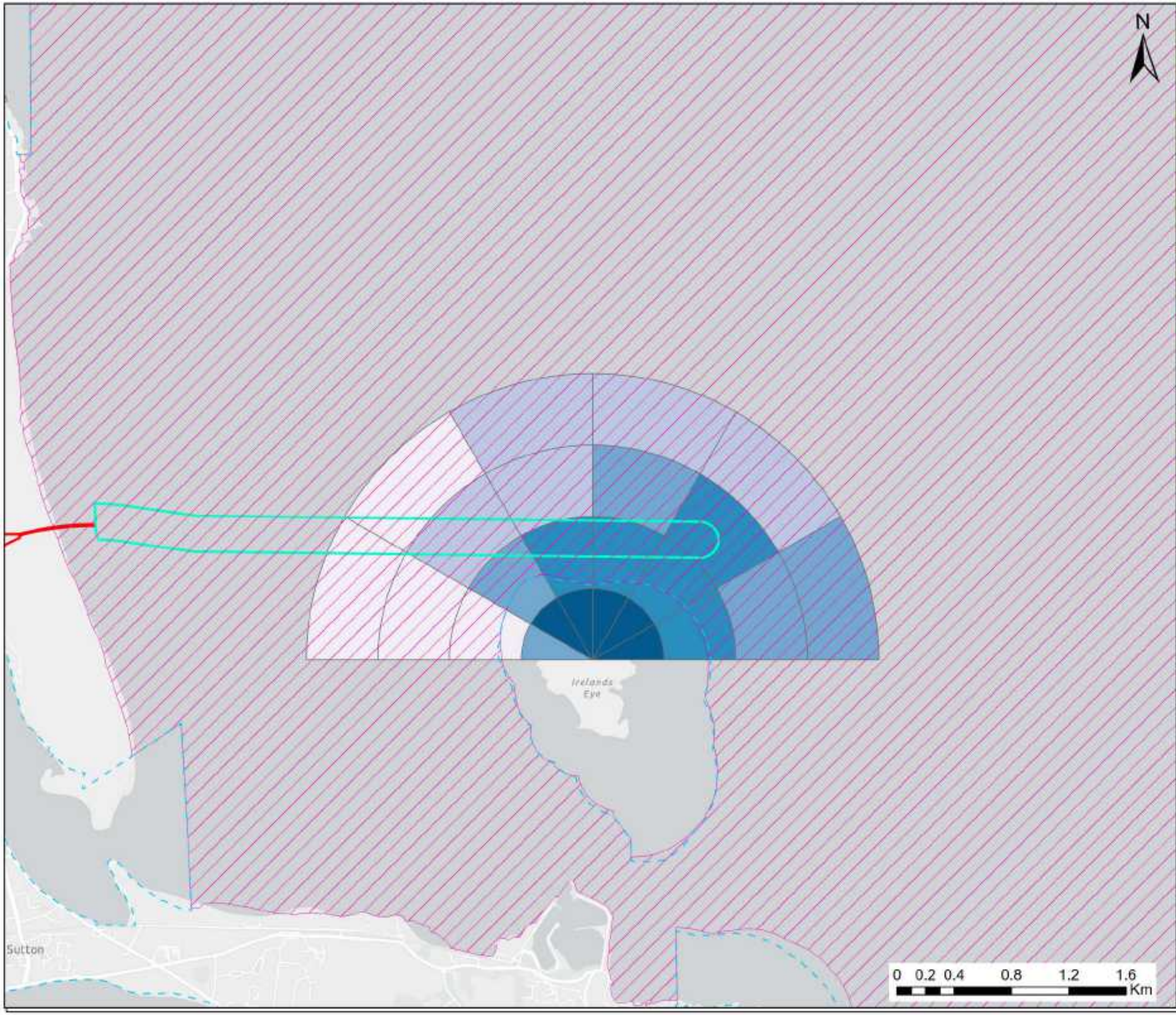
**Common Scoter**

Common scoters were present during the winter months (refer to Table A10.8 in Appendix C) with a peak count of 151 birds in November 2022. Common scoter were completely absent between April and August and present in relatively low numbers during other months (refer to Graph A10.14 in Appendix C). Of the 95 common scoters recorded on the water during VP surveys between March and October, 77 (81.2%) were recorded loafing, whilst 13 birds (13.7%) were recorded feeding (Table A10.18, Appendix C). Records were the most numerous in bands and sectors away from coastlines and in open water. Common scoter utilise the shallow nearshore coastal waters of the wider North-west Irish sea region across the non-breeding period, with over 14,000 individuals recorded in marine waters off Gormanstown in 2018, but it is recognised that their flocks can be quite mobile. It is a diving duck that feeds on prey species that live upon or within the upper few centimetres of the substratum and it's diet primarily comprises of bivalve molluscs (NPWS, 2023).

It is considered that the North-West Irish Sea cSPA common scoter non-breeding population size will not significantly decline. The spatial distribution of the population across the site, as regards area, timing and intensity of use shall not be diminished. Sufficient locations, areas, and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. The intensity, frequency timing and duration of disturbance across the site shall not occur at levels that significantly impact the achievement of targets for population size and spatial distribution. No permanent barriers to connectivity shall be installed as part of the Proposed Project at operational phase. No temporary barriers which could impact the non-breeding common scoter population access to the SPA or other ecologically important sites outside the SPA will occur at construction phase.

Temporary effects of construction capable of resulting in disturbance impacts are not significant at a population level. Adverse effects on the integrity of the North-West Irish Sea cSPA will not occur as a result of short term, localised and reversible disturbance or displacement of common scoter.

**Figure 6.1**




**Legend**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Special Protection Area
- North West Irish Sea cSPA

Index of Abundance

Razorbill - Not Feeding

- 0 - 33
- 34 - 151
- 152 - 318
- 319 - 518
- 519 - 962

| Rev. | Date | Purpose of revision | Drawn | Checkd | Rev'd | Appr |
|---|---|---|---|---|---|---|
| 0 | 25/10/2023 | Final | NR | JN | RR | RR |

Jacobs

Client: Uisce Éireann Irish Water

Project: Greater Dublin Drainage Project

Drawing Title: Figure 6-1 - Distribution of Non-Feeding Razorbill Records from Ireland's Eye Vantage Point during Breeding Season (March to October)

Drawing Status: Final

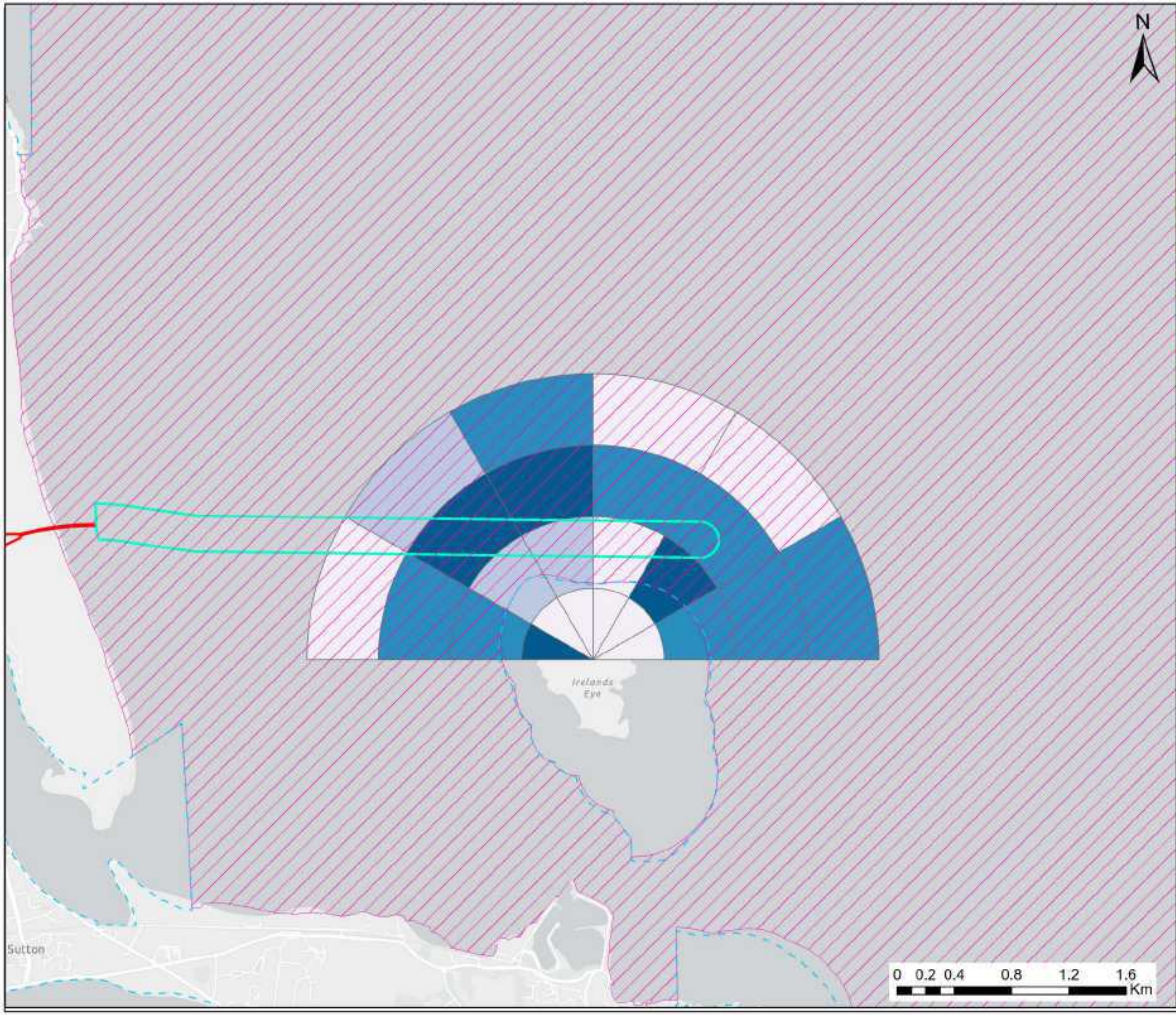
Scale @A3: 1:25,000 DO NOT SCALE

Filepath:

Drawing No. IE000258-RPS-AP-XX-D-Z-0001-A1.C01

This drawing is not to be used in whole or in part other than for the intended purpose and project as defined on this drawing. Refer to the contract for full terms and conditions.

**Figure 6.2**




**Legend**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Special Protection Area
- North West Irish Sea cSPA

Index of Abundance

Guillemot - Feeding

- 0
- 1
- 4 - 13
- 14 - 202

| 0 | 25/10/2023 | Final | NR | JM | RR | RR |
|---|---|---|---|---|---|---|
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Apprd |

Jacobs

Client: Uisce Éireann Irish Water

Project: Greater Dublin Drainage Project

Drawing Title: Figure 6-2 - Distribution of Feeding Guillemot Records from Ireland's Eye Vantage Point during Breeding Season (March to October)

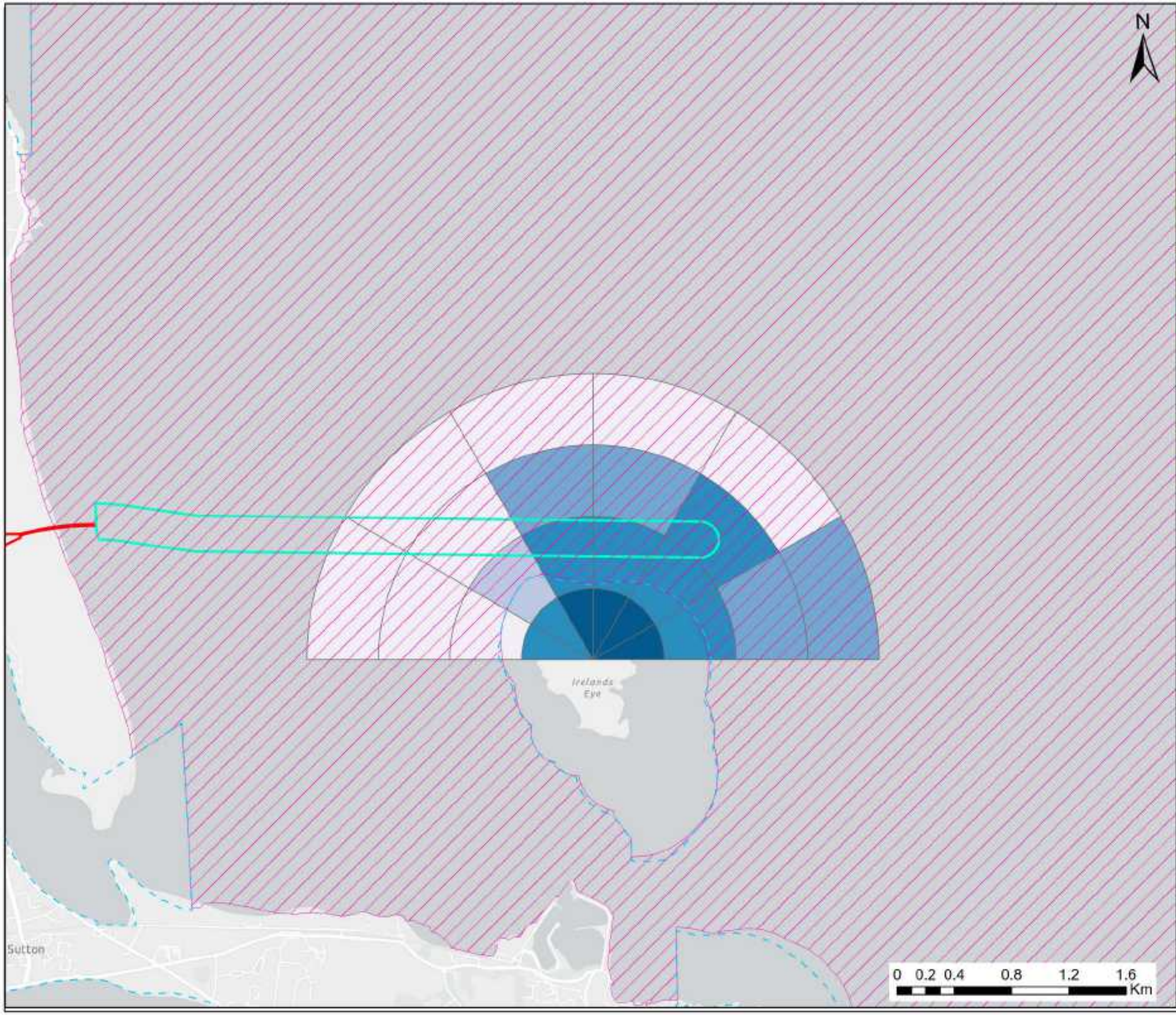
Drawing Status: **Final**

Scale @A3: 1:25,000 DO NOT SCALE

Filepath:

Drawing No. IE000258-RPS-AP-XX-D-Z-0002-A1.C01

**Figure 6-3**




**Legend**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Special Protection Area
- North West Irish Sea cSPA

Index of Abundance

Guillemot - Not Feeding

- 0 - 48
- 49 - 154
- 155 - 301
- 302 - 622
- 623 - 1121

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 0 | 25/10/2023 | Final | NR | JM | RR | RR |

Client

Project: Greater Dublin Drainage Project

Drawing Title: Figure 6-3 - Distribution of Non-feeding Guillemot Records from Ireland's Eye Vantage Point during Breeding Season (March to October)

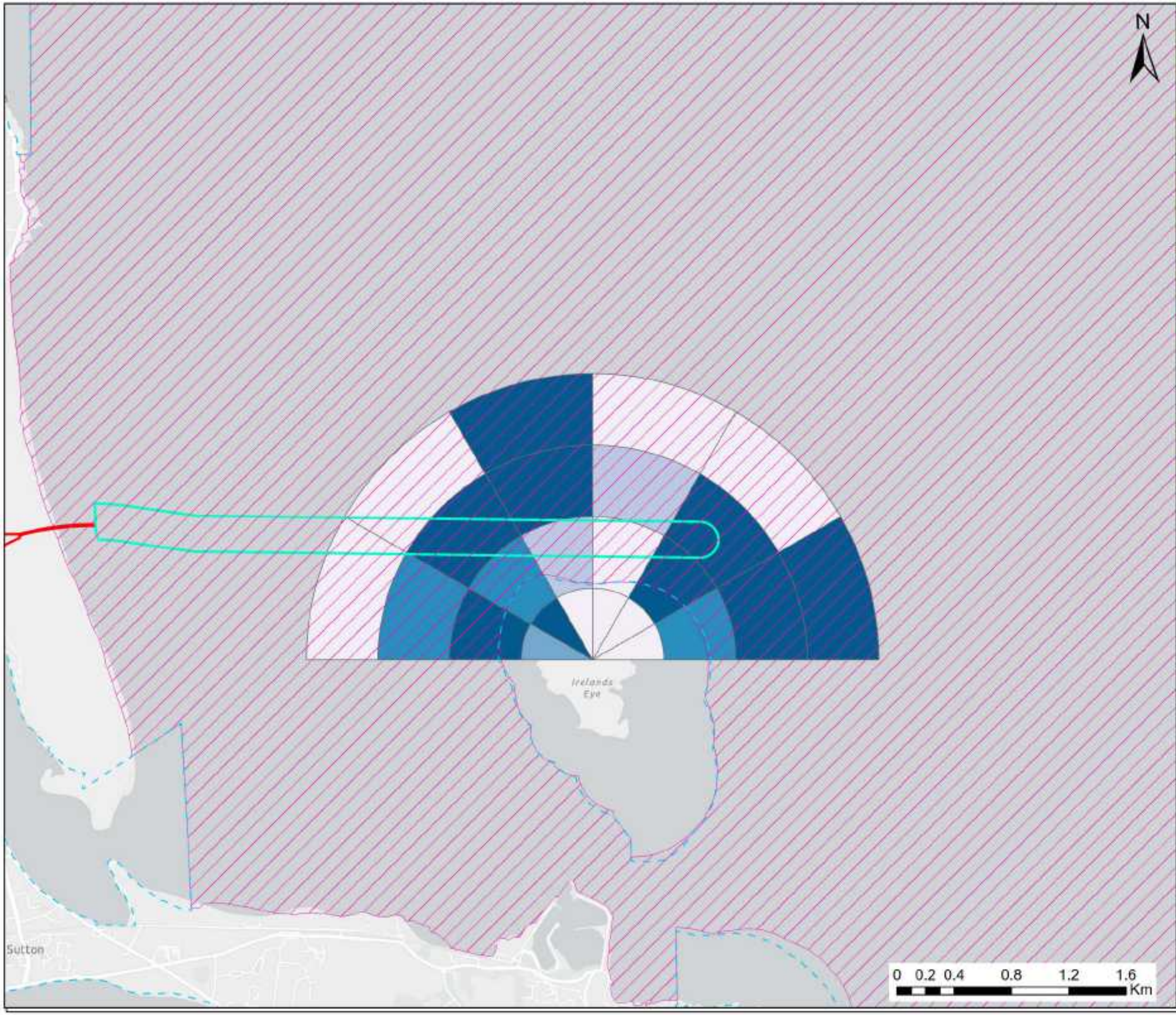
Drawing Status: **Final**

Scale @A3: 1:25,000 DO NOT SCALE

Filepath

Drawing No. IE000258-RPS-AG-XX-D-Z-0003-A1.C01

**Figure 6-4**




**Legend**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Special Protection Area
- North West Irish Sea cSPA

Index of Abundance

Razorbill - Feeding

- 0
- 1 - 2
- 3
- 4 - 5
- 6 - 211

| 0 | 25/10/2023 | Final | NR | JM | RR | RR |
|---|---|---|---|---|---|---|
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |

Jacobs

Client: Uisce Éireann Irish Water

Project: Greater Dublin Drainage Project

Drawing Title: Figure 6-4 - Distribution of Feeding Razorbill Records from Ireland's Eye Vantage Point during Breeding Season (March to October)

Drawing Status: **Final**

Scale @A3: 1:25,000 DO NOT SCALE

Filepath:

Drawing No. IE000258-RPS-AG-XX-D-Z-0904-A1.C01

#### 6.1.3 Other European Sites

The following European Sites are all located at a minimum distance of 2.3km and maximum distance of 16.9km from the proposed Project.

##### 6.1.3.1 North Bull Island SPA

This SPA lies 2.3km to the south of the marine outfall (see Figure 1-1).

No noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the North Bull Island SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed GDD project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmlingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the North Bull Island SPA are more likely to utilise habitat within this SPA and the adjacent South Dublin Bay and River Tolka Estuary SPA, and the subsea habitats in the vicinity of these SPAs.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

##### 6.1.3.2 Malahide Estuary SPA

This SPA lies 2.5km to the north of the marine outfall (see Figure 1-1).

Regarding airborne noise, no noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the Malahide Estuary SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed GDD project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmlingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the Malahide Estuary SPA are more likely to utilise habitat within this SPA and the adjacent subsea habitats.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

##### 6.1.3.3 Howth Head Coast SPA

This SPA lies 2.6km to the south of the marine outfall (see Figure 1-1).

There are no airborne noise or visual disturbance impacts as a result of works in the subsea environment that will result in effects to SCI species inside this SPA due to the distance between this SPA and the proposed GDD project.

There is potential for connectivity between the Howth Head Coast SPA and the subtidal habitats in the vicinity of the outfall pipeline corridor. This could result in disturbance effects on the SCI species using subtidal habitats beyond the SPA boundary. Each element of this impact pathway will be considered in turn.

Airborne noise impacts in the subsea environment (where activities will result in a sound power level of >65 dB $LA_{max}$) are restricted to the areas where piling will be carried out at the microtunnelling/subsea interface and fibre optic cable crossing. Noise levels with the potential to impact birds are predicted to propagate up to 100m from the piling source to encompass an approximate area of 3 hectares, and are expected to last for a maximum of two weeks. They will likely be sequential in nature rather than simultaneous. The result of these works would result in the loss of approximately 3 hectares of subtidal habitat for a period not exceeding four weeks during the construction phase of the proposed GDD project.

Vessel disturbance impacts could occur from the micro-tunnelling/subsea interface, located approximately 600m offshore from Velvet Strand beach, and terminating at the marine diffuser. Two groups of vessels will be present between April and October moving along the outfall pipeline corridor, with any disturbance impacts being restricted to an area around each group of vessels. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity.

There is no potential for connectivity between the Howth Head Coast SPA and the terrestrial and intertidal habitats in the vicinity of Baldoyle Bay due to the fact that the only SCI species is kittiwake. No birds were recorded within the Baldoyle Bay study area within the zone of influence of the impact pathways identified. No birds would be lost from the Howth Head Coast SPA population.

Kittiwake is a highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is considered that kittiwake will not be susceptible to visual vessel disturbance impacts for this reason.

Usage of the subsea habitat in the vicinity of the proposed GDD project suggests that disturbance and displacement of kittiwake could occur from waters in the vicinity of the microtunnelling/subsea interface and fibre optic cable crossing during piling. This will occur on a short term (two weeks in each location), localised (within 100m of each location, occurring sequentially) and reversible basis. For any birds that are displaced, there is high local availability of subtidal habitat beyond the zone of influence of the proposed GDD project which birds can continue to utilise throughout construction.

No birds would be lost from the Howth Head Coast SPA population as a result of the above impacts.

On this basis, it is considered the conservation objectives of the Howth Head Coast SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

#### 6.1.3.4 South Dublin Bay and River Tolka Estuary SPA

This SPA lies 7.6km to the south of the marine outfall (see Figure 1-1).

No noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the South Dublin Bay and River Tolka Estuary SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the South Dublin Bay and River Tolka Estuary SPA are more likely to utilise habitat within this SPA and the adjacent subsea habitats.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.1.3.5 Rogerstown Estuary SPA

This SPA lies 8.5km to the north of the marine outfall (see Figure 1-1).

Regarding airborne noise, no noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the Rogerstown Estuary SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed GDD project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmlingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the Rogerstown Estuary SPA are more likely to utilise habitat within this SPA and the adjacent subsea habitats.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.1.3.6 Lambay Island SPA

This SPA lies 9.3km to the northeast of the marine outfall (see Figure 1-1).

There are no airborne noise or visual disturbance impacts as a result of works in the subsea environment that will result in effects to SCI species inside this SPA due to the distance between this SPA and the proposed GDD project.

There is potential for connectivity between the Lambay Island SPA and the subtidal habitats in the vicinity of the outfall pipeline corridor. This could result in disturbance effects on the SCI species using subtidal habitats beyond the SPA boundary. Each element of this impact pathway will be considered in turn.

Airborne noise impacts in the subsea environment (where activities will result in a sound power level of >65 dB $LA_{max}$) are restricted to the areas where piling will be carried out at the microtunnelling/subsea interface and fibre optic cable crossing. Noise levels with the potential to impact birds are predicted to propagate up to 100m from the piling source to encompass an approximate area of 3 hectares, and are expected to last for a maximum of two weeks. They will likely be sequential in nature rather than simultaneous. The result of these works would result in the loss of approximately 3 hectares of subtidal habitat for a period not exceeding four weeks during the construction phase of the proposed GDD project.

Vessel disturbance impacts could occur from the micro-tunnelling/subsea interface, located approximately 600m offshore from Velvet Strand beach, and terminating at the marine diffuser. Two groups of vessels will be present between April and October moving along the outfall pipeline corridor, with any disturbance impacts being restricted to an area around each group of vessels. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity.

There is no potential for connectivity between the Lambay Island SPA and the terrestrial and intertidal habitats in the vicinity of Baldoyle Bay. This is due to the distance between this SPA and the proposed GDD project, meaning that the possibility of SCI species present in the zones of impact being birds of this SPA is highly remote.

No birds would be lost from the Lambay Island SPA population as a result of the above impacts.

On this basis, it is considered the conservation objectives of the Lambay Island SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

#### 6.1.3.7 Dalkey Island SPA

This SPA lies 14.9km to the south of the marine outfall (see Figure 1-1).

There are no airborne noise or visual disturbance impacts as a result of works in the subsea environment that will result in effects to SCI species inside this SPA.

There is potential for connectivity between the Dalkey Island SPA and the subtidal habitats in the vicinity of the outfall pipeline corridor. This could result in disturbance effects on the SCI species using subtidal habitats beyond the SPA boundary. Each element of this impact pathway will be considered in turn.

Airborne noise impacts in the subsea environment (where activities will result in a sound power level of >65 dB $LA_{max}$) are restricted to the areas where piling will be carried out at the microtunnelling/subsea interface and fibre optic cable crossing. Noise levels with the potential to impact birds are predicted to propagate up to 100m from the piling source to encompass an approximate area of 3 hectares, and are expected to last for a maximum of two weeks. They will likely be sequential in nature rather than simultaneous. The result of these works would result in the loss of approximately 3 hectares of subtidal habitat for a period not exceeding four weeks during the construction phase of the proposed GDD project.

Vessel disturbance impacts could occur from the micro-tunnelling/subsea interface, located approximately 600m offshore from Velvet Strand beach, and terminating at the marine diffuser. Two groups of vessels will be present between April and October moving along the outfall pipeline corridor, with any disturbance impacts being restricted to an area around each group of vessels. The exact distance at which birds may be disturbed is dependent on a range of factors, with different species possessing varying sensitivity.

There is no potential for connectivity between the Dalkey Island SPA and the terrestrial and intertidal habitats in the vicinity of Baldoyle Bay. This is due to the distance between this SPA and the proposed GDD project, meaning that the possibility of SCI species present in the zones of impact being birds of this SPA is highly remote.

No birds would be lost from the Dalkey Island SPA population as a result of the above impacts.

On this basis, it is considered the conservation objectives of the Dalkey Island SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

#### 6.1.3.8 Skerries Islands SPA

This SPA lies 16.7km to the north of the marine outfall (see Figure 1-1).

Regarding airborne noise, no noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the Skerries Islands SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the Skerries Islands SPA are more likely to utilise habitat within this SPA and the adjacent subsea habitats.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.1.3.9 Rockabill SPA

This SPA lies 16.9km to the north of the marine outfall (see Figure 1-1).

Regarding airborne noise, no noise source will propagate into this SPA at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundary. This includes noise from all construction activities in the terrestrial, intertidal and subtidal environments, and encompasses all activities including piling. Visual disturbance distances published by Cutts et al. (2013) indicate that these impacts will not occur at or near this SPA.

Whilst there is potential for connectivity between the Rockabill SPA, Baldoyle Bay SPA and the surrounding terrestrial habitats, and the subtidal habitats in and adjacent to the outfall pipeline corridor, the possibility of significant numbers of birds from this SPA being impacted by the proposed GDD project by this impact pathway is considered to be remote. The reasoning for this is the fact that the birds recorded in and around the Baldoyle Bay SPA are overwhelmingly likely to be birds of the Baldoyle Bay SPA as opposed to be birds from other sites. SCI species of the Rockabill SPA are more likely to utilise habitat within this SPA and the adjacent subsea habitats.

On this basis it is concluded that the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

## 6.2 Impact Pathway - Water quality and habitat deterioration

### 6.2.1 Baldoyle Bay SAC

Based on the information contained in Section 4 there are three potential pathways for LSEs to occur on this SAC; water quality and habitat deterioration, which is discussed here in Section 6.2.1, underwater noise and disturbance, information on which is provided in Section 6.3.1. and habitat loss (see Section 6.4.1).

The proposed marine outfall pipeline passes directly through Baldoyle Bay SAC in a tunnel. The Bay is also discharged into by the Mayne River. This river, along with its tributary the Cuckoo stream, will both is crossed by the orbital sewer just north of the M50 and south of Ballystruan. A satellite compound will be located at the Old Airport Road / R132 Swords Road junction (the Collinstown Crossroads) and will be located approximately 650m from the Mayne River, and approximately 235m from the Cuckoo Stream. The WwTP lies directly south of the Cuckoo Stream.

#### 6.2.1.1 Conservation Objectives

Baldoyle Bay SAC has four SCIs. Table 6-7sets out the conservation objectives for each SCI.

**Table 6-7: Conservation objectives for Baldoyle Bay SAC (NPWS, 2012a)**

| Habitat | Habitat Code | Conservation objective |
|---|---|---|
| 1310, | 1140 | Maintain the favourable conservation condition. |
| **Attribute** | **Measure** | **Target** |
| **Area** | Habitat area was estimated as 409ha using OSi data | The permanent habitat area is stable or increasing, subject to natural processes. |
| **Distribution** | The site exhibits the following community complexes: Fine sand dominated by *Angulus tenuis* and Estuarine sandy mud with *Pygospio elegans* and *Tubificoides benedii.* | Conserve these community types in a natural condition: |
| *Salicornia* and other annuals colonising mud and sand | 1310 | Maintain the favourable conservation condition. |
| **Attribute** | **Measure** | **Target** |
| **Area** | Mosaic of habitat 0.383 Ha | The area should be stable or increasing, subject to natural processes, including erosion and succession. |
| **Distribution** | There are five main areas of saltmarsh in the SAC. Several patches of *Salicornia* habitat located on both sides, towards the lower end of the estuary. | No decline or change in the distribution of these saltmarsh habitats, unless it is the result of natural processes, including erosion, accretion and succession. |
| Atlantic salt meadows *Glauco-Puccinellietalia maritimae (ASM)* | 1330 | Maintain the favourable conservation condition. |
| **Attribute** | **Measure** | **Target** |
| **Area** | Mosaic of habitat 11.976 Ha | The area should be stable or increasing, subject to natural processes, including erosion and succession. |
| **Distribution** | There are five main areas of saltmarsh in the SAC. The main area occurs in the north-west corner of the estuary and to the south of the estuarine river channel. This area contains the largest area of ASM. ASM habitat dominates the older area and is covered by spring tides in Baldoyle Estuary. | No decline or change in the distribution of these saltmarsh habitats, unless it is the result of natural processes, including erosion, accretion and succession. |
| Mediterranean salt meadows *Juncetalia maritime* (MSM) | 1410 | Maintain the favourable conservation condition. |
| **Attribute** | **Measure** | **Target** |
| **Area** | Mosaic of habitat 2.636 Ha | The area should be stable or increasing, subject to natural processes, including erosion and succession. |
| **Distribution** | There are five main areas of saltmarsh in the SAC. The main area occurs in the north-west corner of the estuary and to the south of the estuarine river channel. This area contains a band of MSM on its landward side. The MSM habitat is characterised by clumps of sea rush (*Juncus maritimus*) and is found in small scattered clumps along the landward side of most of the saltmarsh. | No decline or change in the distribution of these saltmarsh habitats, unless it is the result of natural processes, including erosion, accretion and succession. |

#### 6.2.1.2 Relevant Baseline Information

Information on the habitat mapping for Baldoyle Estuary is provided in Section 5.5. Section 5.8 provides details on water quality and the construction and operational plumes.

#### 6.2.1.3 Assessment

The following Likely Significant Effects were identified as part of the screening assessment.

#### 6.2.1.3.1 Pollution Incidents & Elevated Suspended Sediments from Upstream Activities

The potential for LSEs to the SAC are limited to indirect impacts where deterioration occurs through the accidental release of contaminated run-off into the estuary from the tunnelling compounds or construction works upstream, surface water drainage of which flows into the Mayne River catchment and eventually into Baldoyle Bay.

The three saltmarsh related qualifying species within the estuary (i.e. Salicornia and other annuals colonizing mud and sand; Atlantic and Mediterranean salt meadows) are all located on the upper parts of the estuary and are surrounded by existing erosion channels below the level of the habitat. The main channel, fed by the Sluice River in the north, and met by the Mayne River along the western shoreline, meanders along the central part of the estuary below the main vegetation zone. The tidal range within the estuary is 4.1m during spring high waters, with the saltmarsh only surrounded by water during the upper third of the tidal cycle, and only covered by estuarine waters during high water spring events. Consequently, the main saltmarsh is largely unaffected by the water quality during the majority of the tidal cycle and from riverine inputs for significant period of time. When a spring high water event occurs, the overall volume of Baldoyle Bay increases by approximately 1.5 million cubic meters due to the additional 80cm rise in tidal height, increasing the dilution effect of any pollutant within the estuary during this period.

Pollution events that may occur upstream during construction or from the adjacent compounds are deemed to be of low risk, with mitigation applied within the CEMP to trap or isolate discharges where they are likely to occur. However, in the event that a small pollution event does occur, the likely route for this material into the estuary would be the existing eroded riverine flow channels within the estuary which remain away from the main saltmarsh areas. In the event that the estuary is at high water during a spring event where this material may be dispersed onto qualifying saltmarsh habitats, the higher level of seawater exchange within the estuary is expected to dilute this material to a negligible level of impact.

Overall the risk of impact from the compound to the three qualifying saltmarsh habitats is expected to be negligible because any run-off during low water periods would drain quickly into the central channels away from the salt marsh habitat, or be diluted significantly during high water periods where it would be diluted quickly by the increased volume of water in the estuary. On this basis, it is considered the conservation objectives of maintaining a stable habitat (subject to natural processes) and to prevent decline or change in the distribution of these saltmarsh habitats within the Baldoyle Bay SAC will be unaffected and there would be no adverse effect on the integrity of the site.

In addition to the saltmarsh habitats, Baldoyle Bay SAC is also designated for Mudflats and sandflats not covered by seawater at low tide (1140), located throughout the whole of the Bay and a section of coastline named the Velvet Strand along the Portmarnock coastline. The properties of supporting sediments within this habitats varies from fine sand dominated by *Angulus tenuis* and *Tubificoides benedii* in the mouth and along the eastern shoreline and Estuarine sandy mud with *Pygospio elegans* within the bay, based on changes in the hydrodynamic regime within the SAC.

The pathway of possible discharges described above would be directly over this qualifying interest, but the permanent habitat area is stable or increasing, subject to natural processes. As stated in section 2 of the Conservation Objectives supporting document – Marine Habitats for the Baldoyle Bay SAC, "Some activities may cause significant disturbance but may not necessarily represent a continuous or ongoing source of disturbance over time and space. This may arise for intermittent or episodic activities for which the receiving environment would have some resilience and may be expected to recover within a reasonable timeframe relative to the six-year reporting cycle (as required under Article 17 of the Directive)". As the nature and scale of possible contamination to the site from upstream activities is deemed to be rare, minor and very short lived, it is concluded that the resilience of the receiving habitat is such that that this potential would have a negligible impact within the designated site. Consequently, the qualifying interest and conserving conserving the community type in a natural condition will not be impacted by any likely pollution events and therefore will not impact the integrity of the Baldoyle Bay SAC.

#### 6.2.1.3.2 Suspended Sediment arising from Dredging or Piling Plume

Details of the plume created during the dredging and piling at the interface and cable crossing points for the construction of the marine outfall are outlined in section 5.8. Results indicate that the plume created by the controlled discharge of dredged spoil does not impact the Baldoyle Estuary or the coastal area along Velvet Strand within the SAC. There will therefore be no impact from dredging on the Baldoyle Bay SAC.

#### 6.2.1.3.3 Bentonite Release

The risk of a surface breakout by bentonite drilling fluid cannot be negated completely due to variability in the underlying geology. Bentonite is used during the drilling operation to lubricate during micro-tunnelling or TBM progress during construction and is pumped into the cuttings annulus during operations at the ambient pressure at the rock face. A detailed geophysical survey has been carried out along the proposed route in order to anticipate the risk of weak formations and possible faults that may increase the risk of a bentonite breakout. However, should the TBM encounter voids within the formation (such as a fissure or weathered area of rock), and then material can be forced to the surface under pressure to create a breakout. In the littoral and sub-littoral environments, the presence of bentonite at the surface can have a notable impact on sediment turbidity and suspended load. This increase in turbidity could result in increased siltation and the smothering of sediments and organisms accompanied by a reduction in the light available to the seabed for photosynthesis.

The use of bentonite is outlined in the CEMP (see Appendix B). All bentonite usage will be monitored though materials balance calculations, pressure monitoring in the lines and above ground visual assessment of the works to ensure that should breakout occur the volume is minimised. This will limit the volume of any bentonite losses significantly. The depth of the micro-tunnelling route beneath the estuary means that the likelihood of a bentonite breakout making it to the surface of the estuary is very low; however the result of a breakout may result in a small discharge to the surface. If this occurs in the channel or open water environments, then this material will disperse harmlessly. If this occurs within the saltmarsh vegetation, then this material is unlikely to disperse quickly due to the lack of tidal flow in these areas, and may require some intervention to recover and disperse to avoid a smothering effect.

The impacts of increased turbidity are likely to be minimal in the overall context of Baldoyle Bay as the water depth is extremely shallow and the natural suspended sediment very fine. Bentonite is naturally occurring and non-toxic to marine benthic fauna. In the unlikely event of a bentonite breakout, a small quantity of this suspended clay escaping into the water course may produce a localised plume of limited size and duration which may induce some avoidance behaviour by some non-qualifying species (i.e. fish and seals,) within the area, but will have a negligible impact on benthic communities found within the SAC. The fine sand dominated by *Angulus tenuis* community below the exposed beach of the outer estuary and along Velvet Strand is subject to wave action, whilst the estuarine sandy mud with *Pygospio elegans* and *Tubificoides benedii* are not prone to smothering or high turbidity environments and are naturally found in organically enriched sedimentary environments.

Exposure to a possible bentonite breakout to the Salicornia and other annuals colonising mud and sand; Atlantic and Mediterranean salt meadows (1310, 1330 and 1410) is very small, with any impact likely to be very localised (1-2m radius), If lower enough on the shorelines, then this material will harmlessly disperse into the estuary during part of the tidal flow, but may remain in a localised areas where the tidal waters do not reach. In this instance, the site may require intervention to mitigate on any lasting impacts through smothering. This may involve partial recovery of bentonite or enhanced dispersion through washing the bentonite clear of the vegetation, subject to the size of the breakout. As the saltmarsh environment is routinely exposed to naturally high turbidity on a tidal and seasonal basis, the vegetation would not be prone to impact in all but significant breakout events. Through the mitigation activities outlined above the avoidance of a smothering impact can be achieved so as not to impact on the integrity of the saltmarsh and therefore not compromise the conservation objective for these qualifying habitats to maintaining a stable habitat (subject to natural processes) and to prevent decline or change in the distribution of these saltmarsh habitats.

As stated in section 2 of the Conservation Objectives supporting document – Marine Habitats for the Baldoyle Bay SAC, *"Some activities may cause significant disturbance but may not necessarily represent a continuous or ongoing source of disturbance over time and space. This may arise for intermittent or episodic activities for which* *the receiving environment would have some resilience and may be expected to recover within a reasonable timeframe relative to the six-year reporting cycle (as required under Article 17 of the Directive)".* As the nature and scale of possible contamination to the site from a bentonite release to the surface is deemed to be rare, minor and very short lived, it is concluded that the resilience of the receiving habitat is such that that this potential would have a negligible impact within the designated site. Consequently, the qualifying interest and conserving the community type in a natural condition will not be impacted by any likely pollution events and therefore not impact the integrity of the Baldoyle Bay SAC.

#### 6.2.1.3.4 Surface Venting (Air Breakout)

The proposed Tunnel Boring Machine (TBM) to be used in the micro-tunnelling is expected to be 2m in diameter with a standard arrangement employed in the construction of this tunnel. As compressed air is used within the TBM to maintain an slight positive pressure, this can occasionally escape to the surface through trickle of air bubbles and create a small areas of surface sediment loss through liquefaction and winnowing of fines in prevailing marine currents. Whilst this does not have a chemical impact on the surrounding sediments, this can create a small area of physical impact to the SAC and qualifying interests of shallow sand and mudflats habitat (1140 ) in the form of a small pock mark or shallow crater. This may have a very localised impact on the sediments, particularly where they have limited cohesion (i.e. sands and silts making up the main part of the estuary). This is not the case in and around saltmarsh areas (1310, 1330 and 1410) that have significant sediment cohesion and are strengthened by the vegetation itself.

Should this unlikely event occur, it may create some temporary minor depression in a very small area (<1-3m$^2$) in the main part of the estuary, but an imperceptible impact if located within the area of saltmarsh vegetation. There will be no net loss in habitat or impact on the integrity of any of the qualifying habitats. The pathway of possible discharges described above would be directly beneath these qualifying interests, but the permanent habitat area is stable or increasing, subject to natural processes and the natural condition will not be impacted by this unlikely event.

#### 6.2.1.3.5 Discharge Plume – Operational Stage

Details of the effluent discharge qualities modelled during the operational phase are outline in section 5.8.2. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser. This means that the effluent will not impact Baldoyle Bay SAC.

#### 6.2.1.3.6 Overall Assessment Findings

On the basis of the above assessments, it is concluded that the conservation objectives for the SCIs of this SAC are not compromised, and there is no adverse effect on site integrity.

### 6.2.2 Rockabill to Dalkey Island SAC

The Rockabill to Dalkey Island SAC The marine outfall pipeline passes into 1,300m of the SAC and the marine diffuser lies within the SAC.

Based on the information contained in Section 4 there are three potential pathways for LSEs to occur on this SAC; water quality and habitat deterioration, which is discussed here in Section 6.2.2, underwater noise and disturbance, information on which is provided in Section 6.3.2. and habitat loss (see Section 6.4.2).

#### 6.2.2.1 Conservation Objectives

Intertidal and Subtidal Reef Communities

The targets set for the conservation objectives for the qualifying interest of subtidal and intertidal reef habitats found in Rockabill to Dalkey Island SAC, are listed below in Table 6-8. These have defined attributes and targets along with the estimated areas of each community type within the Annex I habitat, based on interpolation.

**Table 6-8: Conservation objective for reefs within the Rockabill to Dalkey Island SAC (NPWS, 2013d)**

| Habitat | 1170 | Intertidal reef community complex |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of Reefs in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Area** | The current area is highly interpolated as Intertidal (10ha) and subtidal (172ha) reef community complex. Activities or operations that permanently remove habitat from the site | The permanent area is stable or increasing, subject to natural processes. |
| **Distribution** | Significant continuous or ongoing disturbance of communities should not exceed 15% of the interpolated area of each community type. | The distribution of reefs is stable or increasing, subject to natural processes. |

Harbour Porpoises (Annex II)

The targets set for the conservation objectives for the qualifying interest of Annex II species found in Rockabill to Dalkey Island SAC, are listed below in Table 6-9. These have defined attributes and targets along with the estimated areas of each community type within the Annex I habitat, based on interpolation.

**Table 6-9: Conservation objective for harbour porpoise within the Rockabill to Dalkey Island SAC**

| Species | Annex II species | Harbour porpoise (*Phocoena phocoena*) |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Range** | Prevent permanent access for the species to suitable habitat and does not refer to short-term or temporary restriction of access or range. | Species range within the site should not be restricted by artificial barriers to site use. |
| **Anthropogenic Activities** | Activities that introduce man-made energy (i.e. noise, light etc.) that could result in a significant negative impact or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc.). | Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. |

#### 6.2.2.2 Relevant Baseline Information

Baseline data relating to the two qualifying interest are summarised in Section 5.6 for the Annex I habitat of Reefs (1170) found at Ireland's Eye, or Section 5.7 the presence of Annex II species of harbour porpoise found within close vicinity of the proposed marine outfall route. Section 5.8 provides details on water quality and the construction and operational plumes.

#### 6.2.2.3 Assessment

The following Likely Significant Effects were identified as part of the screening assessment.

##### 6.2.2.3.1 Pollution Incidents

There is a risk of a release of pollutants during construction as a result of accidental spillages and site run-off. During construction operations, increased shoreline activities and increased vessel operations and movements may increased risk of pollution incidents. During the construction, the most significant level of vessel activity would be during the dredging, piling, stringing and deployment of the outfall pipeline to the seafloor.

This risk will be managed though the CEMP to ensure the likelihood is low. There will be effective measures in place in the event that pollution incidents does occur to prevent any wide reaching or long term adverse effects. Unmanaged, these effects could prevent the maintenance of the favourable conservation condition of *the Annex I habitats* in the SAC. Mitigation is required, and an adverse effect on the integrity of the Site is not predicted as a result of pollution incidents from marine plant with suitable mitigation in place.

##### 6.2.2.3.2 Suspended Sediment Arising from Dredging or Piling Plume

Intertidal and Subtidal Reef Communities

Scientific investigations of the Reefs within the SAC in 2015 identified diverse biological populations, consistent with this habitat type and area. However, no species of particular conservation interest were noted during the studies with any rare or particularly fragile biotopes recorded. The natural siltation levels were high in the sublittoral environment, a fact that has not appeared to have had a significant impact to the biological diversity around the island. Whilst, siltation levels are already high in the sublittoral environment, a significant increase in suspended sediment over a prolonged period, particularly during the summer months during peak algal growth, could potentially cause some damage to the algal biotopes present through reduced light penetration and availability. A model of the plume created along the marine section of the proposed route during dredging is outlined in Section 5.8. These results indicate that the resulting suspended sediments created by the discharge of spoil has been limited to a northern deposition and generally localised elevation when discharged in a controlled manner during the flooding part of the tidal cycle. This has resulted in no significant plume being recorded close to the reef related qualifying interest of the SAC recorded around the Ireland's Eye northern and eastern coastlines. One small exception relates to a small localised eddy of slightly elevated surface suspended sediments recorded just to the north of the island. This is created by the flow of tides around the island itself during the flooding tides. However, the maximum concentration of this patch was between 5 and 10mg/l and well below the natural variability of the waters surrounding the island throughout the year. The conservation objective for the sublittoral reefs along the northern coast of Ireland Eye is to maintain favourable conservation conditions and to prevent permanent removal of the habitat. Moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material on these reef habitats and thereby prevent a degradation of the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. On this basis, it is considered the conservation objectives of the Rockabill to Dalkey Island SAC will be unaffected for this habitat as a result of construction stage suspended sediment plumes and there is no adverse effect on the integrity of the site.

Harbour Porpoises (Annex II)

As presented in section 5.7, the presence of the harbour porpoise has been well documented in the area. Comprehensive survey activities in 2015-2017 showed that harbour porpoises were present throughout the year with lower numbers 0.61 - 0.89ind/km2 recorded between January and April (possibly associated with an offshore movement of this species before calving) and increased numbers 1.91 - 2.29 ind/km2 in the late summer which coincided with the presence of calves and may be due to seasonally abundant food sources such as sprat, herring and gadoid species. Acoustic recordings indicated that the species were also more common within the survey area during slack high water tides and during the hours of darkness. This increased nocturnal activity is consistent with the species observed in other areas. The reason for this is uncertain but potentially linked to an increase in prey abundance or activity in the absence of light (Todd et al., 2009). The overall density estimate of the harbour porpoise was high and emphasized the importance of this site to this species, as indicated by some of the highest densities recorded in Ireland to date (Berrow et al. 2008, 2013 and 2015).

Sediment plumes from the discharge of dredge spoil may present habitat disturbance to local cetacean foraging in the area. The combined surface and seabed plume created during the dredging process recorded a maximum area with elevated suspended sediment above 5mg/l of 4.5km$^2$, of which approximately 1.5km$^2$ is currently inside Rockabill to Dalkey Island SAC. This is equivalent to only 0.55% of the total SAC area (of 273km$^2$). The duration of the dredging is expected to be 60 days (see Sectioj 3.2.8).

This plume is expected to have a temporary but localised impact on the foraging behaviour of the harbour porpoises due to the reduced visibility in the vicinity of the dredging. It should be noted that the noise created during the dredging in the waters surrounding the dredgers (see section 6.3.2) are likely to induce avoidance behaviour by this species prior to species encountering the discharge plume itself. Porpoises feed mainly on small shoaling fish, such as herring, but may also feed upon prey taken at or close to the benthos. As harbour porpoises use a series of high frequency clicks for echo-location during navigation and hunting, they are less susceptible to the impacts of suspended sediment plumes during foraging and are routinely found in inshore areas of high natural turbidity (e.g. southern North Sea, Liverpool Bay in the Irish Sea).

The conservation objective relate to the prevention of permanent access to suitable habitat or activities that introduce man-made energy (i.e. noise, light etc.) that could result in a significant negative impact or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc.). As the direct impact by the plume will be localised (<0.55% of the SAC), short term (< 60 days) and will not deteriorate any resources within the range of the species, no significant impact is expected from the dredging plume to this qualifying interest.

On this basis, it is considered the conservation objectives of the Rockabill to Dalkey Island SAC will be unaffected for this species as a result of construction stage suspended sediment plumes and there is no adverse effect on the integrity of the site.

#### 6.2.2.3.3 Discharge Plume – Operational Stage

The operational period of the outfall will create a plume of nutrient enriched waters which will disperse naturally on the prevailing tidal currents over a large area. The siting of the outfall has been undertaken based on modelling of the oceanography to maximise the dilutions and spread of this material so that localised enrichment will not occur. However, as the levels of dissolved inorganic nitrogen (DIN) will increase slightly close the site, there is a possibility of increased organic enrichment to the seabed through increased primary productivity and organic flux to the seabed via the food chain, particularly during the summer months, when sea temperature and light conditions are suitable for photosynthesis.

Details of the effluent discharge qualities modelled during the operational phase are outlined in section 5.8.2. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution achieved within 50m of the diffuser and between a 33 and 100 fold dilution within 500m of the diffuser. Based on a maximum suspended sediment load of 89mg/l, a worst case scenario would show a minimum dilution rate of 33 fold within 500m of the diffuser. This is an increase of up only 2.7mg/l above a minimum background concentration of between 4 mg/l and 15 mg/l. This is an almost imperceptible increase in the background turbidity at this distance. The majority of effluent diluting will occur to below 5 mg/l within 50m of the outfall. A radius of 500m is equivalent to an area of approximately 0.2km$^2$ or 0.07% of the total SAC area.

The modelling of the discharge shows that the discharge from the Marine Diffuser will disperse and dissipate over a large area. The dispersed discharge is not predicted to impact the reefs features within the Ireland Eye SAC which is approximately 900m from the diffuser location. Therefore the overall impact is predicted to be none or negligible and have no impact on the conservation objectives of the Reefs within the SAC.

Whilst the plume from the effluent discharge is located within the SAC, the concentration of suspended sediments is predicted during the operational phase is to be below that detectable by this Annex II species and no impact to this qualifying species is expected.

On this basis, it is considered the conservation objectives of the Rockabill to Dalkey Island SAC will be unaffected for this habitat as a result of operational stage suspended sediment plumes and there is no adverse effect on the integrity of the site.

### 6.2.3 Lambay Island SAC

Lambay Island SAC (site code: 00204) is a large (250ha) island lying 4km off Portrane and 9.3km north east of the proposed marine outfall.

Based on the information contained in Section 4 and Table 4-3 there are two potential pathways for LSEs to occur on this SAC; water quality and habitat deterioration, which is discussed here in Section 6.2.3 and underwater noise and disturbance, information on which is provided in Section 6.3.3.

#### 6.2.3.1 Conservation Objectives

The two target qualifying interests that relate to Annex I habitats, (i.e. vegetated sea cliffs and the reefs) are outside the influence from the outfall during both construction and operation. However the foraging range of the two remaining Annex II qualifying interests falls within the vicinity of the proposed Outfall. The targets set for the conservation objectives listed within the Lambay Island SAC are listed below in Table 6-10. These are defined attributes and targets.

**Table 6-10: Conservation objective for grey or harbour seal within Lambay Island SAC (NPWS, 2013e)**

| Species | Annex II species | Grey seal (*Halichoerus grypus*)<br>Harbour seal (*Phoca vitulina*) |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of Grey or Harbour Seal in Lambay Island SAC, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Range** | Prevent permanent access for the species to suitable habitat and does not refer to short-term or temporary restriction of access or range. | Species range within the site should not be restricted by artificial barriers to site use. |
| **Anthropogenic Activities** | Activities that introduce man-made energy (i.e. noise, light etc.) that could result in a significant negative impact or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc.). | Human activities should occur at levels that do not adversely affect the grey seal population at the site |

#### 6.2.3.2 Relevant Baseline Information

Section 5.8 provides details on water quality and the construction and operational plumes.

The marine qualifying interests relating to the Lambay Island SAC relates to the seals (pinnepeds). There are two species of seal native to Irish waters, both of which are found within the proposed outfall pipeline. These are the grey seal (*Halichoerus grypus*) and the smaller and slightly rarer harbour seal (also known as the common seal; *Phoca vitulina*). Breeding sites exist for both species here, although the grey seal also has breeding sites on

Ireland's Eye (approximately 1km south) and on Dalkey Island (approximately 14.9km south). Given the proximity and size of these populations, it is extremely likely that both seals currently forage within and around the proposed discharge site.

The grey seal is present at the site throughout the year including its breeding (around August to December) and moulting seasons (around December to April). During the breeding season, the relationship between pup production and total population size is not well known. An estimated 56 pups were born in Lambay Island SAC in 2005. The corresponding minimum population estimate for the site numbered between 196 and 252 grey seals of all ages. Harbour seal are also present on Lambay Island throughout the year including its breeding (around May to July) and moulting seasons (around August to September). A total of 31 harbour seal were recorded ashore within Lambay Island SAC in August 2003 during a national aerial survey for the species, while maximum counts of 38-47 harbour seal were recorded more recently during the moult season. The haul-out groups of harbour seals have tended historically to be found among inshore bays and islands, coves and estuaries (Lockley 1966; Summers 1980), particularly around the hours of lowest tide. The grey seal breeds on exposed rocky shores, on sand bars or in sea caves with ready access to deep water. Other haul-out areas for the grey seal are located on exposed rocky areas or steeply shelving sandbanks.

Results from the recent IWDG study of harbour porpoise (see Section 5.7) revealed the presence of seals within the survey. This survey clearly demonstrated that the area off Portmarnock is important for both grey seals which were recorded throughout the year in small numbers and distributed throughout the survey area. Peaks in sightings from Howth Head occurred during spring and autumn, coinciding with pupping and post-moult periods at the local well-known breeding and haul out sites at Lambay Island, Skerries and Irelands Eye. In all, 260 sightings of grey seal were recorded during the survey totalling 325 animals made up of all but 2 adults. Sighting rates was more consistent over the survey period with the highest sightings in April 2015, although high numbers were also recorded in September 2015, January 2016 and October 2016. Group size also increased during this time. Grey seal were often recorded feeding within close proximity to the northern cliffs of Howth Head.

#### 6.2.3.3 Assessment

The following Likely Significant Effects were identified as part of the screening assessment.

##### 6.2.3.3.1 Suspended Sediment arising from Dredging or Piling Plume

A model of the plume created along the marine section of the proposed route during dredging is outlined in Section 5.8.1. These results indicate that the resulting suspended sediments created by the discharge of spoil has been limited to a northern deposition and generally localised elevation when discharged in a controlled manner during the flooding part of the tidal cycle. The plume does not directly impact the Lambay island SAC, although connectively remains through the plumes impact to waters south of the SAC frequently used by the pinnepeds that are a Annex II qualifying interest. The overall plume footprint above 5mg/l covers an area of 4.5km$^2$. The highest concentrations of suspended sediments >10 g/l were recorded at bed level within 50-100m from the discharge point but the fast settlement rate of this granular material means that seabed and mid-depth concentrations generally fall below 1 g/l within 200m from the discharge. Lower levels of sediment fines (silts and clays), recorded in the sub-surface layers of the corridor are modelled to travel further on discharge, and with concentration of between 10 and 100mg/l recorded out to a maximum distance of around 1,400m north of the route. These values are similar to the natural back ground levels of suspended sediments recorded within the region throughout the year, but particularly during the winter months.

For visual hunters, such as pinnipeds, the impact of the plume is likely to induce an avoidance reaction when not feeding, or potentially encourage predation within or close to the plume, with fish feeding on suspended benthos and the seals feeding upon the fish.

The size of the plume into the area surrounding the SAC is not likely to be significant at any given time, and negligible when compared to the foraging range elsewhere around the Lambay Island SAC. Seals are expected to show a simple avoidance reaction if a plume is encountered. The maximum concentration of the plume is predicted to be around 50 mg/l near the surface , which is approximately within the range expected for natural suspended sediment loads recorded in the vicinity of the Marine Diffuser. The duration of the dredging is expected to take 60 days and analysis of the pre-dredged sediments results indicated natural uncontaminated sediments throughout the route based on the samples analysed.

Overall the impact to Annex II species from Lambay Island SAC from the construction dredging plume will be negligible, although this may introduce minor behavioural changes for the short construction period. The conservation objective relate to the prevention of permanent access to suitable habitat or activities that introduce man-made energy (i.e. noise, light etc.) that could result in a significant negative impact or operations that may result in the deterioration of the key resources (e.g. water quality, feeding, etc.). As the direct impact by the plume will be very localised (within 1,500m of the source), short term (< 60 days) and will not deteriorate any resources within the range of the species, no significant impact is expected from the dredging plume to this qualifying interest and will not cause an adverse effect on site integrity.

On this basis, it is considered the conservation objectives of the Lambay Island SAC will be unaffected for seal species as a result of construction stage suspended sediment plumes and there is no adverse effect on the integrity of the site.

#### 6.2.3.3.2 Operational Plume

During the operational phase of the projects, no loss of pelagic habitats is predicted due to the level of treatment being applied to the outfall where a maximum suspended sediment load of 35mg/l will be applied (95th percentile). As noted above, this is currently within the range routinely recorded for suspended sediments at this water mass and would be expected to disperse with the ambient seawater by a factor of 20 within 50m on discharge. This discharge is expected to provide a localised plume visible to marine mammals at certain time of the year, particularly for visual hunters such as pinnipeds and may attract these species to around the Marine Diffuser in search of prey species, that themselves might be attracted to the outfall discharge or the increased productivity surrounding it.

The impact of the discharged plume into the waters south of Lambay Island SAC will be long term (the lifetime of the outfall). However, the magnitude of this impact will be negligible for the Annex II species of the grey and harbour seals as this area constitutes a small fraction of the animal’s habitat range, and would be imperceptible above background conditions for the majority of the time with no significant effect on the animals foraging ability or behaviour. This results in a negligible significance for the two seal species and will not impact on the conservation objectives for the Lambay Island SAC.

On this basis, it is considered the conservation objectives of the L:ambay Island SAC will be unaffected for seal species as a result of operational stage suspended sediment plumes and there is no adverse effect on the integrity of the site.

### 6.2.4 Other European Sites

#### 6.2.4.1 Baldoyle Bay SPA

With regard to water quality and habitat deterioration, there are several mechanisms by which LSEs on the Baldoyle Bay SPA could occur during construction. These are pollution incidents and elevated suspended sediments occurring upstream of the SPA, bentonite release, surface venting and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8.2).

It has been predicted that any impacts caused by upstream pollution incidents represent a negligible level of impact on Baldoyle Bay (Section 6.2.1.3). Details of the plume created during the dredging part of the construction phase are outlined in Section 5.8.1. Results indicate that the plume created by the controlled discharge of dredged spoil does not impact the Baldoyle Bay SPA. Assessment of bentonite release and surface venting has concluded that any impacts are likely to be minimal in the overall context of the Baldoyle Bay SPA (Section 6.2.1.3). On this basis, it is considered that there will be no effect on the prey species of the SCIs of the Baldoyle Bay SPA by these impact pathways.

Results of the effluent discharge qualities modelled during the operational phase indicate that the plume created by the effluent discharge will be subject to significant dispersion, with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser (Section 5.8.2). The Baldoyle Bay SPA is located approximately 5km from the marine diffuser. The effluent plume will therefore not impact prey species of the Baldoyle Bay SPA SCIs.

For all of these impact pathways, it has been concluded that the conservation objectives the Baldoyle Bay SAC will be unaffected and there would be no adverse effect on the integrity of the site (Section 6.2.1.3). On this basis, it is concluded that any prey species of the Baldoyle Bay SPA SCI species will also be unaffected. No birds would be lost from the Ireland's Eye SPA population as a result of the above impact pathways.

These impact pathways therefore do not compromise any of the conservation objectives of the Baldoyle Bay SPA SCIs. It is considered the conservation objectives of all SCIs of the Baldoyle Bay SPA will be unaffected for this species and there is no adverse effect on the integrity of the site.

#### 6.2.4.2 Ireland's Eye SPA and the North-West Irish Sea cSPA

With regard to water quality and habitat deterioration, there are several mechanisms by which LSEs on the marine waters of North-West Irish Sea cSPA and Ireland's Eye SPA could occur during construction. These are pollution incidents and elevated suspended sediments occurring upstream of the SPAs, bentonite release, surface venting and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.2.2).

It has been predicted that any impacts caused by upstream pollution incidents represent a negligible level of impact on Baldoyle Bay (Section 6.2.1.3). The North-West Irish Sea cSPA is located 2.7km from the Baldoyle Bay crossing, and Ireland's Eye SPA is located approximately 6km from this location, so it is not possible for this impact pathway to cause LSE at the North-West Irish Sea cSPA or Ireland's Eye SPA when at most, negligible effects will occur at the site of pollution itself. Assessment of bentonite release and surface venting has concluded that any impacts are likely to be minimal in the overall context of the Baldoyle Bay SPA (Section 6.2.1.3), and because the North-West Irish Sea cSPA is located 2.7km from the Baldoyle Bay crossing, and Ireland's Eye SPA is located 5km from this location, this impact pathway cannot cause LSE at these two SPAs.

Details of the plume created during the dredging part of the construction phase are outlined in Section 5.2.2. With the exception of a small surface plume of 1-5 mg/l and 200-300m across caught in a small back-eddy 350m north of the Irelands Eye north coast (which falls within the Ireland's Eye SPA boundary), all of the plume discharge are predicted to disperse to the north of the outfall pipeline corridor within the North-West Irish Sea cSPA following a controlled discharge. None of the discharged sediment is predicted to impact the qualifying Annex I habitats of littoral and sublittoral reef features of the Rockabill to Dalkey Island SAC along the north and eastern coastline of Irelands Eye. The prey species of the SCI species of Ireland's Eye SPA and the North-West Irish Sea cSPA are highly mobile and the birds follow their prey. Even with the temporary low level elevated levels of suspended sediments arising, there will be no reduction in prey species across the expanse of marine waters in the wider area. Sufficient locations, areas, and availability of suitable habitats to support the population and the foraging biomass it requires across the site shall remain intact and unaffected. On this basis, it is not predicted that there will be any significant impacts to the prey species of the SCIs of Irelands Eye SPA or the North-West Irish Sea cSPA or Ireland's Eye SPA due to the sediment plume produced by dredging activity.

The operational period of the outfall will create a plume of nutrient enriched waters which will mostly disperse naturally on the prevailing tidal currents over a large area. The siting of the outfall has been undertaken based on modelling of the oceanography to maximise the dilutions and spread of this material so that localised enrichment will not occur. However, as the levels of dissolved inorganic nitrogen (DIN) will increase slightly close the site of discharge, there is a possibility of increased organic enrichment to the seabed through increased primary productivity and organic flux to the seabed via the food chain, particularly during the summer months, when sea temperature and light conditions are suitable for photosynthesis.

Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution achieved within 50m of the diffuser and between a 33 and 100 fold dilution within 500m of the diffuser. Based on a maximum suspended sediment load of 89 mg/l, a worst case scenario would show a minimum dilution rate of 33 fold within 500m of the diffuser. This is an increase of up only 2.7 mg/l above a minimum background concentration of between 4 mg/l and 15 mg/l. This is an almost imperceptible increase in the background turbidity at this distance. The majority of effluent diluting will occur to below 5 mg/l within 50m of the outfall.

The modelling of the operational discharge shows that the discharge from the marine diffuser will disperse and dissipate over a large area. The dispersed discharge is not predicted to impact the reefs features within the Ireland's Eye SAC which is approximately 900m from the diffuser location. Therefore the overall impact is predicted to be none or negligible and have no impact on the conservation objectives of the Reefs within the SAC. On this basis, it is judged there will also be no impact on the prey species of the Ireland's Eye SPA or the North-West Irish Sea cSPA SCIs through this impact pathway.

These impact pathways therefore do not compromise any of the conservation objectives of the Ireland's Eye SPA SCIs or on maintaining the breeding and non-breeding population sizes of the North-West Irish Sea cSPA SCIs. It is considered the conservation objectives of all SCIs of the Ireland's Eye SPA and the North-West Irish Sea cSPA will be unaffected and there will be no adverse effect on the integrity of either site.

#### 6.2.4.3 North Dublin Bay SAC

The North Dublin Bay SAC (000206) is located 2.3km south of the marine outfall.  Table 4-3 lists the site's marine qualifying interests. The following Likely Significant Effects were identified as part of the screening assessment.

Suspended Sediment arising from Dredging or Piling Plume

The spread of the sediment plume (see Section 5.7) shows the controlled release of spoil material by hopper barge every 7 hours on flooding tides over the duration of the construction phase. The granular nature of these sediments results in a fast settlement of material to the bottom with seabed and mid-depth concentrations generally falling within 200m from the discharge. Low level concentrations of between 5 and 10mg/l were recorded out to 1500m from the corridor or remained just detectable out to 2600m. None of the discharged sediment is predicted to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

Operational Plume

Details of the effluent discharge qualities modelled during the operational phase are outline in section 5.12. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser. This means that the effluent will not to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

#### 6.2.4.4 North Bull Island SPA

This SPA lies 2.3km to the south of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.5 Malahide Estuary SPA

This SPA lies 2.5km to the north of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration,. These are pollution incidents and elevated suspended sediments from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.6 Malahide Estuary SAC

The Malahide Estuary SAC (000205) is located 2.5km north of the marine outfall. Table 4-3 lists the site's marine qualifying interests. The following Likely Significant Effects were identified as part of the screening assessment.

**Suspended sediment arising from dredging or piling plume**

The spread of the sediment plume (see Section 5.7) shows the controlled release of spoil material by hopper barge every 7 hours on flooding tides over the duration of the construction phase. The granular nature of these sediments results in a fast settlement of material to the bottom with seabed and mid-depth concentrations generally falling within 200m from the discharge. Low level concentrations of between 5 and 10mg/l were recorded out to 1,500m from the corridor or remained just detectable out to 2600m. None of the discharged sediment is predicted to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

**Operational Plume**

Details of the effluent discharge qualities modelled during the operational phase are outline in section 5.12. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser. This means that the effluent will not to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

#### 6.2.4.7 Howth Head Coast SPA

This SPA lies 2.6km to the south of the marine outfall ((see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration,. These are pollution incidents suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.8 South Dublin Bay and River Tolka Estuary SPA

This SPA lies 7.6km to the south of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

With regard to water quality and habitat deterioration, there are several mechanisms by which LSEs on this SPA could occur during construction. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8)

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.9 Rogerstown Estuary SPA

This SPA lies 8.5km to the north of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

With regard to water quality and habitat deterioration, there are several mechanisms by which LSEs on this SPA could occur during construction. These are pollution incidents and elevated suspended sediments occurring upstream of the SPA, bentonite release, surface venting and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.10 Rogerstown Estuary SAC

The Rogerstown Estuary SAC (000208) is located 8.5km north of the marine outfall. Table 4-3 lists the site's marine qualifying interests. The following Likely Significant Effects were identified as part of the screening assessment.

**Suspended sediment arising from dredging or piling plume**

The spread of the sediment plume (see Section 5.7) shows the controlled release of spoil material by hopper barge every 7 hours on flooding tides over the duration of the construction phase. The granular nature of these sediments results in a fast settlement of material to the bottom with seabed and mid-depth concentrations generally falling within 200m from the discharge. Low level concentrations of between 5 and 10mg/l were recorded out to 1500m from the corridor or remained just detectable out to 2600m. None of the discharged sediment is predicted to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

**Operational Plume**

Details of the effluent discharge qualities modelled during the operational phase are outline in section 5.12. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser. This means that the effluent will not to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

#### 6.2.4.11 South Dublin Bay SAC

The North Dublin Bay SAC (000210) is located 9.7km south of the marine outfall.  Table 4-3 lists the site's marine qualifying interests. The following Likely Significant Effects were identified as part of the screening assessment.

**Suspended sediment arising from dredging or piling plume**

The spread of the sediment plume (see Section 5.7) shows the controlled release of spoil material by hopper barge every 7 hours on flooding tides over the duration of the construction phase. The granular nature of these sediments results in a fast settlement of material to the bottom with seabed and mid-depth concentrations generally falling within 200m from the discharge. Low level concentrations of between 5 and 10mg/l were recorded out to 1500m from the corridor or remained just detectable out to 2600m. None of the discharged sediment is predicted to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

**Operational Plume**

Details of the effluent discharge qualities modelled during the operational phase are outline in section 5.12. Results indicate that the plume created by the effluent discharge will be subject to significant dispersion with a 20 fold dilution obtained within 50m of the diffuser and between 33 and 100 fold dilution within 500m of the diffuser. This means that the effluent will not to reach the boundary of the SAC or qualifying habitats and therefore no impact is expected within this SAC.

#### 6.2.4.12 Lambay Island SPA

This SPA lies 9.3km to the northeast of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.13 Dalkey Island SPA

This SPA lies 14.9km to the south of the marine outfall. Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration,. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.14 Skerries Islands SPA

This SPA lies 16.7km to the north of the marine outfall (see Figure 1-1). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

#### 6.2.4.15 Rockabill SPA

This SPA lies 16.9km to the north of the marine outfall (see Figure 1-1).). Table 4-3 lists the site's Special Conservation Interests.

There are several mechanisms by which LSEs on this SPA could occur during construction from water quality and habitat deterioration,. These are pollution incidents and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume could also result in LSEs (see Section 5.8).

These impact pathways do not compromise any of the conservation objectives of the Ireland's Eye SPA (Section 6.2.4.2) or Baldoyle Bay SPA (Section 6.2.4.1) SCIs, and and there is no adverse effect on the integrity of either site. These impact pathways are judged to produce highly localised effects and/or produce no/imperceptible impact.

On this basis it is concluded that because this SPA is located at a substantially greater distance from the marine outfall than either the Baldoyle Bay SPA or Ireland's Eye SPA, the conservation objectives for the SCIs of this SPA are not compromised, and there is no adverse effect on site integrity.

## 6.3 Impact Pathway - Underwater Noise and Disturbance

### 6.3.1 Baldoyle Bay SAC

Conservation objectives for the Baldoyle Bay SAC and the four SCIs are outlined in Table 6-7 (see Section 6.2.1.1).

#### 6.3.1.1 Relevant Baseline Information

Details of the underwater noise modelling completed for the proposed construction works are included in Section 5.9.

#### 6.3.1.2 Assessment

The micro-tunnelling operation will produce low level noise emissions into the sediments and water column above the route of the Outfall Pipeline. Noise levels from micro-tunnelling and TBM operations are created from a slowly rotating cutter head which will produce a low level ground vibration through the sediments and water column above the route of the Outfall Pipeline. Different micro-tunnelling machines will rotate at different speeds but the likely vibration produced from a similar TBM in a shallow marine estuary, compared to other similar projects (Sruwaddacon Bay, Hamburg to Elbe and Boston MWWST tunnels), typically produced 160 dB re. 1 µPa in the range from 20 Hz to 100 Hz, but max peak decreasing to 149.5 dB re. 1 µPa within a 30m distance from the TBM.

The marine habitats are not affected by noise but will be exposed to ground vibration as the TBM travels below. Operation at other similar tunnel construction sites has been modelled in the range of 0.1- 0.6 mm/s/meter TBM diameter. Recent measurements of vibration above a very similar TBM in the west of Ireland has shown that the actual peak particle velocity was found almost an order of magnitude below this when the seabed was exposed at low tide (c. 0.06 - 0.12 mm/s; Nedwell unpublished). All of these measurements are predictions that are far below a minimum action level of 2.5 mm/s where this vibration can be perceived by passing fauna.

The conservation objectives for the SAC are to conserve the exposed mudflats and sandflat communities in a natural condition and prevent decline or change in the distribution of the saltmarsh habitats, unless it is the result of natural processes (including erosion, accretion and succession).

Expected noise/vibration from the micro-tunnelling is below that perceived by fauna inhabiting the SAC. None of the four SCIs listed within the SAC are susceptible to impact from low level ground noise (or in this case vibration). The expected level of vibration will be insufficient to create any instability within the saltmarsh.

### 6.3.2 Rockabill to Dalkey SAC

The marine outfall pipeline passes into 1,300m of the SAC and the marine diffuser lies within the SAC. The marine outfall pipeline will be constructed using dredging operations. Two piling locations are also identified at the proposed tunnel/dredge interception pit approximately 2.6km west of the SAC and the fibre optic cable crossing point, approximately 120m west of the SAC.

#### 6.3.2.1 Conservation Objectives

Harbour Porpoises (Annex II)

The targets set for the conservation objectives for the qualifying interest of Annex II species found in Rockabill to Dalkey Island SAC, are listed below in Table 6-11. These have defined attributes and targets along with the estimated areas of each community type within the Annex I habitat, based on interpolation.

**Table 6-11: Conservation objective for harbour porpoise within the Rockabill to Dalkey Island SAC**

| Species | Annex II species | Harbour porpoise (*Phocoena phocoena*) |
|---|---|---|
| **Conservation objective** | To maintain the favourable conservation condition of harbour porpoise in Rockabill to Dalkey Island SAC, which is defined by the following list of attributes and targets | |
| **Attribute** | **Measure** | **Target** |
| **Range** | Prevent permanent access for the species to suitable habitat and does not refer to short-term or temporary restriction of access or range. | Species range within the site should not be restricted by artificial barriers to site use. |
| **Anthropogenic Activities** | Activities that introduce man-made energy (i.e. noise, light etc.) that could result in a significant negative impact or operations that may result in the deterioration of key resources (e.g. water quality, feeding, etc.). | Human activities should occur at levels that do not adversely affect the harbour porpoise community at the site. |

#### 6.3.2.2 Relevant Baseline Information

Refer to Section 5.7 for surveys relating to the presence of the qualifying Annex II species within and close to the SAC and Section 5.9 for details on underwater noise modelling during construction.

Background noise levels recorded during a baseline survey indicated a mean sound pressure level of 103dB re 1µPa at 125Hz, falling to 98dB re 1µPa at 1 kHz and 92dB re 1µPa at 5.04 kHz (the highest frequency recorded during the study; TML, 2017).

#### 6.3.2.3 Assessment

A model of expected underwater noise created during the dredging exercise (section 5.9) was estimated at 188 dB ref 1µPa in the 50Hz to 89 kHz range. The output using third octave bands of 125Hz, 1kHz and 8kHz were calculated to range between 172 and 176 dB ref 1µPa. The contouring of sound exposure levels (SEL) from a source along the proposed route at these three frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 1km at 125Hz, around 30km for 1kHz and 12km for 8 kHz.

The same model was used to assess the noise impact from an impact hammer source that might be used at the tunnel interface or at the fibre optic cable crossing. The source was based on a piling of 600mm with the sounds generated impulsively. At two of the same lower third octave bands used for the dredging assessments, the sound pressure level of the piling was estimated to be 186 dB 1µPa²@1m at 125Hz dropping to 172 dB 1µPa²@1m at 1kHz. Contouring of sound exposure levels (SEL) from a source along the proposed route at these two frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 2km at 125Hz, around 12km for 1kHz.

Knowledge about the hearing range of cetacean species is not fully understood, although it is assumed that whales and dolphins hear over similar frequency ranges to the sounds they produce, noting that hearing ranges can extend beyond that of frequencies used for vocalisations (Southall *et al.* 2007). If anthropogenic noise, such as that produced during dredging operations, coincides with species' hearing ranges, it has the potential to affect individuals and populations of cetaceans present within the area at the time. Following Southall et al., (2007) and Lucke et al. (2009), the sound thresholds of behaviour disturbance for harbour porpoises in the frequency range 0.2 – 180kHz is 145 dB re 1 µPa²s for single burst over 1 second, but increases to 162 dB re 1 Pa²s over a 24 hour period. A temporary threshold shift (TTS), a temporal elevation of the hearing threshold, can be induced by prolonged or loud noises in the environment. For the harbour porpoise a TTS can be induced over 24 hours with an SEL of 181 dB re 1 µPa²s, with a permanent threshold shift (PPS), the permanent elevation of an animals hearing threshold, caused by a SEL of 215 dB re 1 µPa²s (Southall *et al* 2007). An animals sensitivity to noise sources may alter significantly with the frequency, and resulting behavioural responses may depend on many factors including the age, condition, sex, season, social state and existing behaviour (Richardson *et al.* 1995). Based on these criteria, the majority of sounds produced by dredgers will be at frequencies within the lower frequencies of the cetacean's auditory range. The levels expected will not be sufficient to cause any damage, but may alter the species behaviour either through avoidance or curiosity, particularly when in close proximity. The propagation plots modelled for the dredger noise following 1/3rd octave frequencies indicated that the greatest impact would be found at the low frequency of 1kHz frequency, but potentially can be heard 20km from the site. The harbour porpoise has a relatively high sensitivity to low frequency noise, although the overall amplitude is relatively low and not dissimilar to large shipping activity within a busy port. The noise created by the piling was higher and above the TTS for the harbour porpoise when in close proximity to the source.

The overall level of dredging noise is expected to be low but to induce some behavioural responses by harbour porpoises when in close proximity (<1km). Although the majority of these works are carried out outside the SAC, the impact pathway is open and additional mitigation methods are required to ensure that affects on this Annex II species do not compromise the conservation objectives for the SAC. The noise impacts from piling are significantly greater and whilst both potential piling locations are located outside the boundary of the SAC a high level of mitigation will be required to ensure that these Annex II species are not found within close proximity to piling when it is started. Details of this mitigation are outlined in Section 7.4.

### 6.3.3 Lambay Island SAC

Lambay Island SAC (site code: 000204) is a large (250 ha) island lying 4km off Portrane and 9.3km north east of the proposed marine outfall. Conservation objectives for the two Annex II qualifying interests are outlined in Section 6.2.3.1.

#### 6.3.3.1 Relevant Baseline Information

Details of the seal population are discussed in Section 6.2.3.2. Section 5.9 provides details on underwater noise modelling during construction.

#### 6.3.3.2 Assessment

A model of expected underwater noise created during the dredging exercise (section 5.9) was estimated at 188 dB ref 1µPa in the 50Hz to 89 kHz range. The output using third octave bands of 125Hz, 1kHz and 8kHz were calculated to range between 172 and 176 dB ref 1µPa. The contouring of sound exposure levels (SEL) from a source along the proposed route at these three frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 1km at 125Hz, around 30km for 1kHz and 12km for 8 kHz.

The same model was used to assess the noise impact from an impact hammer source that might be used at the tunnel interface or at a telecom cable crossing, midway along the proposed corridor. The source was based on a piling of 600mm with the sounds generated impulsively. At two of the same lower third octave bands used for the dredging assessments, the sound pressure level of the piling was estimated to be 186 dB 1µPa$^2$@1m at 125Hz dropping to 172 dB 1µPa$^2$@1m at 1kHz. Contouring of sound exposure levels (SEL) from a source along the proposed route at these two frequencies showed a propagation of sound to an SEL of around 100 dB re 1 µPa, within 2km at 125Hz, around 12km for 1kHz.

The sensitivity of hearing in seals, in particular the harbour seal (*Phoca vitulina*), was tested by Kastelein *et al* (2009) under laboratory conditions using a tonal signals between 0.2 and 80kHz using 1/3$^{rd}$ octave bands . The results are presented in the audiogram in Figure 6.5 and show a sensitive hearing ability at low frequencies below 40KHz, and in particularly between 1kHz and 4KHz. The grey seal (*Halichoerus grypus*) indicated a similar hearing audiogram (Figure 6.5) although slightly less sensitive at the lower frequencies and an optimum sensitivity at 12kHz (Erbe *et al,* 2015). These audiograms confirm that the hearing range of seals overlaps in frequency with the loudest and most common anthropogenic noise sources found in the marine environment. The effect of anthropogenic noise on marine mammals is highly variable in type and magnitude (Richardson et al., 1995), with these animals showing avoidance behaviour to certain sounds in certain contexts (Kastelein et al.,2008). This sensitivity to anthropogenic noise might reduce the time they can forage in particular areas close to loud sources with the distance of avoidance and/or disturbance zones surrounding a noise sources dependant on several other factors such as background noise level, water depth, ocean floor sediment properties, the spectrum, level and duration of the anthropogenic source noise.

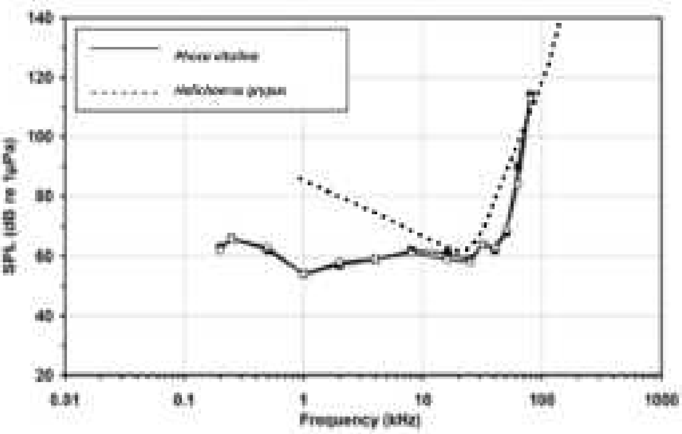



**Figure 6-5: The mean detection thresholds (dB re 1 µPa, rms) for 1/3-octave noise bands for a Harbour Seal (Phoca vitulina) compared to a Grey Seal (Halichoerus grypus) between 0.2 and 80KHz ((Kastelein *et al.,* 2008 and Erbe *et al.,* 2015).**

A temporary threshold shift (TTS), a temporal elevation of the hearing threshold, can be induced by prolonged or loud noises in the environment. For the harbour and grey seals a TTS can be induced over 24 hours with an SEL of 188 dB re 1 µPa$^2$s, with a permanent threshold shift (PTS), the permanent elevation of an animals hearing threshold, caused by a SEL of 203 dB re 1 µPa$^2$s (Southall *et al* 2007). Based on these criteria, the majority of sounds produced by dredgers will be at frequencies within the lower frequencies well within the seals auditory range and sensitivity. The levels expected will not be sufficient to cause any damage, but may alter the species behaviour either through avoidance or curiosity, particularly when very in close proximity. The propagation plots modelled for the dredger noise following 1/3$^{rd}$ octave frequencies indicated that the greatest impact would be found at the low frequency of 1kHz frequency, but potentially can be heard 20km from the site. The noise created by the piling was higher and above the TTS for both seal species when in close proximity to the source.

The overall level of dredging noise is expected to be low but to induce some behavioural responses seals when in close proximity (< 1km). Although these works are carried out outside the SAC, the impact pathway is open and additional mitigation methods are required to ensure that effects on this Annex II species do not compromise the conservation objectives for the SAC. The noise impacts from piling are significantly greater and a high level of mitigation will also be required to ensure that these Annex II species are not found within close proximity to piling when it is started. Details of this mitigation are outlined in Section 7.4.

## 6.4 Impact Pathway – Habitat Loss

### 6.4.1 Baldoyle Bay SAC

Conservation objectives for the Baldoyle Bay SAC and the four SCIs are outlined in Table 6-7 (see Section 6.2.1.1).

#### 6.4.1.1 Assessment

Section 6.2.1.3 describes the Likely Significant Effects arising from bentonite release and surface venting (air breakout) on water quality. Whilst both would affect water quality, there remains a small potential for habitat loss to occur through damage or disruption to the saltmarsh vegetation or benthos. These are discussed as follows:

**Bentonite Release**

Following the discussion of risk from bentonite breakout in Section 6.2.1.3., there are two main habitat types that exist above the proposed micro-tunnelling route that may be impacted by a bentonite breakout. Should this ocurr in the inter-tidal or sub-littoral zones within the main part of the estuary where the designated habitat of mudflats and sandflats not covered by seawater at low tide (1140) exists, then this discharge will result in a temporary localised area of pollution that will subsequently be broken down and dispersed by the prevailing tidal flow within or outside the estuary. In this area there will be no habitat loss encountered within the SAC.

Where a bentonite breakout occurs within the saltmarsh vegetation (habitats 1310, 1330 and 1410), then this material is unlikely to disperse naturally or quickly due to the lack of tidal flow in these areas, and may require some intervention to a smothering effect. The size of the impact would be dictated by the amount of bentonite that is received at the surface; however because the use of bentonite is controlled during construction, it can be estimated that this release, should it occur, is unlikely to be <1m$^3$ which would produce a discharge impact area of <6m$^2$. This is equivalent to 0.004% of the combined area of the qualifying saltmarsh habitats within the SAC. As previously stated, bentonite is a viscous, naturally occurring, non-toxic clay-based fluid that can potentially smother a localised area of saltmarsh vegetation. In the unlikely event of an incident, surface mitigation would prevent the bentonite causing habitat loss. Details of this mitigation are outlined in Section 7.2.

**Surface Venting (Air Breakout)**

Following the discussion of risk from air breakout in Section 6.2.1.4., there are two main habitat types that exist above the proposed micro-tunnelling route that may be impacted by an air breakout. Should this occur in the saltmarsh vegetation (habitats 1310, 1330 and 1410), then the cohesive nature of the substrate and surrounding vegetation and the limited influence from significant tidal flow would result in a minor and temporary area of venting, but this is unlikely to create any persistent damage. In this area there will be no habitat loss encountered within the SAC.

Should this occur in the inter-tidal or sub-littoral zones within the main part of the estuary or the coastal area of Velvet Strand where the designated habitat of mudflats and sandflats not covered by seawater at low tide (1140) exists, then this discharge can create a small but temporary depression at the site in the region of 1-3m$^2$. There will be no net loss in habitat or impact on the integrity of the substrate as this impact would be short lived and naturally infill on subsequent tidal cycles. As the permanent habitat area is stable or increasing, subject to natural processes, the natural condition will not be impacted by this unlikely event. There will therefore be no habitat loss encountered within the SAC.

### 6.4.2 Rockabill to Dalkey Island SAC

The Rockabill to Dalkey Island SAC The marine outfall pipeline passes into 1,300m of the SAC and the marine diffuser lies within the SAC.

Conservation objectives for the Rockabill to Dalkey Island SAC and the two SCIs are outlined in Section 6.2.2.1. and listed in Table 6 8.

#### 6.4.2.1 Relevant Baseline Information

Baseline data relating to the two qualifying interest are summarised in Section 5.6 for the Annex I habitat of Reefs (1170) found at Ireland's Eye, or Section 5.7 the presence of Annex II species of harbour porpoise found within close vicinity of the proposed marine outfall route.

#### 6.4.2.2 Assessment

Intertidal and Subtidal Reef Communities

The route of the pipeline and diffuser does not connect with the qualifying interest within the SAC. There will be no habitat loss as a result of this project.

Harbour Porpoises (Annex II)

A 1,300m section of marine outfall pipeline will be laid within the boundary of the SAC, along with the diffuser. Construction along the marine pipeline corridor requires dredging and subsequent burial of the main pipeline which will disrupt the benthos over a temporary period as well as create a source of anthropogenic noise through vessel activity and dredging operations during the period of construction. However, on completion of the outfall, the benthos will return to its natural state with only the addition of the diffuser remaining within the site. This will be a hard structure that will replace approximately 3.5m$^2$ of granular seabed.

The physical presence of the diffuser at the seabed is not anticipated to create a habitat loss to the harbour porpoise. In this instance, the perception of habitat has been interpreted as a suitable environment in which the species has full access and can forage for food. The harbour porpoise is a highly mobile species with ranges that far exceeds the influence from outfall or the boundaries of the SAC. Porpoises feed on pelagic, demersal and benthic species although they are believed to feed mainly close to or on the seabed. The dredging can disrupt large areas of seafloor sediments and their benthic communities with the potential loss of foraging, although this material is not actually removed from the system altogether. Following completion of the dredging activities there may be a slight reduction in the density of benthos and resulting fish until the seabed recovers, probably within one larval settlement, but the impact to the seabed will only be temporary (i.e. <1year).

The residual structure of the diffuser will create a hard structure on the seabed in an area that is currently made up of mixed sands and gravels. This will introduce some epibenthic faunal assemblages to the site, similar to the species recorded at the nearby sub-littoral reefs recorded around Ireland Eye, 1km to the south. The structure will also attract small fish which may become prey species to the porpoises.

During the operational phase of the works, the outfall will pump out treated effluent based on standards outlined in Section 3.3. The volume of discharge into the SAC will be variable, based on weather conditions due to rain input but the average dry weather flow (ADWF) for the system is estimated as 1.46 m$^3$/s with a full flow to treatment (FFT) capacity of 2.93 m$^3$/s. The dispersion characteristics during the operational phase was modelled (Chapter 8 of the EIAR) but are summarised in Section 5.8. This indicated a positively buoyant plume which will reach the surface layers within 50m of the discharge and remain near the surface until dissipating in the surface waters. Minor level of suspended sediments will also be discharged but as these will remain below a maximum of 8 mg/l and the average discharge below 35mg/l ($95^{th}$ percentile); this is within the natural turbidity range recorded within the area. This will dilute by 20 times within 50m of discharge. It is therefore expected that the plume itself will visibly be imperceptible to porpoises within 50-100m of the diffuser. The presence of organically enriched waters through slightly elevated levels of dissolved inorganic nitrogen (DIN), may enhance plankton productivity over the larger area which itself may encourage feeding from prey species in the vicinity, but the impact of this is expected to be negligible.

Overall, the impact to the foraging area within the SAC will be very small and for a short term during construction works. Following completion, the site will be fully accessible by the species for foraging, with a possibly slightly enhanced capacity to support small prey species targeted by the porpoises. There will be no impact upon the conservation objectives for the SAC through habitat loss.

### 6.4.3 Baldoyle Bay SPA

The conservation objectives for the Baldoyle Bay SPA are provided in Section 6.1.1.1.

#### 6.4.3.1 Relevant Baseline Information

Within the areas affected by direct habitat loss (i.e. land where the microtunnelling compounds will be constructed), a single record of one ringed plover (eastern compound) was the only SCI species of the Baldoyle Bay SPA recorded during the baseline surveys.

No habitat within the Baldoyle Bay SPA will be impacted due to habitat loss.

#### 6.4.3.2 Assessment

Habitat loss due to the proposed project is confined to the areas outside the Baldoyle Bay SPA, where there is potential for connectivity between the Baldoyle Bay SPA and the surrounding terrestrial habitats. This could result in potential disturbance effects on SCI species using habitats beyond the SPA boundary. The habitat subject to land take will be occupied by the microtunnelling compounds and 125m of access track associated with the western microtunnelling compound (see Figure 1-2). Habitat loss will occur from the commencement of construction to the completion of site restoration (approximately 18 months), and will be restricted to the footprint of the microtunnelling compounds and the access track. Habitat loss impacts are reversible.

There is no habitat loss as a result of construction or operation of the proposed project in the subsea environment either inside or outside the Baldoyle Bay SPA.

Because ringed plover was the only SCI recorded in the habitats where the microtunnelling compounds will be constructed, and these impacts occur outside the SPA boundary, it is judged that all other SCIs (light-bellied brent goose, shelduck, golden plover, grey plover and bar-tailed godwit), it is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for these SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for these species.

The baseline survey data show that ringed plover do not regularly utilise habitats which fall within the zones of impact for the habitat loss impact pathway identified for the Baldoyle Bay SPA, being recorded only once in these areas during the estuarine survey programme. Whilst small numbers of this species could be subject to disturbance and displacement, this effect would be restricted to a small spatial extent, temporary and reversible. As a result, it is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objective for this species. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for this species.

#### 6.4.4 Irelands Eye SPA and the North-West Irish Sea cSPA

The conservation objectives for the Ireland's Eye SPA and for the North-West Irish Sea cSPA are provided in Section 6.1.2.1.

##### 6.4.4.1 Relevant Baseline Information

Baseline information is presented in Section 5.1.1 and Section 5.1.2.

##### 6.4.4.2 Assessment

Within the Baldoyle Bay study area small numbers of herring gull were recorded within the zone of influence of the habitat loss impact pathway. Within the marine area of the North-West Irish Sea cSPA, all SCIs of that SPA were recorded during the surveys. All these species are highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019). It is to be recalled that the North-West Irish Sea cSPA is a very large site (232,300 hectares) stretching from Dublin Bay to Dundalk Bay and for 40km out to sea.

Disturbance to the marine benthos and the sand dwelling shellfish (such as the razor clam) along the marine pipeline corridor are expected to be high, although this will be limited to a relatively small area directly relating to the trenched route (approximately 0.16km$^2$), or neighbouring sediments (approximately 1km$^2$) affected by localised smothering of stored or plume-dispersed material. The area is routinely disturbed by clam dredgers but the substrate routinely repopulates within the short-term. The benthos may be impacted by dredging activities as a result of the physical removal of substratum and associated organisms from the seabed along the path of the dredge head, and the subsequent deposition of material through side casting or settlement of a dispersed plume of suspended sediment. A review of the impact of aggregate dredging in European coastal waters suggests that marine communities conform to well-established principles of ecological succession, that is to say that the recovery of benthic communities following a disturbance are well known both in terms of population and recovery times, and that these allow some realistic predictions on the likely recovery of benthic communities following cessation of dredging (Newell et al. 1998). In general, communities living in fine mobile deposits are characterised by large populations of a restricted variety of species that are well adapted to rapid recolonisation of deposits that are subject to frequent disturbance. Recolonisation of dredged deposits is initially by these 'opportunistic' species, and the community is subsequently supplemented by an increased species variety of long-lived and slow-growing 'equilibrium' species that characterise stable undisturbed deposits such as coarse gravels and reefs. Rates of recovery reported in the literature suggest that a recovery time of six to eight months is characteristic of many estuarine muds where frequent disturbance of the deposits precludes the establishment of long-lived components. In contrast, the community of sands and gravels may take two to three years to establish, depending on the proportion of sand and level of environmental disturbance by waves and currents, and may take even longer where rare slow-growing components were present in the community prior to dredging. As the deposits get coarser along a gradient of environmental stability, estimates of five to 10 years are probably realistic for development of the complex biological associations between the slow-growing components of equilibrium community characteristic of reef structures.

The benthos along the proposed outfall pipeline route (marine section) in the North-West Irish Sea cSPA are based predominantly on sands, particularly in the western inshore section of the proposed outfall pipeline route (marine section). Here, the water depth is very shallow and subject to continuous reworking by wave induced currents. The central part of the proposed outfall pipeline route (marine section) in the North-West Irish Sea cSPA is a silty sand, becoming increasingly coarser towards a muddy sandy gravel near the proposed marine diffuser location. There is an absence of any developed biogenic or geogenic features with any significant epifaunal component. The physical recovery of the surface sediments along the proposed outfall pipeline route (marine section) is expected to show recovery within a few months, with a recolonisation by the benthos to occur within six months for the majority of species, but possibly one to two years for some the of larger slower-growing taxa.

Given that the area that may be affected (1km$^2$) within the North-West Irish Sea cSPA comprises only 0.04% of the marine area of the SPA, and that the primary use of the marine area in the SPA is by SCI birds either in the air, on the surface of the sea or plunge diving into the top few metres of the marine water column, and that their prey species are predominantly highly mobile and the birds follow their prey throughout wide areas as they forage and feed, and given that the habitat disturbance of the seabed is highly localised, temporary and reversible, the habitat loss impact pathway could result in a temporary redistribution of a small number of birds of the North-West Irish Sea cSPA to elsewhere within the site.

In relation to the North-West Irish Sea cSPA, the seabed habitat disturbance occurs entirely within the European site. In relation to Ireland's Eye SPA, the seabed habitat disturbance occurs outside of and between 200m and 300m to the north of the marine waters of this SPA. The temporary effects of dredging that could result in disturbance have been discussed previously in Section 6.1. The effect of the placement of the pipeline on the seabed in a trench that will be backfilled will result in no loss of habitat available to the SCI species of the North-West Irish Sea cSPA because the birds use the surface waters of the SPA and not the seabed. Even the temporary effect of dredging a trench will have no bearing on the SCI species (aside from the potential for disturbance as discussed previously) as this does not result in loss of habitat. The seabed material is moved or repositioned to create a trench, but the bottom of the trench remains seabed habitat even during construction. No habitat loss occurs from the North-West Irish Sea cSPA at any time.

Construction activities will result in highly localised, temporary and reversible effects that are not of sufficient magnitude or duration to affect the maintenance of the Ireland's Eye SPA SCI populations, the natural range of the populations, or the amount of habitat available to the populations. These activities will not compromise the maintenance (or enhancement as the case may be) of the range of marine habitats utilised by the qualifying species of the North-West Irish Sea cSPA. On this basis, it is considered that adverse effects upon the integrity of the North-West Irish Sea cSPA will not occur. The conservation objectives of the Ireland's Eye SPA will be unaffected for this species and there is no adverse effect on the integrity of Ireland's Eye SPA .

#### 6.4.5 Other European Sites

Habitat loss due to the proposed project is confined to the areas outside the other European sites identified in Section 4. However, there is potential for connectivity between these sites and terrestrial habitats that will be occupied by the proposed GDD project. This could result in potential disturbance effects on SCI species using habitats beyond the SPA boundary. The habitat subject to land take will be occupied by the microtunnelling compounds and 125m of access track associated with the western microtunnelling compound (see Figure 1.2). Habitat loss will occur from the commencement of construction to the completion of site restoration (approximately 18 months), and will be restricted to the footprint of the microtunnelling compounds and the access track. Habitat loss impacts are reversible.

##### 6.4.5.1 North Bull Island SPA

The assessment carried out in Section 6.4.1 covers the Baldoyle Bay SPA SCIs bar-tailed godwit, golden plover, grey plover, light-bellied brent goose and shelduck. It states that because these SCIs were not recorded where the microtunnelling compounds will be constructed during the estuarine survey programme, it is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for these SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for these species. It is considered that this is also the case for these SCIs of this SPA.

This SPA has some additional SCIs. Of these, black-tailed godwit, dunlin, knot, oystercatcher, pintail, redshank, sanderling, shoveler, teal and turnstone were not recorded where the microtunnelling compounds will be constructed. It is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for these SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for these species.

Black-headed gull was recorded in small numbers (nine records consisting of 31 birds) within the footprint of the eastern microtunnelling compound. This species is highly mobile and opportunistic with respect to the habitats it utilises. It is considered that the highly localised, temporary and reversible nature of the habitat loss impact pathway could result in a temporary redistribution of a small number of birds, none of which would be lost from the North Bull Island SPA population.

Curlew were also recorded roosting and loafing in small numbers (two records consisting of 33 birds) within the footprint of the western microtunnelling compound. The habitat loss impact pathway will result in the displacement of these birds to alternative habitat. It is considered that this redistribution of birds will not result in the loss of any birds to the SPA population.

It is therefore considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for any of its SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.2 Malahide Estuary SPA

The assessment carried out in Section 6.4.1 covers the Baldoyle Bay SPA SCIs bar-tailed godwit, golden plover, grey plover, light-bellied brent goose and shelduck. It states that because these SCIs were not recorded where the microtunnelling compounds will be constructed during the estuarine survey programme, it is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for these SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for these species. It is considered that this is also the case for these SCIs of this SPA.

This SPA has some additional SCIs. Of these, black-tailed godwit, dunlin, knot, oystercatcher, pintail, redshank, sanderling, shoveler, teal and turnstone were not recorded where the microtunnelling compounds will be constructed. It is considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for these SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity for these species.

Curlew were also recorded roosting and loafing in small numbers (two records consisting of 33 birds) within the footprint of the western microtunnelling compound. The habitat loss impact pathway will result in the displacement of these birds to alternative habitat. It is considered that this redistribution of birds will not result in the loss of any birds to the SPA population.

It is therefore considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for any of its SCIs. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.3 Howth Head Coast SPA

No SCIs of this SPA (kittiwake only) were recorded within habitats where the microtunnelling compounds will be constructed. It is there considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for the single SCI of this SPA. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.4 South Dublin Bay and River Tolka SPA

The only SCIs of this SPA recorded within habitats where the microtunnelling compounds will be constructed was black headed gull. Black-headed gull was recorded in small numbers (nine records consisting of 31 birds) within the footprint of the eastern microtunnelling compound. This species is highly mobile and opportunistic with respect to the habitats it utilises. It is considered that the highly localised, temporary and reversible nature of the habitat loss impact pathway could result in a temporary redistribution of a small number of birds, none of which would be lost from the South Dublin Bay and River Tolka SPA population.

The SCIs Arctic tern, bar-tailed godwit, common tern, dunlin, grey plover, knot, light-bellied brent goose, oystercatcher, redshank, ringed plover, roseate tern and sanderling were not recorded within habitats where the microtunnelling compounds will be constructed.

It is there considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for the SCIs of this SPA. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.5 Rogerstown Estuary SPA

The only SCIs of this SPA recorded within habitats where the microtunnelling compounds will be constructed was ringed plover (Section 6.4.1). It is considered beyond reasonable doubt that these birds originated from the Ireland's Eye SPA, where it is also an SCI.

No other SCIs of this SPA (black-tailed godwit, dunlin, grey plover, greylag goose, knot, light-bellied brent goose, oystercatcher, redshank, ringed plover, shelduck and shoveler were not recorded within habitats where the microtunnelling compounds will be constructed.

It is there considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for the SCIs of this SPA. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.6 Lambay Island SPA

The only SCIs of this SPA recorded within habitats where the microtunnelling compounds will be constructed were herring gull and lesser black-backed gull. Both are highly mobile species that spend a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019).

The other SCIs (cormorant, fulmar, greylag goose, guillemot, kittiwake, puffin, razorbill and shag) were not recorded within habitats where the microtunnelling compounds will be constructed.

The highly localised, temporary and reversible nature of the habitat loss impact pathway could result in a temporary redistribution of a small number of birds, none of which would be lost from the SPA population. It is considered highly likely that the birds in question were unlikely to have originated from this SPA due to the distance between it and the proposed GDD project.

On this basis, it is considered the conservation objectives of this SPA will be unaffected and there is no adverse effect on the integrity of the site.

#### 6.4.5.7 Dalkey Islands SPA

No SCIs of this SPA (Arctic tern, common tern and roseate tern) were recorded within habitats where the microtunnelling compounds will be constructed. Furthermore, this SPA is situated at substantial distance from the proposed GDD project. It is there considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for the single SCI of this SPA. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

#### 6.4.5.8 Skerries Islands SPA

The only SCI of this SPA recorded within habitats where the microtunnelling compounds will be constructed was herring gull, which is a highly mobile species that spends a significant amount of time in flight (Garthe and Hüppop, 2004; Furness and Wade, 2012), and have large foraging ranges (Woodward *et al.*, 2019).

The other SCIs (cormorant, light-bellied brent goose, purple sandpiper, shag and turnstone) were not recorded within habitats where the microtunnelling compounds will be constructed.

The highly localised, temporary and reversible nature of the habitat loss impact pathway could result in a temporary redistribution of a small number of birds, none of which would be lost from the SPA population. It is considered highly likely that the birds in question were unlikely to have originated from this SPA due to the distance between it and the proposed GDD project.

On this basis, it is considered the conservation objectives of this SPA will be unaffected and there is no adverse effect on the integrity of the site.

#### 6.4.5.9 Rockabill SPA

No SCIs of this SPA (Arctic tern, common tern, purple sandpiper and roseate tern) were recorded within habitats where the microtunnelling compounds will be constructed. Furthermore, this SPA is situated at substantial distance from the proposed GDD project. It is there considered that the habitat loss impact pathway of the proposed project during construction and operation will not compromise the targets of the conservation objectives for the single SCI of this SPA. The construction and operation of the proposed project will therefore not cause an adverse effect on site integrity.

## 6.5 ASSESSMENT OF IN COMBINATION EFFECTS WITH OTHER PLANS OR PROJECTS

Article 6(3) of the Habitats Directive requires that in-combination effects with other plans or projects are considered. On this basis, a range of other projects were considered in terms of their potential to have in-combination effects with the proposed project in accordance with Section 4.1.6. Those projects are identified in Chapter 22 of the EIAR and listed below in Table 6-12:

**Table 6-12 Other Projects and the potential for In-combination Effects**

| Project | Potential for in-combination effects on European sites? |
|---|---|
| Aviation fuel pipeline from Dublin Airport to Dublin Port; pipeline route crosses the proposed orbital sewer route approx. 200m west of WwTP compound.<br>Permission granted. | This project is located approximately 3km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Belcamp Housing Development redevelopment of Belcamp Hall and construction of further residential development to provide total of 260 dwellings, including associated works.<br>Permission granted. | This project is located approximately 3.5km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| | pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Remediation of 1.5ha of land Clonshagh, Belcamp – excavation and off-site disposal of historically deposited waste and restoration of the area. A temporary site compound will be constructed.<br>Permission was extended to May 2017, however as this permission has lapsed a new planning permission will be sought by IDA Ireland. | This project is located approximately 2.5km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| The Coast Development – Baldoyle, Growth Area 1 - Construction of 550 residential units, a village centre and surface water wetlands.<br>Permission granted. | This project is located approximately 1km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Connolly Hospital Development – Paediatric Outpatients and Urgent Care Centre.<br>Permission granted. | This project is located approximately 10km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Irish Water: Blanchardstown Regional Drainage Scheme (BRDS) for development in the Tolka River Valley Park. | This project is located approximately 3km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from project to those marine receptor species of European sites. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| | There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Drumnigh Housing Development- Housing development immediately to the north of the proposed orbital sewer route.<br>Permission granted. | This project is located <1km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Dublin Airport Authority Plc: Construction on airport lands of a runway, 3110m in length and 75m in width.<br>Under construction. | This project is located approximately 4km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this element of the project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Red Arches Housing Development, The Coast Construction of 205 residential units.<br>Application for modifications granted 2015. | This project is located >500m from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Ringsend WwTP Upgrade Project Extension of Ringsend WwTP, use of AGS technology.<br>Permission granted. | This project is located located adjacent to South Dublin Bay and River Tolka Estuary SPA and in proximity to South Dublin Bay SAC.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| | There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>It is predicted that the operation of this WwTP may have positive impacts on general water quality. |
| Station Manor Portmarnock Housing Development - Housing development, comprising 684 residential units, north of proposed outfall pipeline; proposed outfall pipeline route crosses distributor road of Phase A of development; sewer to Grange pumping station runs next to/beneath road.<br>Granted and construction commenced in 2017. | This project is located adjacent to Baldoyle Bay SAC and SPA.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli could occur during construction should the construction periods coincide, however the western micro tunnelling compound will be screened to minimise impacts on Baldoyle Bay SPA.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| Sutton to Malahide Greenway – pedestrian and cycle route along the Fingal Coast.<br>A planning application is currently being prepared for submission. | This project is located adjacent to Baldoyle Bay SAC and SPA.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli could occur during construction should the construction periods coincide, however the western micro tunnelling compound will be screened to minimise impacts on Baldoyle Bay SPA. Due to the linear nature of the cycle way development, any possibility of construction activities coinciding will be short term.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project.<br>Habitat loss cannot occur as this project is located outside of any European sites. |
| Chemco (Ireland) Limited.<br>19,151 sqm of warehousing within 6 No. units for the storage and distribution of materials including chemicals within a proposed secure 33 Acre site.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Construction of a Data Centre comprising 4 no. buildings at Damastown Avenue, Mulhuddart, Co. Dublin.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| | Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Phase 2 of a two-phase masterplan for a residential development, consisting of 33 houses at Kinsealy, Co. Dublin.<br>Permission granted. | This project is located over 3 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Streamview Connect Trading DAC.<br>Construction of 50 no. residential units, comprising detached and semi-detached dwellings.<br>Permission granted. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Lyreco Ireland Limited.<br>Construction of a circa 6,479sqm warehouse / logistics centre at Huntstown, Dublin 11.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| TLI Group Ltd.<br>Installation of electrical infrastructure between Finglas substation and Huntstown Power | This project is located over 5 km from the European Sites considered in this NIS. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| Station to facilitate the retirement of existing Electricity Supply Board overhead powerlines and facilitate site clearance for the future development of a data centre and substation<br>Permission granted. | Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Mayne Stability Limited.<br>Development of a Synchronous Compensator Development (Grid Stabilisation Facility) on the site of c. 1.65 ha at lands south of Belcamp 220kV Substation, Belcamp, Dublin 17.<br>Permission granted. | This project is located over 3 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Minister for Agriculture, Food and the Marine.<br>Dredging, stabilisation of dredge material, reclamation of land, embankment construction, slipway construction, provision or storage and services at Howth Harbour, Co. Dublin.<br>Permission granted. | This project is located adjacent to the North-Eest Irish Sea cSPA and is hydrologically connected to the other European sites considered in this NIS. It is located 4.3 km from the marine diffuser.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli is not likely to occur within the harbour area at Howth.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration could occur as there is an open pathway from this project to those marine receptor species of European sites also potentially affected by the Proposed Project.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction of this project as it is hydrologically linked to the same marine waters traversed by the proposed Project. |
| Gerard Gannon Properties.<br>Construction of a mixed-use development (within 3 no blocks) at Clongriffin, Dublin 13.<br>Permission granted. | This project is located over 3 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Transport Infrastructure Ireland. | This project is located over 5 km from the European Sites considered in this NIS. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| MetroLink from Swords (Estuary) to Charlemont via Dublin City Centre.<br>Application submitted September 2022. | Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| National Transport Authority.<br>BusConnects – Clongriffin to City Centre Core Bus Corridor Scheme.<br>Application submitted April 2022. | This project is located over 3 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| National Transport Authority.<br>BusConnects - Blanchardstown to City Centre Core Bus Corridor Scheme.<br>Application submitted June 2022. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| National Transport Authority.<br>BusConnects - Ballymun / Finglas to City Centre Core Bus Corridor Scheme.<br>Application submitted September 2022. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| National Transport Authority.<br>BusConnects - Swords to City Centre Core Bus Corridor Scheme. | This project is located over 5 km from the European Sites considered in this NIS. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| Application submitted May 2023. | Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Omni Park Shopping Centre Consortium.<br>SHD - Demolition of existing structures, construction of 324 no. apartments, creche and associated site works. Lands to the northeast of Omi Park Shopping Centre including vacant warehouse, Swords Road, Santry, Dublin 9.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| MKN Developments Ltd.<br>SHD - 278 no. apartments, childcare facility and associated site works. Fosterstown North and Cremona, Forest Road, Swords, Co. Dublin.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Quintain Developments Ireland Limited.<br>SHD - 172 no. residential units (150 no. houses, 22 no. apartments) and associated site works. Station Road, Portmarnock, Townlands of Drumnigh, Maynetown and Portmarnock, Co. Dublin.<br>Permission granted. | This project is located within 1 km of Baldoyle Bay SPA and Baldoyle Bay SAC. It's access road crosses the route of the Proposed Project approximately 300 m west of proposed Compound 9.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli could occur if both projects were to be under construction at the same time.<br>Release of suspended sediment or contaminated run off could occur if both projects were to be under construction at the same time.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites. |
| GLL PRS Holdco Limited.<br>SHD - 162 no. residential units distributed across 3 blocks. Deer Park, Howth, Dublin. | This project is located within 1 km from the European Sites considered in this NIS. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| Permission granted. | Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Sport Ireland<br>Planning permission for the construction of a national velodrome and badminton arena over a footprint of 8,100 sqm comprising 250m cycle track with 12 no. badminton courts within, internal bicycle store area, changing rooms, medical and emergency rooms, areas for offices, administration and meetings, timing, event and training control, training and event preparation, strength and conditioning, circulation and storage, stairs and lifts, and proposed service area to the rear. Provision of circa 1,000 no. permanent spectator seats, with provision to accommodate other occasional sporting events within the track with scope for a further temporary 2.500 seats for non cycling and badminton sporting events.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Gannon Properties<br>Residential development on lands at Belcamp Hall (a Protected Structure). The proposed development will consist of the construction of 78 no. residential units comprising 58 no. houses and one no. three storey multi-dwelling block consisting of 10 no. own-door duplex units and 8 no. apartments.<br>Permission granted. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Gannon Properties<br>10 year permission for the construction of 2,527 no. residential units (473 no. houses, 2054 no. apartments), creche and associated site works.<br>Application submitted May 2022. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| Gannon Properties<br>Construction of 78 residential units comprising 58 houses, 20 apartment/duplex/triplex units and associated works at Belcamp Hall, Malahide Road, Dublin 17.<br>Permission granted. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Gerard Gannon Properties<br>Construction of 77 residential units in 2 blocks, 65 car parking and 184 bike spaces at Belcamp Hall, Malahide Road, Dublin 17.<br>Permission granted. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Gerard Gannon Properties<br>Construction of 40 residential units in one block, including a childcare facility and café at Belcamp Hall, Malahide Road, Dublin 17.<br>Permission granted. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| daa<br>Expansion of North Apron at Dublin Airport to provide twelve replacement Code C aircraft stands and ground servicing equipment storage area, construction of blast fences, pavement rehabilitation, two new underground attenuation tanks and 26 high mast lights and aerodrome ground lights.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |

| Project | Potential for in-combination effects on European sites? |
|---|---|
| EirGrid<br>CP1213 - The development will consist of the provision of new electricity transmission infrastructure at the existing ESB Belcamp 220 kV substation.<br>Application submitted February 2023. | This project is located over 4 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Frylite (Dublin) Limited<br>Construction of an industrial development facility for the processing and distribution of fresh and used cooking oils (UCO) including ancillary offices and staff amenities, roof-mounted photovoltaic array, delivery vehicle maintenance building, external covered storage area, weighbridge, lorry wash, tank farm, fuel tanks, signage, lighting, landscaping, car/lorry/trailer parking areas, and all associated site development.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Roadstone Ltd.<br>The development comprises the construction and operation of 3 no weighbridges (each with a dedicated weighbridge office), a new 2,160$m^2$ soil waste inspection and quarantine shed, new site offices and associated parking facilities. The development will facilitate internal re-routing of soil intake for future backfilling and restoration of Huntstown South Quarry.<br>Permission granted. | This project is located over 5 km from the European Sites considered in this NIS.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli cannot occur at this distance.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss cannot occur due to the distance of this project away from the European sites.<br>There is a possibility of release of suspended sediment or contaminated run off during construction into the same catchments traversed by the proposed Project. |
| Fingal County Council<br>Park development project at the Racecourse Park comprising 4.5km of new walking and cycling routes including a bridge over the Mayne river and repair to the railway underpass on lands located between Baldoyle and Portmarnock, Co. Dublin.<br>Permission granted. | This project is located within 1 km of Baldoyle Bay SPA and Baldoyle Bay SAC. A section of the land-based outfall pipeline and compound 9 are located within the red line boundary of the permitted Racecourse Park.<br>Disturbance or displacement of feature species of European sites as a result of airborne noise, vibration or other visual stimuli could occur if both projects were to be under construction at the same time.<br>Release of suspended sediment or contaminated run off could occur if both projects were to be under construction at the same time.<br>Disturbance or displacement of feature species of European sites as a result of underwater noise or vibration cannot occur as there is no open pathway from this project to those marine receptor species of European sites.<br>Habitat loss will not occur as part of the Racecourse Park project is to manage habitats within Baldoyle Bay SAC positively as a European site. |

Table 6-12 concludes that there is potential for cumulative impacts during construction arising as a result of surface water run-off during construction of these other projects listed above if they are under construction at the same time as the Proposed Project..

All projects have listed 'Adherence to CEMP and implementation of effective surface water management procedures' in application documents. Similarly the construction of the GDD will require adherence to a CEMP and surface water manamagent during construction and maintenance of SUDs during operation.

The Quintain Developments SHD residential development at Portmarnock is located in sufficient proximity to the zone of influence of the Proposed Project such that it may cause disturbance of SCI species of Baldoyle Bay SPA and that cumulative disturbance effects could also occur if the SHD residential housing project is under construction at the same time as the Proposed Project.

As a condition of the permission for Phase 1A (ABP-300514-17), the Quintain Developments SHD residential development implemented a range of mitigation measures in accordance with Condition No.3 requiring the developer to submit a schedule of ecological mitigation measures as detailed in the NIS, including:

- Provision of a large area of Ecological buffer/parkland, located between residential zoned lands within the LAP to the west and the boundary with Coast Road to the east and with Mayne Road to the south;
- Provision of a 'Quiet Zone' for birds, in the southern part of the Portmarnock South Local Area Plan lands;
- Provision of an arable plot and retention of an existing small attenuation pond located between the above 'Bird Quiet Zone' and Mayne Road; and
- Clearing of bramble scrub and reseeding of areas to grassland within the Murragh Spit east of the R106 Coast Road (within Baldoyle Bay SAC and SPA), undertaken in agreement with Fingal County Council and NPWS, to provide additional areas of foraging habitat for bird species, in particular overwintering light-bellied Brent geese.

Potential disturbance effects of construction of the Proposed Project on the SCI species of Baldoyle Bay SPA are discussed in Section 6.1 and potential water quality and wetland habitat deterioration effects of construction of the Proposed Project on the QIs of Baldoyle Bay SAC and the wetland habitat of Baldoyle Bay SPA is discussed in Section 6.2.

In its appropriate assessment of the Phase 1D development (ABP- ABP-312112-21), the Board adopted a part of the assessment made in the Developer's NIS which stated that, regardless of the duration and potential impacts of the eventual delivery of the GDD project on Baldoyle Bay SAC and SPA, the construction of the SHD project will be complete prior to the commencement of the GDD project, and as such, there can be no potential for in-combination effects to arise. This may turn out to be the sequence of construction, but if the two projects were to be under construction at the same time, then there are adequate mitigations included in both the SHD Phase 1D project planning permission conditions (Condition No 1, 2, 3, 4, 18, 24, 25) and the mitigation measures proposed as part of the Proposed Project in relation to disturbance of waterbirds and deterioration of wetland habitats to ensure that there would be no adverse effects on the integrity of both Baldoyle Bay SAC and Baldoyle Bay SPA.

The Balscadden GP3 Limited SHD (ABP-313133-22) residential development at Howth did not predict any impacts on the waterbird populations of Baldoyle Bay SPA during its construction and no mitigation was required. As such, there is no potential for cumulative disturbance effects between this SHD residential development and the Proposed Project.

The Racecourse Park development (ABP-311315-21) has conditions attached to its planning permission to avoid adverse effects on the integrity of Baldoyle Bay SPA by introducing seasonal restrictions to construction at Red Arches Playing Pitches to prevent adverse effects on Light-bellied Brent Geese (Condition No.3), and further seasonal restrictions on dog walking at operational phase by way of the introduction of a bye-law also to prevent adverse effects on Light-bellied Brent Geese (Condition No.2). Construction and operation of the Proposed Project does not disturb or displace Light-bellied Brent Geese from using the Red Arch playing pitches. Mitigation is proposed to prevent adverse effects of constructing the Proposed Project on Light-bellied Brent Geese. When taken together with the mitigations conditioned to the planning permission for the Racecourse Park development, there will be no adverse in-combination effects on Light-bellied Brent Geese

The operation of the proposed Project will not result in any potential for cumulative impacts with the above projects due to the distance of the only above ground elements of the project i.e. the WwTP and Pumping Station away from European sites.

Therefore, there are no impacts from the above proposals that would have the potential to give rise to in-combination or cumulative effects on the European Sites assessed as part of this NIS.

# 7. Mitigation Measures for the Protection of Natura 2000 sites

## 7.1 Baldoyle Bay SPA

To eliminate the compromise of conservation objectives on light-bellied brent goose, shelduck and golden plover, a 2.4m high hoarding will be used for the duration of the construction works at both microtunnelling compounds (no. 9 & 10). Compound construction cannot proceed without the installation of hoarding around the entire perimeter of each compound and any associated access track. The deployment of this hoarding will reduce visual disturbance impacts on birds to zero. To avoid disturbance to wintering birds, the hoarding can only be erected and uninstalled between April and August unless supervised by a professional ecologist.

## 7.2 Ireland's Eye SPA and the North-West Irish Sea cSPA

Due to the potential for adverse impacts on site integrity during the time period that auks are leaving the Ireland's Eye breeding colony, it will be necessary to put in place a Vessel Management Plan (see Appendix B). This plan will have two key functions. The first is to ensure that the Ireland's Eye SPA boundary is not unnecessarily approached or crossed by construction vessels working on the marine diffuser and subsea pipeline section at any time during the construction phase. The second is to ensure the protection of rafting auks (guillemot and razorbill) which are SCI species of both Ireland's Eye SPA and the North-West Irish Sea cSPA, when they are leaving the Ireland's Eye colony in July to mid-August at the end of the breeding season. Although not required on the basis of the assessments completed on potential effects, as a matter of good practice, the bird observer appointed by the contractor as part of the Vessel Management Plan, will notify the Marine Coordinator if there are any additional agglomerations of SCI species during their watching brief in place over the period of 8 July to 31 August in any given year during the construction period.

## 7.3 Baldoyle Bay SAC

A summary of mitigation for the protection of Baldoyle Bay SAC is summarised in Table 7-1 below.

**Table 7-1: Summary of Proposed Mitigation Requirements for Baldoyle Bay SAC**

| Operation | Area at risk | Sensitive receptor | Mitigation required |
|---|---|---|---|
| Construction | | | |
| Tunnelling under Baldoyle Estuary (including micro tunnelling compounds) | Runoff of pollutants and suspended sediment loads from construction compounds into estuary. | Saltmarsh | No discharges to estuary.<br><br>Surface water management including bunded storage areas and sediment settlement areas.<br><br>Implementation of Construction Environmental Management Plan (CEMP) including Surface Water Management Plan. |
| | Air breakout to surface | | Management of pressures. |
| | Bentonite breakout | | Management of bentonite and pressures during drilling.<br><br>In the event of bentonite breakout in saltmarsh area, intervention by mechanical recovery or washing[3]. |

[3] Washing the vegetation using a seawater pump and spray - typically this would be carried out during a high water period where washings can dispersed out of the estuary naturally.

| Operation | Area at risk | Sensitive receptor | Mitigation required |
|---|---|---|---|
| Construction Activities upstream of Baldoyle Bay | Runoff of pollutants and suspended sediment loads from construction activities into estuary | Saltmarsh | Implementation of Construction Environmental Management Plan (CEMP) including Surface Water Management Plan (see Appendix B) |
| Operational | Functioing of SUDS | Saltmarsh | Implementation of maintenance programme |

## 7.4 Rockabill to Dalkey Island SAC

Due to the increase in noise and suspended sediments some additional mitigation methods will be employed in order to prevent negative interaction with sensitive receptors in the area (in particular the cetaceans). A summary of mitigation for the marine ecology is summarised in Table 7-2.

**Table 7-2 : Summary of Proposed Mitigation Requirements for Rockabill to Dalkey Island SAC**

| Operation | Area at risk | Sensitive receptor | Mitigation required |
|---|---|---|---|
| Construction | | | |
| Dredging for the Marine outfall pipeline | Suspended sediments | Impact to Annex 1 Reef within SAC | Monitoring of plume during dredging operations.<br><br>For precautionary purposes, the turbidity will be monitored using a vessel deployed turbidity meter during peak dredging activity and dredging discharges restricted to peak flooding tides if a plume is detected >50mg/l above background on Ireland's Eye northern coastline. |
| | Noise and vibration if option for piling in a caisson for connection with dredging required | Marine mammals | Mitigation plan (see below)<br>Passive acoustic monitoring and marine mammal observers to establish safe zone. |
| | Noise and vibration of dredging | Marine mammals | Mitigation plan (see below)<br>Passive acoustic monitoring and marine mammal observers to establish safe zone. |
| | Pollution | Impact to Annex 1 Reef within SAC | Implementation and auditing of CEMP. |
| Installation of Marine Diffuser | Noise and vibration | Marine mammals | Mitigation plan (see below)<br>Passive acoustic monitoring and marine mammal observers to establish safe zone. |
| Operational | Habitat loss | Annex 1 Reef (Irelands Eye) | No mitigation required |
| | Pollution | All marine ecology | Output to be secondary treated with strict targets for suspended sediment and DIN level outputs (see chapter 4). |
| Installation of Marine Diffuser | Noise and vibration | Marine mammals | Mitigation plan (see below)<br>Passive acoustic monitoring and marine mammal observers to establish safe zone. |
| Operational | Habitat loss | Annex 1 Reef (Irelands Eye) | No mitigation required |

| Operation | Area at risk | Sensitive receptor | Mitigation required |
|---|---|---|---|
| | Pollution | All marine ecology | Output to be secondary treated with strict targets for suspended sediment and DIN level outputs (see chapter 4). |

**Mitigation Plan**

Mitigation during construction that create significant acoustic signatures will be undertakan during the main periods of marine works (piling and dredging) to ensure minimal impact to marine mammal within the vicinity of the survey works. This will include as a minimum marine mammal observers and a high frequency hydrophone system so as to establish an operational safe zone around the site in order to prevent the commencement of operations in the event that sensitive receptors (pinnipeds and cetaceans) are observed within this perimeter.

- Assessing and monitoring of the responses of harbour porpoise to noise, particularly within the SAC, during construction is recommended. Following appropriate guidelines from the regulatory authorities, the National Parks & Wildlife Service (2013), the following precautionary measures are advised to minimise the risk of direct injury to marine mammals in the area of operations: A trained and experienced Marine Mammal Observer (MMO) should be put in place during piling, dredging, pipeline laying. The MMO will scan the surrounding area to ensure no marine mammals are in a pre-determined exclusion zone in the 30-minute period prior to operations. It is suggested that this exclusion zone is 500m for dredging activities, and 1000m for piling activities considering the potential risks outlined.
- Noise-producing activities shall only commence in daylight hours where effective visual monitoring, as performed and determined by the MMO, has been achieved. Where effective visual monitoring is not possible, the sound-producing activities shall be postponed until effective visual monitoring is possible. Visual mitigation for marine mammals (in particular harbour porpoise) will only be effective during daylight hours and if the sea state is 2-3 (Beaufort scale) or less..
- For piling activities, where the output peak sound pressure level (in water) exceeds 170dB, a rampup procedure must be employed following the pre-start monitoring. Underwater acoustic energy output shall commence from a lower energy start-up and thereafter be allowed to gradually build up to the necessary maximum output over a period of 20-40 minutes.
    - Once operations have begun, operations should cease temporarily if a cetacean or seal is observed swimming in the immediate (<50m) area of piling and dredging and work can be resumed once the animal(s) have moved away.
    - Any approach by marine mammals into the immediate (<50 m) works area should be reported to the National Parks and Wildlife Service.
- If there is a break in piling activity for a period greater than 30 minutes then all pre-activity monitoring measures and ramp-up (where this is possible) should recommence as for start-up.
- Once normal operations commence (including appropriate ramp-up procedures), there is no requirement to halt or discontinue the activity at night-time, nor if weather or visibility conditions deteriorate, nor if marine mammals occur within a radial distance of the sound source that is 500m for dredging works, and 1000m for piling activities.
- The MMO will keep a record of the monitoring using “MMO form location and effort (coastal works)” available from the National Parks & Wildlife Service (NPWS) and submit to the NPWS on completion of the works, as described in the NPWS guidance (2014).
- In order to reliably quantify the zone of responsiveness associated with the proposed programme of piling activities associated with the interface pit or cable crossing, hydrophones in combination with passive acoustic monitoring will be used.

## 7.5 Lambay Island SAC

See mitigation measures for marine mammals listed above for Rockabill to Dalkey Island SAC.

## 7.6 Other European Sites

No further mitigation is required for the following sites other than the implementation of the CEMP and surface water management plan for construction acivities associated with all elements of the projects as listed in Table 4-1:

1. North Dublin Bay SAC;
2. North Bull Island SPA;
3. Malahide Estuary SPA;
4. Malahide Estuary SAC;
5. Howth Head Coast SPA;
6. Howth Head Coast SAC;
7. South Dublin Bay and River Tolka Estuary;
8. Rogerstown Estuary SAC;
9. Rogerstown Estuary SPA;
10. Lambay Island SPA;
11. Dalkey Island SPA;
12. Skerries Islands SPA; and
13. Rockabill SPA.

# 8. Conclusions

This revised Natura Impact Statement has considered the potential for significant impacts arising from the proposed Greater Dublin Drainage Project that would have the potential to adversely affect any Natura 2000 site; with regard to their qualifying interests and conservation objectives. The marine outfall pipeline of the proposed development runs under the Baldoyle Bay SAC and SPA in a tunnel and a 1,300m section of the marine outfall pipeline and the marine diffuser are located in the Rockabill to Dalkey Island SAC. The same 1,300m section lies north of Ireland's Eye SPA and SAC and south of Lambay Island SAC. The length of the marine-based outfall pipeline beyond Velvet Strand to the terminal marine diffuser (4,800m) is located within the North-West Irish Sea cSPA.

The potential for direct, indirect and in combination impacts affecting the above designations has therefore been assessed in this NIS. The appraisal undertaken in this NIS has been informed by project-specific site investigations and specialist reporting with reference to the ecological communities and habitats potentially affected by the proposed development, in order to provide a scientific basis for evaluations.

Measures for impact reduction have been incorporated into the project proposal, including design-stage avoidance, in addition to mitigation measures proposed in the NIS for the avoidance and reduction of impacts on the qualifying interests and conservation objectives of the designated Natura 2000 sites within the study area. With the implementation of these measures the project will not result in direct, indirect or in combination impacts which would have the potential to adversely affect the qualifying interests/special conservation interests of the Natura 2000 sites within the study area with regard to the range, population densities or conservation status of the habitats and species for which these sites are designated (i.e. conservation objectives).

It is therefore concluded, beyond reasonable scientific doubt, that the proposed project with the implementation of the prescribed mitigation measures will not give rise to significant impacts, either individually or in combination with other plans and projects, in a manner which adversely affects the integrity of any designated site within the Natura 2000 network.

## 8.1 Baldoyle Bay SPA

The Baldoyle Bay SPA has two conservation objectives:

1. To maintain the favourable conservation condition of the waterbird SCI species; and

2. To maintain the favourable conservation condition of the wetland habitat at Baldoyle Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

Conservation objectives could be compromised due to the proposed GDD project through visual disturbance during construction activities at the microtunnelling compounds (Section 6.1.1). Adverse effects on light-bellied brent goose, shelduck and golden plover were identified. It was also identified that no effect on the conservation objectives of any SCIs would occur as a result of airborne noise disturbance (Section 6.1.1).

No adverse effect on site integrity is predicted due to the water quality and habitat deterioration impact pathway during construction and operation of the proposed GDD project (Section 6.2.4.1), which covers several mechanisms. During construction, these are pollution incidents and elevated suspended sediments occurring upstream of the SPA, bentonite release, surface venting and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume was also considered.

Conservation objectives could be compromised due to the proposed GDD project through habitat loss, none of which occurs within the SPA boundary (Section 6.4.4). Whilst a small number of one SCI species (ringed plover) was recorded in affected areas during the baseline survey programme, these birds will not be lost from the SPA population as a result of construction of the proposed GDD project. There is no adverse effect on site integrity.

Following the implementation of mitigation to reduce the impact of visual disturbance (screening around both microtunnelling compounds and access track; Section 7.1), no residual impact on the Baldoyle Bay SPA is predicted. On this basis it is concluded that the proposed development will not adversely affect the integrity of the above Baldoyle Bay SPA, having regard to the conservation objectives of the site.

## 8.2 Ireland's Eye SPA and the North-West Irish Sea cSPA

The single conservation objective of the Ireland's Eye SPA is to maintain or restore the favourable conservation condition of the bird species listed as SCIs. Site-specific conservation objectives have recently been assigned to the North-West Irish Sea cSPA (NPWS, 2023) and as anticipated, are similar to objectives from the existing marine SPAs.

Due to the highly localised airborne noise impacts that are predicted (Section 5.2) there are no airborne noise impacts as a result of works in the subsea environment that will result in effects to SCI species inside Ireland's Eye SPA or the North-West Irish Sea cSPA. Whilst small scale disturbance effects due to airborne noise could occur in subsea locations outside the SPAs this is not considered to compromise the conservation objectives of Ireland's Eye SPA or result in adverse effects upon the SCIs of the North-West Irish Sea cSPA. With regard to visual disturbance, it is possible that vessels operating along the outfall pipeline corridor and marine diffuser have the potential to cause disturbance to the SCI species of the Ireland's Eye SPA within and outwith its boundary, and disturbance to the SCI species of the North-West Irish Sea cSPA within the site (Section 6.1.2). For two SCIs of both Ireland's Eye SPA and the North-West Irish Sea cSPA (guillemot and razorbill) it is considered that the conservation objectives of the Ireland's Eye SPA and the North-West Irish Sea cSPA could potentially be compromised for these species in the time period of July to mid-August.

No adverse effect on site integrity is predicted due to the water quality and habitat deterioration impact pathway during construction and operation of the proposed GDD project (Section 6.2.4.2), which covers several mechanisms. During construction, these are pollution incidents and elevated suspended sediments occurring upstream of the SPA, bentonite release, surface venting and suspended sediment arising from dredging or piling plume originating from the outfall pipeline corridor. During operation, the operational plume was also considered.

It was identified that habitat loss outwith Ireland's Eye SPA could impact a single SCI (herring gull) during construction (Section 6.4.4), and that temporary habitat loss on the seabed within the North-West Irish Sea cSPA could result in a temporary redistribution of a small number of birds of the North-West Irish Sea cSPA to elsewhere within the site. In both cases and for both sites, the level of this impact would not result in a compromising of the conservation objectives for Ireland's Eye SPA or theNorth-West Irish Sea cSPA.

Following the implementation of mitigation to reduce the impact of visual disturbance (Vessel Management Plan; Section 7.2), no residual impact on the Ireland's Eye SPA or the North-West Irish Sea cSPA is predicted. On this basis it is concluded that the proposed development will not adversely affect the integrity of te Ireland's Eye SPA, having regard to the conservation objectives of the site. The proposed development will also not adversely affect the integrity of the North-West Irish Sea cSPA.

## 8.3 Baldoyle Bay SAC

The current assessment has determined that there would be no potential for adverse effects on the coastal habitats listed as qualifying interests of this SAC, arising from the proposed project.

The conservation objective for the Baldoyle Bay SAC is to maintain the favourable conservation conditions of the qualifying habitats of *Salicornia* and other annuals colonising mud and sand (1310), Atlantic salt meadows (*Glauco-Puccinellietalia maritimae; 1330), Mudflats and sandflats not covered by seawater at low tide (1140) and Mediterranean salt meadows (Juncetalia maritime; 1410).* The proposed construction method of tunnelling carried out below the estuary will avoid any direct impact to this environment, with only a limited potential for small or isolated incidents occurring through unlikely breakout or pollution events. Mitigation is proposed in Section 7.1.3. but no residual impact to the SAC is predicted. The water quality modelling (see Section 5.8) show there is no impact from the construction of the marine outfall pipeline on Baldoyle Bay or from the operation of the project. Mitigation is also proposed to manage surface water run-off from construction acitivities upstream of Baldoyle Bay, but no residual impact to the SAC is predicted.

On this basis it is concluded that the proposed development will not adversely affect the integrity of the above Baldoyle Bay SAC, having regard to the conservation objectives of the site.

## 8.4 Rockabill to Dalkey Island SAC

The conservation objective for the Rockabill to Dalkey Island SAC is to maintain the favourable conservation conditions for reefs (subtidal and intertidal; 1170) and for the harbour porpoise (Annex II species).

The current target of the reef is to maintain a stable or increasing habitat subject to natural processes. Survey operations revealed that the sublittoral reef is already subject to high levels of natural siltation although this has not affected the naturally high diversity. The reef is to be protected against "activities or operations that permanently remove habitat from the site". Modelling of the expected suspended sediment plume created during the construction following a controlled tidal release of spoil has shown no effect on the reef (see section 5.8).

Residual impacts of the proposed works affecting marine mammals will not be significant. Potential direct impacts from the noise from the proposed construction activities on marine mammals will be insignificant once the mitigation measures are implemented. Behavioural responses to noise from dredging and construction are considered to be temporary and limited to the duration of the works, and will be reduced for the duration of the works through mitigation measures (see Section 7.4). There will be no significant impacts of the proposed development on the Conservation Objectives of the Rockabill to Dalkey Island cSAC.

On this basis, the proposed Project will not adversely affect the integrity of Rockabill to Dalkey Island cSAC, in view of the site's conservation objectives.

## 8.5 Lambay Island SAC

Although not directly within the development area, the conservation objective for the Annex II species found at the Lambay Island SAC, but may forage within the development area is to maintain the favourable conservation conditions for both grey and harbour seal species (1364 and 1365).

The proposed construction method of surface dredging out to the Marine Diffuser will provide a negligible level of impact in the immediate vicinity of the diffuser location through increased suspended sediments and increased noise. The impact to the two Annex II species or their expected pretty species will be negligible as the introduction to a sediment plume will be short term, localised and not affect the species ability to forage elsewehere within the vicinity of the development.

Residual impacts of the proposed works affecting marine mammals will not be significant. Potential direct impacts from the noise from the proposed construction activities on marine mammals will be insignificant once the mitigation measures included in this assessment are implemented. Behavioural responses to noise from dredging and construction are considered to be temporary and limited to the duration of the works, and will be reduced for the duration of the works through mitigation measures (see Section 7.4). There will be no significant impacts of the proposed development on the Conservation Objectives of the Lambay Island SAC.

On this basis, the proposed Project will not adversely affect the integrity of Lambay Island cSAC, in view of the site's conservation objectives.

## 8.6 Other European Sites

The separation distance of the following SACs from the proposed Project results in none of the discharged sediment from construction or the effluent from operation reaching the SAC boundaries and therefore no impact is expected within this SAC.

1. North Dublin Bay SAC;
2. Malahide Estuary SAC;
3. Howth Head Coast SAC;
4. Rogerstown Estuary SAC;

On this basis it is concluded that the proposed development will not adversely affect the integrity of the above SACs, having regard to the conservation objectives of each site.

Due to the location of the following SPAs at a greater distance from the project elements, no source of airborne noise disturbance will occur at a sound power level of sufficient magnitude to potentially trigger disturbance within the SPA boundaries. Similarly, there are no visual disturbance sources that will exert an effect within these SPA boundaries. Whilst there is potential for connectivity between these SPAs and habitats that are within the zone of impact of the proposed GDD project (through airborne noise, visual disturbance and habitat loss), the possibility of significant numbers of birds from these more distant SPAs being impacted by the proposed GDD project by this impact pathway is considered to be remote. Similarly, the separation distance of the following SPAs from the proposed Project results in none of the discharged sediment from construction or the effluent from operation reaching the SPA boundaries and therefore no impact is expected within this SAC.

1. North Bull Island SPA;
2. Malahide Estuary SPA;
3. Howth Head Coast SPA;
4. South Dublin Bay and River Tolka Estuary SPA;
5. Rogerstown Estuary SPA;
6. Lambay Island SPA;
7. Dalkey Island SPA;
8. Skerries Islands SPA; and
9. Rockabill SPA.

On this basis it is concluded that the proposed development will not adversely affect the integrity of the above SPAs, having regard to the conservation objectives of each site.

# 9. REFERENCES

Berrow, S and J. O'Brien (2013). Harbour Porpoise SAC Survey 2013. Irish Whale and Dolphin Group Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. November 2013

BSL (2015a) Phase I Ireland's Eye Reef Survey Field Report for RPS relating to Irish Water Greater Dublin Drainage. June 2015. Produced by Benthic Solutions Limited. Revision 0.

BSL (2015b) Phase II Ireland's Eye Reef Survey Final Report for RPS relating to Irish Water Greater Dublin Drainage. November 2015. Produced by Benthic Solutions Limited. Revision 0.

de Jong, C. A. F., Ainslie, M. A., Dreschler, J., Jansen, E., Heemskerk, E. & Groen, W (2010). Underwater noise of Trailing Suction Hopper Dredgers at Maasvlakte 2: Analysis of source levels and background noise – TNO-DV 2010 C335.DEHLG (2010a) Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin

DEHLG (2010b) Department of Environment Heritage and Local Government Circular NPWS 1/10 and PSSP 2/10 on Appropriate Assessment under Article 6 of the Habitats Directive – Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government, Dublin

Dickerson, C., K.J. Reine, and D.G. Clarke (2001). Characterization of underwater sounds produced by bucket dredging operations. U.S. Army Corps of Engineers Research and Development Center. DOER Technical Notes Collection ERDC TN-DOER-E14. http://el.erdc.usace.army.mil/elpubs/pdf/doere14.pdf

Cummins, S.; Lauder, C.; Lauder, A.; Tierney, T. D. (2019). The status of Ireland's breeding seabirds. Irish Wildlife Manual No. 114

European Commission (2000a) Communication from the Commission on the Precautionary Principle. Office for Official Publications of the European Communities, Brussels

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

European Commission (2001) Assessment of plans and projects significantly affecting Natura 2000 sites: Methodological guidance on the provisions of Articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels

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

European Commission (2009) Estuaries and Coastal Zones within the Context of the Birds and Habitats Directives - Technical Supporting Document on their Dual Roles as Natura 2000 Sites and as Waterways and Locations for Ports. Office for Official Publications of the European Communities, Brussels

European Commission (2011). Guidance document on the implementation of the birds and habitats directive in estuaries and coastal zones with particular attention to port development and dredging. Office for Official Publications of the European Communities, Brussels

European Commission (2013) Interpretation Manual of European Union Habitats. Version EUR 28. Office for Official Publications of the European Communities, Brussels.

European Commission (2018) EC Notice C(2018) 7621 Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels.

European Commission (2021) EC Notice C(2021) 6913 Assessment of plans and projects in relation to Natura 2000 sites - Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC. Office for Official Publications of the European Communities, Brussels.

European Commission (2022) EC Guidance document on Assessment of plans and projects in relation to Natura 2000 sites - A summary. Office for Official Publications of the European Communities, Brussels.

Gilbert, G., Gibbons, D.W. and Eans, J. (1998) Bird Monitoring Methods: A Manual of Techniques for Key UK Species. Royal Society for the protection of Birds, Sandy, Bedfordshire

IAQM (2020) A guide to the assessment of air quality impacts on designated nature conservation sites (Version 1.1). Institute of Air Quality Management, London.

Furness, B.; Wade, H. (2012). Vulnerability of Scottish Seabirds to Offshore Wind Turbines. Report by MacArthur Green. Report for Marine Scotland Science

Furness, R. W., Wade, H. M., and Masden, E. A. (2013). Assessing vulnerability of marine bird populations to offshore wind farms. Journal of Environmental Management, 119, 56-66. https://doi.org/10.1016/j.jenvman.2013.01.025

Garthe, S. Hüppop, O. (2004). Scaling Possible Adverse Effects of Marine Wind Farms on Seabirds: Developing and Applying a Vulnerability Index. Journal of Applied Ecology, 41(4), 724-734. https://doi.org/10.1111/j.0021-8901.2004.00918.x

Jarrett, D. Cook, A., Woodward, I., Ross, K., Horswill, C., Dadam, D. and Humphreys, L. (2018). Short-Term Behavioural Responses of Wintering Waterbirds to Marine Activity: Quantifying the Sensitivity of Waterbird Species during the Non-Breeding Season to Marine Activities in Orkney and the Western Isles. Scottish Marine and Freshwater Science Vol 7 No 9, 88pp. DOI: 10.7489/12096-1

Mc Corry, M & T. Ryle (2009) Saltmarsh Monitoring Project 2007-2008. Contract reference D/C/227. A Report for Research Branch, National Parks and Wildlife Service

Nedwell, J. R., Parvin, S. J., Brooker, A. G. & Lambert, D. R (2008). Modelling and measurement of underwater noise associated with the proposed Port of Southampton capital dredge and redevelopment of berths 201/202 and assessment of the disturbance to salmon. 05 December 2008. Subacoustech Report No. 805R0444. Subacoustech.

NPWS (2012a) Marine Natura Impact Statements in Irish Special Areas of Conservation: A working document, April 2012. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2012b) Conservation Objectives: Baldoyle Bay SAC 000199. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2012c) Baldoyle Bay SAC Conservation objectives supporting document – Marine habitats. Version 1 September 2012. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2012d) Baldoyle Bay SAC Conservation objectives supporting document – Coastal habitats. Version 1 November 2012. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2012e) Baldoyle Bay SPA Conservation objectives supporting document. Version 1 December 2012. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2013a) The Status of EU Protected Habitats and Species in Ireland. Habitat Assessments Volume 2. Version 1.0. Unpublished Report, National Parks & Wildlife Services. Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2013b) Conservation Objectives: Baldoyle Bay SPA 004016. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2013c) Rockabill to Dalkey Island SAC Conservation objectives supporting document - Marine Habitats and Species. Version 1, April 2013. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2013d) Conservation Objectives: Rockabill to Dalkey Island SAC 003000. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2013e) Conservation Objectives: Lambay Island SAC 003000. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2015) Conservation objectives for Ireland's Eye SPA [004117]. Generic Version 4.0. Department of Arts, Heritage and the Gaeltacht, Dublin

NPWS (2023) Conservation Objectives: North-West Irish Sea SPA 004236. Version 1. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin

OPR (2021) Practice Note (PN01) Appropriate Assessment Screening for Development Management. Office of the Planning Regulator, Dublin.

Reine, K. J., D. G. Clarke, and C. Dickerson (2012). Characterization of underwater sounds produced by a backhoe dredge excavating rock and gravel. DOER Technical Notes Collection ERDC TN-DOER-E36, U.S. Army Engineer Research and Development Centre, Vicksburg, Mississippi, USA

Robinson, S. P., Theobald, P. D., Hayman, G., Wang, L. S., Lepper, P. A., Humphrey, V. & Mumford, S (2011). Measurement of underwater noise arising from marine aggregate dredging operations – MEPF report 09/P108. Marine Aggregate Levy Sustainability Fund.

Robinson, S.P., P.D. Theobald, P.A. Lepper, G. Hayman, V.F. Humphrey, L.S. Wang, and S. Mumford (2012). Measurement of underwater noise arising from marine aggregate operations. In: Popper, A.N. and A.D. Hawkins, eds. The effects of noise on aquatic life. New York: Springer Science + Business Media, LLC. Pp. 465-469.

Southall, Brandon L. & Ann E. Bowles, William T. Ellison, James J. Finneran, Roger L. Gentry, Charles R. Greene Jr., David Kastak, Darlene R. Ketten, James H. Miller, Paul E. Nachtigall, W. John Richardson, Jeanette A. Thomas, & Peter L. Tyack (2007) Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations Aquatic Mammals, Volume 33, Number 4, 2007 ISSN 0167-5427

Woodward, I., Thaxter, C.B., Owen, E. and Cook, A.S.C.P (2019). Desk-based revision of seabird foraging ranges used for HRA screening. BTO Research Report No. 724. BTO, Norfolk

**Appendix A – RPS Ornithology Reports**

1. Estuarine, Coastal and Marine Ornithology Technical Report 2018
2. Estuarine, Coastal and Marine Ornithology Baseline Report 2023

# Greater Dublin Drainage

# Appendix A

# Estuarine, Coastal and Marine Ornithology Technical Report

**May 2018**

**Project Number: SEC7909**

**RPS**
Belford House, 3rd Floor,
59 Belford Road,
Edinburgh,
EH4 3DE

**Tel: 0131 555 5011**
**Fax: 0131 555 4911**
**Email: rob.iredale@rpsgroup.com**

# QUALITY MANAGEMENT

<table>
<tr><td rowspan="2">Prepared by:</td><td>Name:</td><td>Dr Rob Iredale</td><td>Title:</td><td>Principal Ornithologist</td></tr>
<tr><td>Signature:</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Authorised by:</td><td>Name:</td><td>Dr Simon Zisman</td><td>Title:</td><td>Senior Director</td></tr>
<tr><td>Signature:</td><td colspan="3"></td></tr>
<tr><td>Status:</td><td colspan="4">Final</td></tr>
<tr><td rowspan="2">Issue Date:</td><td rowspan="2">23rd May 2018</td><td>Revision Number:</td><td colspan="2">20180523_F1</td></tr>
<tr><td>Revision Notes:</td><td colspan="2">-</td></tr>
<tr><td>Project File Path:</td><td colspan="4">W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Reports\EIS\2018_05_17_FinalSub\Final\2018_05_23_SEC7909 Marine Ornithology Appendix A10.1 RI_vf_clean.docx</td></tr>
</table>

This report has been prepared within the RPS Planning and Development Quality Management System to British Standard EN ISO 9001 : 2008



REPORT TEMPLATE

| | |
|---|---|
| TYPE: | Technical |
| ISSUE DATE: | 18 May 2011 |
| REVISION NUMBER: | 1 |
| REVISION DATE: | 26 April 2012 |

# CONTENTS


**1. INTRODUCTION........................................................................1**

**1.1 Purpose of this Document ........................................................1**

**2. ESTUARINE BIRD SURVEYS .........................................................2**

**2.1 Survey Methodology.................................................................2**
**2.1.1** Introduction..........................................................................2
**2.1.2** **Survey** Location....................................................................2
**2.1.3** **Target Species**....................................................................2
**2.1.4** **Survey** Timing **and Effort**...................................................2
**2.1.5** **Field** Recording...................................................................2
**2.2 Results ..................................................................................2**
**2.2.1** **Survey** Effort.........................................................................2
**2.2.2** **Peak** Counts.........................................................................2
**2.2.3** Figures.................................................................................3

**3. COASTAL AND MARINE VANTAGE POINT (VP) SURVEYS ...............4**

**3.1 Survey Methodology.................................................................4**
3.1.1 Introduction............................................................................4
3.1.2 Survey Locations.....................................................................4
3.1.3 Target Species .......................................................................4
3.1.4 Survey Timings.......................................................................5
3.1.5 Field Recording .....................................................................5
**3.2 Results ..................................................................................5**
**3.2.1** Survey Effort.........................................................................5
3.2.2 VP Peak Counts .....................................................................5

**4. REFERENCES**

**FIGURES**

**APPENDIX 1 – ESTUARINE BIRD SURVEY EFFORT**

**APPENDIX 2 – ESTUARINE BIRD SURVEY DATA**

**APPENDIX 3 – MARINE VP SURVEY EFFORT**

**APPENDIX 4 – MARINE VP RECORDS**

**APPENDIX 5 – MARINE VP GRAPHS**

# 1. INTRODUCTION

## 1.1 Purpose of this Document

This document outlines the protocols for surveys and presents the ornithology data collected for the Greater Dublin Drainage (GDD) Project on estuarine, coastal and marine ornithology. It should be read in conjunction with the relevant Environmental Impact Assessment Report (EIAR) chapter (Chapter 10: Marine Ornithology).

The following surveys are covered by this document:

- Coastal and Marine VP (Velvet Strand; VP1);
- Coastal and Marine VP (Ireland's Eye; VP2); and
- Estuarine bird surveys (Baldoyle Bay).

.
Data collected between December 2014 and March 2018 is included.

# 2. ESTUARINE BIRD SURVEYS

## 2.1 Survey Methodology

### 2.1.1 Introduction

Estuarine walkover surveys were carried out based on the standard Wetland Bird Survey methods (Gilbert *et al*., 1998; BTO 2016a and 2016b), using a more refined methodology involving the recording of precise locations of birds as well as their behaviour. Surveys aimed to count, map and record behaviour of wildfowl and waders using the estuarine habitat, in addition to other species of bird present.

### 2.1.2 Survey Location

The survey area is shown in Figure 10.1 of the EIAR chapter. The survey area covered the route of the pipeline to the outfall where it crosses intertidal/ estuarine habitat, and extended up to 1km from this route across the Baldoyle Bay SPA and surrounding habitats. The size of the survey area was approximately 4.95km².

### 2.1.3 Target Species

The key species groups were wildfowl, waders and seabirds. However, during the surveys all birds were recorded. Priority was given to recording birds on the ground or on water within the survey area. Records of notable flying birds were made, for example raptors or flocks of waterfowl and waders.

### 2.1.4 Survey Timing and Effort

In each month, two estuarine survey counts were completed. Each survey was of six hours duration. If the survey area was covered before the allotted time has elapsed (which was possible at high tide), the remaining time was used to undertake repeat counts of any wader or wildfowl hotspots.

Timings of counts throughout the survey period were made so that the whole tidal cycle was equally covered. Counts were made during full daylight.

### 2.1.5 Field Recording

Species were recorded using standard BTO codes and the behaviour codes specified on the survey map. Information on the age and sex of target species was also desirable. Notable observations that occurred outside the study area but within sight of the surveyors inside the study area were recorded.

## 2.2 Results

### 2.2.1 Survey Effort

Survey effort during the estuarine walkover surveys is presented in Appendix 1 (Table A10.1).

### 2.2.2 Peak Counts

Peak counts from estuarine walkover surveys are presented in Appendix 2 (Tables A10.2 to A10.4).

### 2.2.3 Figures

The distribution of 53 species encountered during the estuarine walkover surveys is presented in Figures TA10.1 to TA10.53. A figure was produced for species that were named on citations of the Baldoyle Bay, Ireland's Eye or Howth Head Coast SPA, or if more than ten records of the species were made during the surveys.

# 3. COASTAL AND MARINE VANTAGE POINT (VP) SURVEYS

## 3.1 Survey Methodology

### 3.1.1 Introduction

VP surveys were carried out based on those undertaken for the MeyGen Tidal Energy Project in the Pentland Firth (RPS, 2013). They were carried out from December 2014, with six hours of survey carried out monthly per VP to March 2018.

Survey protocol was designed to count birds on the water (primary focus) and in flight (through snapshot recording).

### 3.1.2 Survey Locations

One location on the mainland and one location on Ireland's Eye were used. The mainland coastal VP was positioned as in previous surveys at the proposed landfall location at Portmarnock (IO250423, Lat. 53.41631, Long. -6.11966, mean viewing angle 70°). The Ireland's Eye VP was positioned at IO287415 (Lat. 53.40792, Long. -6.06387, mean viewing angle 0°).

The mainland coastal VP covered the area of the marine outfall out to sea using a 2km viewing arc; and the Ireland's Eye VP covered the remaining pipeline route using a 2km viewing arc. In this way, a buffer around the marine outfall pipeline footprint and working area was achieved.

### 3.1.3 Target Species

Key species/ species groups are as listed below. These are primarily seabirds which utilise the marine environment for breeding, foraging or roosting. All species listed were covered, but species marked in bold were considered priority.

- Seaducks
- Divers
- Grebes
- **Fulmar** and other tubenoses (petrels, shearwaters)
- Gannet
- **Cormorant**
- **Shag**
- Skuas
- **Lesser black-backed gull**
- **Herring gull**
- Other large gulls
- **Kittiwake**
- Other small gulls (e.g. black-headed gull, common gull)
- **Roseate tern**
- **Common tern**
- **Arctic tern**
- **Auks**

### 3.1.4 Survey Timings

From each VP, six hours of survey were undertaken each month, timed to give coverage over a range of tide states, whilst ensuring a spread between neap and spring tides. Surveys commenced and ended no earlier than half an hour before sunrise and or no later than half an hour after sunset. Each VP survey was three hours long, and a minimum of 30 minutes taken as a break between surveys.

### 3.1.5 Field Recording

The 2km 180° viewing arc was divided into 6 (30°) sections labelled A-F. Each section was subdivided into 500m distance bands (numbered sequentially 1 to 4 away from observer). Each section was identified using land features, rangefinders, and by measuring the compass bearing from the observer.

A full binocular/telescope (dependent on distance band) scan of the whole area was made every 10 minutes, the surveyor working sequentially through the grid and distance bands and recording all birds observed on the water. Only birds on the sea surface, or birds in flight but using the sea (e.g. plunge diving or surface feeding, or clearly observing the sea surface in preparation to do so, or even, if not feeding, regularly dropping to the sea surface) were recorded during this scan; flying birds were ignored. The location of each record was determined using bearings, angles of declination or with reference to static easily identifiable objects in the sea. Standardised protocols for dealing with recording of behaviours and associations were used.

At the end of each full scan, birds in flight were counted in each sector. To reduce/ eliminate double counting this should be as near an instantaneous count as possible.

Throughout a day's observations, environmental conditions were recorded at hourly intervals using standard recording forms.

The following behaviour codes were used to describe birds on the water:

- SU: Surface feeding;
- PL: Plunge feeding;
- DP: Dip feeding;
- FE: Feeding (other);
- SC: Scavenging;
- SF: Scavenging at fishing vessel;
- KL: Kleptoparasitising;
- CN: Carrying nest material;
- CF: Carrying food;
- PR: Preening or bathing;
- ED: Escape diving from vessel;
- EF: Escape flight from vessel;
- RO: Roosting on water;
- LO: Loafing.

## 3.2 Results

### 3.2.1 Survey Effort

Survey effort during the Coastal and Marine VP surveys is presented in Appendix 3.

### 3.2.2 VP Peak Counts

Peak counts from Coastal and Marine VP surveys are presented in Appendix 4. Presented are tables which show the species recorded during both the breeding (April to August) and passage/winter (September to March) seasons, the total number of times they were recorded during surveys (split by in flight or on sea), and the peak count of birds that were recorded during a single scan (split by in flight or on sea, and combined). Species have been split into tables based on SPA citation (i.e. Ireland's Eye/Howth Head Coast SPA, Baldoyle Bay SPA, and non-cited species).

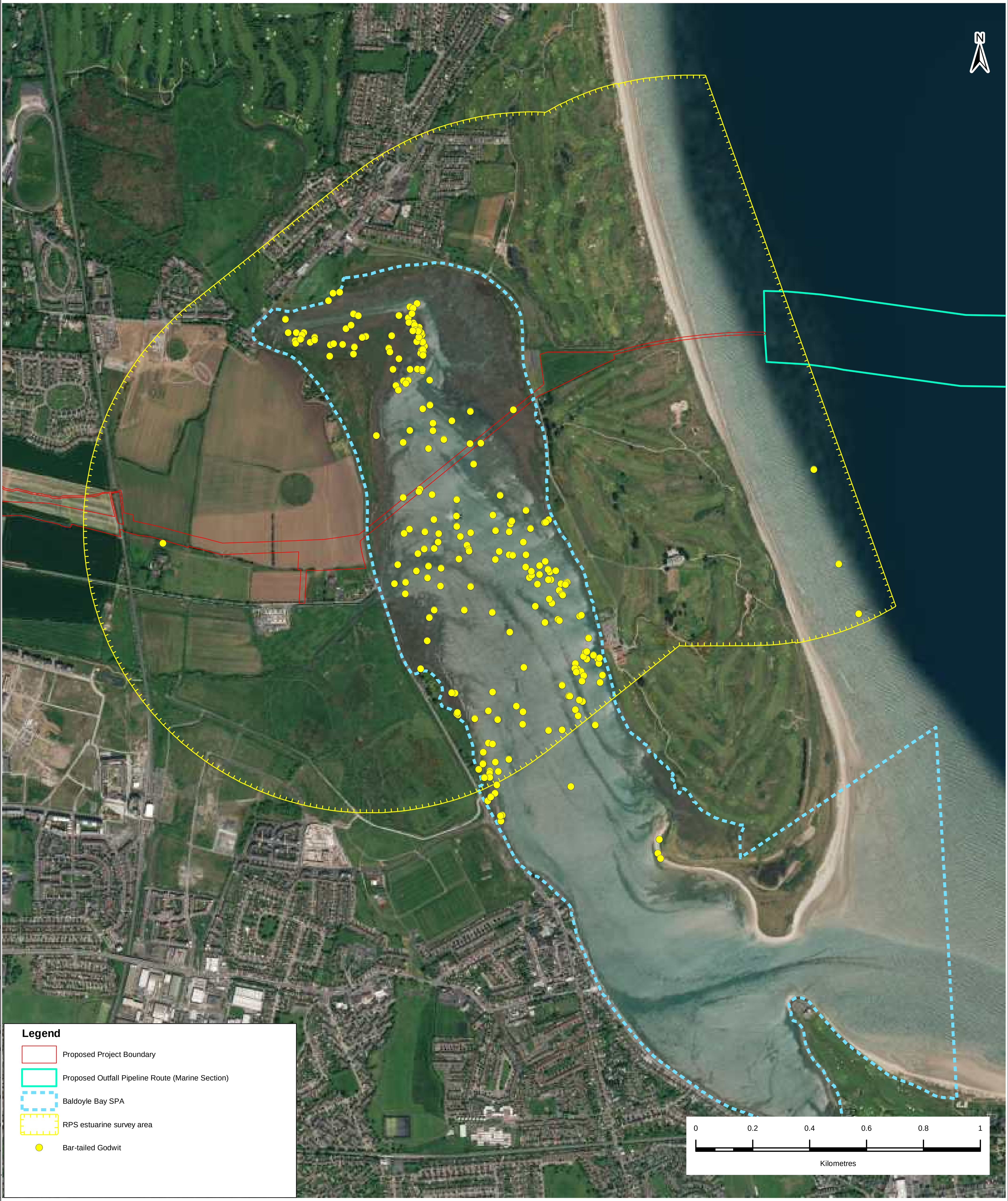
# 4. REFERENCES


- BTO (2016a). WeBS Core Counts Method. Available at: http://www.bto.org/volunteer-surveys/webs/taking-part/core-counts-methods.
- BTO (2016b). WeBS Low Tide Counts Method. Available at: http://www.bto.org/volunteer-surveys/webs/taking-part/low-tide-counts.
- Gilbert G., Gibbons D.W. & Evans, J. (1998) Bird Monitoring Methods: A Manual of Techniques for Key UK Species. RSPB, Sandy.
- RPS (2013). MeyGen Tidal Energy Project Inner Sound, Pentland Firth Ornithological Technical Report.

# FIGURES


| | |
|---|---|
| Bar-tailed Godwit Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.1 |
| Brent Goose (LB) Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.2 |
| Golden Plover Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.3 |
| Grey Plover Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.4 |
| Ringed Plover Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.5 |
| Shelduck Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.6 |
| Black-tailed Godwit Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.7 |
| Curlew Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.8 |
| Dunlin Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.9 |
| Great Crested Grebe Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.10 |
| Greenshank Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.11 |
| Grey Heron Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.12 |
| Knot Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.13 |
| Lapwing Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.14 |
| Mallard Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.15 |
| Oystercatcher Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.16 |
| Pintail Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.17 |
| Red-breasted Merganser Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.18 |
| Redshank Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.19 |
| Sanderling Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.20 |
| Teal Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.21 |
| Turnstone Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.22 |
| Black Guillemot Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.23 |
| Guillemot Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.24 |
| Razorbill Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.25 |
| Great Northern Diver Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.26 |
| Red-throated Diver Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.27 |
| Mute Swan Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.28 |
| Common Scoter Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.29 |
| Coot Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.30 |
| Little Grebe Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.31 |
| Moorhen Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.32 |
| Wigeon Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.33 |
| Black-headed Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.34 |
| Common Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.35 |
| Great Black-backed Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.36 |
| Herring Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.37 |
| Kittiwake Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.38 |
| Lesser Black-backed Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.39 |
| Little Egret Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.40 |
| Buzzard Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.41 |
| Peregrine Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.42 |

| | |
|---|---|
| Cormorant Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.43 |
| Shag Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.44 |
| Common Tern Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.45 |
| Sandwich Tern Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.46 |
| Common Sandpiper Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.47 |
| Common Snipe Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.48 |
| Whimbrel Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.49 |
| Kestrel Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.50 |
| Mediterranean Gull Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.51 |
| Roseate Tern Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.52 |
| Ruff Records in Baldoyle Bay (Dec 2014 to March 2018) | Figure A10.53 |
| Distribution of all on sea black guillemot records from Ireland's Eye VP during breeding season (March to October) | Figure A10.54 |
| Distribution of all on sea cormorant records from Ireland's Eye VP during breeding season (March to October) | Figure A10.55 |
| Distribution of all on sea fulmar records from Ireland's Eye VP during breeding season (March to October) | Figure A10.56 |
| Distribution of all on sea gannet records from Ireland's Eye VP during breeding season (March to October) | Figure A10.57 |
| Distribution of all on sea great black-backed gull records from Ireland's Eye VP during breeding season (March to October) | Figure A10.58 |
| Distribution of all on sea guillemot records from Ireland's Eye VP during breeding season (March to October) | Figure A10.59 |
| Distribution of all on sea guillemot or razorbill records from Ireland's Eye VP during breeding season (March to October) | Figure A10.60 |
| Distribution of all on sea herring gull records from Ireland's Eye VP during breeding season (March to October) | Figure A10.61 |
| Distribution of all on sea kittiwake records from Ireland's Eye VP during breeding season (March to October) | Figure A10.62 |
| Distribution of all on sea puffin records from Ireland's Eye VP during breeding season (March to October) | Figure A10.63 |
| Distribution of all on sea razorbill records from Ireland's Eye VP during breeding season (March to October) | Figure A10.64 |
| Distribution of all on sea shag records from Ireland's Eye VP during breeding season (March to October) | Figure A10.65 |




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

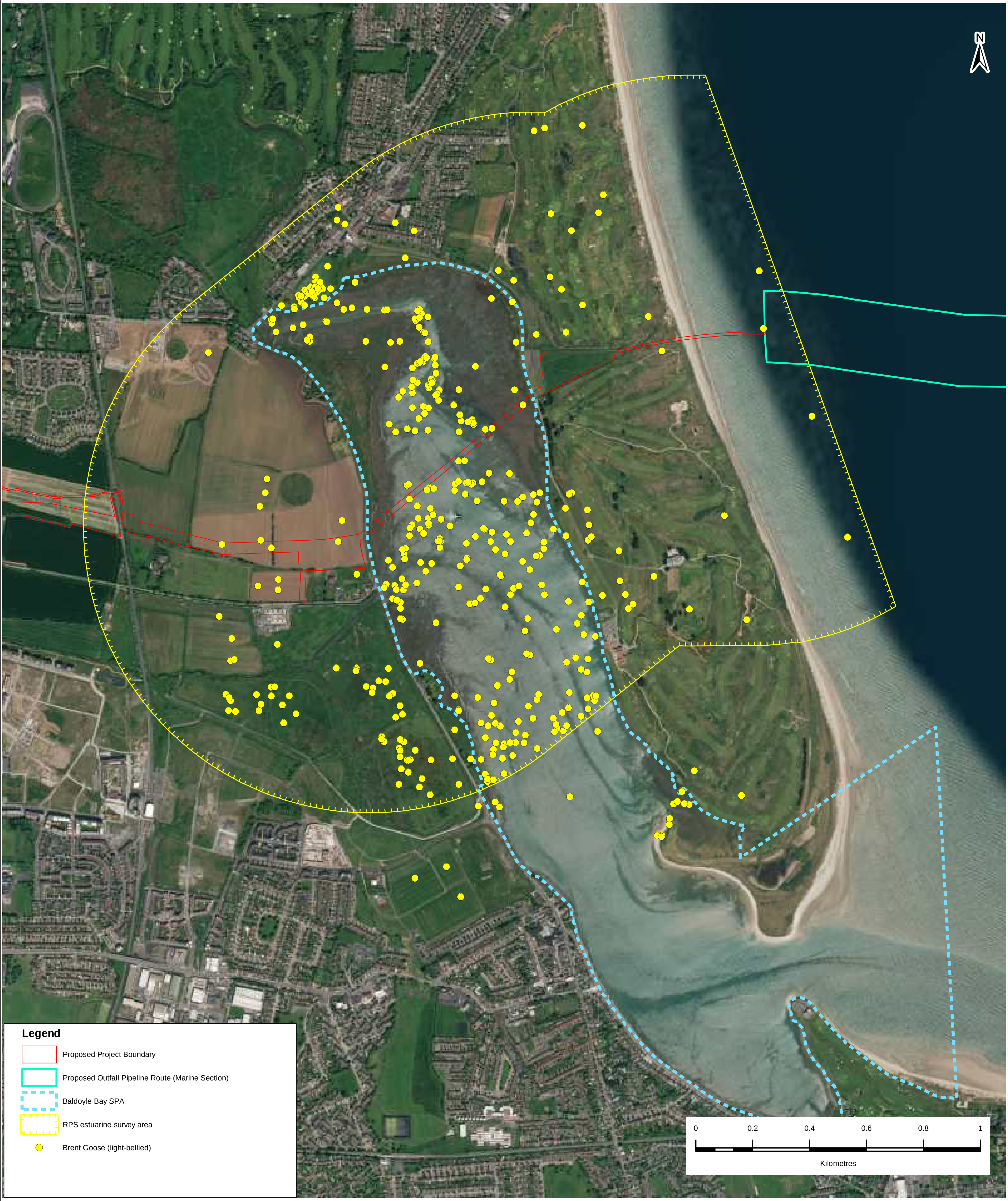
Drawing Title
Figure A10.1 Bar-tailed Godwit Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A101 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.2 Brent Goose (LB) Records in Baldoyle Bay (Dec 2014 to March 2018)



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A102 |


Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.3 Golden Plover Records in Baldoyle Bay (Dec 2014 to March 2018)



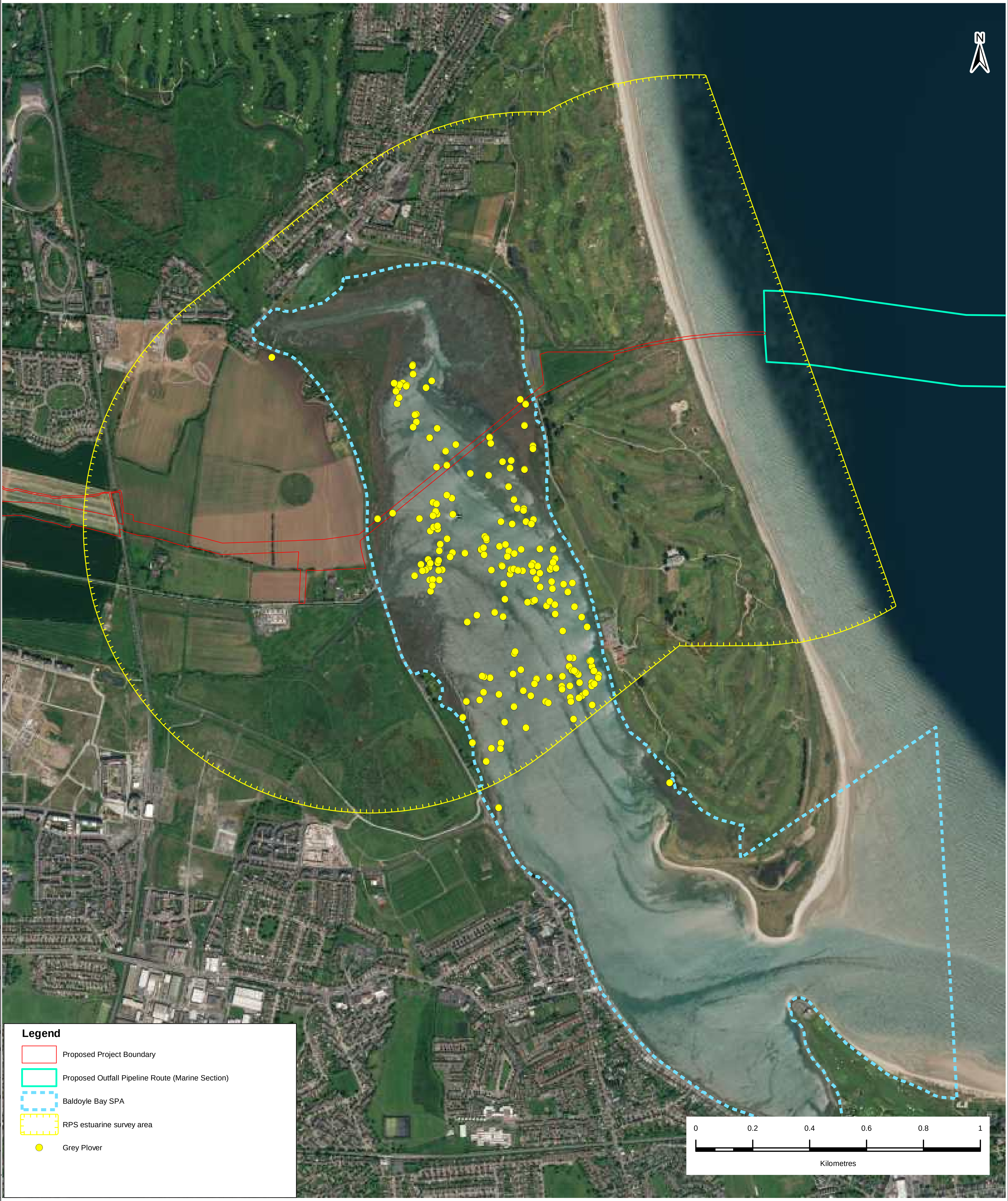
UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A103 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

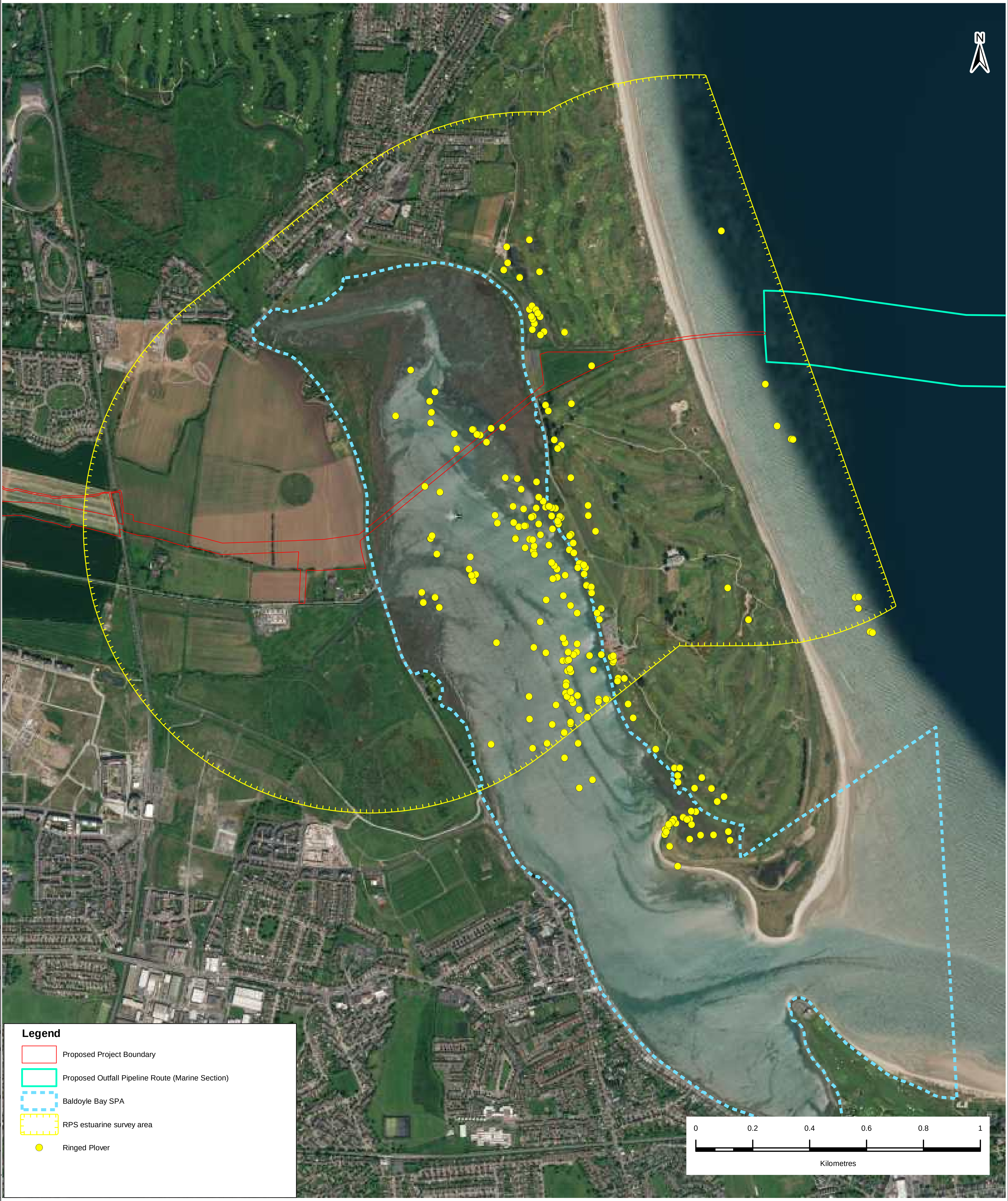


Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.4 Grey Plover Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A104 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




## Legend

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Baldoyle Bay SPA
- RPS estuarine survey area
- Ringed Plover

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project


Drawing Title
Figure A10.5 Ringed Plover Records in Baldoyle Bay (Dec 2014 to March 2018)

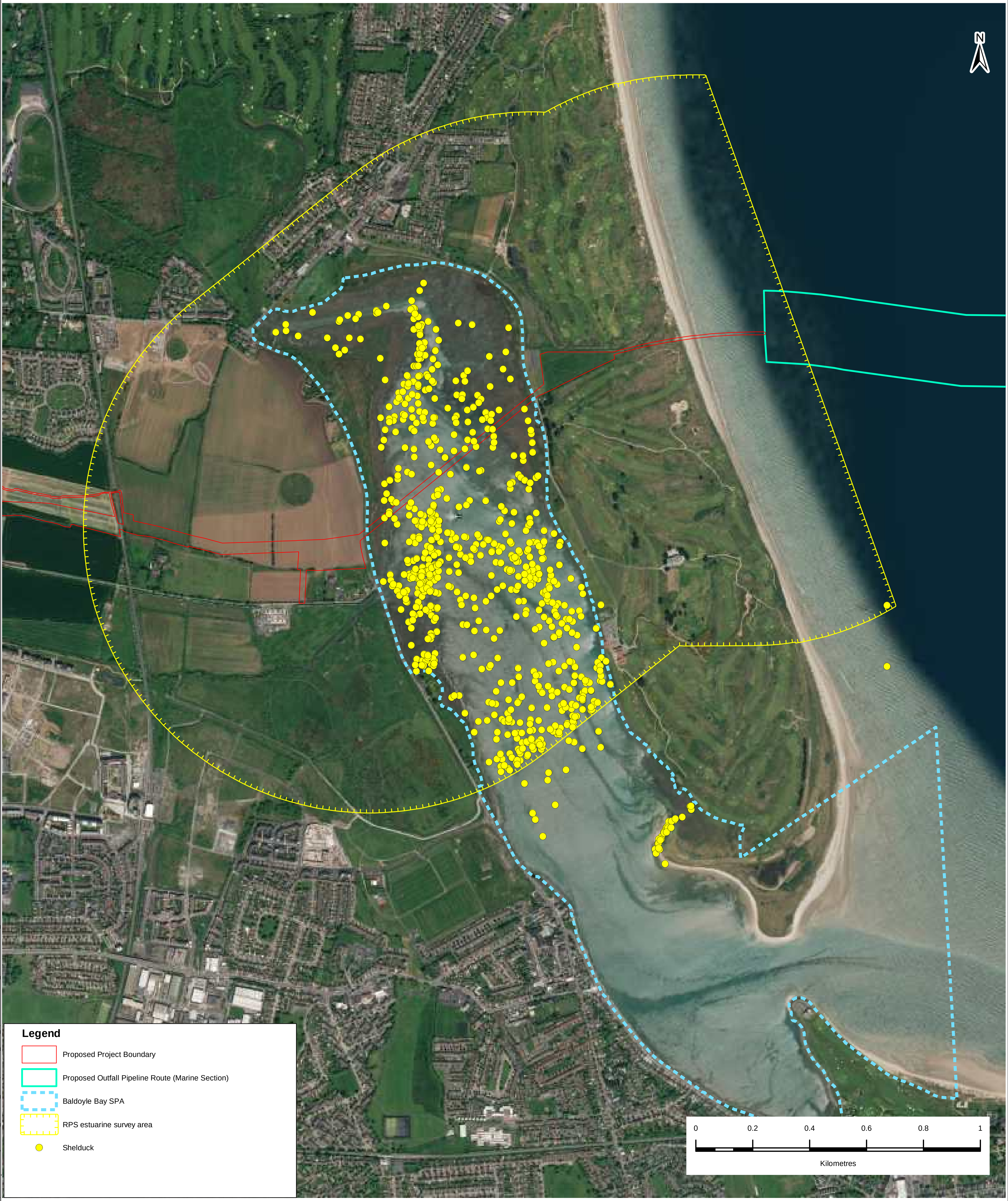
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE ÉIREANN : IRISH WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A105 |





Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.6 Shelduck Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

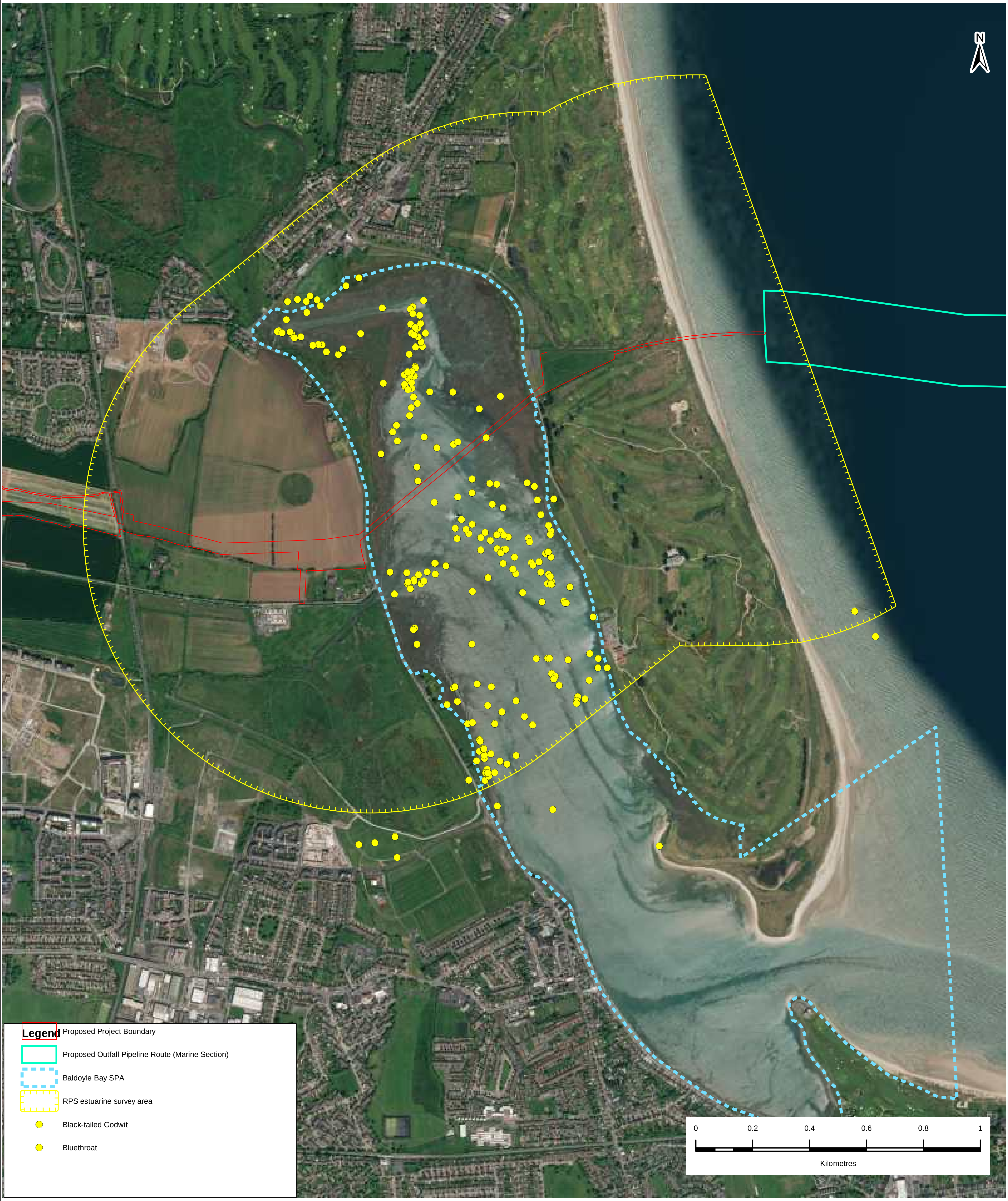


UISCE Éireann : Irish WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A106 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

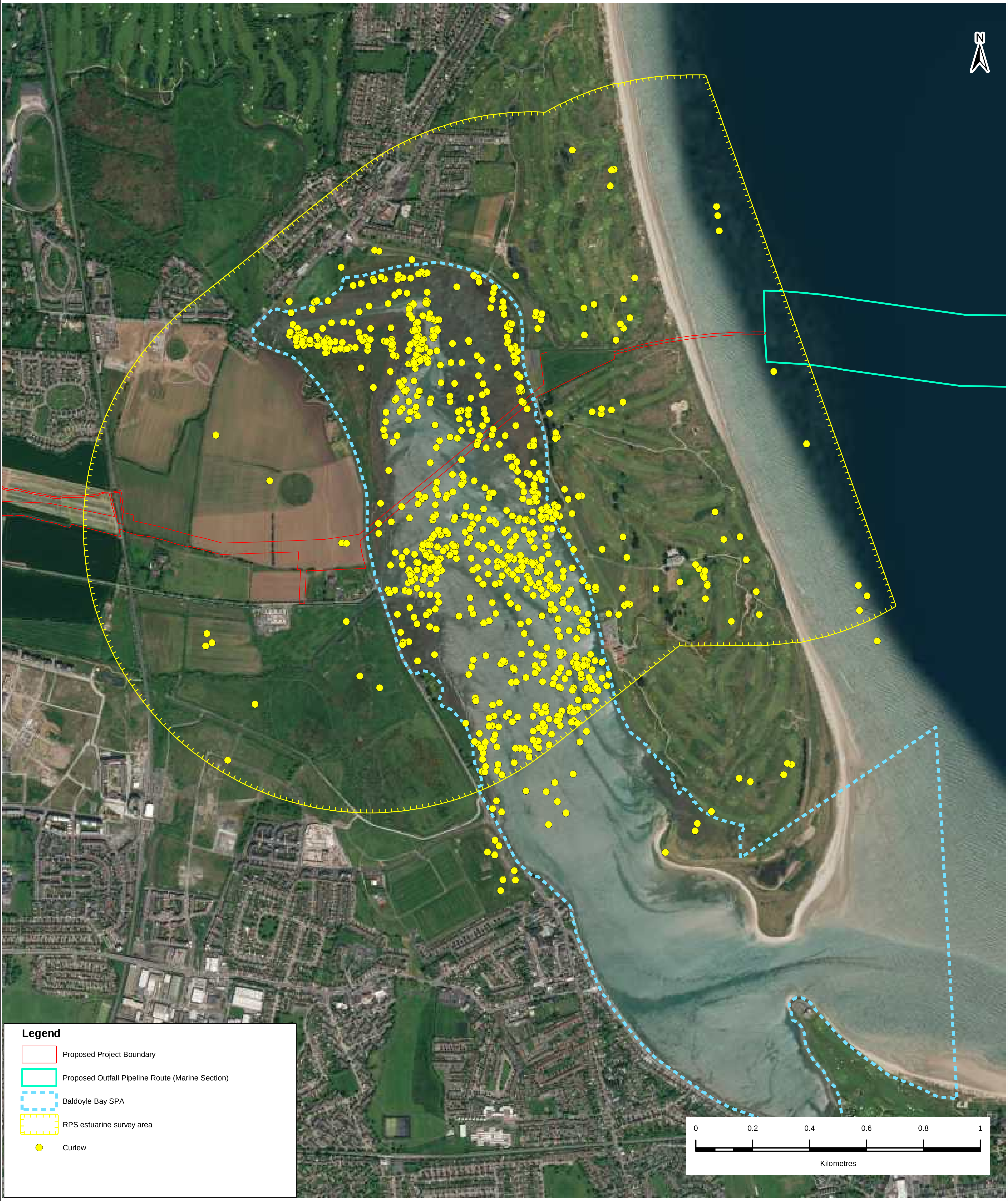


Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.7 Black-tailed Godwit Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A107 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.8 Curlew Records in Baldoyle Bay (Dec 2014 to March 2018)

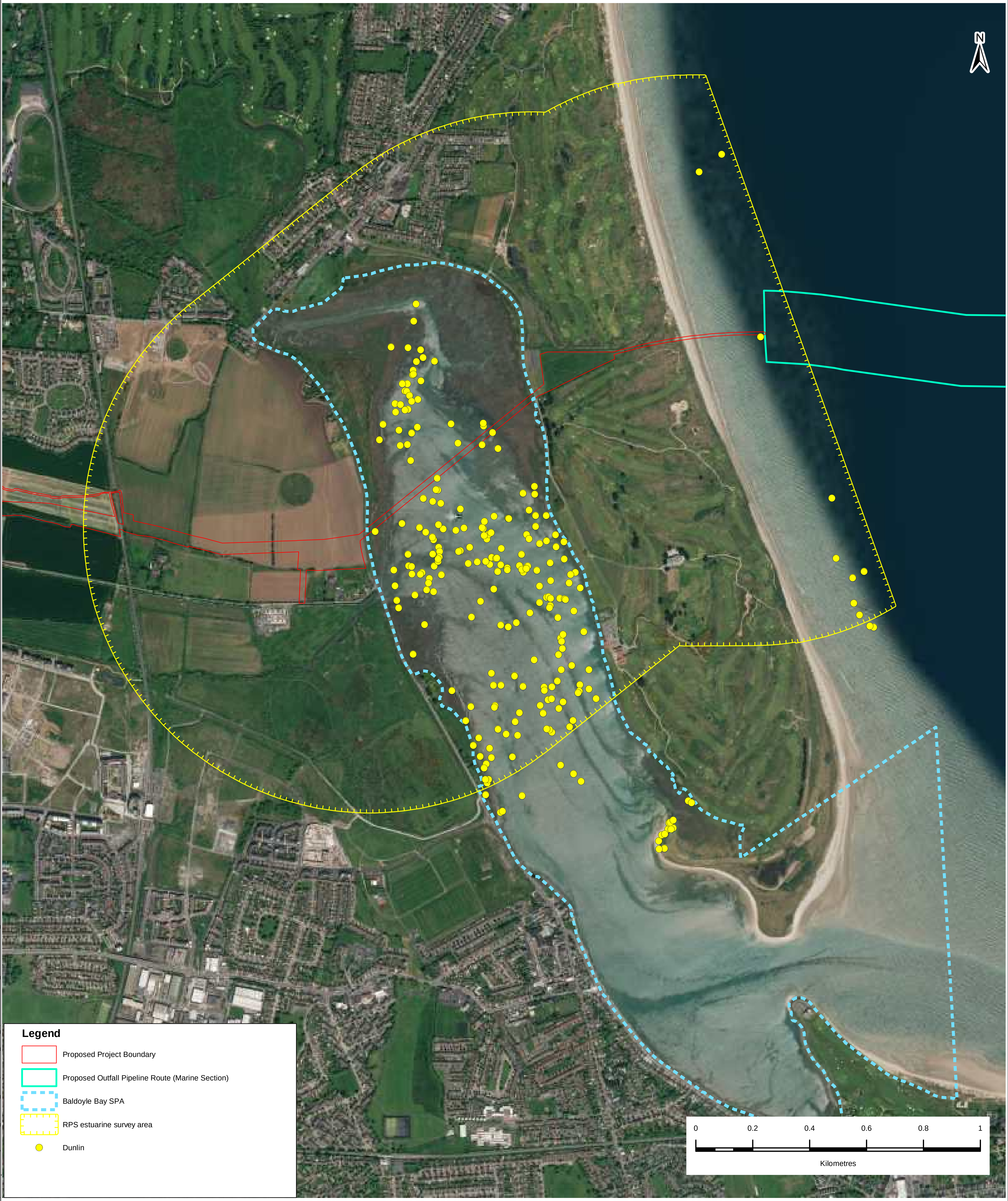

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



Uisce Éireann Irish Water

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A108 |




Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.9 Dunlin Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A109 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.10 Great Crested Grebe Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

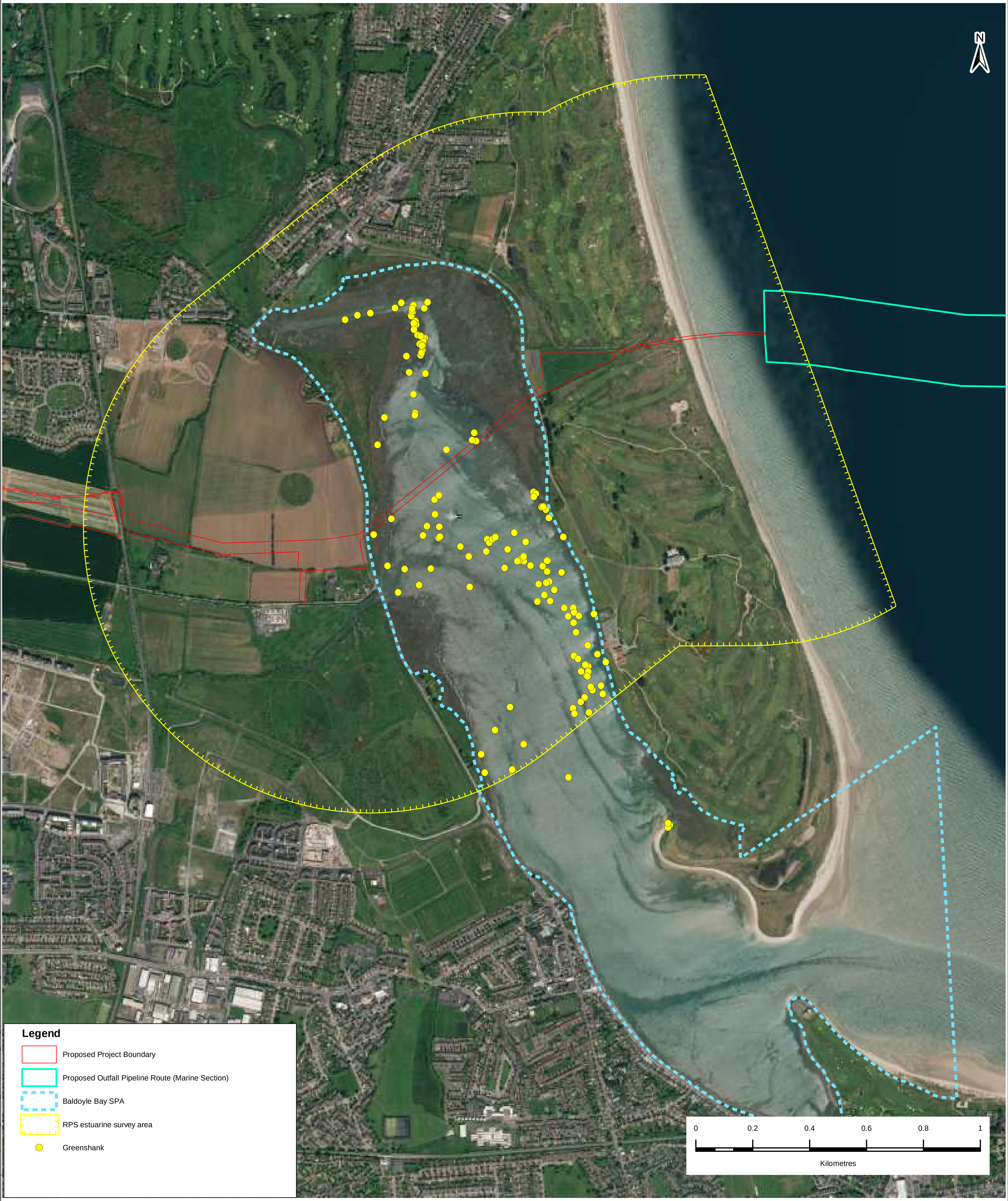


UISCE ÉIREANN : IRISH WATER

JACOBS  TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1010 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_orni\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.11 Greenshank Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



JACOBS
TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1011 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


## Legend

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Baldoyle Bay SPA
- RPS estuarine survey area
- Grey Heron

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.12 Grey Heron Records in Baldoyle Bay (Dec 2014 to March 2018)

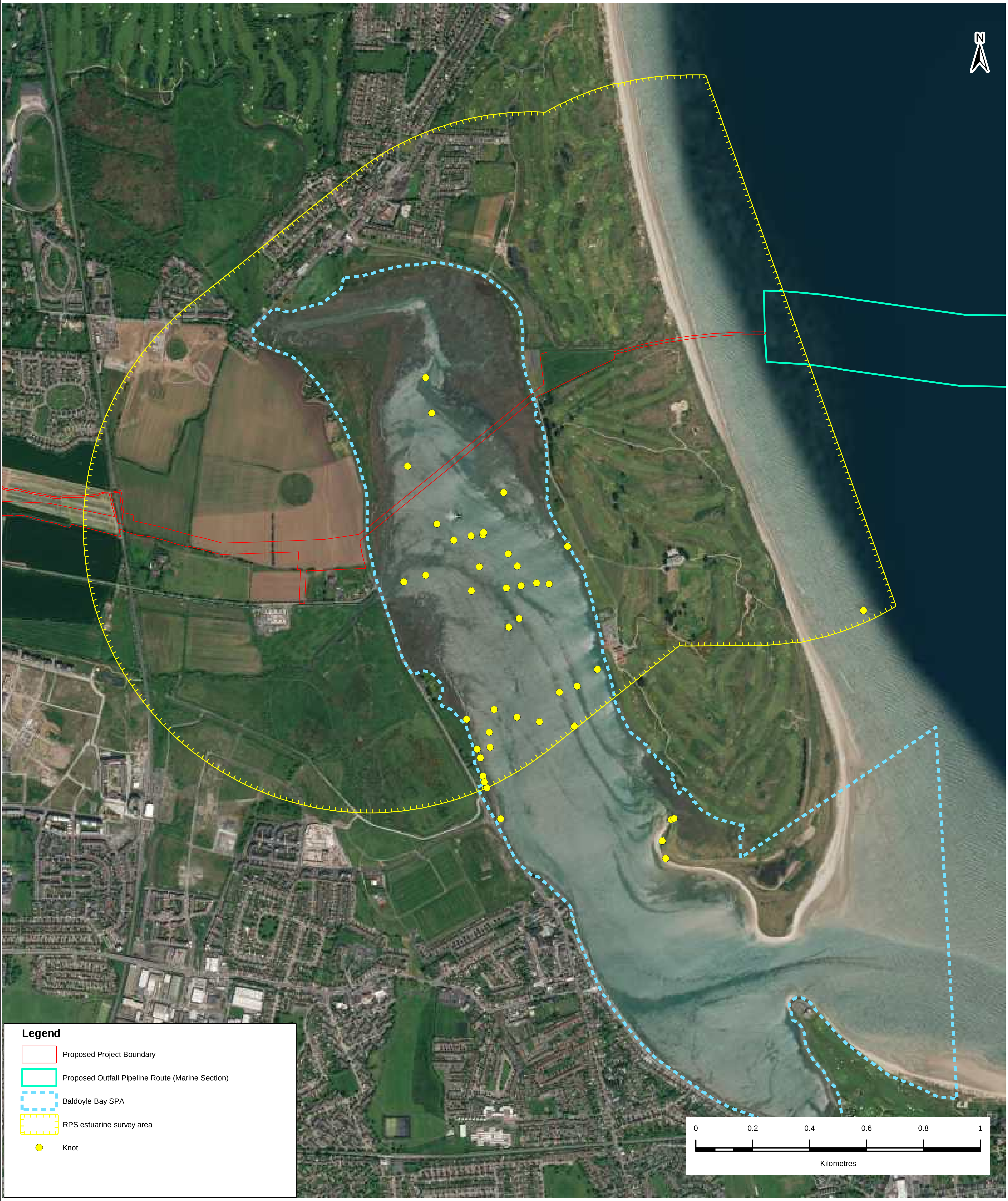
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1012 |





Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.13 Knot Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



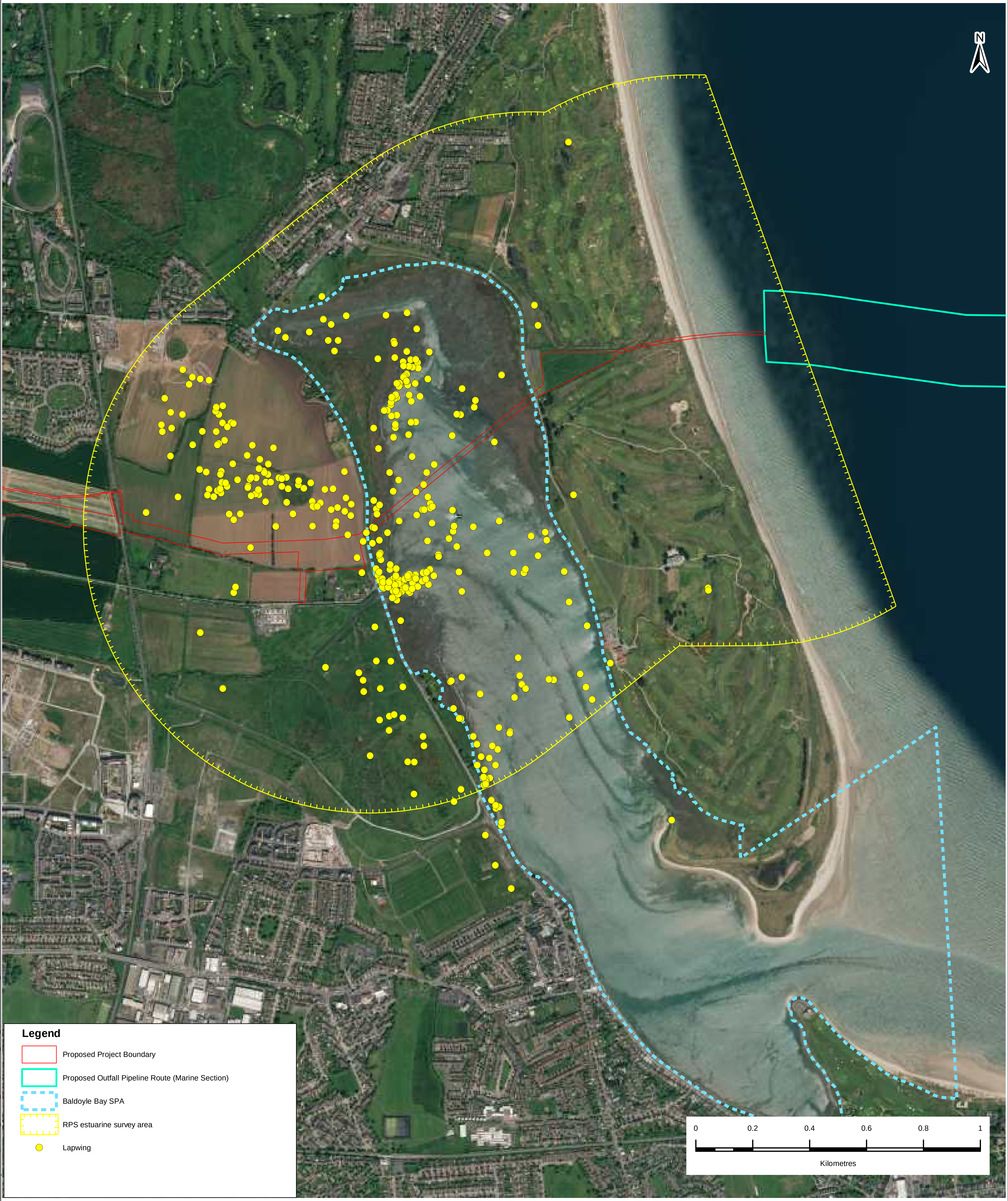
UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1013 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Project
Greater Dublin Drainage Project

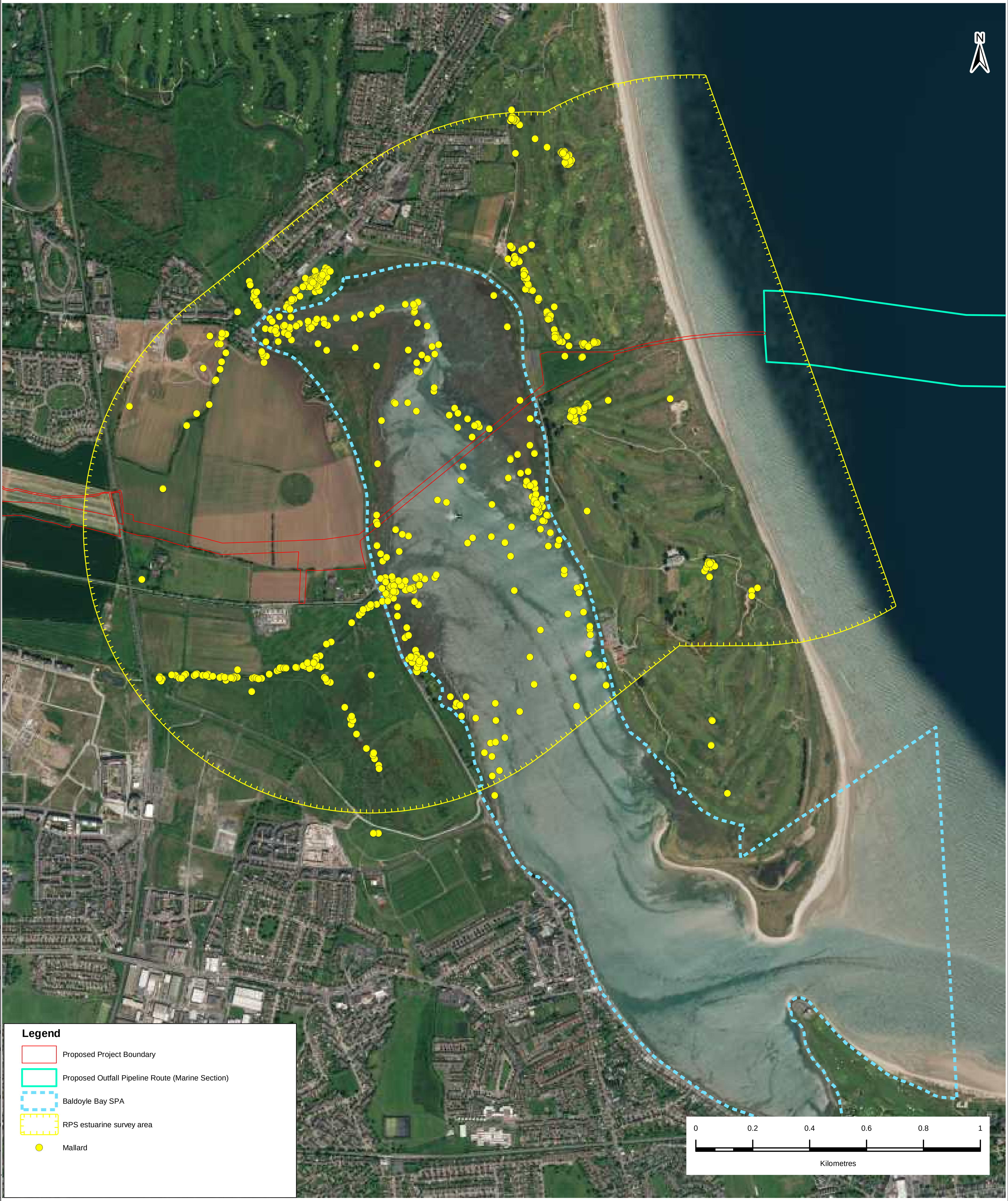
Drawing Title
Figure A10.14 Lapwing Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1014 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.15 Mallard Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



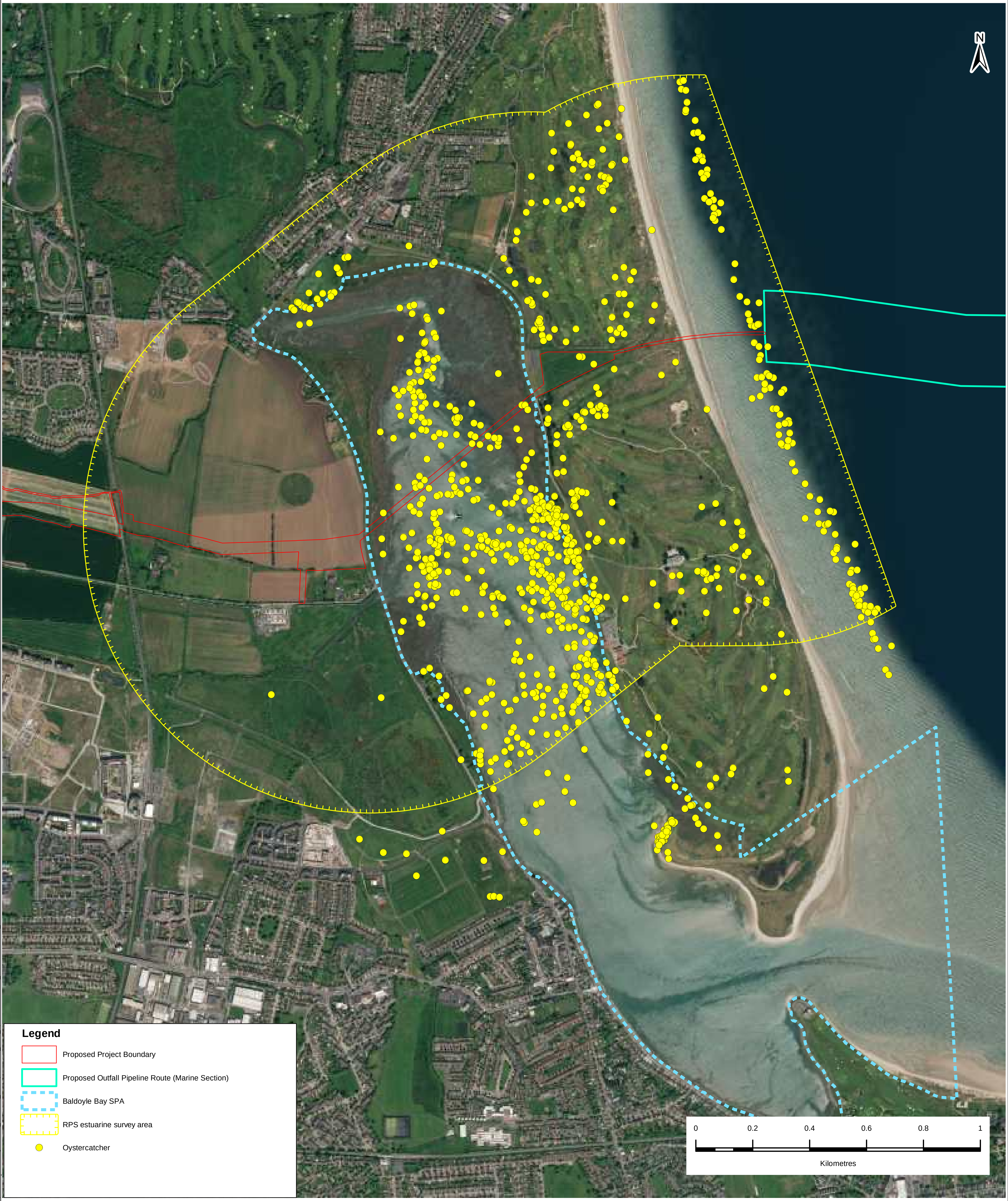
UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1015 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.16 Oystercatcher Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1016 |


Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |





Project
Greater Dublin Drainage Project

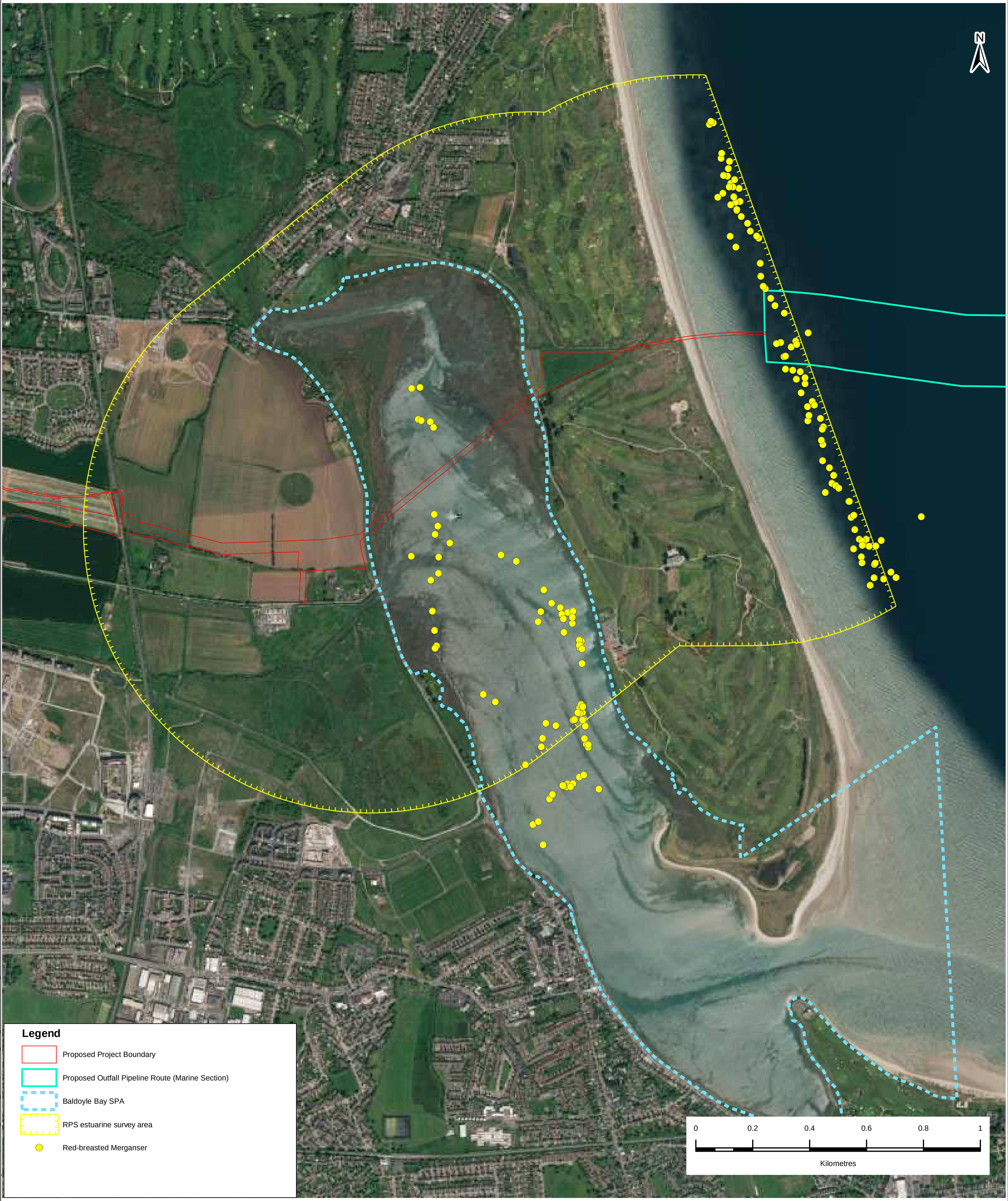
Drawing Title
Figure A10.17 Pintail Records in Baldoyle Bay (Dec 2014 to March 2018)

UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1017 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Project

Greater Dublin Drainage Project

Drawing Title

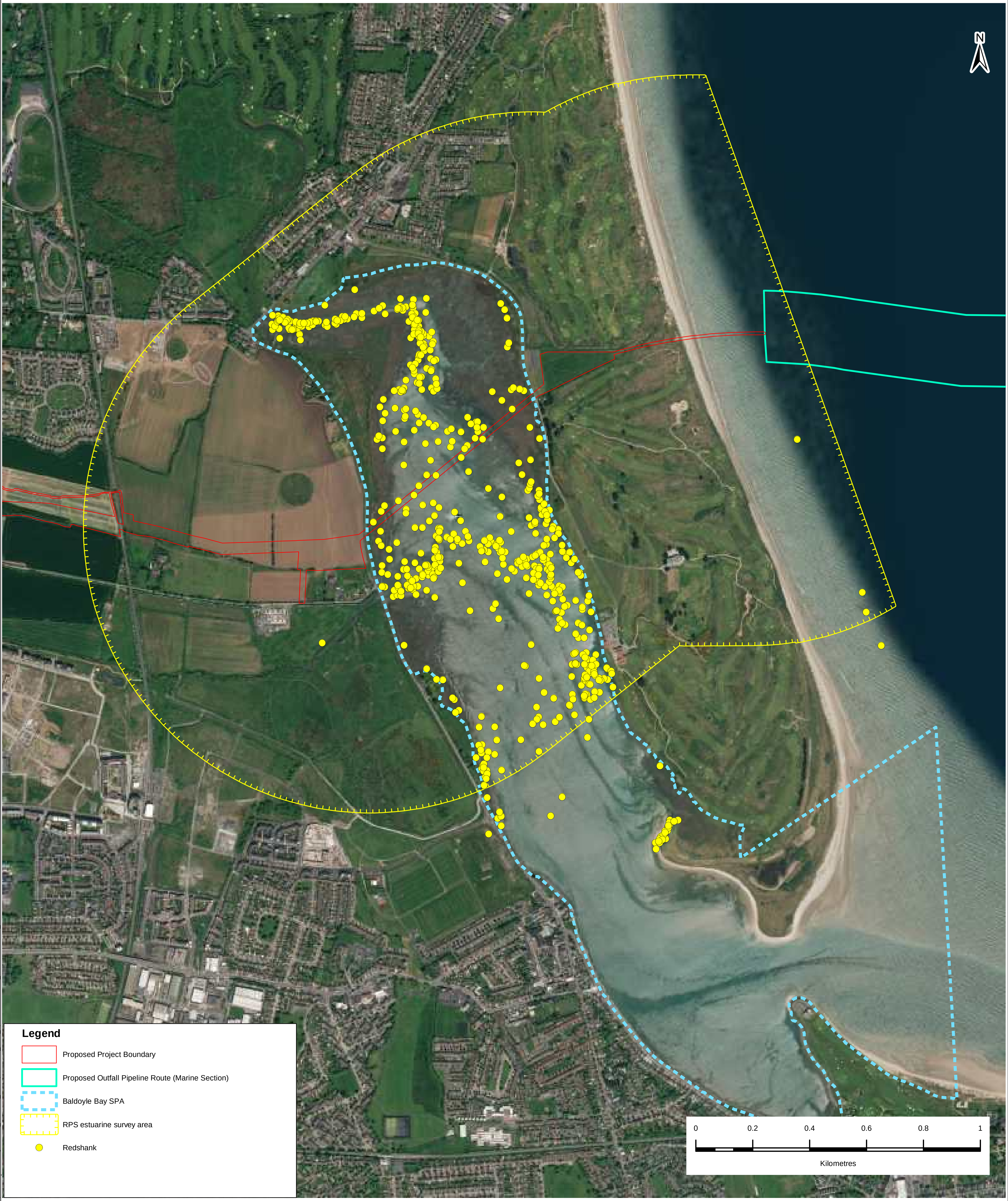
Figure A10.18 Red-breasted Merganser Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1018 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

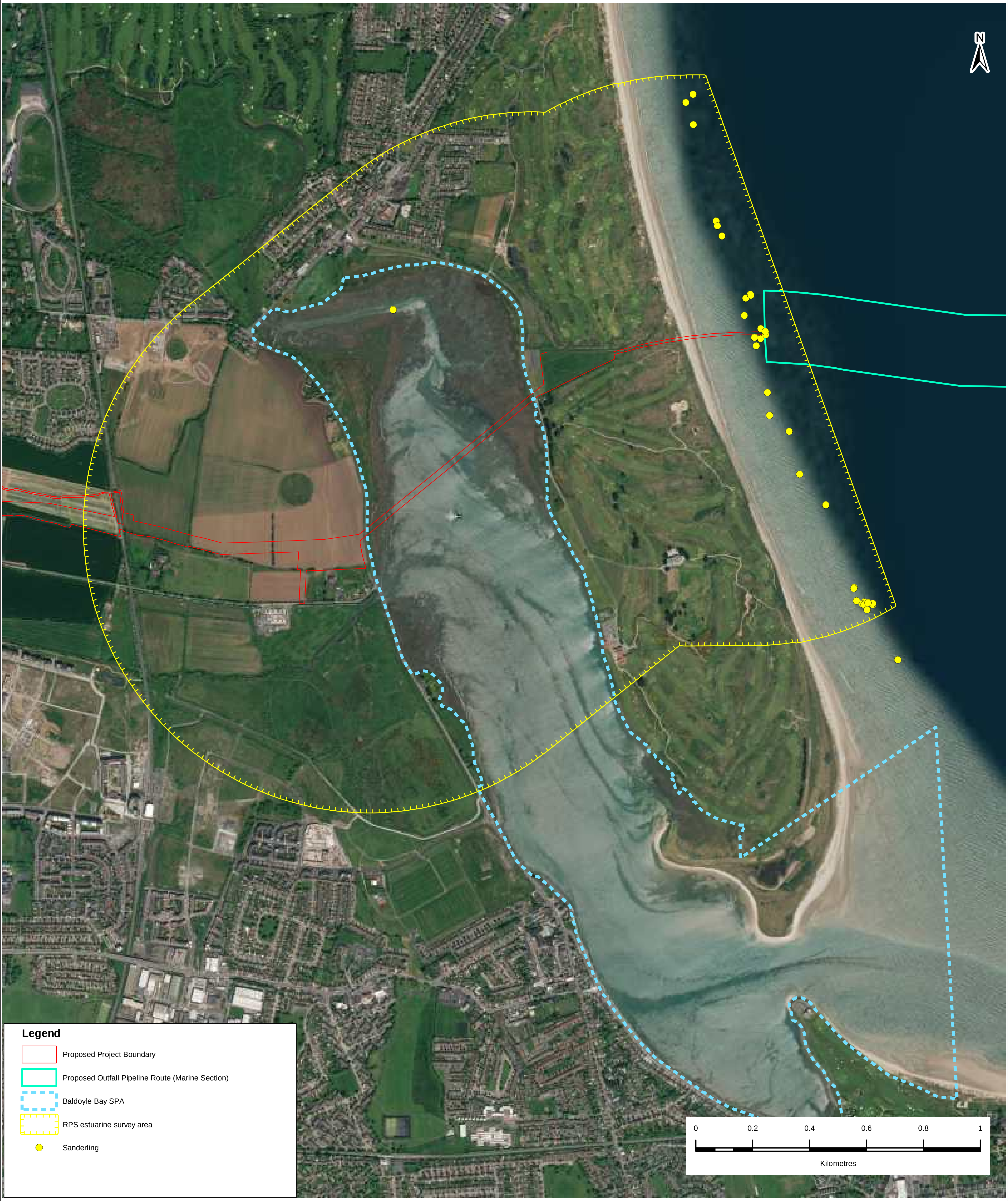
Drawing Title
Figure A10.19 Redshank Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1019 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Greater Dublin Drainage

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.20 Sanderling Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

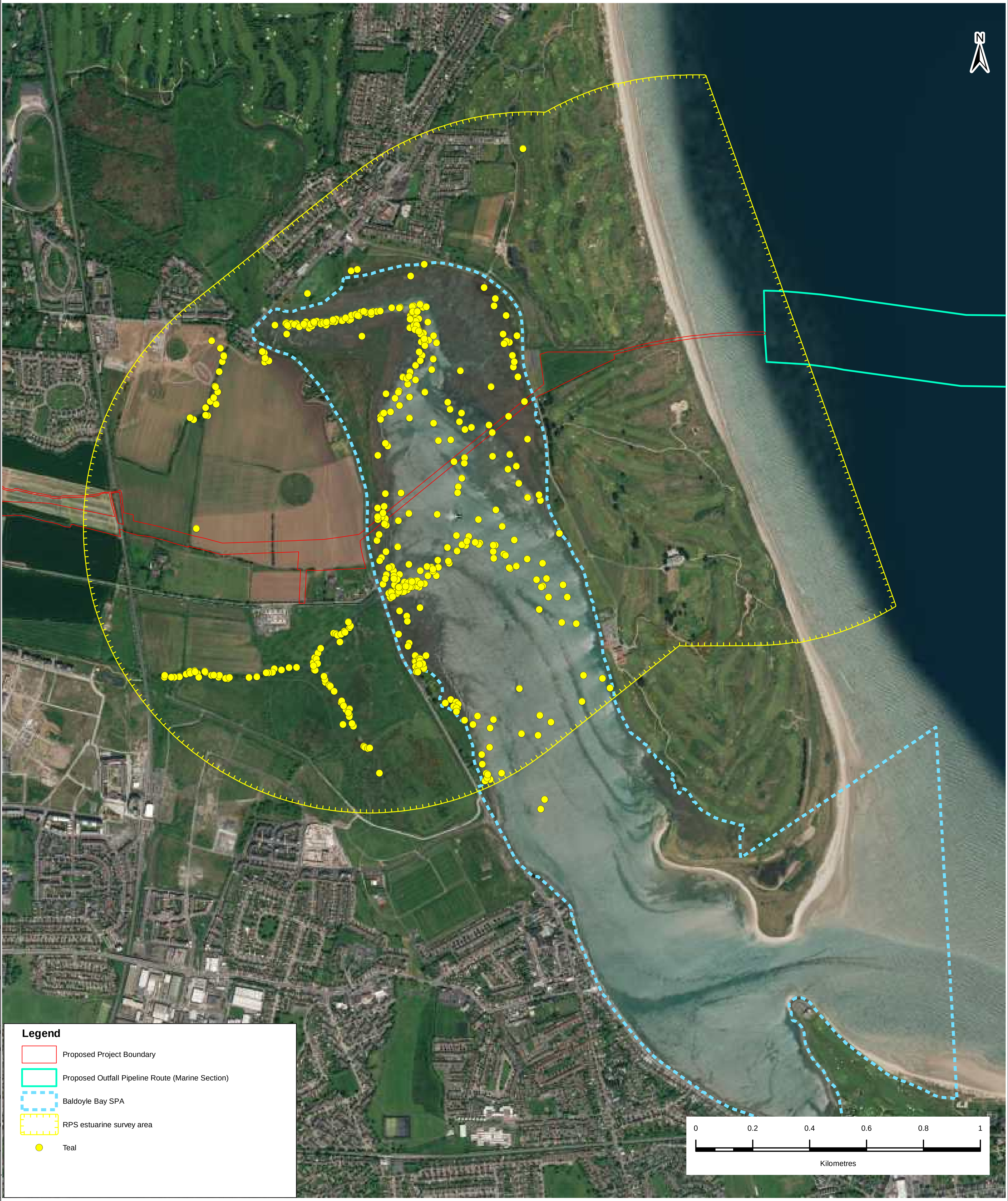


UISCE ÉIREANN : IRISH WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1020 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.21 Teal Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

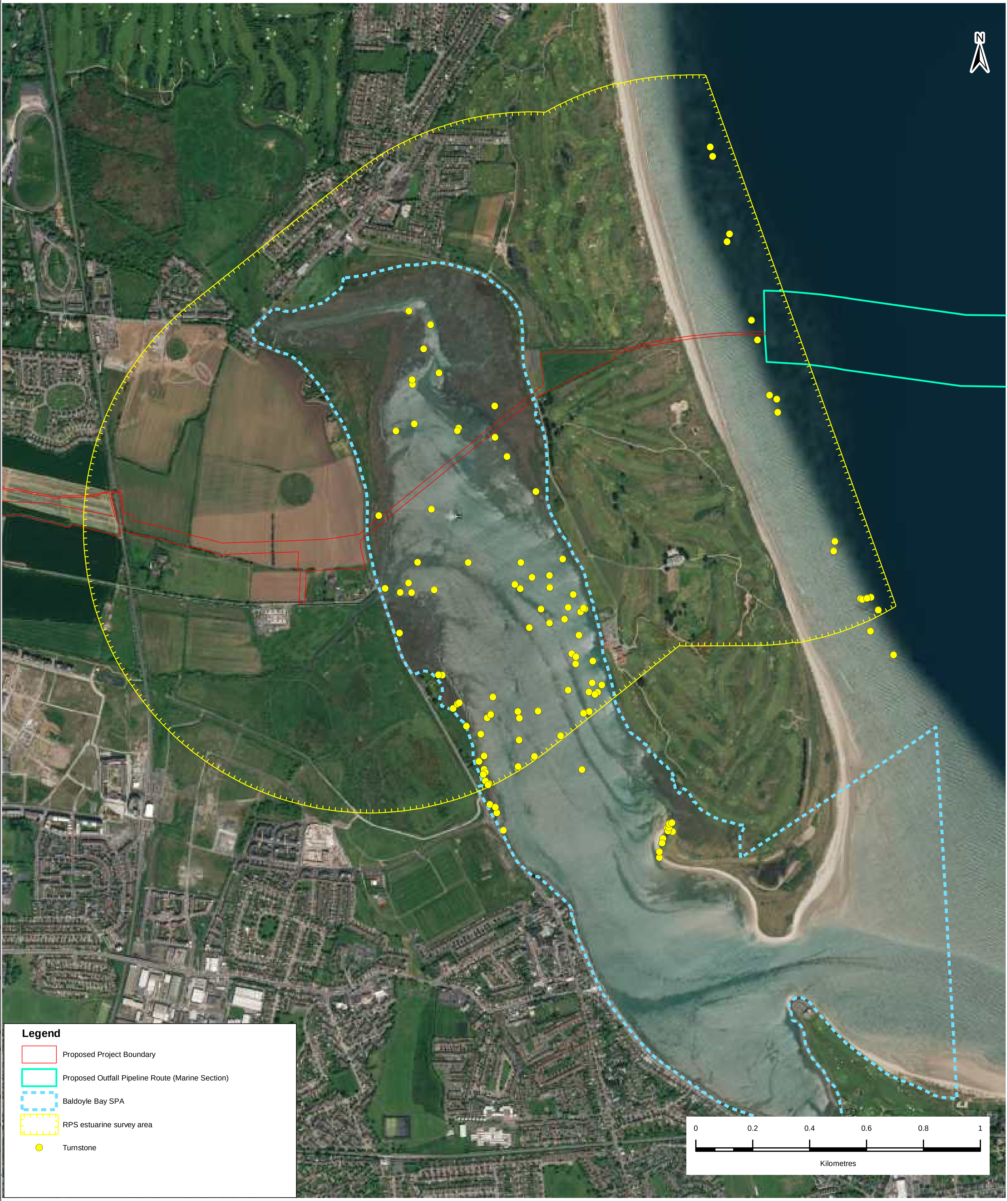
Drawing Status: Final

Scale @ A3: 1:12,500

Job No.: SEC7909

Drawing No.: 32102902-EIAR-A1021

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.22 Turnstone Records in Baldoyle Bay (Dec 2014 to March 2018)

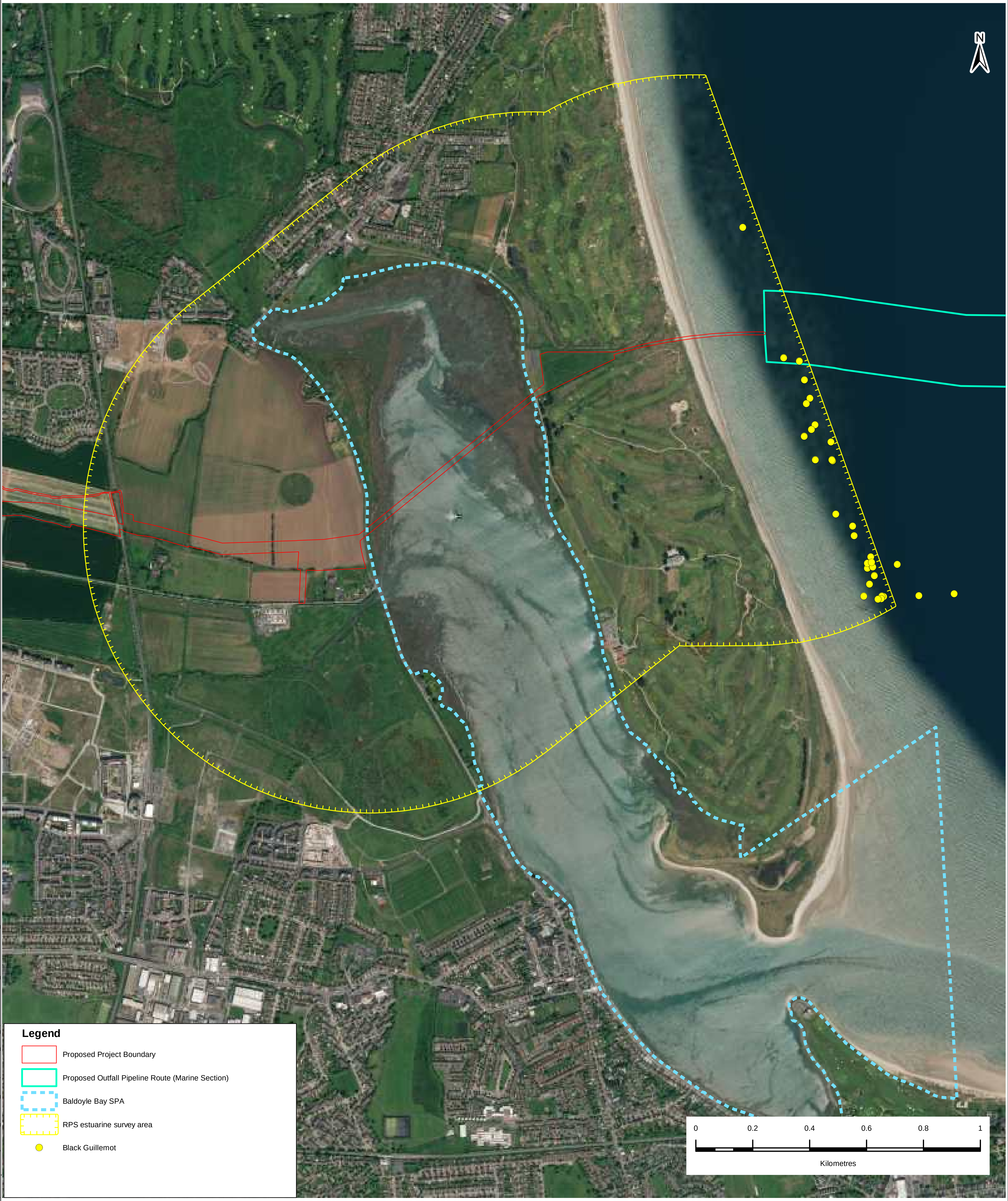
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE ÉIREANN : IRISH WATER

JACOBS    TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1022 |




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.23 Black Guillemot Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

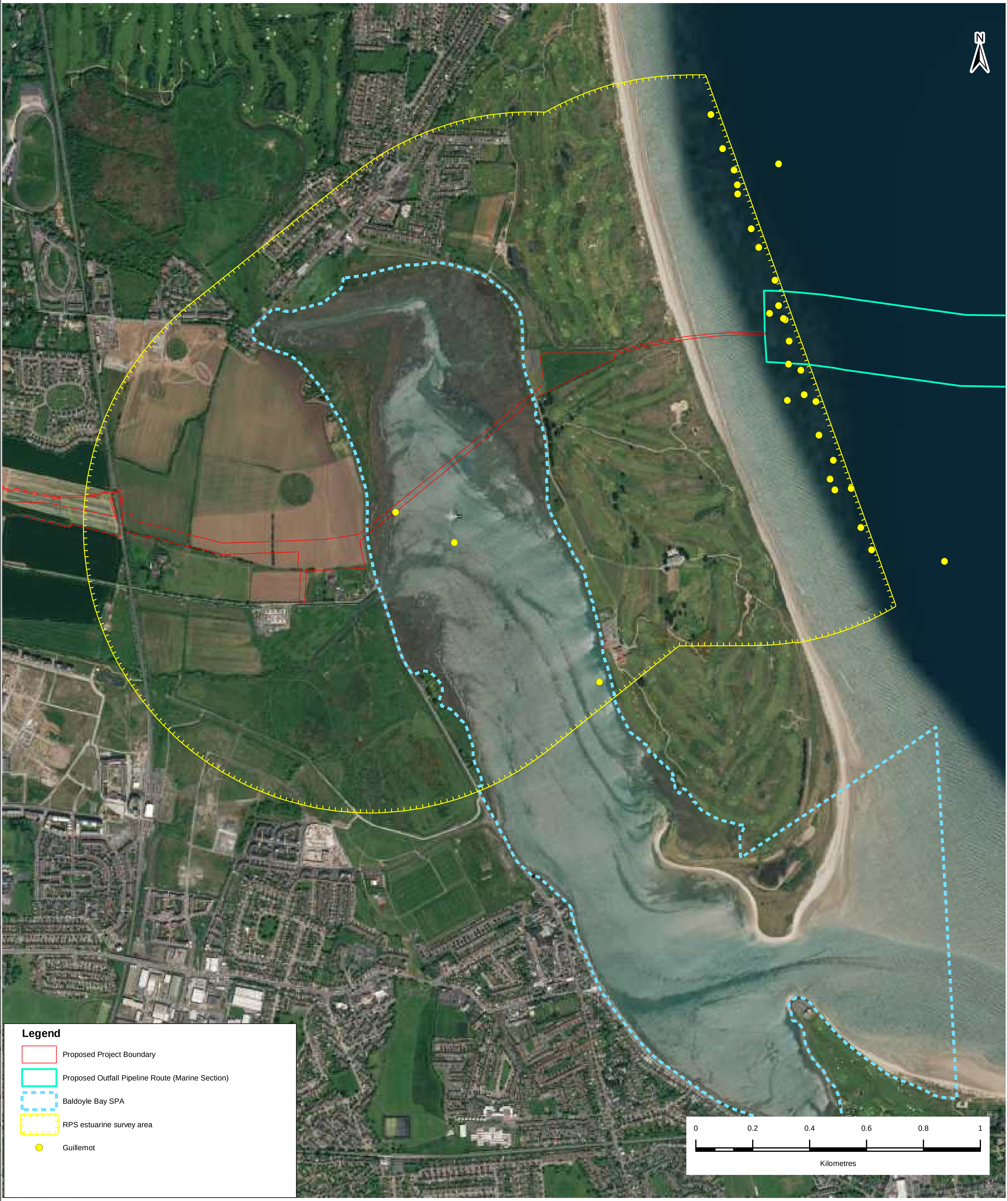


Uisce Éireann Irish Water

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1023 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Greater Dublin Drainage

Project
Greater Dublin Drainage Project

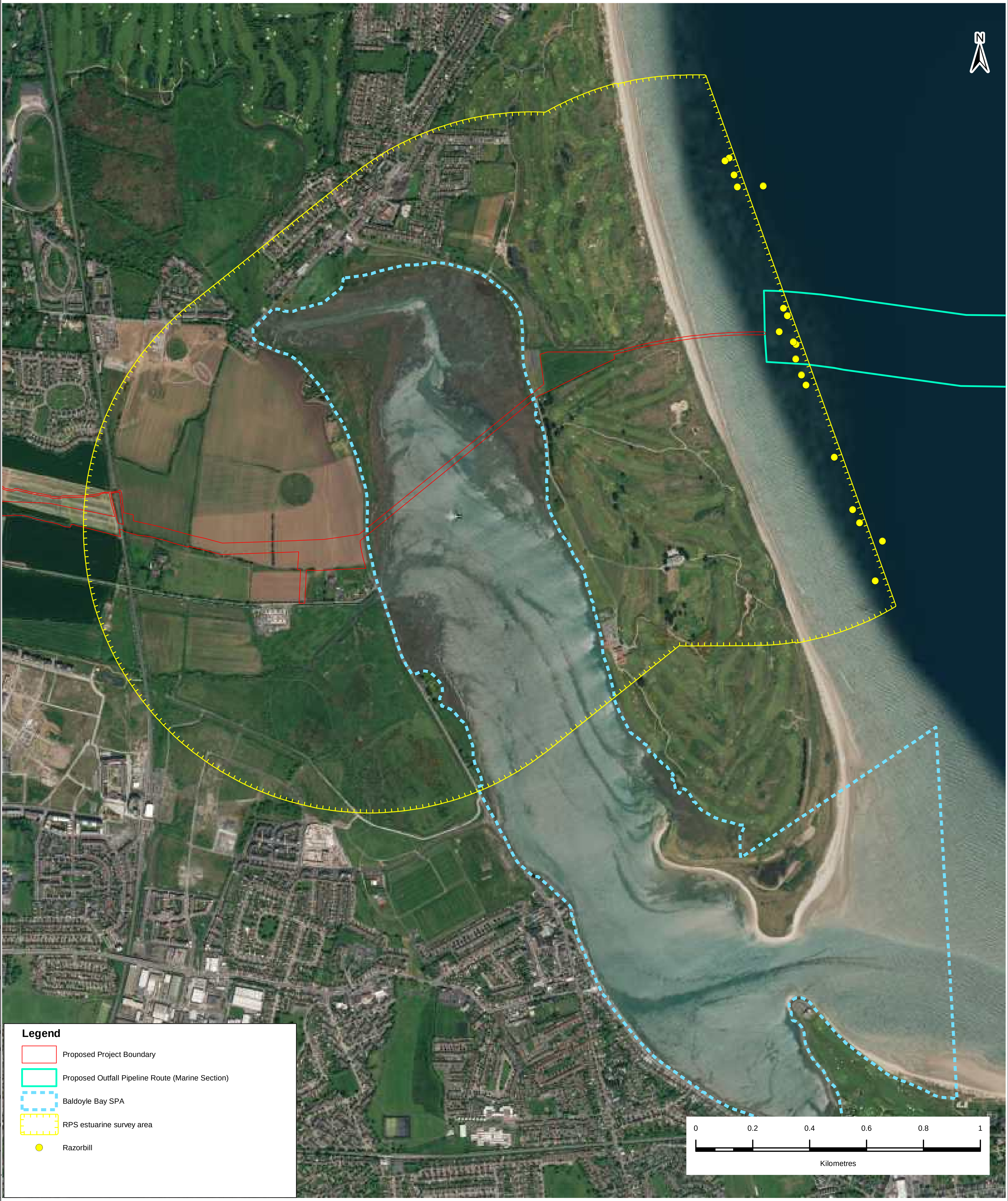
Drawing Title
Figure A10.24 Guillemot Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1024 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.25 Razorbill Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

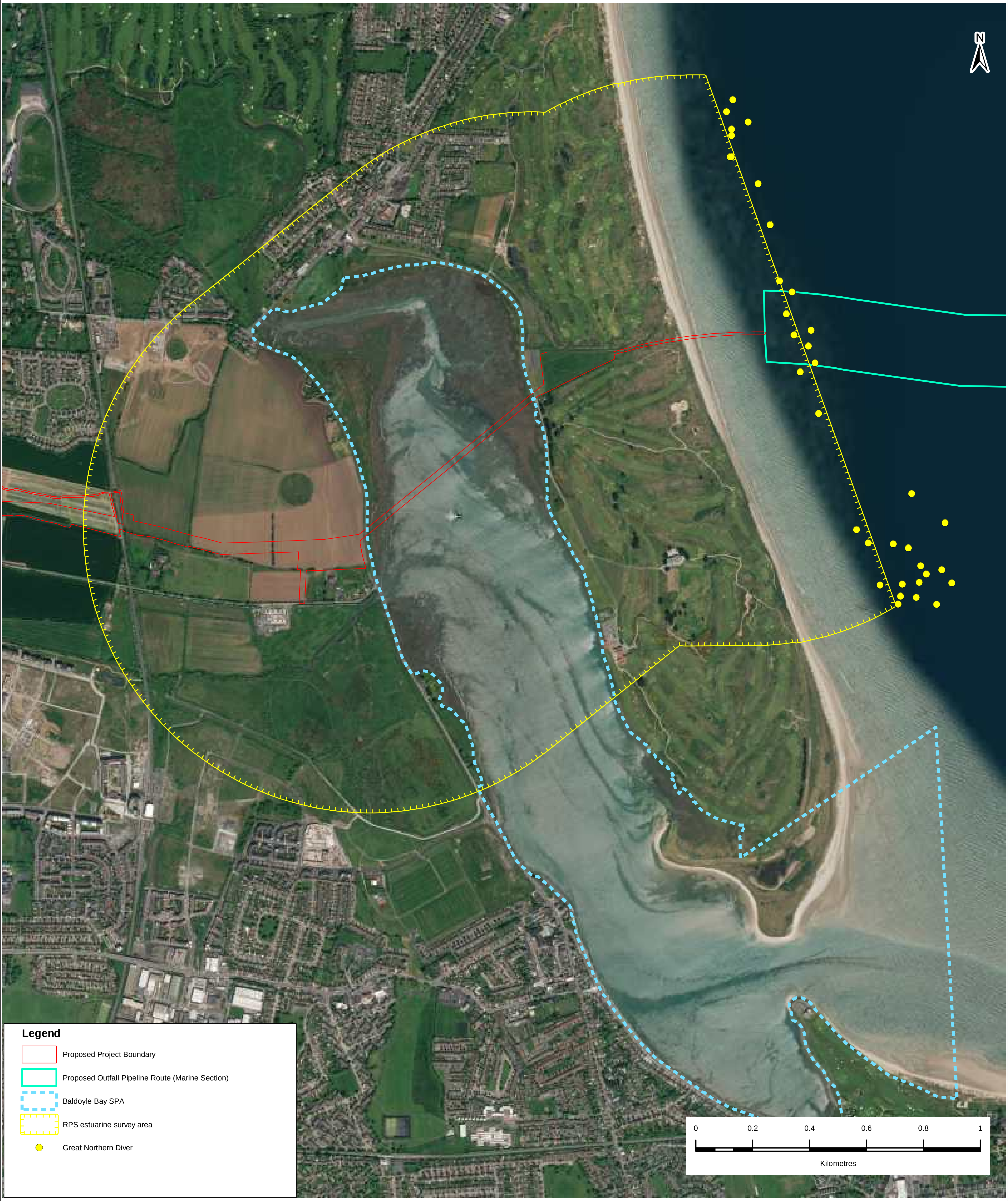


Uisce Éireann Irish Water

JACOBS TOBIN

Drawing Status: Final
Scale @ A3: 1:12,500
Job No.: SEC7909
Drawing No.: 32102902-EIAR-A1025

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.26 Great Northern Diver Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

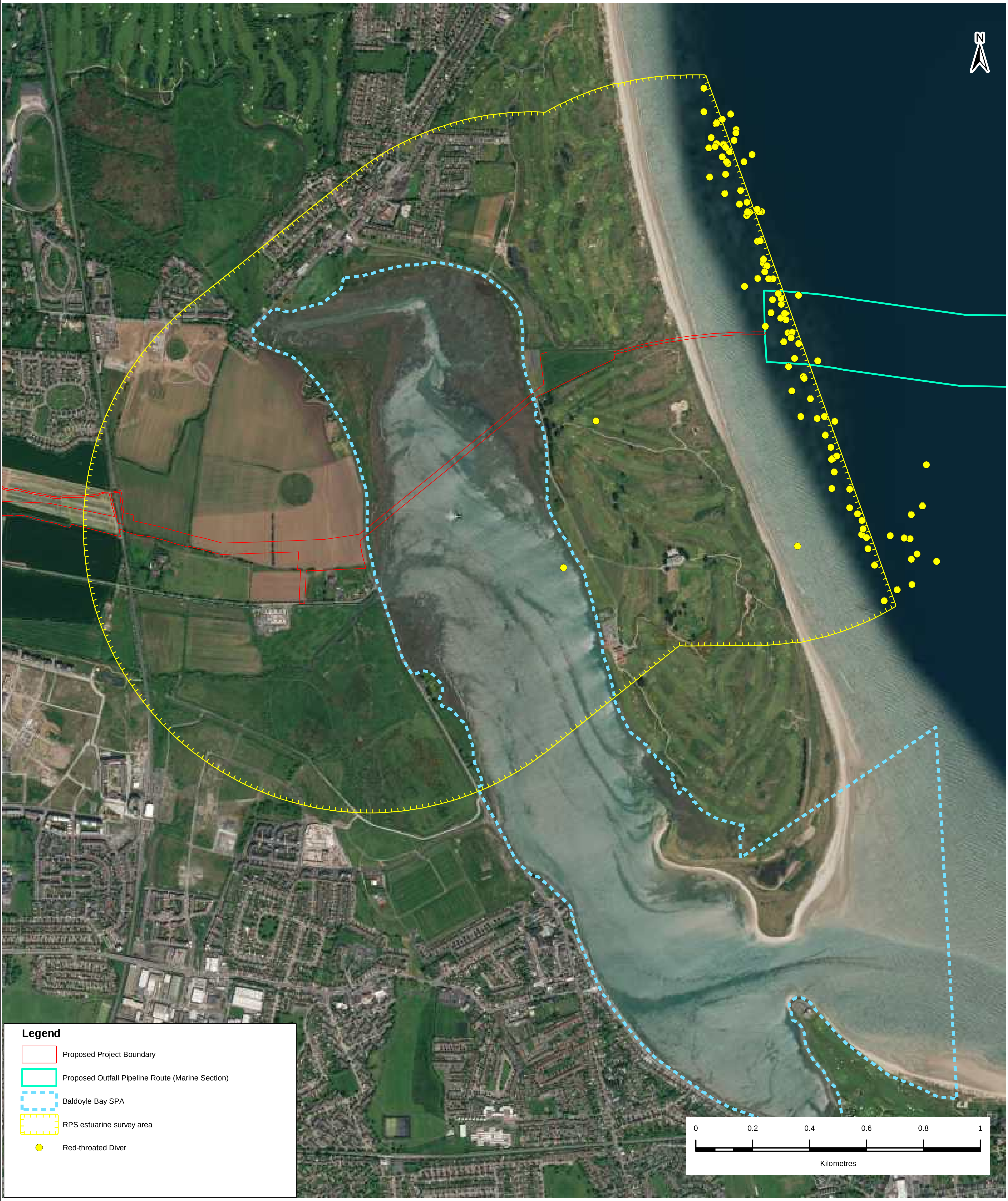


UISCE ÉIREANN : IRISH WATER

JACOBS TOBIN

Drawing Status: Final
Scale @ A3: 1:12,500
Job No.: SEC7909
Drawing No.: 32102902-EIAR-A1026

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

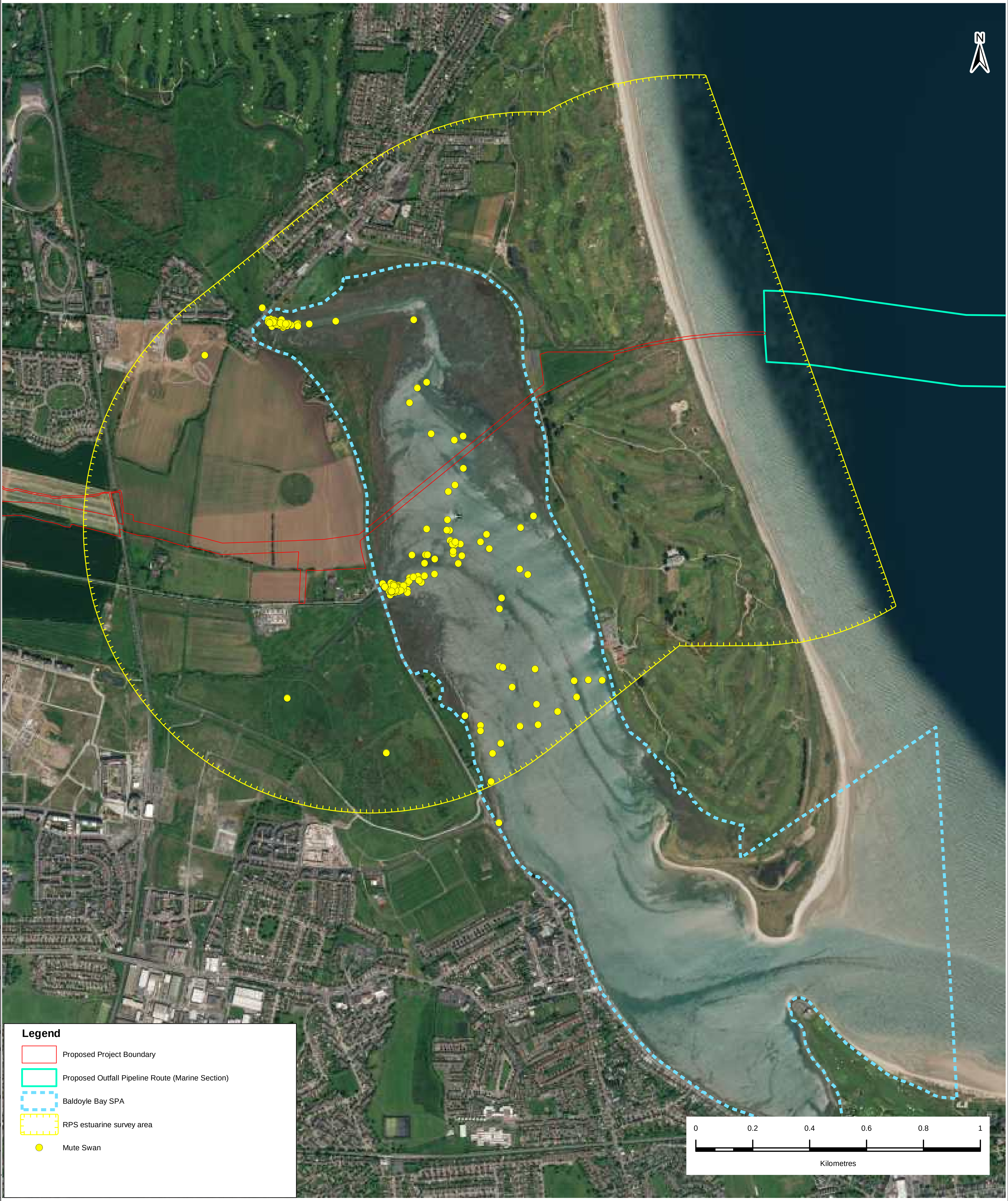
Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.27 Red-throated Diver Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1027 |



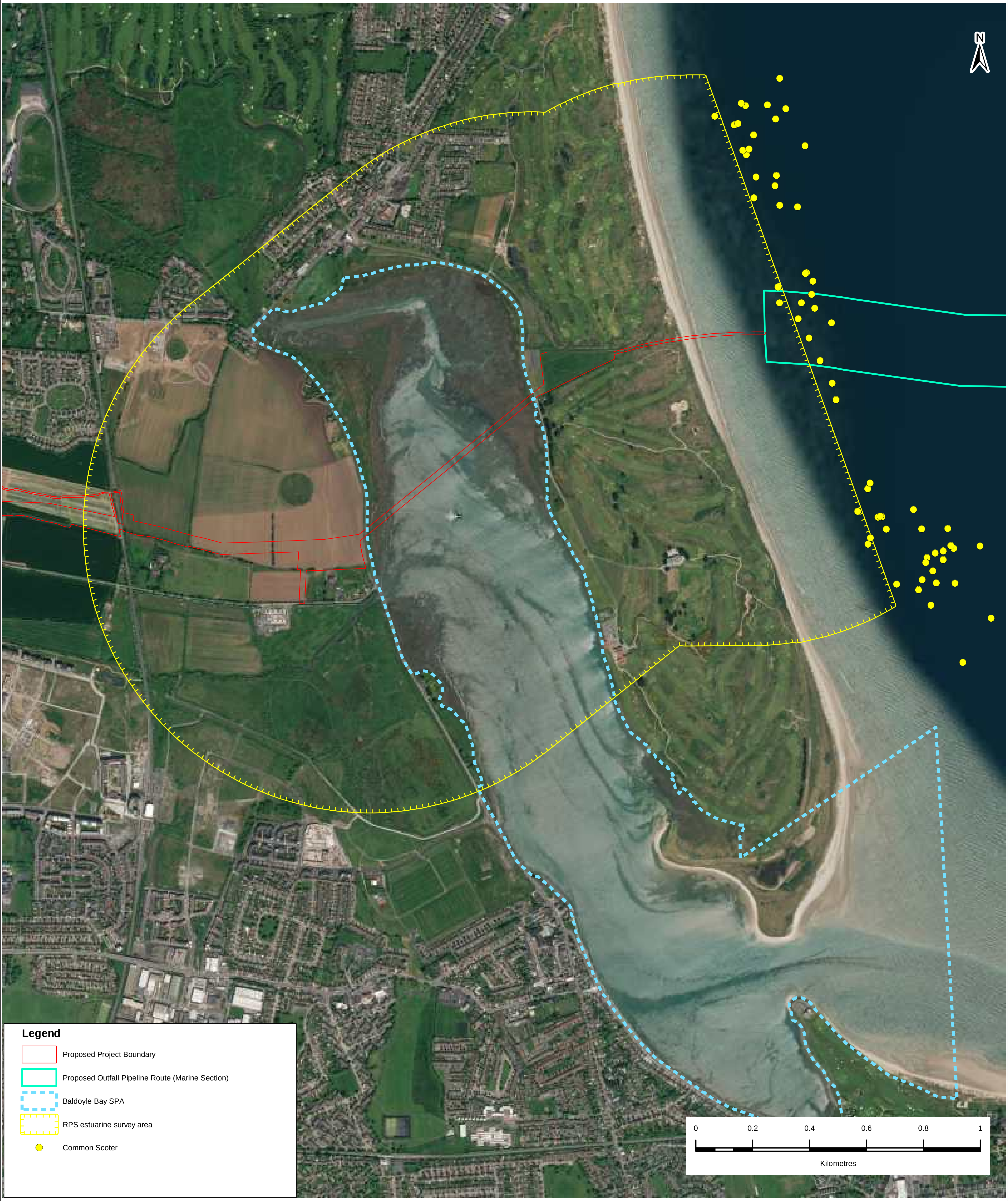

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.28 Mute Swan Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1028 |




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.29 Common Scoter Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



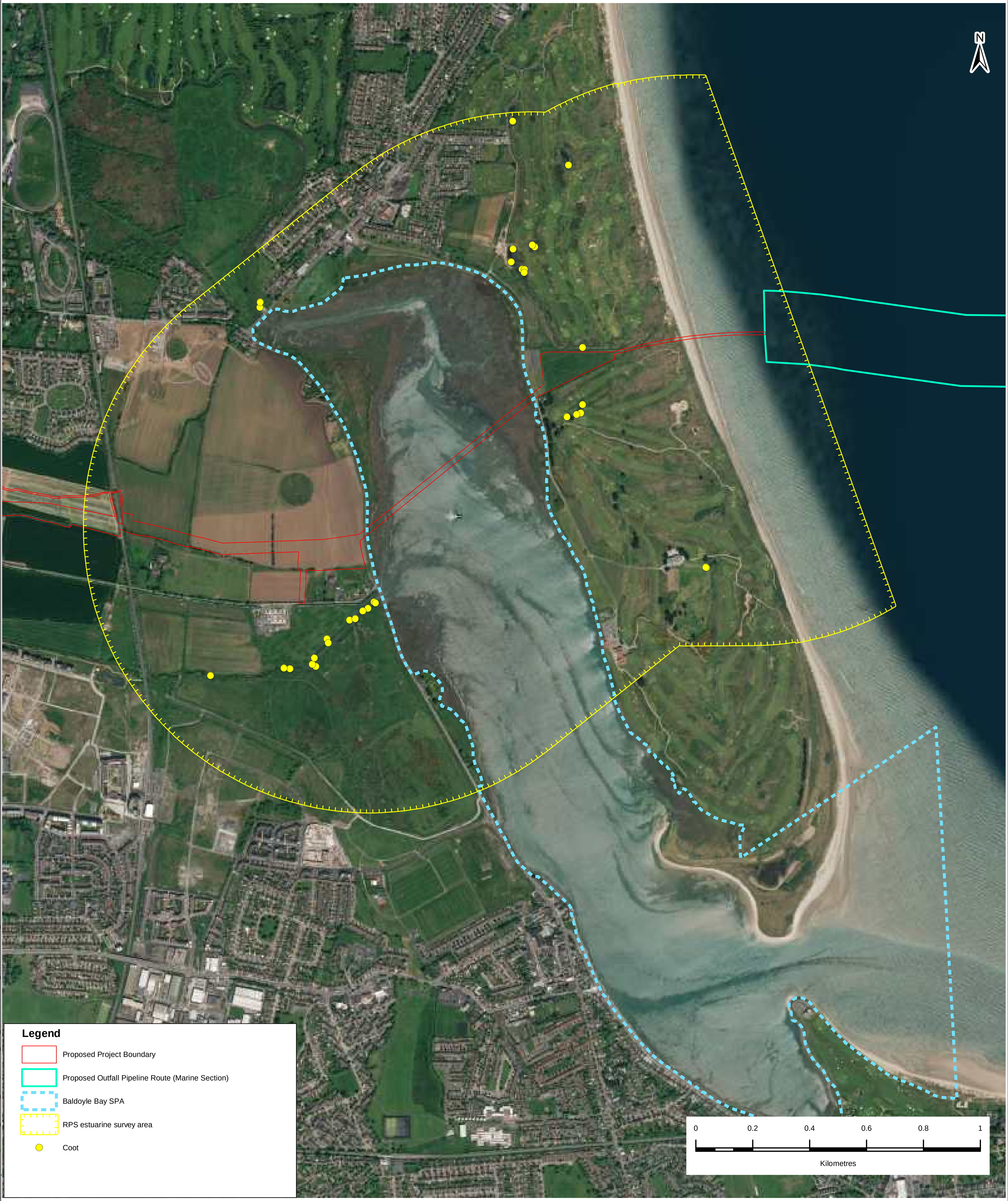
UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1029 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.30 Coot Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1030 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.31 Little Grebe Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE ÉIREANN : IRISH WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1031 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

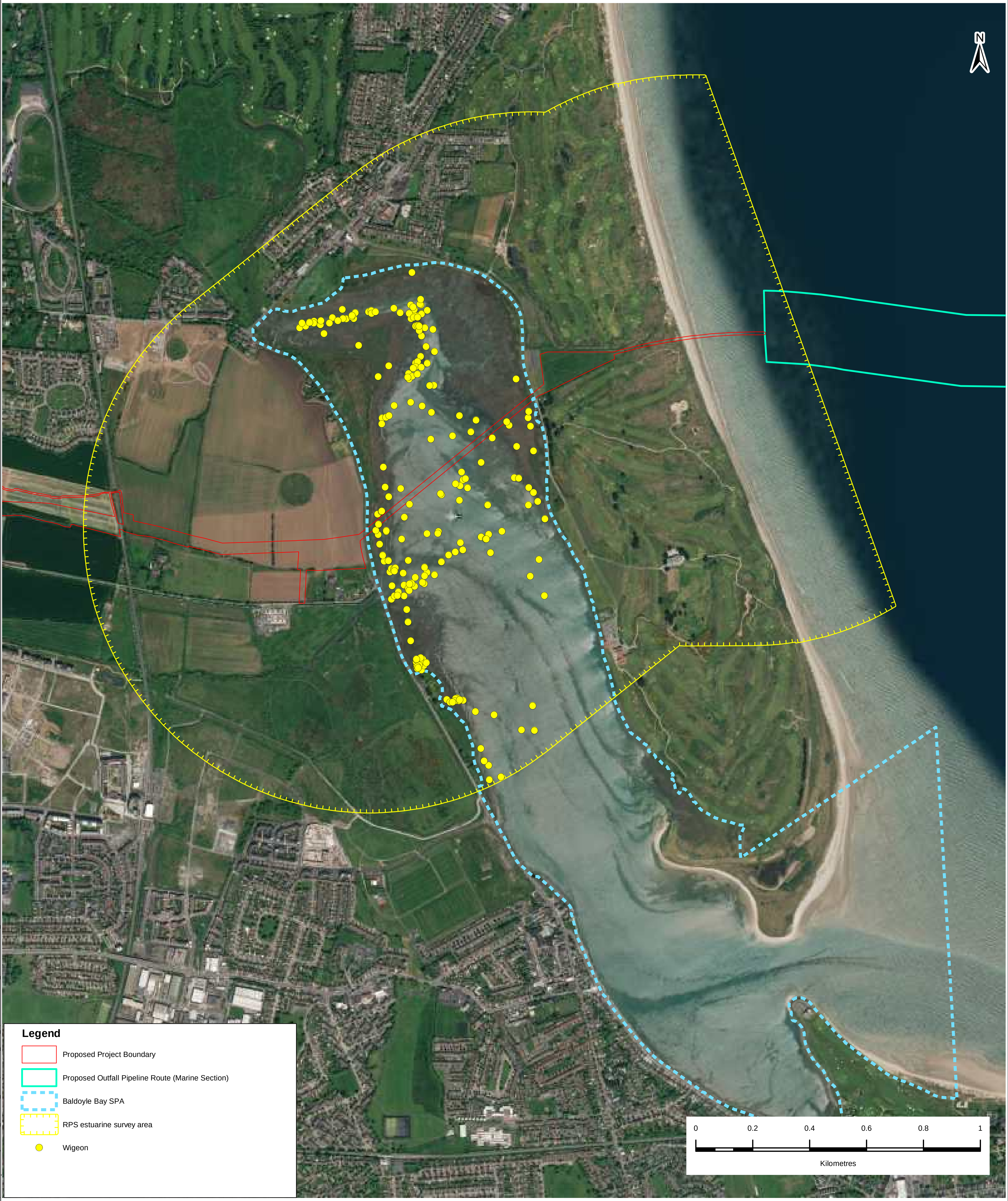


Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.32 Moorhen Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1032 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd





Project
Greater Dublin Drainage Project

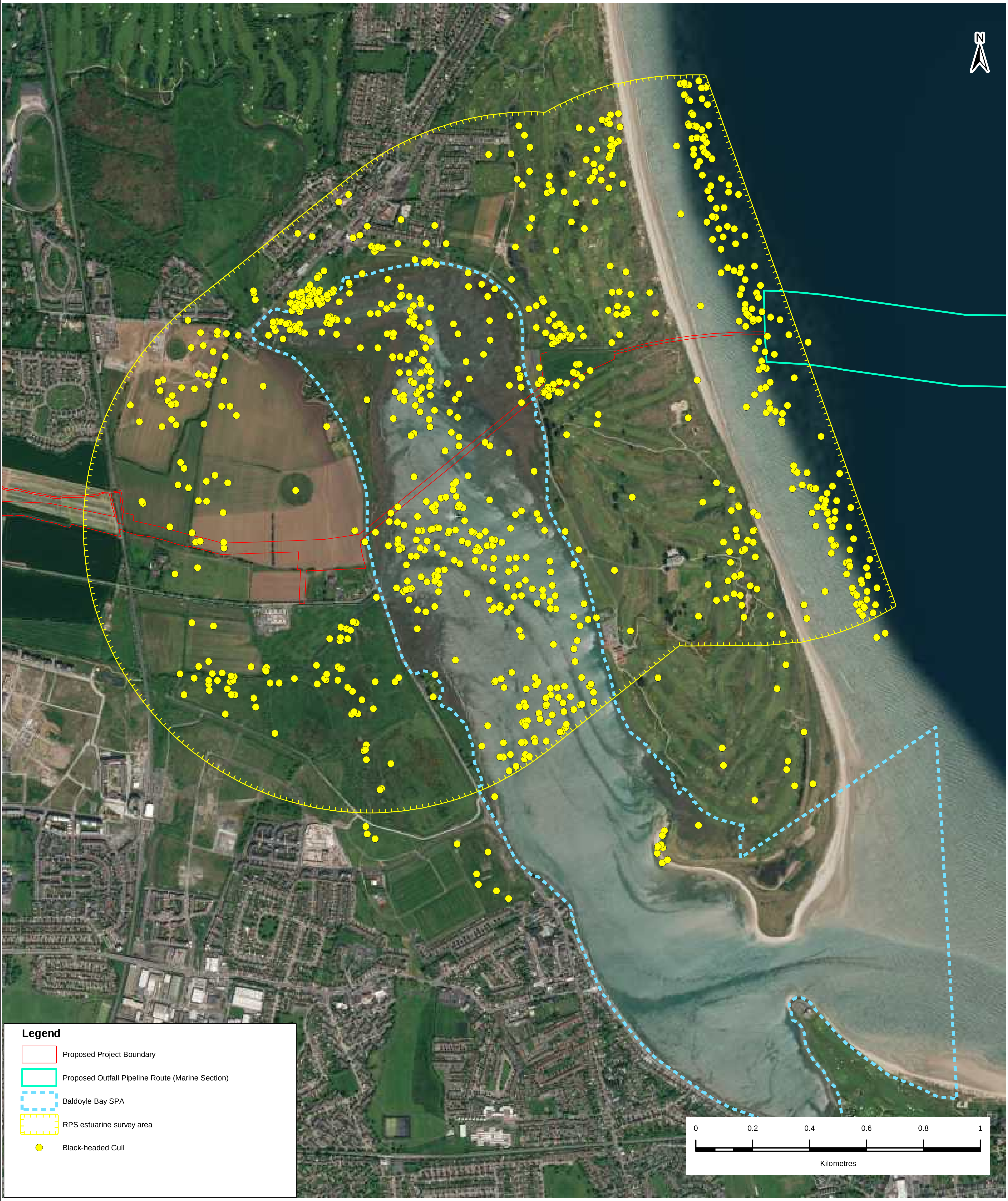
Drawing Title
Figure A10.33 Wigeon Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1033 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.34 Black-headed Gull Records in Baldoyle Bay (Dec 2014 to March 2018)

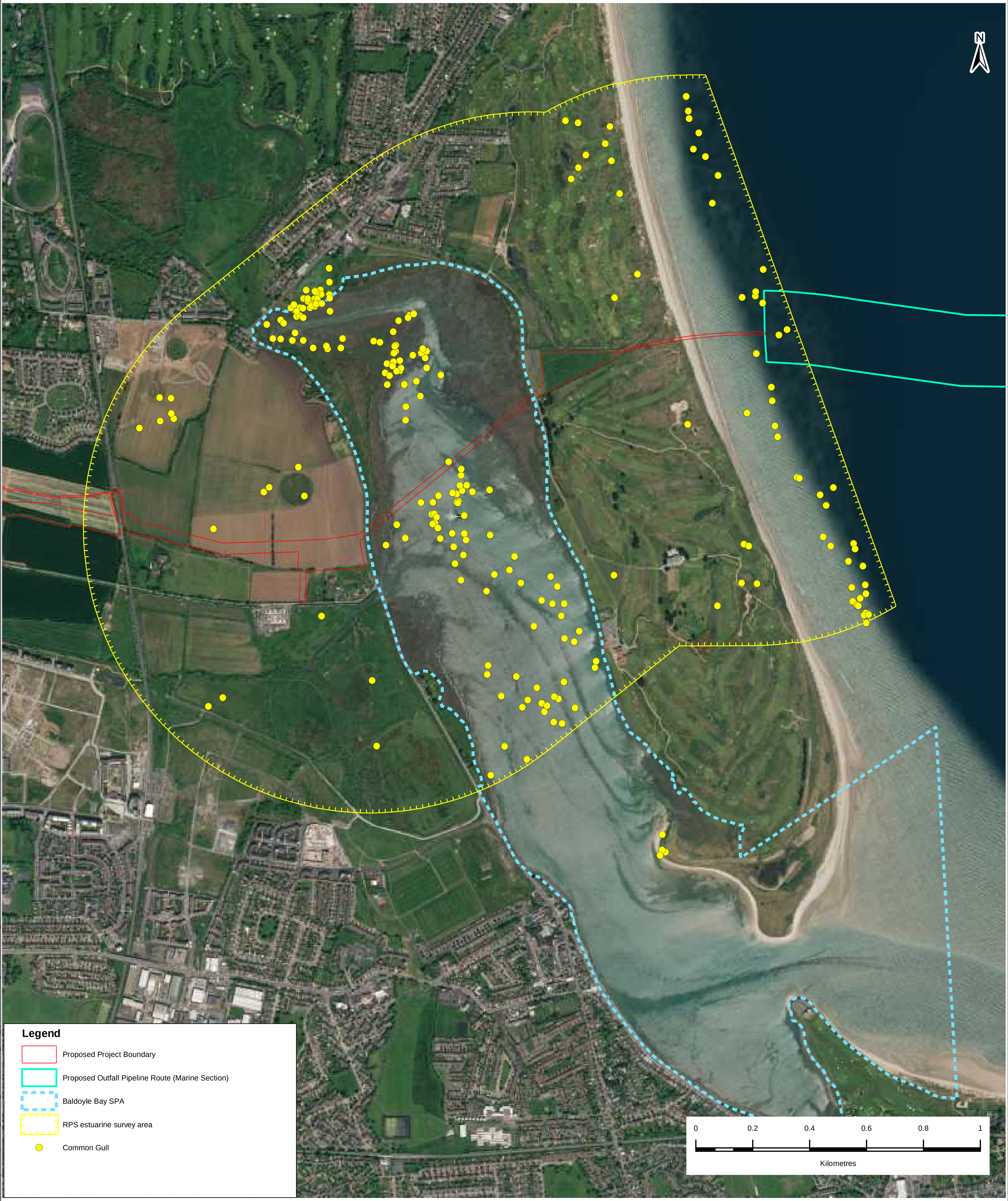

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1034 |




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.35 Common Gull Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

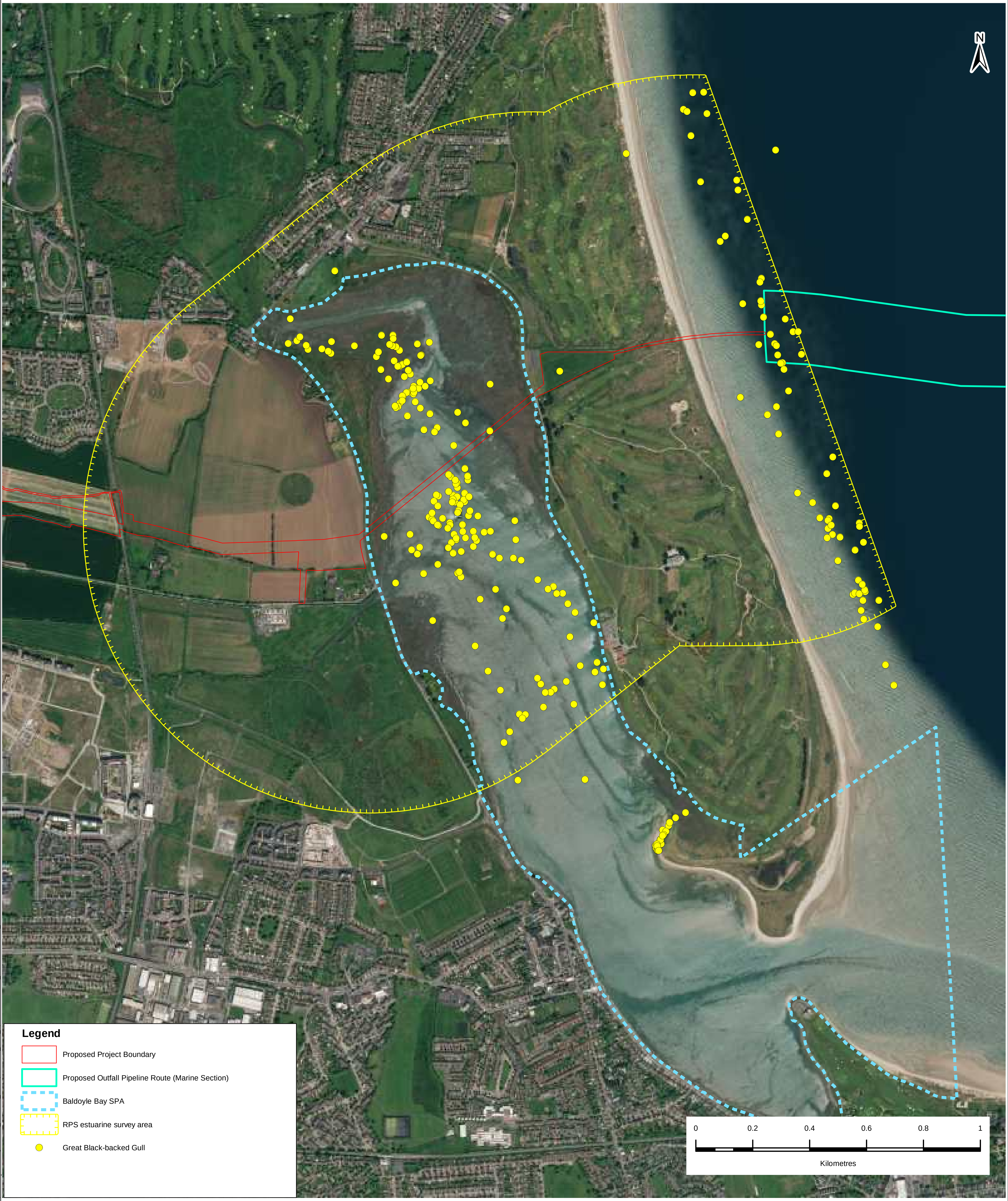


UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1035 |




Project
Greater Dublin Drainage Project

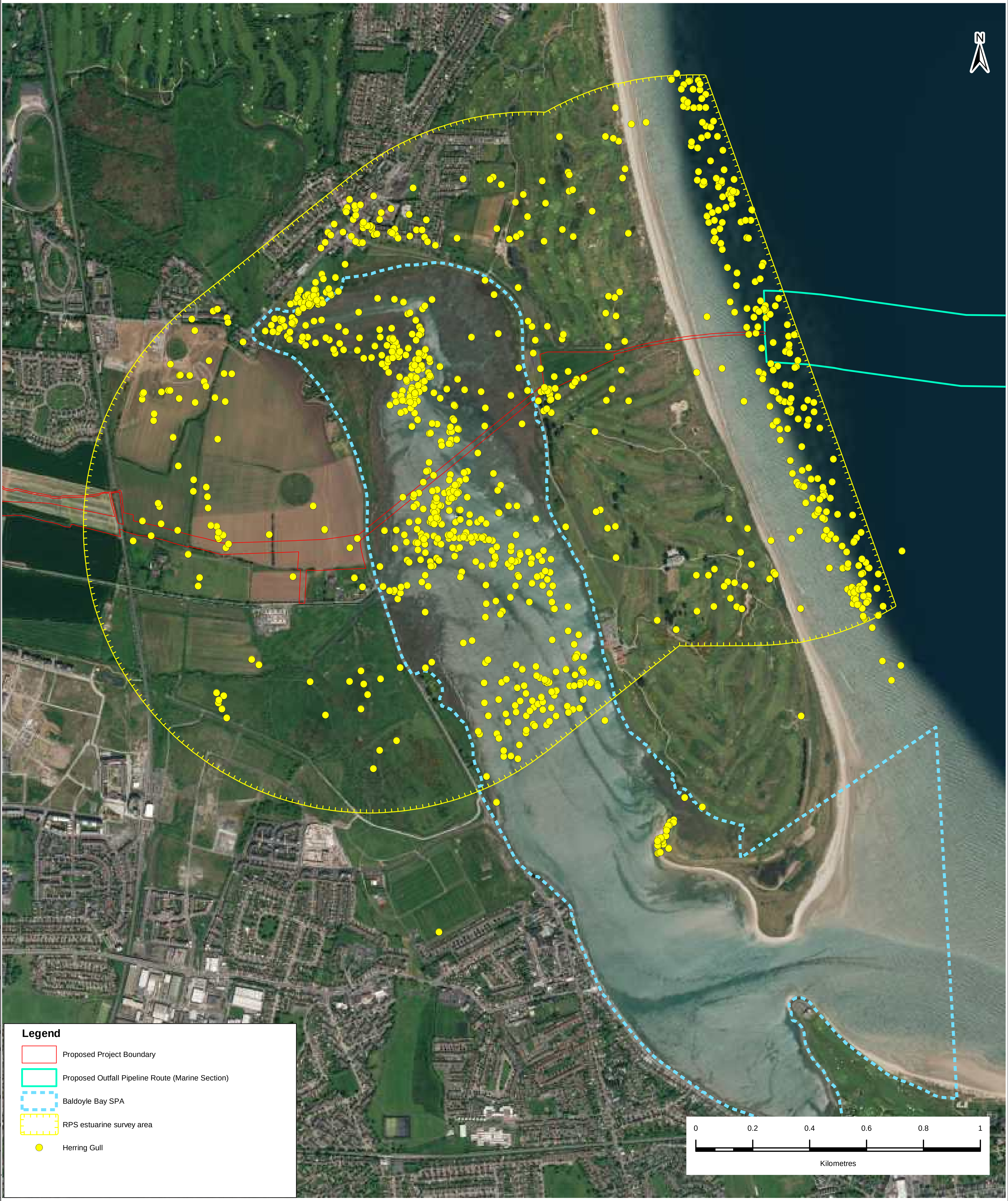
Drawing Title
Figure A10.36 Great Black-backed Gull Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1036 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




**Legend**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- Baldoyle Bay SPA
- RPS estuarine survey area
- Herring Gull

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.37 Herring Gull Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



Uisce Éireann Irish Water

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1037 |


Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.38 Kittiwake Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



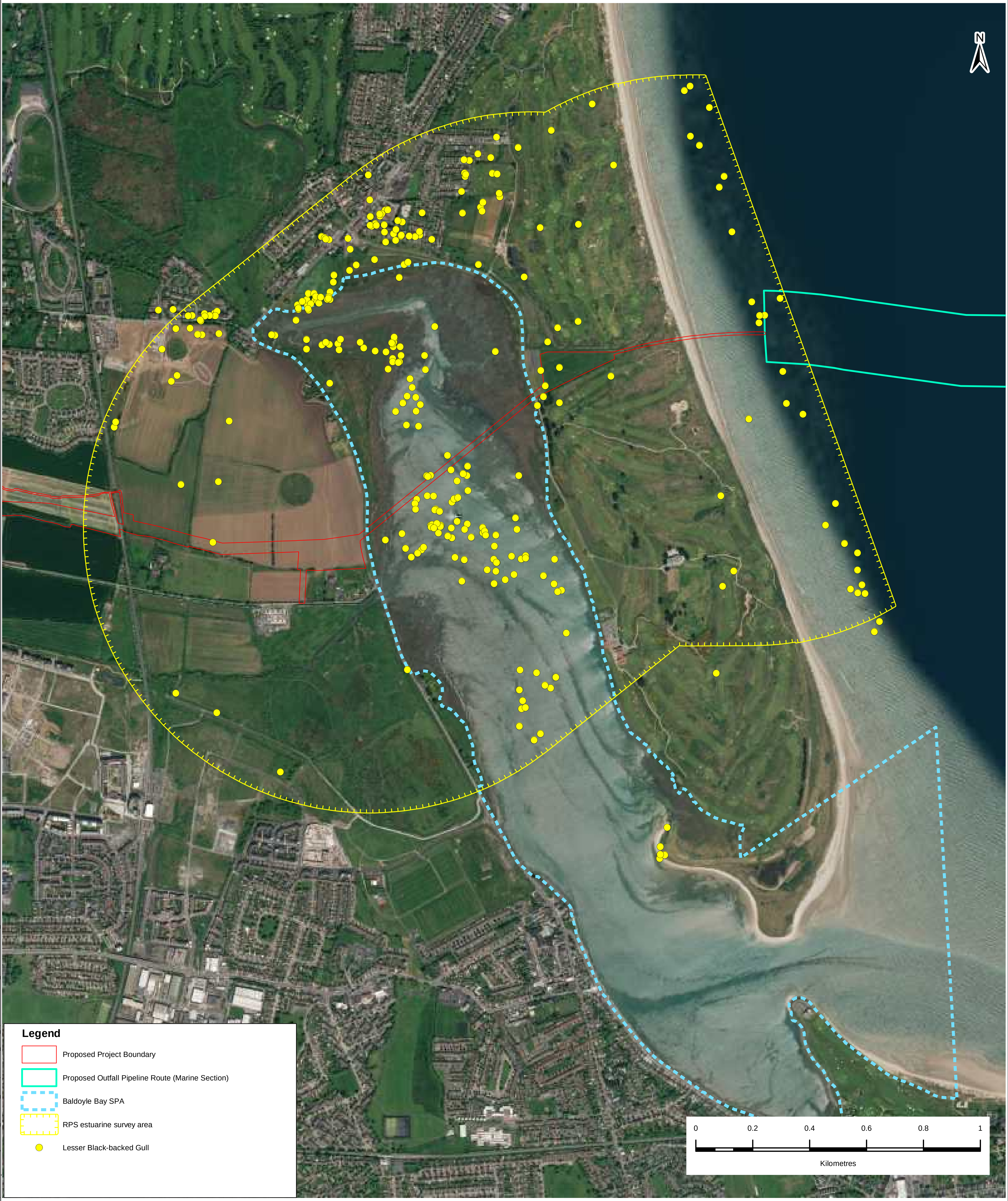
UISCE WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1038 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.39 Lesser Black-backed Gull Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

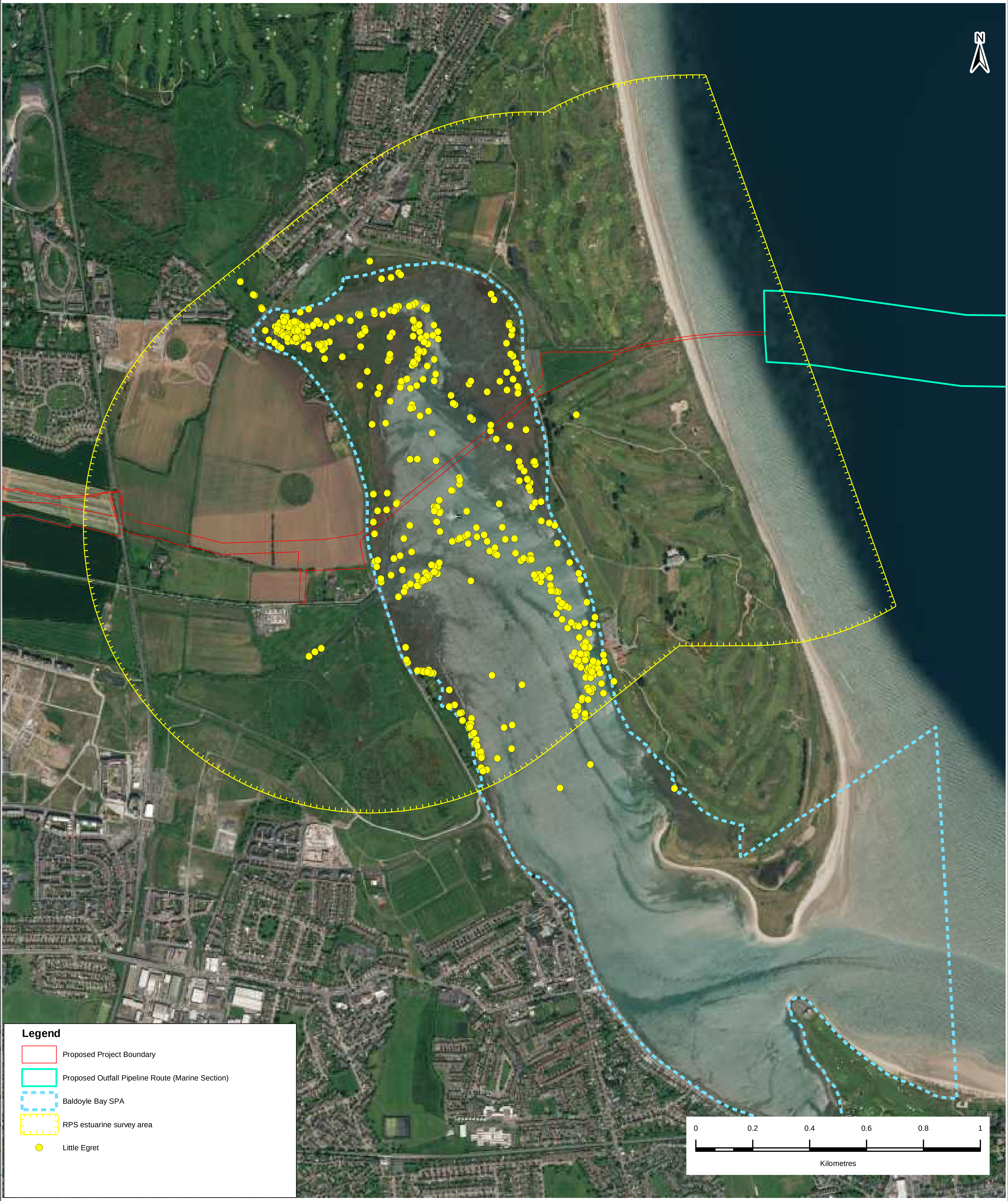


UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1039 |




W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.40 Little Egret Records in Baldoyle Bay (Dec 2014 to March 2018)

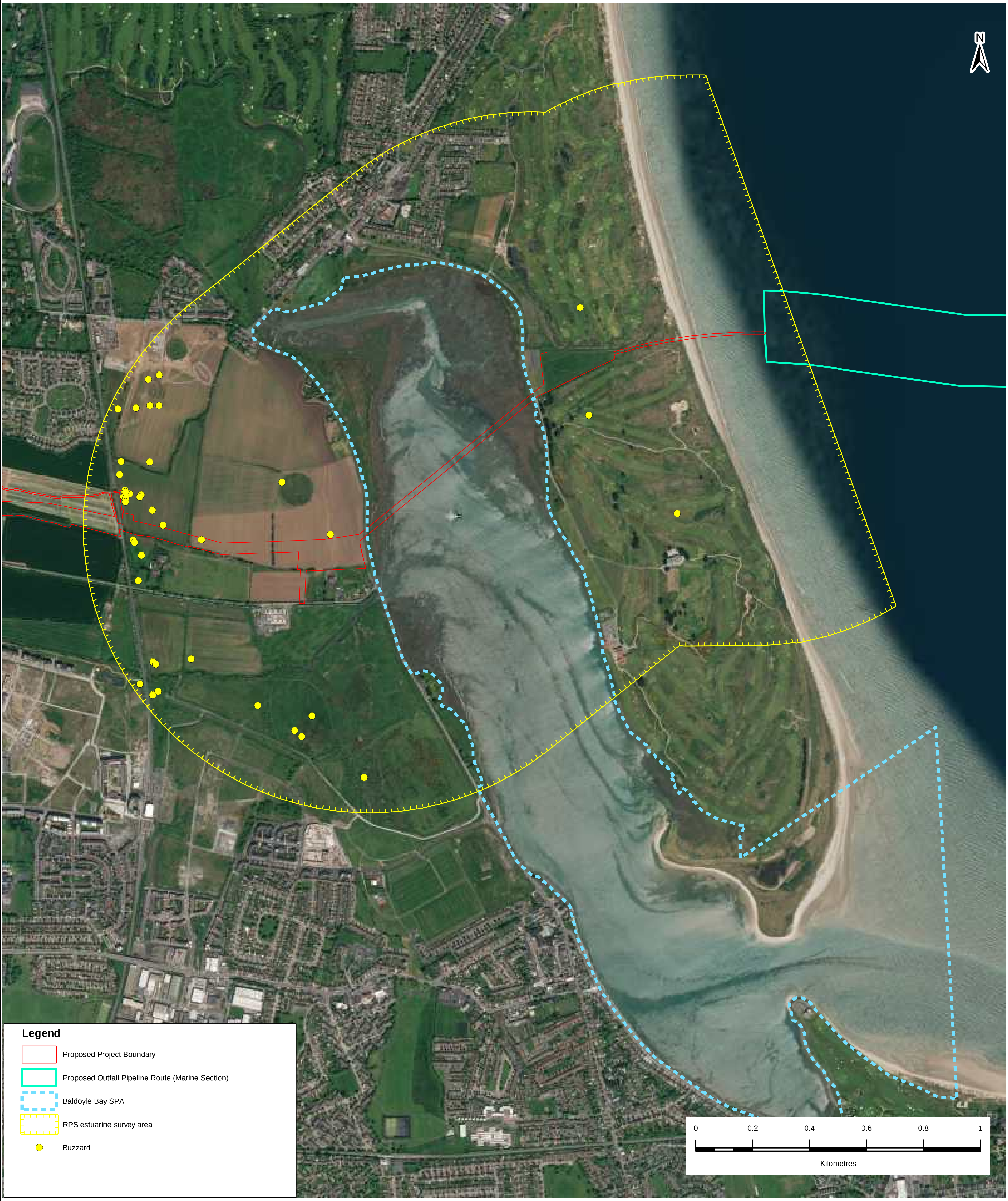

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1040 |




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.41 Buzzard Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1041 |


Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.42 Peregrine Records in Baldoyle Bay (Dec 2014 to March 2018)



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1042 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.43 Cormorant Records in Baldoyle Bay (Dec 2014 to March 2018)



| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1043 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd



Greater Dublin Drainage

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.44 Shag Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1044 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.45 Common Tern Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



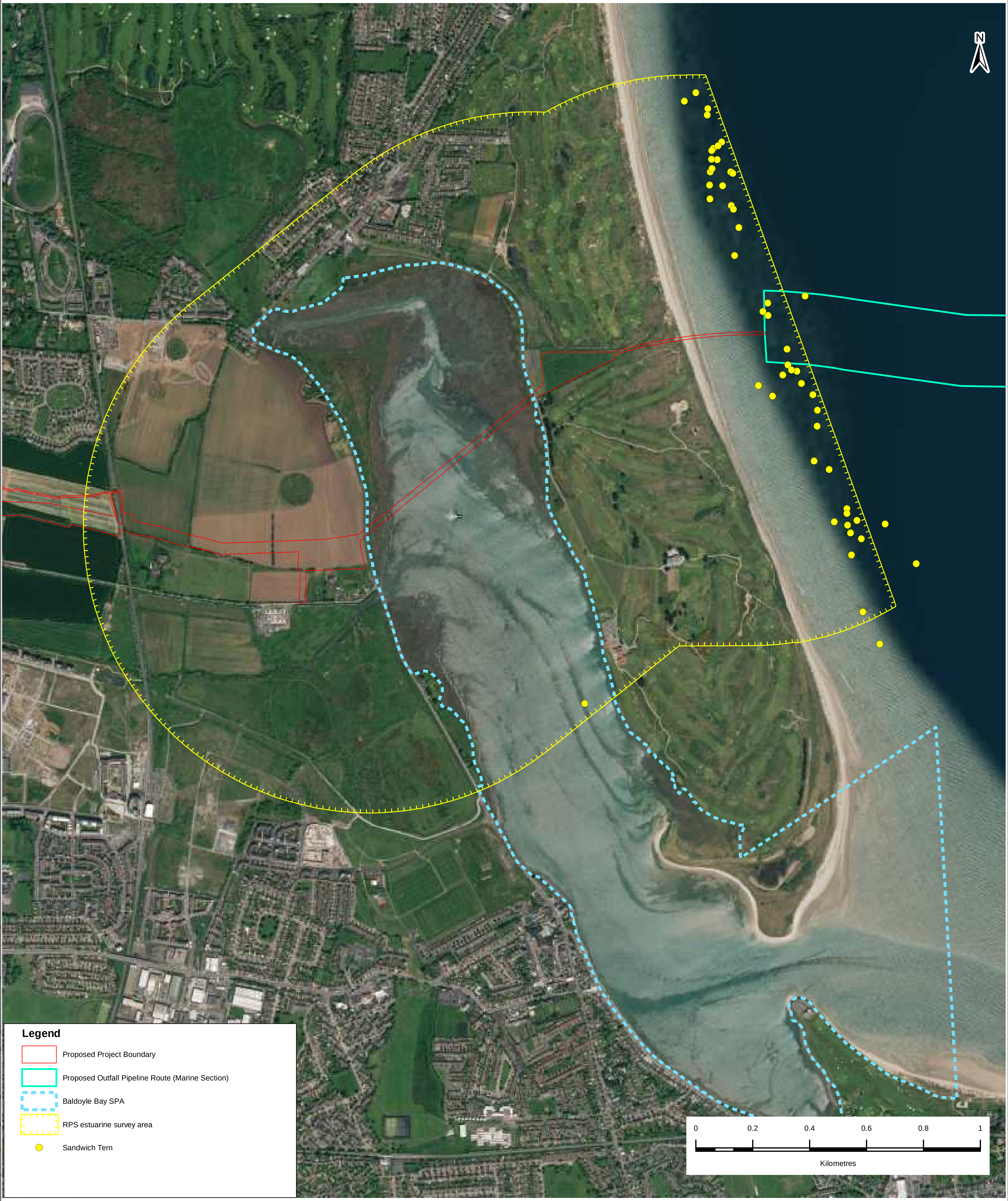
UISCE WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1045 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

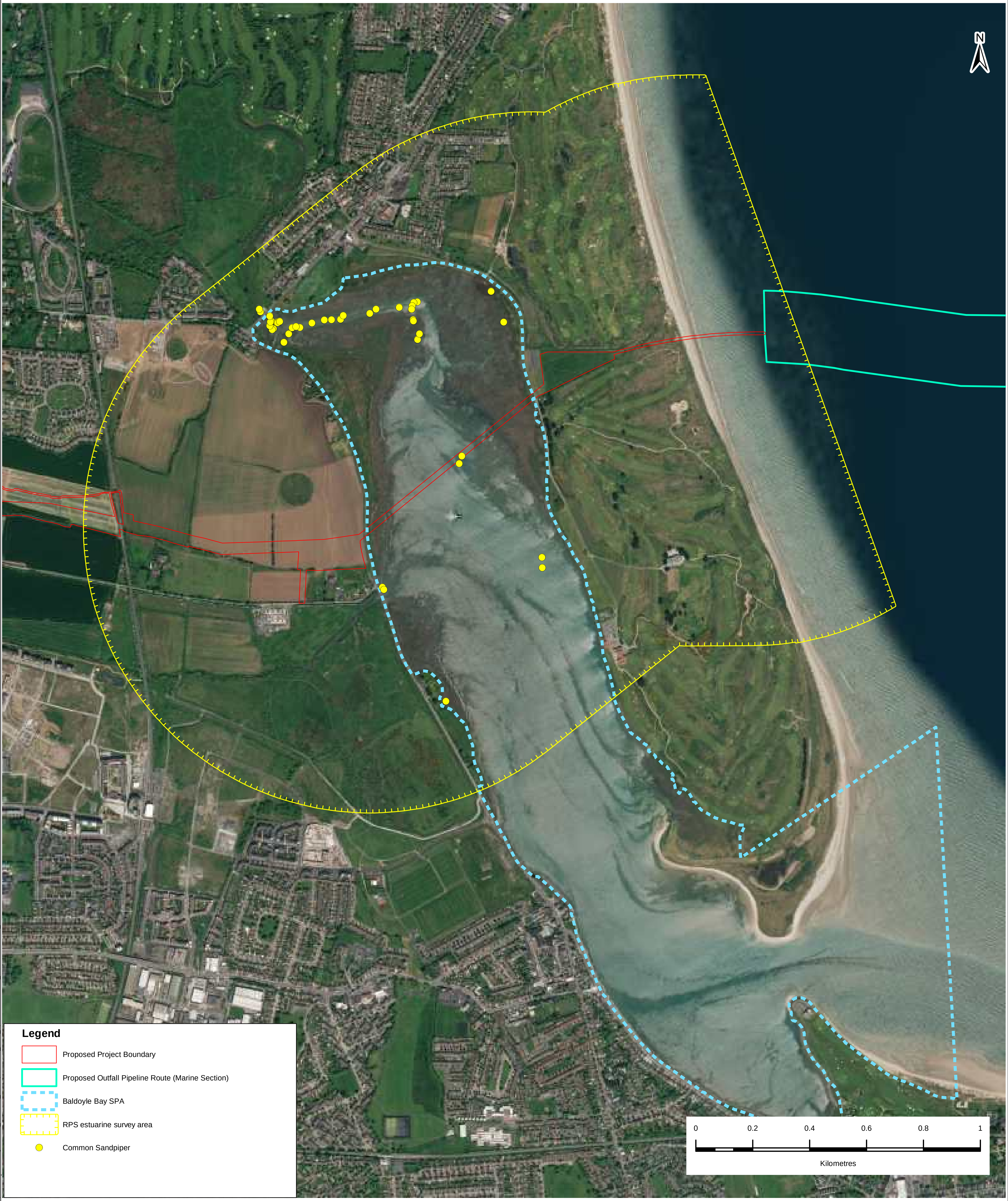


Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.46 Sandwich Tern Records in Baldoyle Bay (Dec 2014 to March 2018)

| | |
|---|---|
| Drawing Status | **Final** |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1046 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.47 Common Sandpiper Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

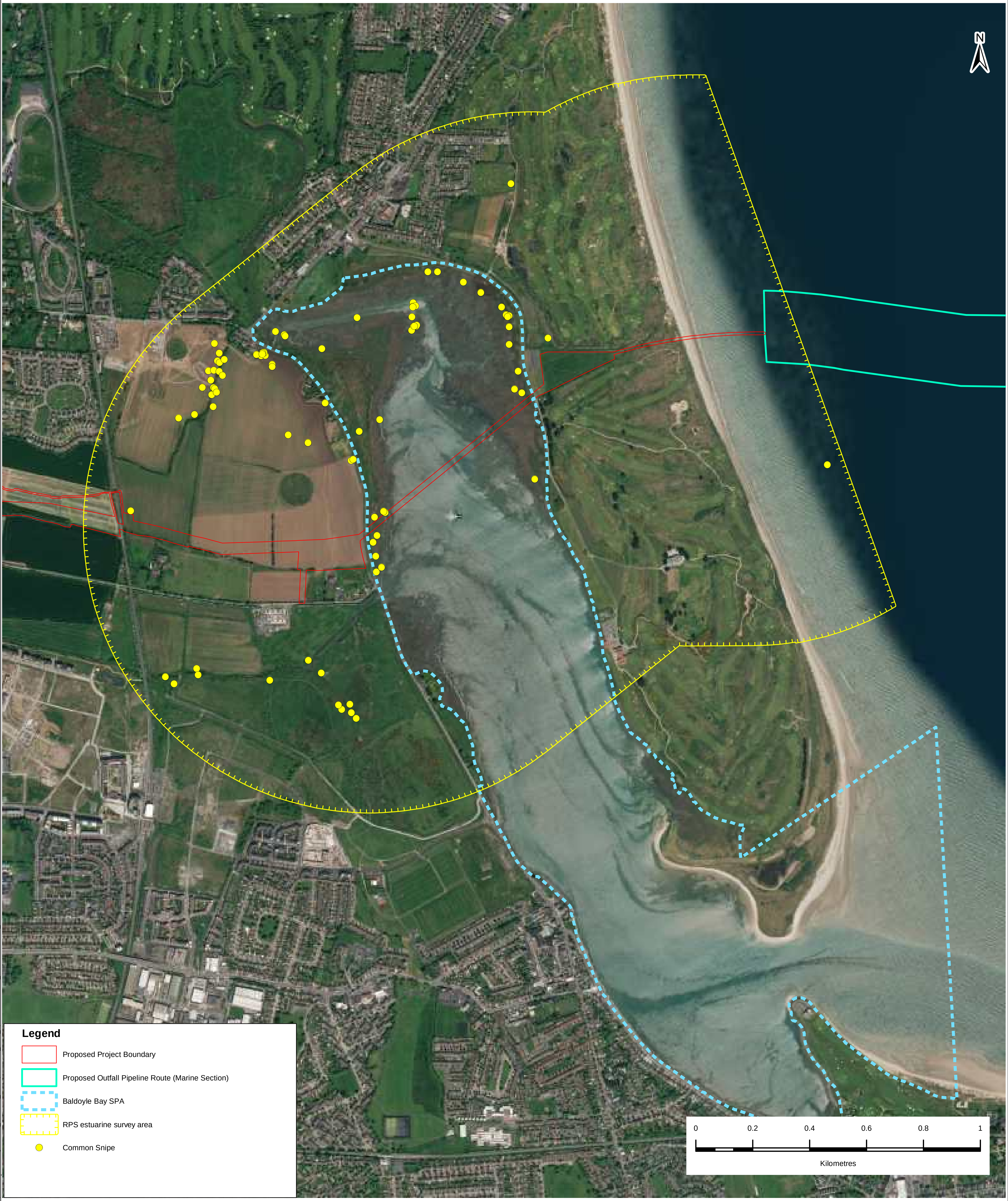


UISCE ÉIREANN : IRISH WATER

JACOBS

TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1047 |





Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.48 Common Snipe Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

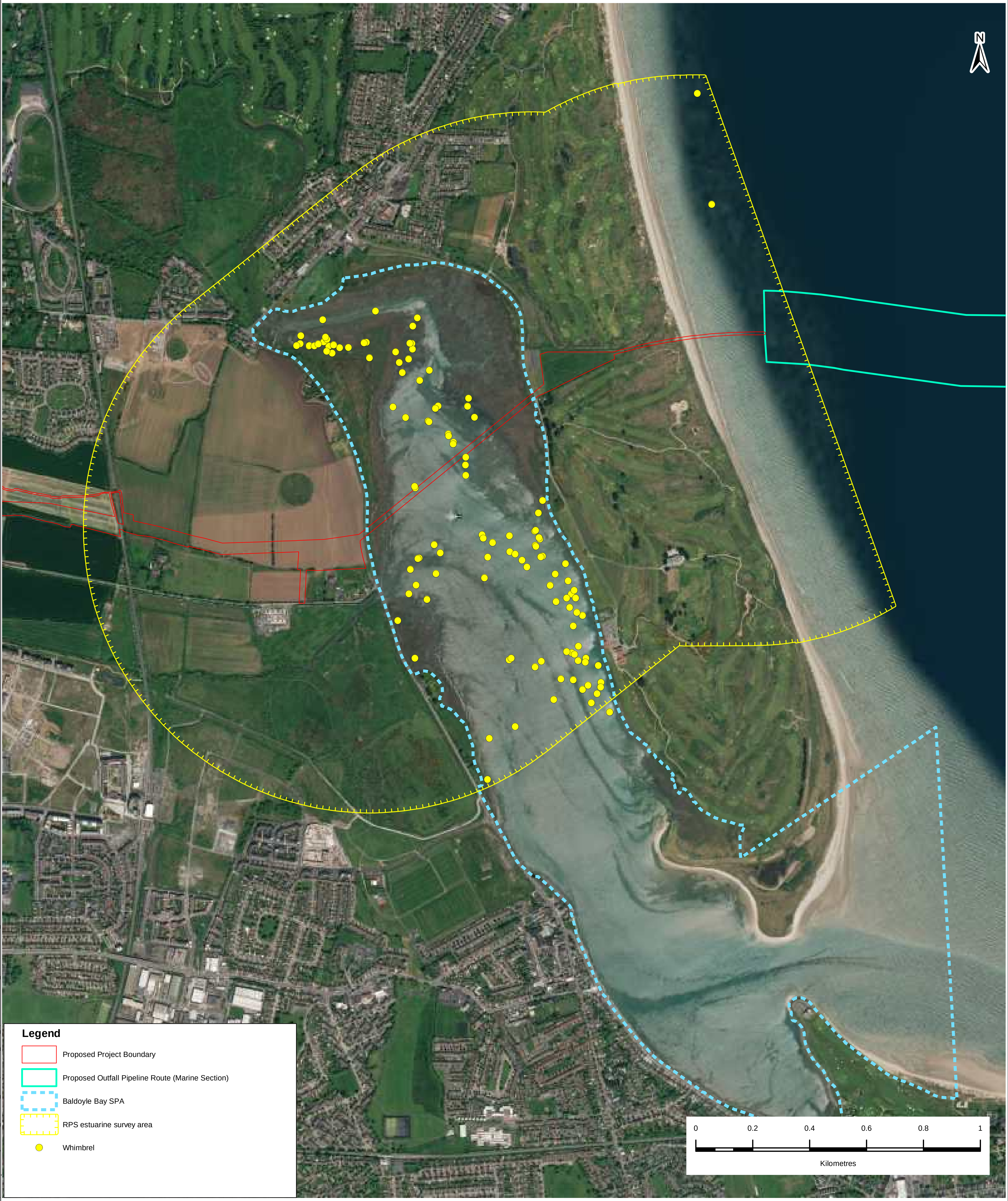


Uisce Éireann Irish Water

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1048 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.49 Whimbrel Records in Baldoyle Bay (Dec 2014 to March 2018)

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

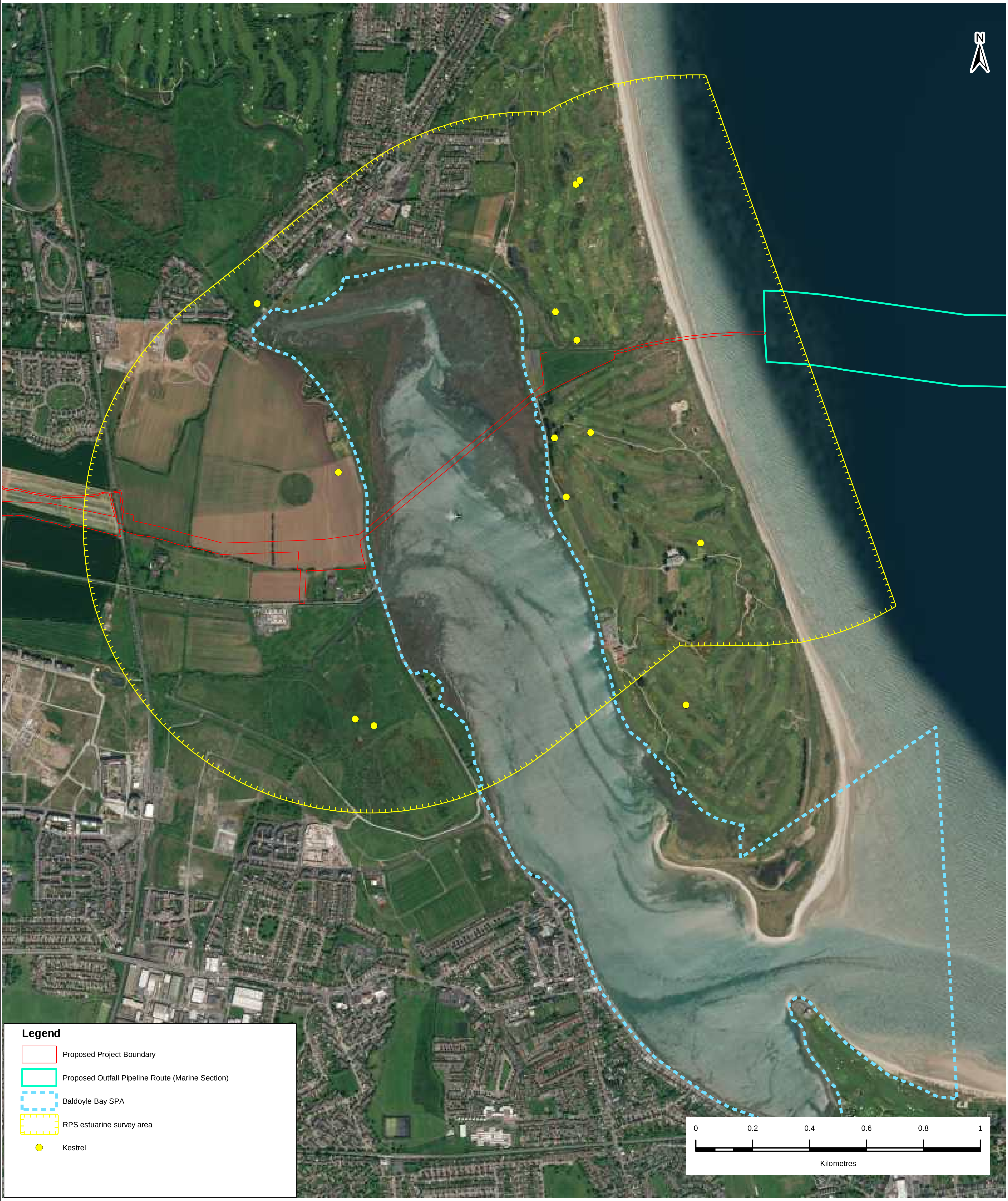


UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1049 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_orni\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd

Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.50 Kestrel Records in Baldoyle Bay (Dec 2014 to March 2018)

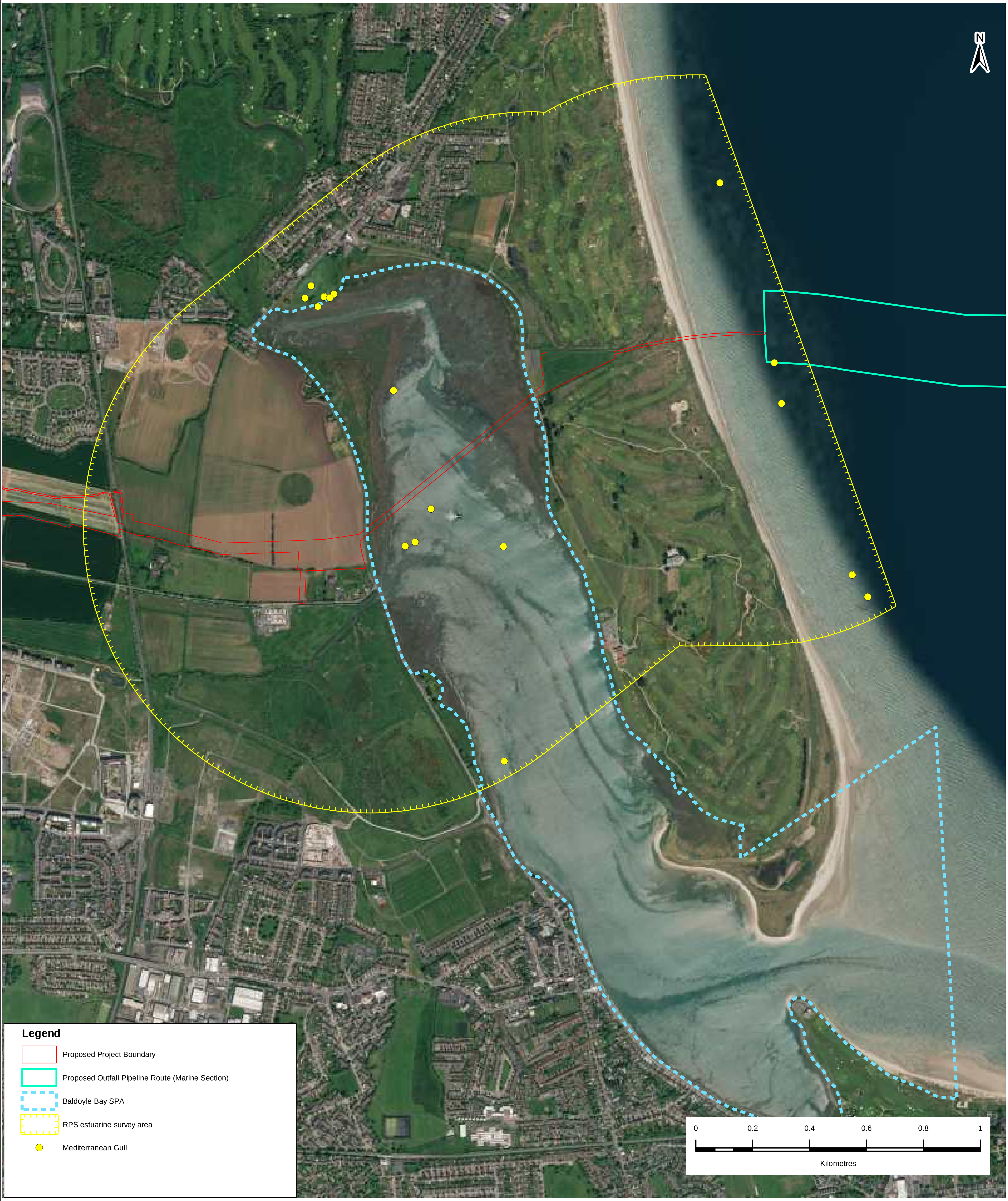

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |



UISCE ÉIREANN : IRISH WATER

JACOBS
TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1050 |




Greater Dublin Drainage


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.51 Mediterranean Gull Records in Baldoyle Bay (Dec 2014 to March 2018)



UISCE WATER

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1051 |

W:\7909SEC - RPS Belfast, WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd


Greater Dublin Drainage

Project
Greater Dublin Drainage Project

Drawing Title
Figure A10.52 Roseate Tern Records in Baldoyle Bay (Dec 2014 to March 2018)


| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

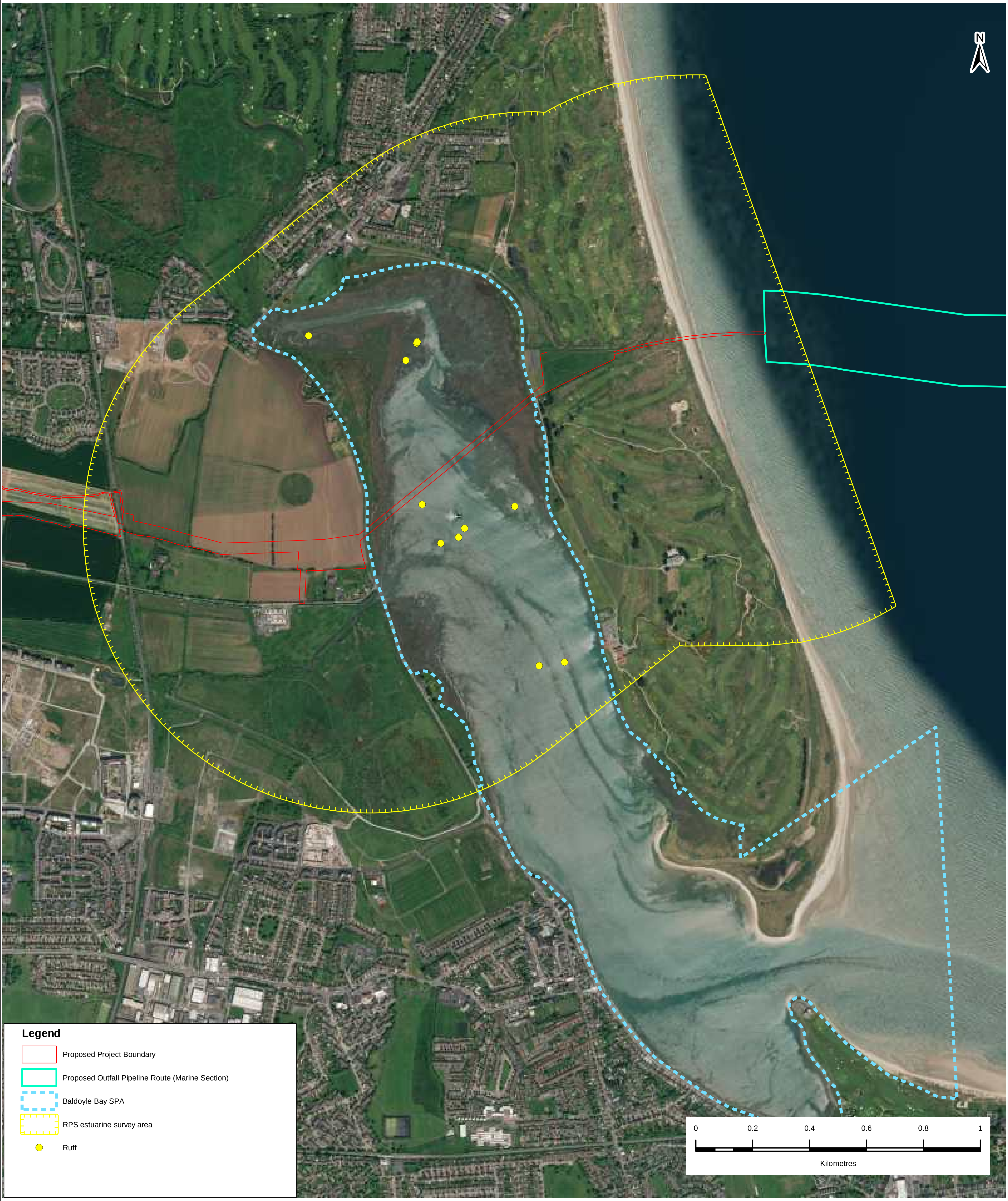


Uisce Éireann | Irish Water

JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1052 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




Greater Dublin Drainage


Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.53 Ruff Records in Baldoyle Bay (Dec 2014 to March 2018)

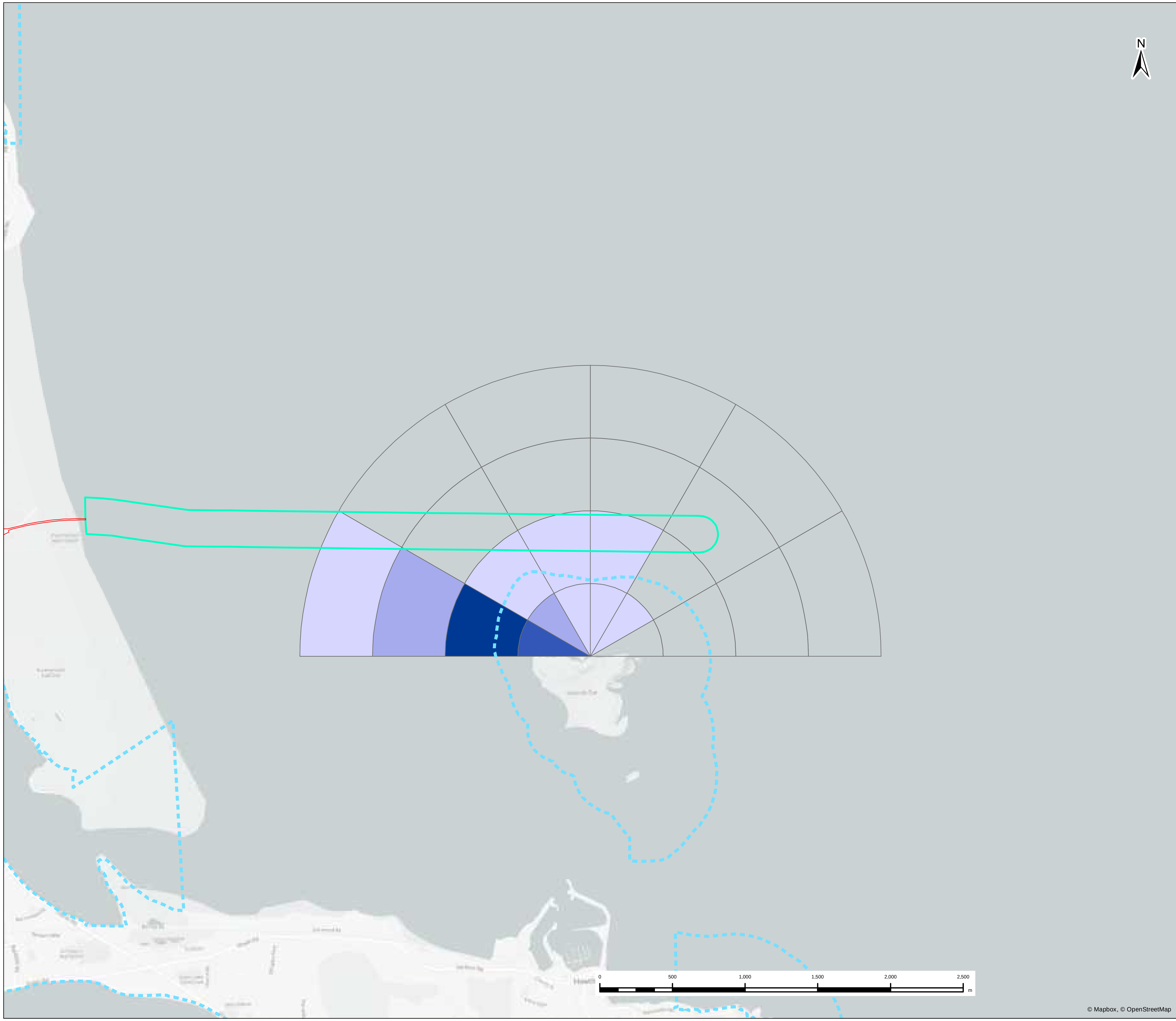
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 21/05/18 | Additional survey data | CH | RI | KAG | RI |
| 1 | 19/03/18 | Infrastructure updated | CH | RI | KAG | RI |
| 0 | 17/10/17 | Draft | CH | RI | KAG | RI |

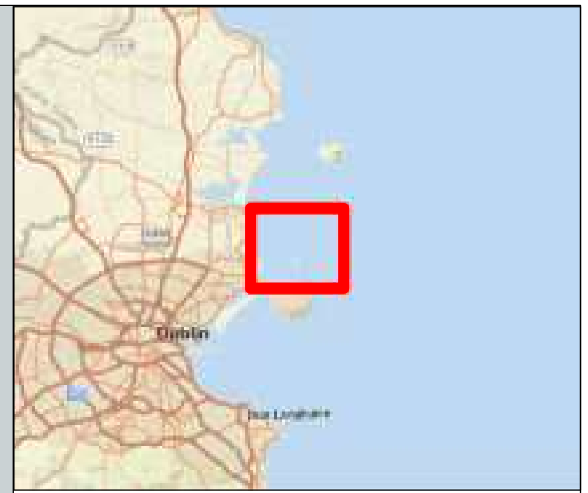


JACOBS TOBIN

| | |
|---|---|
| Drawing Status | Final |
| Scale @ A3 | 1:12,500 |
| Job No. | SEC7909 |
| Drawing No. | 32102902-EIAR-A1053 |

W:\7909SEC - RPS Belfast_WW EIS NIS Ornithology\Technical\Graphics\GIS\mxd\figures\ES_ornith\ES_techrep\sec7909_A101_SpeciesDistribution_Dec2014Mar2018_DDP.mxd




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Black guillemot - all behaviours

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60
- 61 - 70

Greater Dublin Drainage

| 1 | 06/06/2018 | Infrastructure updated | CH | RI | KG | RI |
|---|---|---|---|---|---|---|
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |

JACOBS TOBIN

Client

UISCE ÉIREANN IRISH WATER

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.54 Distribution of all on sea black guillemot records from Ireland's Eye VP during breeding season (March to October)

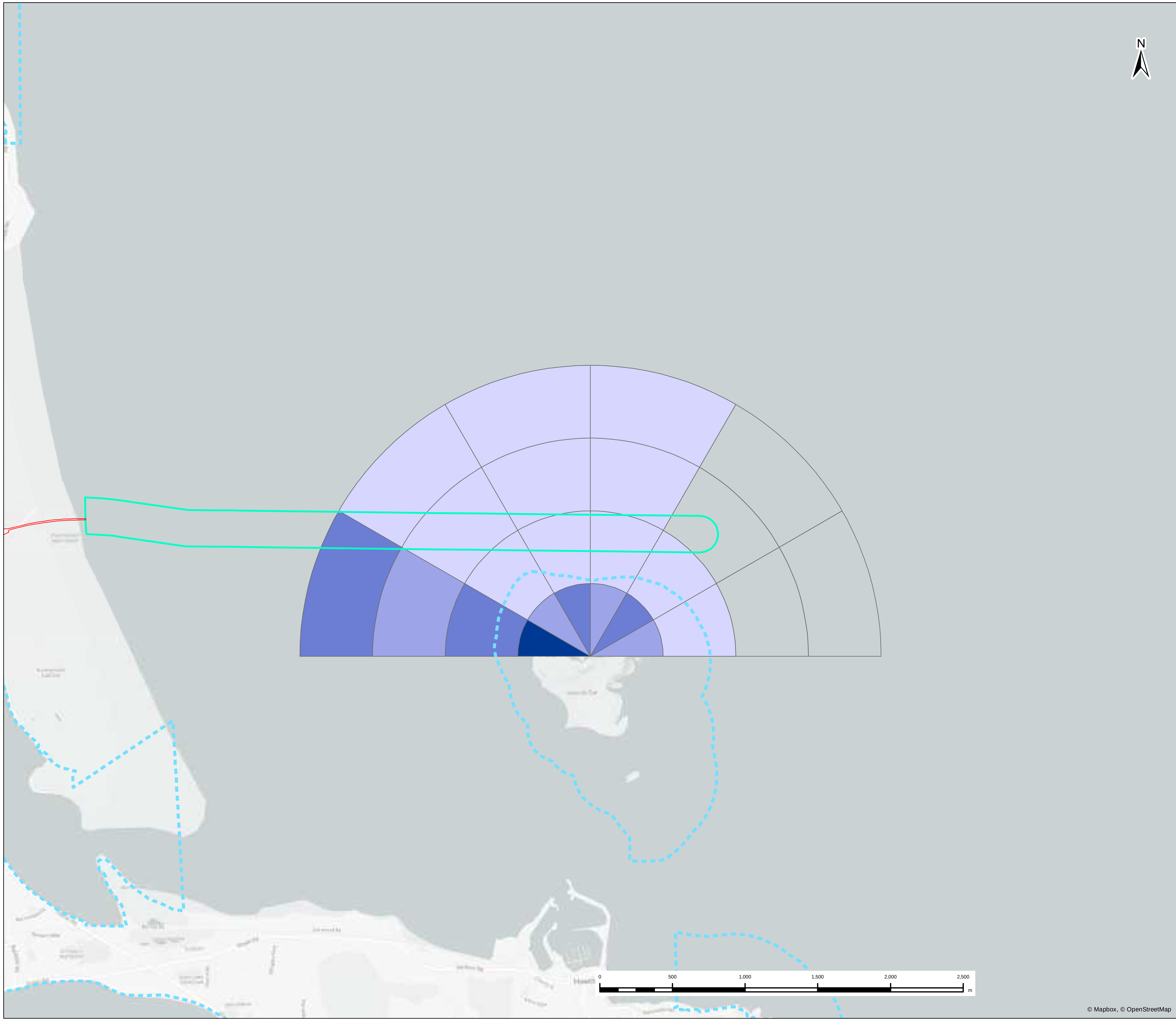
Drawing Status

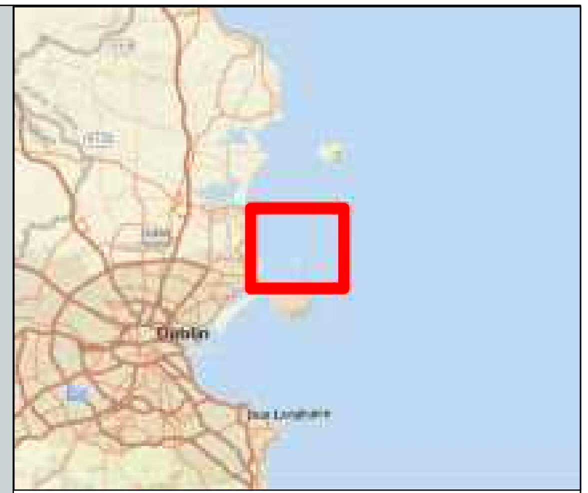
Final

Scale @A3 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1054




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Cormorant - all behaviours

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50
- 51 - 60

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 06/06/2018 | Infrastructure updated | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE WATER

Project

Greater Dublin Drainage Project

Drawing Title

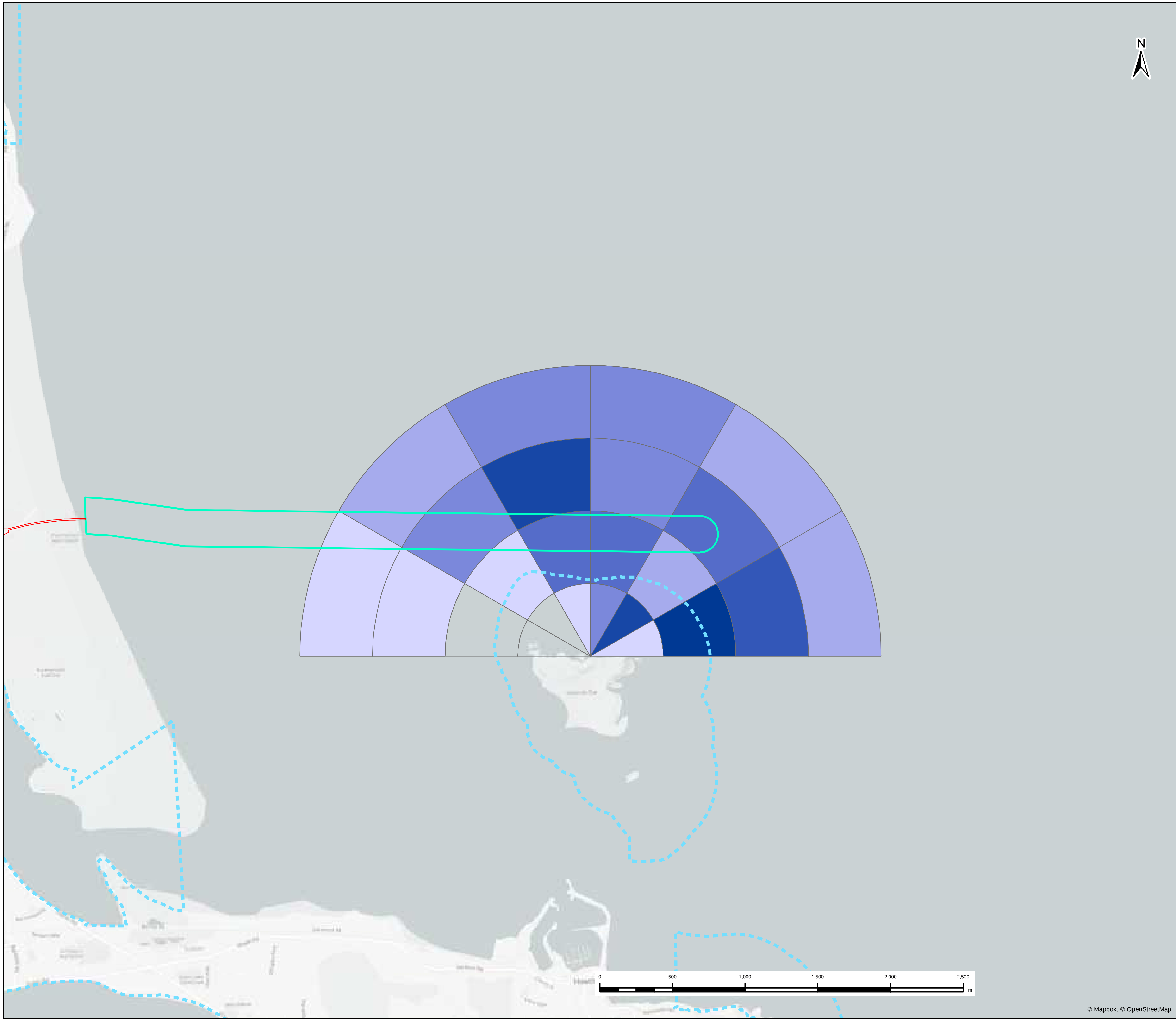
Figure A10.55 Distribution of all on sea cormorant records from Ireland's Eye VP during breeding season (March to October)

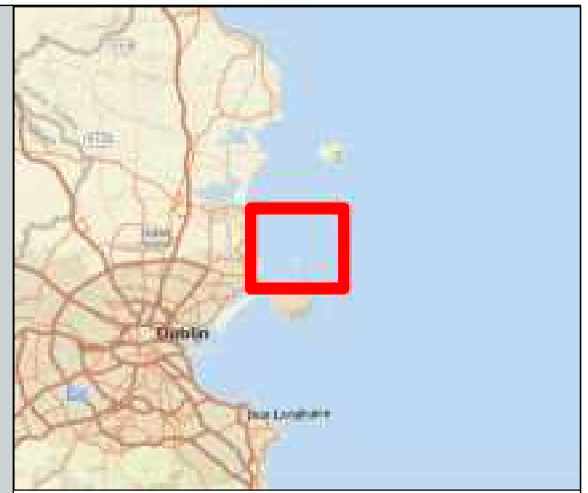
Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1055




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Fulmar - all behaviours

- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25
- 26 - 30
- 31 - 35

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE ÉIREANN WATER

Project

Greater Dublin Drainage Project

Drawing Title

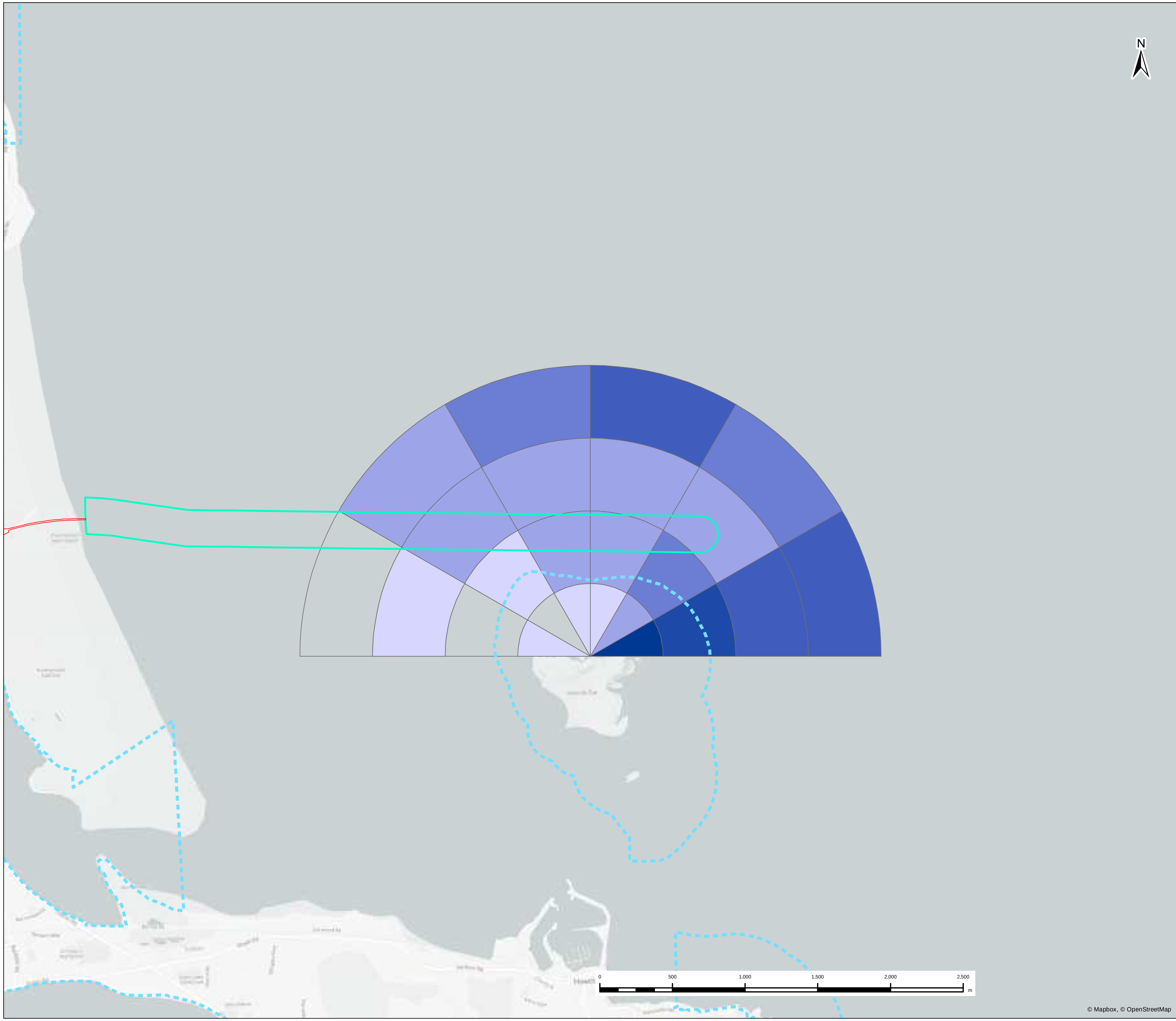
Figure A10.56 Distribution of all on sea fulmar records from Ireland's Eye VP during breeding season (March to October)

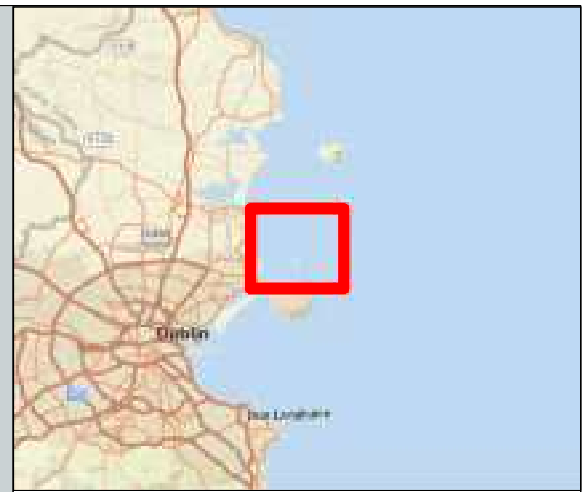
Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1056




**Key**

Proposed Project Boundary

Proposed Outfall Pipeline Route (Marine Section)

SPA boundaries

Index of abundance

Gannet - all behaviours

3 - 25

26 - 50

51 - 75

76 - 100

101 - 125

126 - 150

Greater Dublin Drainage

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 06/06/2018 | Infrastructure updated | CH | RI | KG | RI |
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |

JACOBS TOBIN

Client

UISCE ÉIREANN WATER

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.57 Distribution of all on sea gannet records from Ireland's Eye VP during breeding season (March to October)

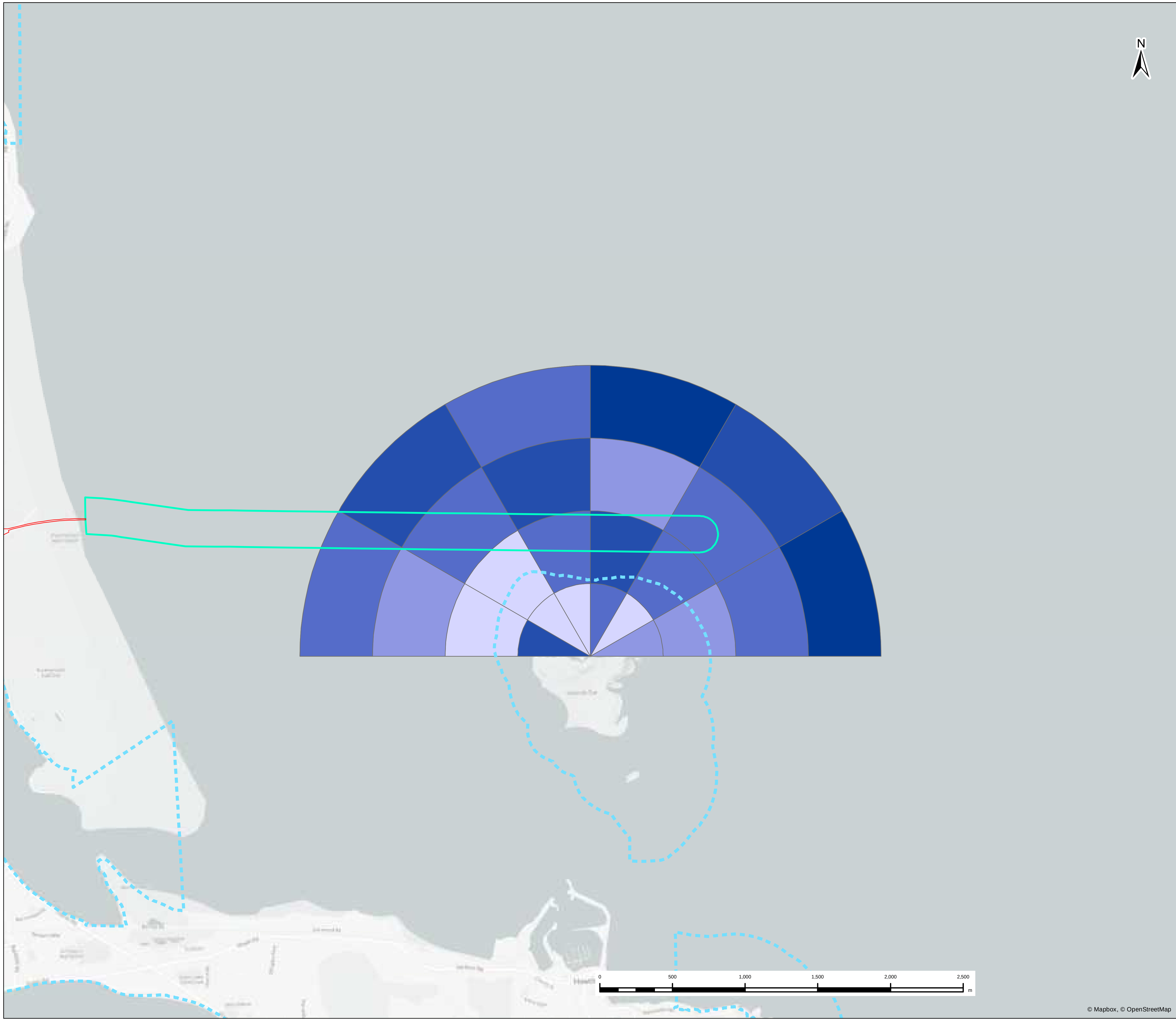
Drawing Status

**Final**

Scale @A3 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1057




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Great black-backed gull - all behaviours

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 41 - 50

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 1 | 06/06/2018 | Infrastructure updated | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE ÉIREANN IRISH WATER

Project

Greater Dublin Drainage Project

Drawing Title

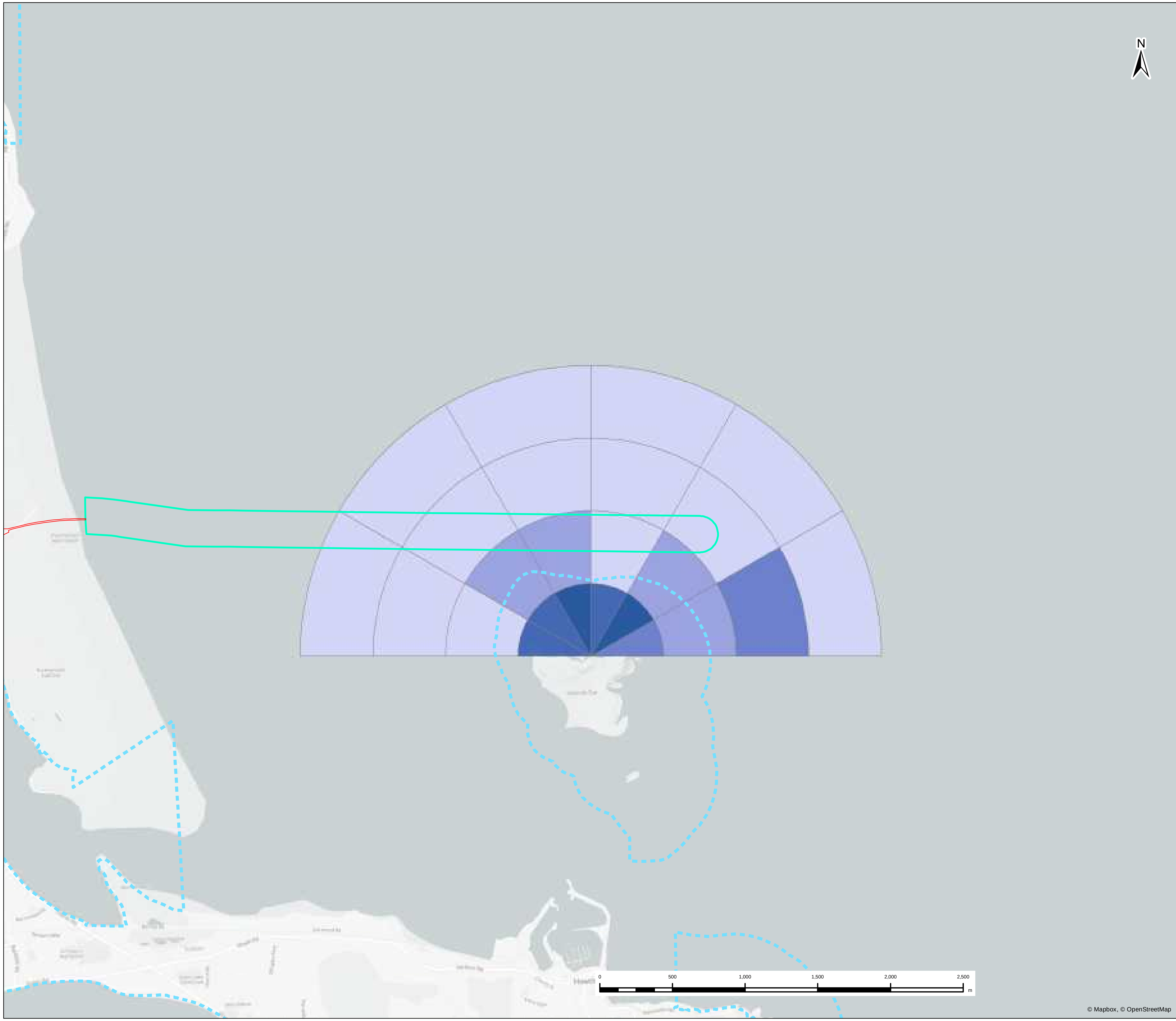
Figure A10.58 Distribution of all on sea great black-backed gull records from Ireland's Eye VP during breeding season (March to October)

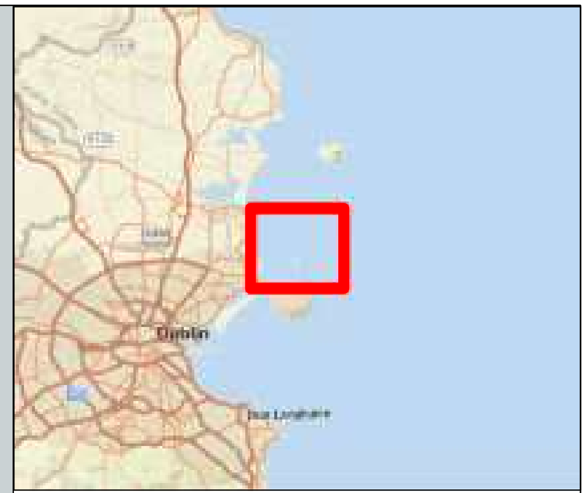
Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1058




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Guillemot - all behaviours

- 32 - 200
- 201 - 400
- 401 - 600
- 601 - 800
- 801 - 1000

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE ÉIREANN IRISH WATER

Project

Greater Dublin Drainage Project

Drawing Title

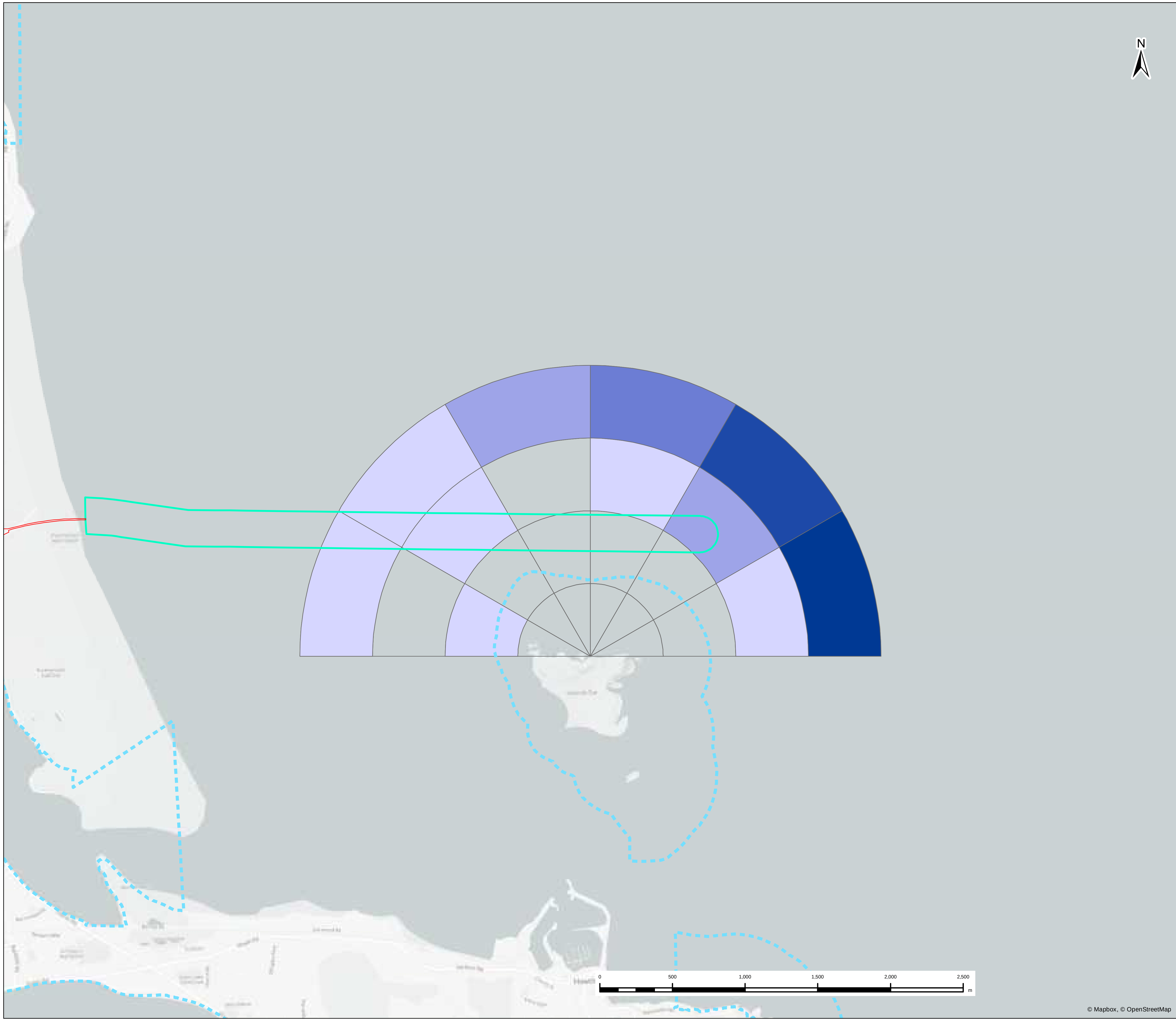
Figure A10.59 Distribution of all on sea guillemot records from Ireland's Eye VP during breeding season (March to October)

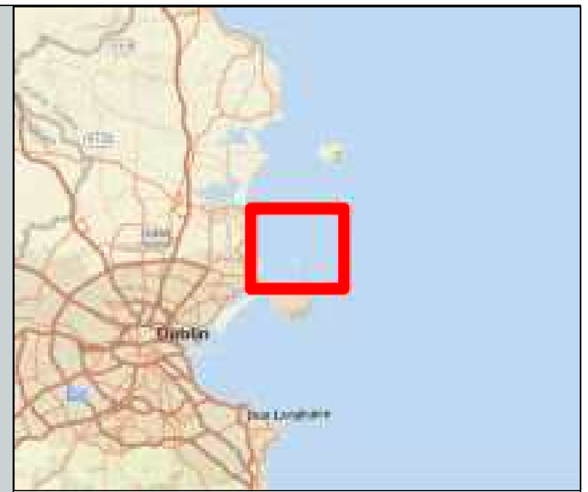
Drawing Status: **Final**

Scale @A3: 1:25,000

Filepath:

Drawing No. 32102902-EIAR-A1059




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Guillemot or razorbill - all behaviours

- 3 - 75
- 76 - 150
- 151 - 225
- 226 - 300
- 301 - 375
- 376 - 450

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE WATER

Project

Greater Dublin Drainage Project

Drawing Title

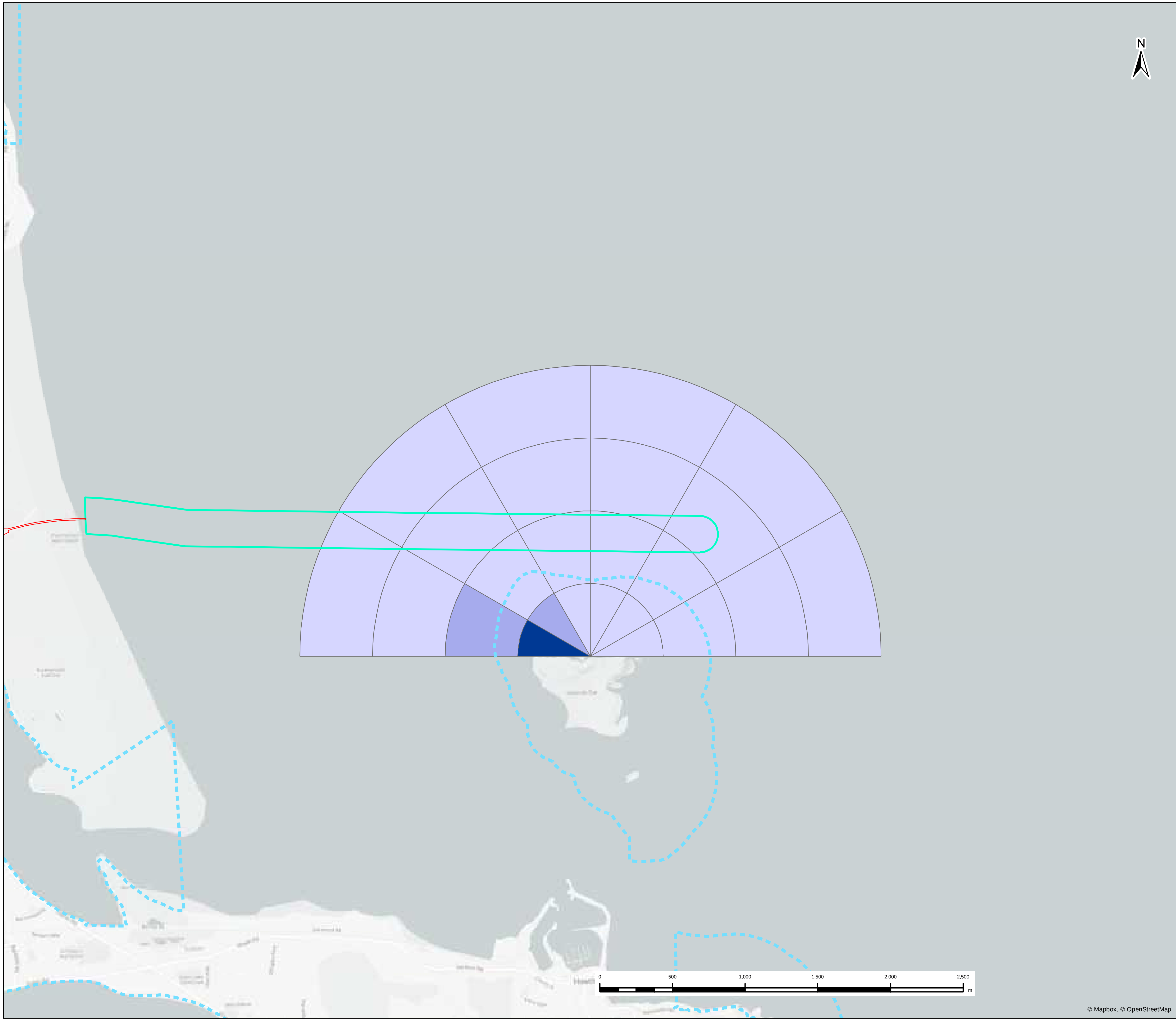
Figure A10.60 Distribution of all on sea guillemot or razorbill records from Ireland's Eye VP during breeding season (March to October)

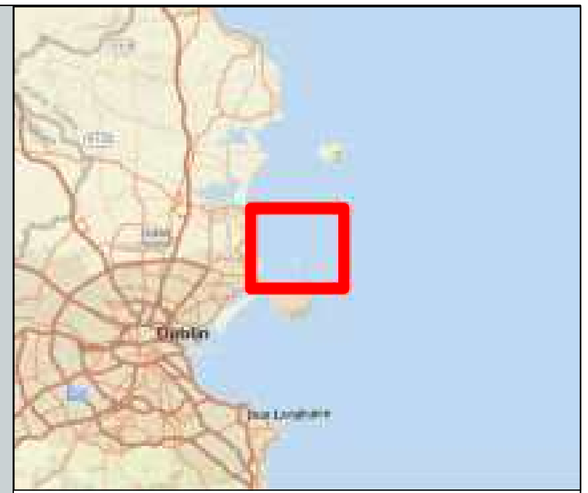
Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1060




## Key

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Herring gull - all behaviours

- 7 - 150
- 151 - 300
- 301 - 450
- 451 - 600
- 601 - 750
- 751 - 900
- 901 - 1050

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

Client

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.61 Distribution of all on sea herring gull records from Ireland's Eye VP during breeding season (March to October)

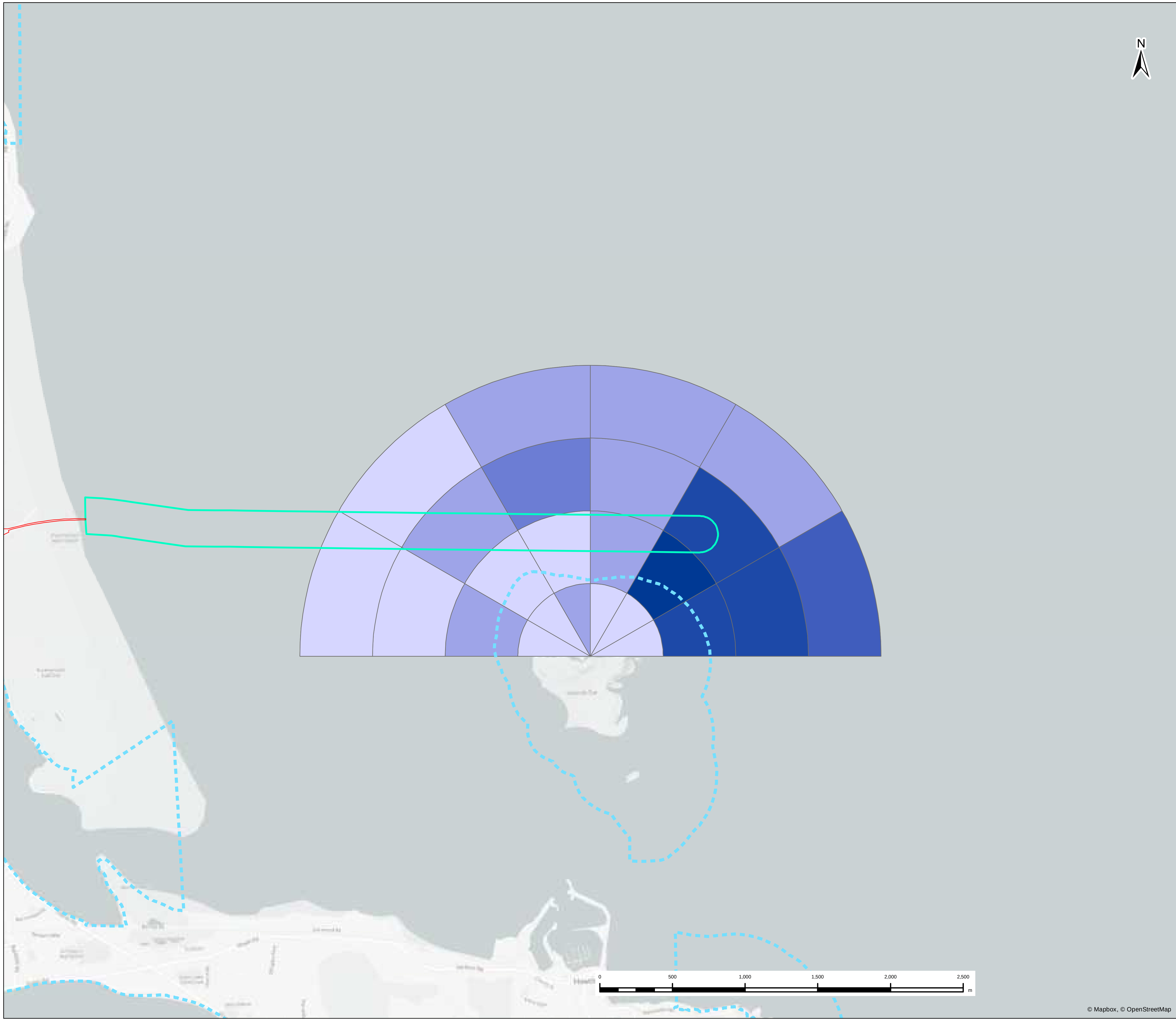
Drawing Status

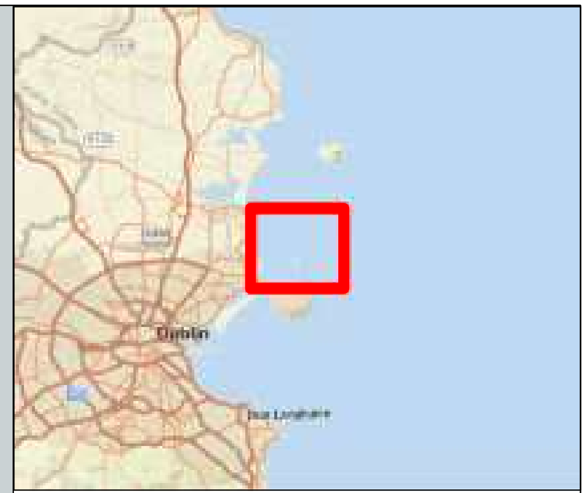
Final

Scale @A3 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1061




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Kittiwake - all behaviours

- 9 - 75
- 76 - 150
- 151 - 225
- 226 - 300
- 301 - 375
- 376 - 450

Greater Dublin Drainage

| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |
|---|---|---|---|---|---|---|
| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |

JACOBS TOBIN

Client

UISCE ÉIREANN WATER

Project

Greater Dublin Drainage Project

Drawing Title

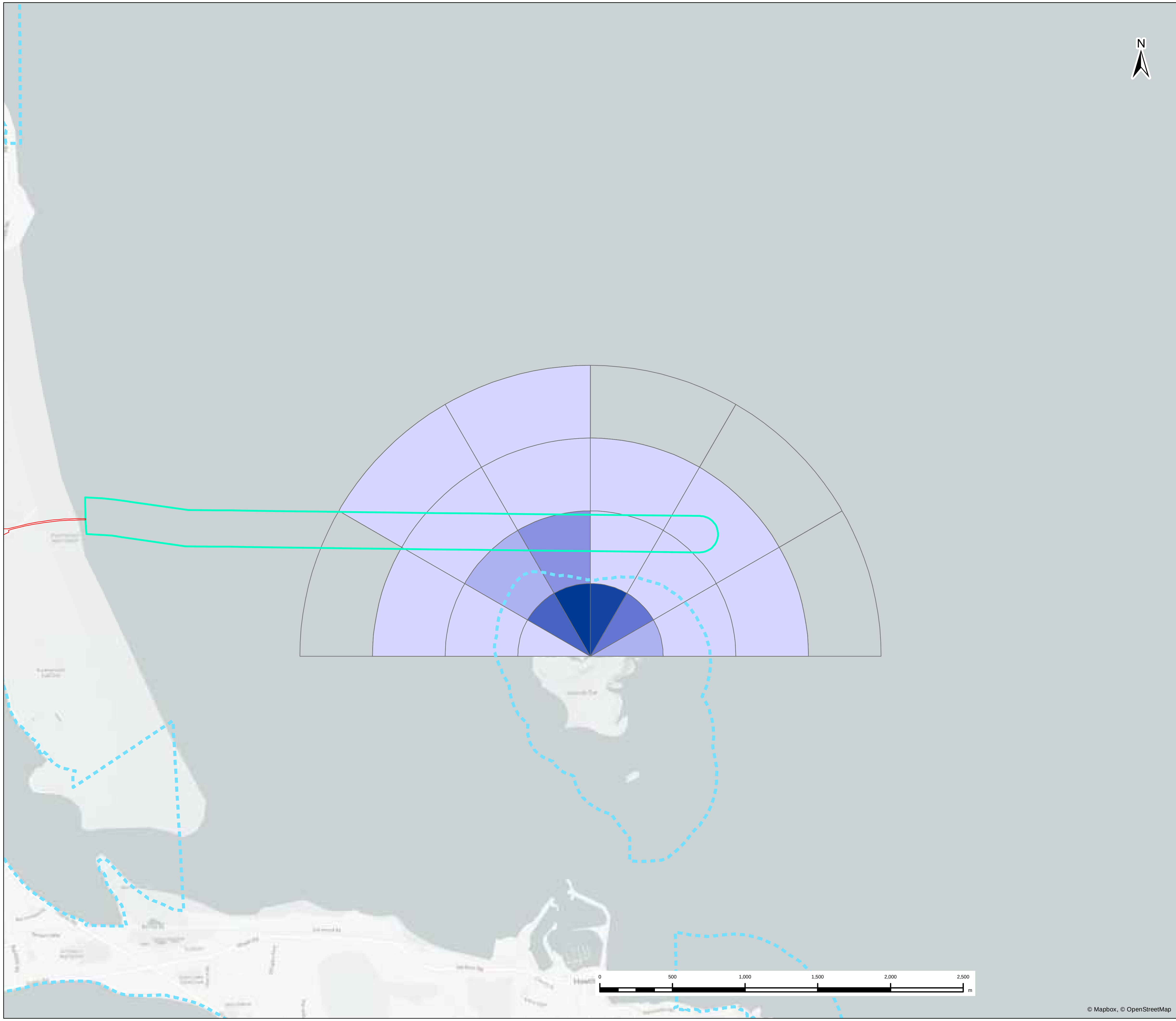
Figure A10.62 Distribution of all on sea kittiwake records from Ireland's Eye VP during breeding season (March to October)

Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1062




**Key**

Proposed Project Boundary

Proposed Outfall Pipeline Route (Marine Section)

SPA boundaries

Index of abundance

Puffin - all behaviours

1 - 25

26 - 50

51 - 75

76 - 100

101 - 125

126 - 150

151 - 175

176 - 200

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

Client

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.63 Distribution of all on sea puffin records from Ireland's Eye VP during breeding season (March to October)

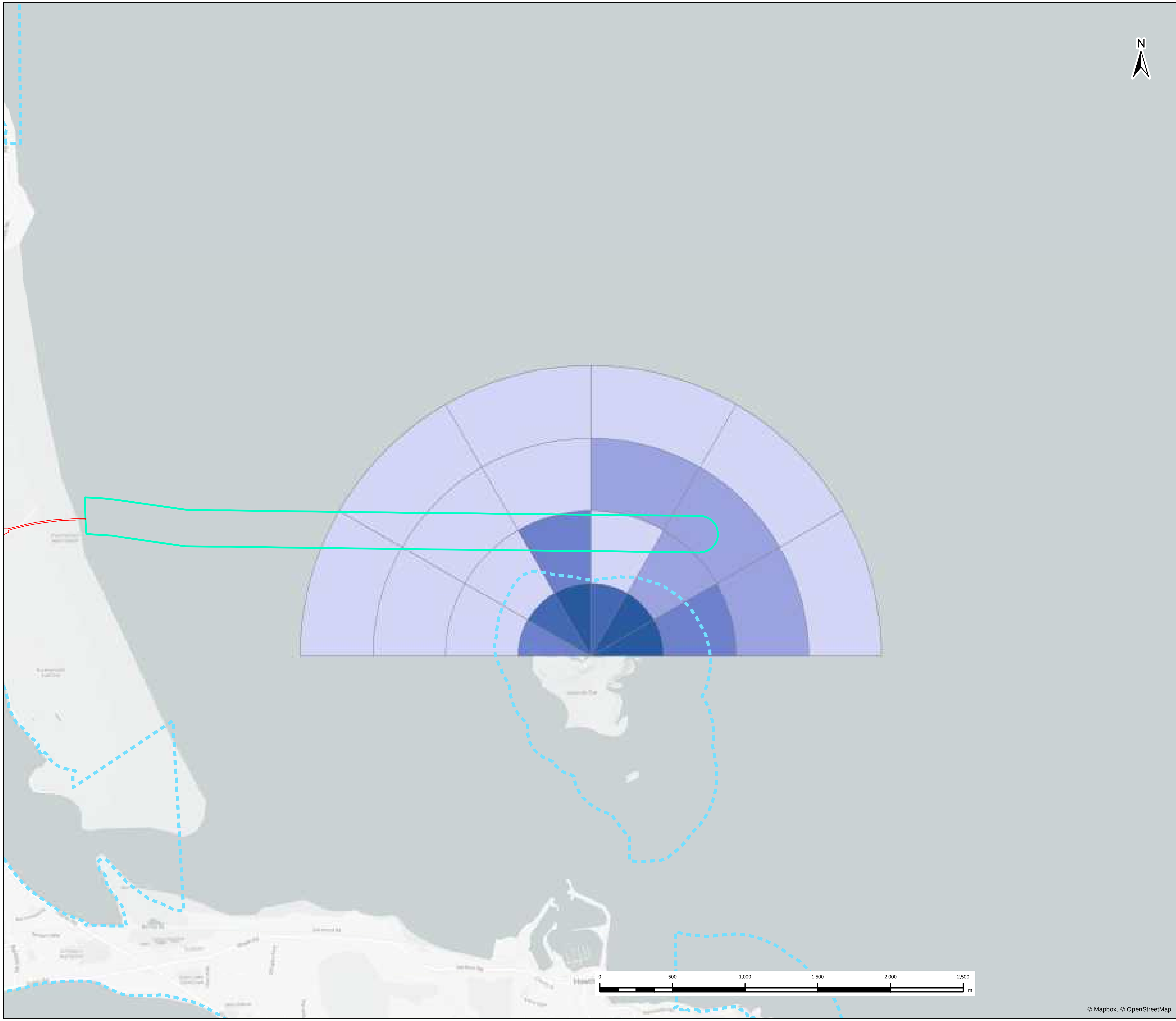
Drawing Status

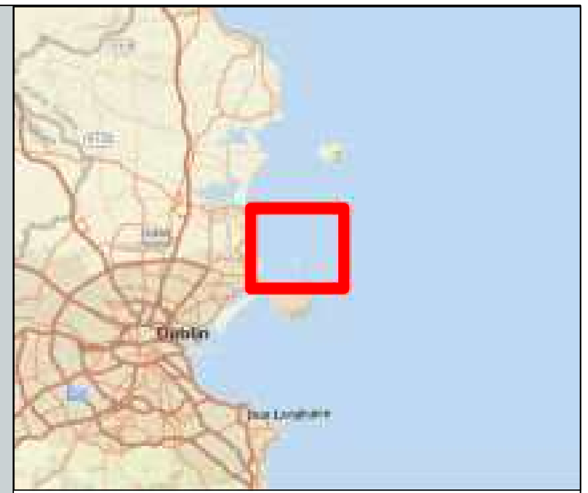
Final

Scale @A3 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1063




**Key**

- Proposed Project
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Razorbill - all behaviours

- 31 - 175
- 176 - 350
- 351 - 525
- 526 - 700
- 701 - 875

Greater Dublin Drainage

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

JACOBS TOBIN

Client

UISCE ÉIREANN WATER

Project

Greater Dublin Drainage Project

Drawing Title

Figure A10.64 Distribution of all on sea razorbill records from Ireland's Eye VP during breeding season (March to October)

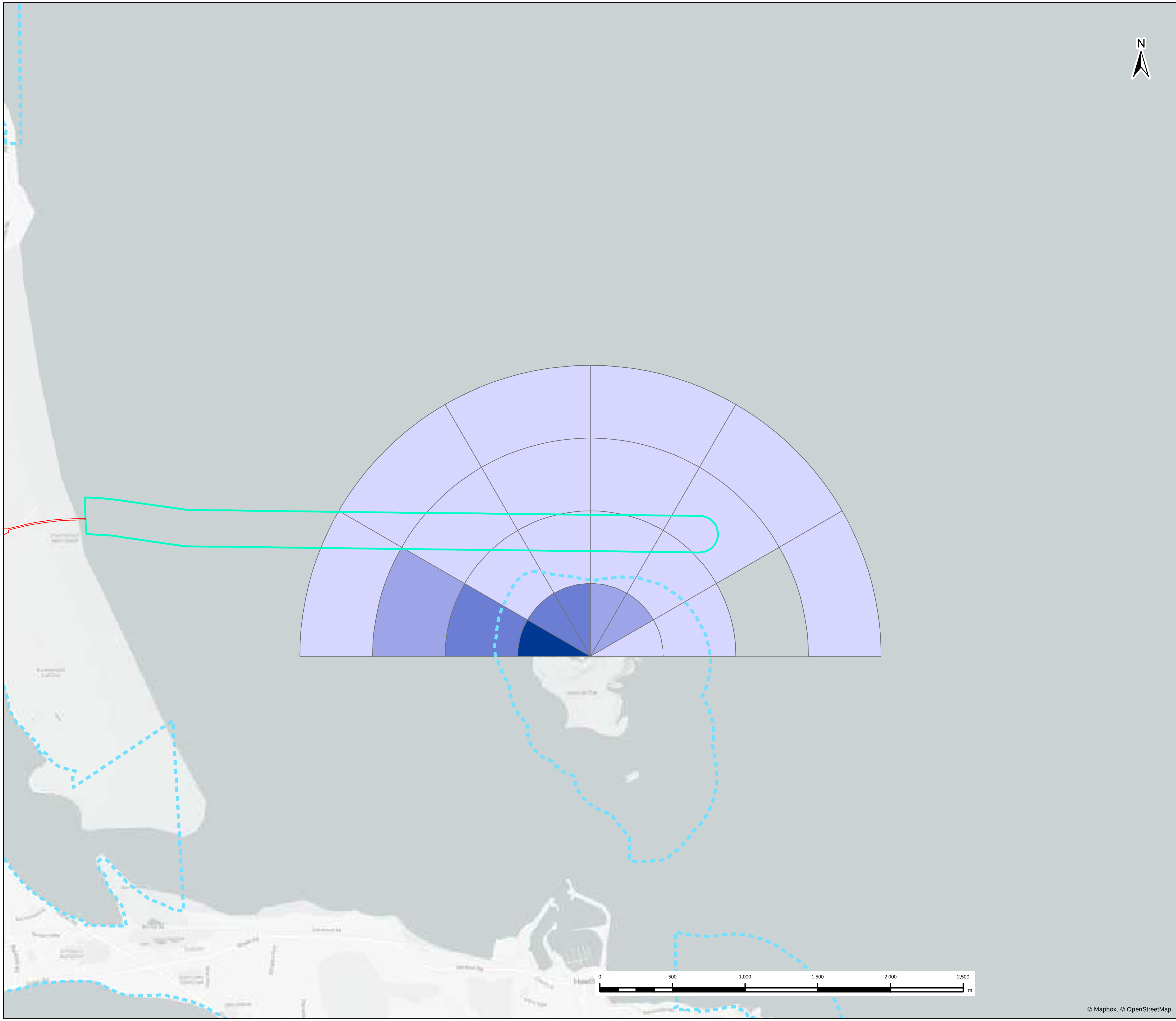
Drawing Status

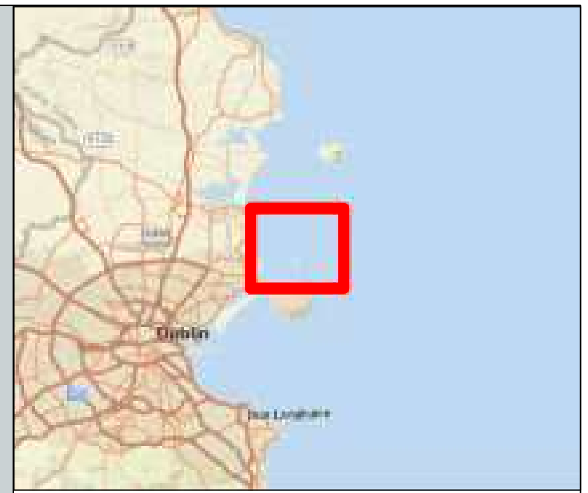
**Final**

Scale @A3 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1064




**Key**

- Proposed Project Boundary
- Proposed Outfall Pipeline Route (Marine Section)
- SPA boundaries

Index of abundance

Shag - all behaviours

- 1 - 50
- 51 - 100
- 101 - 150
- 151 - 200
- 201 - 250
- 251 - 300

| Rev. | Date | Purpose of revision | Drawn | Check'd | Rev'd | Appr'd |
|---|---|---|---|---|---|---|
| 2 | 06/06/2018 | Additional survey data included | CH | RI | KG | RI |

Client

Project: Greater Dublin Drainage Project

Drawing Title: Figure A10.65 Distribution of all on sea shag records from Ireland's Eye VP during breeding season (March to October)

Drawing Status: Final

Scale @A3: 1:25,000

Filepath

Drawing No. 32102902-EIAR-A1065

# APPENDIX 1 – ESTUARINE BIRD SURVEY EFFORT

| Date | Surveyor* | Start Time | Finish Time | Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** | Area surveyed |
|---|---|---|---|---|---|---|---|---|---|---|
| 16/12/2014 | AMcC | 11:00 | 14:10 | 03:10 | 1.99 | 2.11 | 2.32 | 0.33 | L | Partial |
| 22/12/2014 | AMcC | 09:40 | 12:00 | 02:20 | 4.44 | 4.80 | 4.95 | 0.51 | H | Partial |
| 13/01/2015 | AMcC | 09:00 | 12:00 | 03:00 | 2.06 | 2.21 | 2.49 | 0.43 | L | Partial |
| 13/01/2015 | AMcC | 12:00 | 15:00 | 03:00 | 2.49 | 3.20 | 3.85 | 1.36 | T | Partial |
| 20/01/2015 | KM | 09:00 | 11:55 | 02:55 | 4.13 | 4.64 | 4.85 | 0.72 | H | Full |
| 20/01/2015 | KM | 11:55 | 14:50 | 02:55 | 2.03 | 3.44 | 4.58 | 2.55 | T | Full |
| 20/02/2015 | NV | 08:30 | 14:30 | 06:00 | 2.85 | 4.40 | 5.14 | 2.29 | H | Full |
| 27/02/2015 | NV | 08:30 | 14:30 | 06:00 | 1.59 | 2.10 | 3.27 | 1.68 | T | Full |
| 11/03/2015 | NV | 08:00 | 14:00 | 06:00 | 1.36 | 2.62 | 4.16 | 2.8 | T | Full |
| 19/03/2015 | NV | 10:00 | 16:00 | 06:00 | 0.47 | 2.73 | 4.57 | 4.1 | T | Full |
| 13/04/2015 | NV | 07:30 | 13:30 | 06:00 | 1.48 | 2.15 | 3.58 | 2.1 | T | Full |
| 20/04/2015 | NV | 07:30 | 13:30 | 06:00 | 1.47 | 3.74 | 4.80 | 3.33 | T | Full |
| 18/05/2015 | NV | 05:15 | 11:15 | 06:00 | 1.07 | 3.23 | 4.94 | 3.87 | T | Full |
| 27/05/2015 | NV | 08:00 | 14:00 | 06:00 | 1.59 | 2.23 | 3.52 | 1.93 | T | Full |
| 05/06/2015 | NV | 06:30 | 12:30 | 06:00 | 1.00 | 2.66 | 4.47 | 3.47 | T | Full |
| 30/06/2015 | NV | 09:15 | 15:15 | 06:00 | 1.42 | 3.18 | 4.29 | 2.87 | T | Full |
| 06/07/2015 | NV | 07:00 | 13:00 | 06:00 | 0.91 | 2.15 | 4.10 | 3.19 | T | Full |
| 15/07/2015 | NV | 09:00 | 15:00 | 06:00 | 1.74 | 3.51 | 4.27 | 2.53 | T | Full |
| 03/08/2015 | NV | 08:00 | 14:00 | 06:00 | 1.26 | 3.51 | 4.84 | 3.58 | T | Full |
| 25/08/2015 | NV | 09:15 | 15:15 | 06:00 | 1.98 | 2.41 | 3.40 | 1.42 | T | Full |
| 02/09/2015 | NV | 07:30 | 13:30 | 06:00 | 0.62 | 2.76 | 4.61 | 3.99 | T | Full |
| 22/09/2015 | NV | 07:30 | 13:30 | 06:00 | 1.84 | 2.26 | 3.22 | 1.38 | T | Full |
| 02/10/2015 | NV | 09:30 | 15:30 | 06:00 | 1.71 | 3.62 | 4.51 | 2.8 | T | Full |
| 21/10/2015 | NV | 08:00 | 14:00 | 06:00 | 2.01 | 2.39 | 3.06 | 1.05 | T | Full |
| 08/11/2015 | NV | 08:00 | 13:48 | 05:48 | 2.20 | 3.66 | 4.39 | 2.19 | T | Full |
| 19/11/2015 | NV | 08:45 | 14:45 | 06:00 | 1.73 | 2.39 | 3.65 | 1.92 | T | Full |
| 08/12/2015 | NV | 09:30 | 15:30 | 06:00 | 1.87 | 3.17 | 4.51 | 2.64 | T | Full |
| 14/12/2015 | NV | 09:30 | 15:30 | 06:00 | 3.05 | 4.32 | 4.95 | 1.9 | H | Full |
| 07/01/2016 | NV | 09:30 | 15:30 | 06:00 | 1.85 | 3.28 | 4.61 | 2.76 | T | Full |
| 21/01/2016 | NV | 09:00 | 15:00 | 06:00 | 1.58 | 3.21 | 4.54 | 2.96 | T | Full |
| 15/02/2016 | NV | 10:00 | 16:00 | 06:00 | 1.11 | 2.52 | 4.14 | 3.03 | T | Full |
| 22/02/2016 | NV | 11:00 | 17:00 | 06:00 | 1.37 | 3.39 | 4.60 | 3.23 | T | Full |
| 10/03/2016 | NV | 10:00 | 16:00 | 06:00 | 1.40 | 3.77 | 4.70 | 3.3 | T | Full |
| 16/03/2016 | NV | 12:00 | 18:00 | 06:00 | 1.47 | 2.84 | 3.89 | 2.42 | T | Full |
| 01/04/2016 | NV | 09:00 | 15:00 | 06:00 | 1.95 | 2.32 | 3.09 | 1.14 | T | Full |
| 18/04/2016 | NV | 08:00 | 14:00 | 06:00 | 1.70 | 3.40 | 4.23 | 2.53 | T | Full |
| 06/05/2016 | NV | 09:00 | 15:00 | 06:00 | 1.31 | 3.75 | 4.82 | 3.51 | T | Full |
| 22/05/2016 | NV | 06:00 | 12:00 | 06:00 | 1.43 | 3.18 | 4.49 | 3.06 | T | Full |

| Date | Surveyor* | Start Time | Finish Time | Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** | Area surveyed |
|---|---|---|---|---|---|---|---|---|---|---|
| 16/03/2017 | NV | 07:00 | 13:00 | 06:00 | 1.07 | 2.62 | 4.44 | 3.37 | T | Full |
| 28/03/2017 | NV | 09:20 | 15:20 | 06:00 | 1.91 | 4.04 | 4.88 | 2.97 | T | Full |
| 12/04/2017 | NV | 11:30 | 17:30 | 06:00 | 1.05 | 3.17 | 4.60 | 3.55 | T | Full |
| 26/04/2017 | NV | 05:38 | 11:38 | 06:00 | 1.12 | 3.37 | 4.68 | 3.56 | T | Full |
| 17/05/2017 | NV | 05:20 | 16:20 | 11:00 | 1.60 | 2.76 | 4.03 | 2.43 | T | Full |
| 18/05/2017 | NV | 11:00 | 17:00 | 06:00 | 1.85 | 3.04 | 3.92 | 2.07 | T | Full |
| 12/06/2017 | NV | 05:10 | 11:10 | 06:00 | 1.37 | 2.15 | 3.68 | 2.31 | T | Full |
| 28/06/2017 | NV | 12:30 | 18:30 | 06:00 | 2.17 | 3.87 | 4.57 | 2.4 | T | Full |
| 13/07/2017 | NV | 12:00 | 18:00 | 06:00 | 2.05 | 3.61 | 4.27 | 2.22 | T | Full |
| 19/07/2017 | NV | 08:00 | 14:00 | 06:00 | 1.46 | 2.51 | 4.21 | 2.75 | T | Full |
| 01/08/2017 | NV | 05:50 | 11:50 | 06:00 | 1.84 | 3.06 | 4.03 | 2.19 | T | Full |
| 21/08/2017 | NV | 06:00 | 12:00 | 06:00 | 1.51 | 3.55 | 4.62 | 3.11 | T | Full |
| 05/09/2017 | NV | 09:10 | 15:10 | 06:00 | 1.88 | 3.69 | 4.52 | 2.64 | T | Full |
| 12/09/2017 | NV | 10:30 | 16:30 | 06:00 | 1.76 | 3.45 | 4.40 | 2.64 | T | Full |
| 12/10/2017 | NV | 10:40 | 16:40 | 06:00 | 1.80 | 3.25 | 4.36 | 2.56 | T | Full |
| 26/10/2017 | NV | 13:00 | 18:00 | 05:00 | 3.21 | 3.85 | 4.15 | 0.94 | H | Full |
| 06/11/2017 | NV | 09:00 | 15:00 | 06:00 | 2.80 | 4.16 | 4.85 | 2.05 | H | Full |
| 20/11/2017 | NV | 08:30 | 14:30 | 06:00 | 2.82 | 4.20 | 4.81 | 1.99 | H | Full |
| 01/12/2017 | NV | 08:20 | 14:20 | 06:00 | 1.24 | 3.07 | 4.16 | 2.92 | T | Full |
| 11/12/2017 | NV | 08:15 | 14:15 | 06:00 | 1.82 | 2.25 | 3.19 | 1.37 | T | Full |
| 11/01/2018 | NV | 08:45 | 14:45 | 06:00 | 1.84 | 2.41 | 3.61 | 1.77 | T | Full |
| 22/01/2018 | NV | 08:50 | 14:50 | 06:00 | 1.54 | 3.22 | 4.47 | 2.93 | T | Full |
| 01/02/2018 | NV | 08:20 | 14:20 | 06:00 | 2.82 | 4.08 | 4.73 | 1.91 | H | Full |
| 27/02/2018 | NV | 07:00 | 13:00 | 06:00 | 2.19 | 3.72 | 4.36 | 2.17 | T | Full |
| 16/03/2018 | NV | 07:00 | 13:00 | 06:00 | 2.63 | 4.04 | 4.67 | 2.04 | T | Full |
| 28/03/2018 | NV | 09:20 | 15:20 | 06:00 | 1.01 | 2.50 | 4.30 | 3.29 | T | Full |

**Notes:**

* Surveyors: AMcC = Adam McClure, KM = Kevin Mawhinney, NV= Nick Veale.

** Tidal state for each survey is designated as follows. Surveys designated as 'high tide' (H) when survey mean tide >= mid height of the tide AND survey min tide >= highest low tide. Surveys designated as 'low tide'(L) when survey mean tide < the mid height of the tide AND survey max tide < lowest high tide. All other surveys are designate 'through the tide' 'T'

**Table A10.1: Estuarine walkover survey effort December 2014 to March 2018**

# APPENDIX 2 – ESTUARINE BIRD SURVEY DATA

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bar-tailed godwit | 2014 | - | - | - | - | - | - | - | - | - | - | - | 6 | 353 | 134 | 275 |
| | 2015 | 20 | 0 | 33 | 0 | 0 | 1 | 16 | 35 | 30 | 117 | **273** | 257 | | | |
| | 2016 | 57 | 99 | 78 | 13 | 1 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 36 | 37 | 0 | 11 | 14 | 34 | 88 | 95 | **276** | 202 | | | |
| | 2018 | 81 | 201 | 36 | **-** | - | - | - | - | - | - | - | - | | | |
| Brent goose (LB) | 2014 | - | - | - | - | - | - | - | - | - | - | - | 475 | 726 | 874 | 816 |
| | 2015 | 543 | 296 | 364 | 403 | 0 | 0 | 0 | 0 | 8 | 174 | 706 | 803 | | | |
| | 2016 | 462 | **991** | 429 | 323 | 1 | - | - | - | - | - | - | - | | | |
| | 2017 | - | **-** | 328 | 270 | 0 | 0 | 0 | 0 | 0 | 231 | 524 | **641** | | | |
| | 2018 | 569 | 481 | 328 | - | - | - | - | - | - | - | - | - | | | |
| Golden plover | 2014 | - | - | - | - | - | - | - | - | - | - | - | 14 | 1810 | 914 | 3061 |
| | 2015 | **2822** | 120 | 447 | 87 | 0 | 0 | 0 | 65 | 0 | 870 | 680 | 750 | | | |
| | 2016 | 0 | 1850 | 950 | 0 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | **-** | 850 | 0 | 0 | 0 | 0 | 550 | 0 | 630 | 1700 | 1850 | | | |
| | 2018 | 950 | **3300** | 850 | - | - | - | - | - | - | - | - | - | | | |
| Grey plover | 2014 | - | - | - | - | - | - | - | - | - | - | - | 7 | 200 | 122 | 487 |
| | 2015 | 17 | 3 | **669** | 0 | 0 | 0 | 0 | 0 | 17 | 31 | 123 | 63 | | | |
| | 2016 | 7 | 77 | **304** | 6 | 0 | - | - | - | - | - | - | - | | | |

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2017 | - | - | 136 | 0 | 0 | 0 | 0 | 0 | 13 | 31 | 113 | 79 | | | |
| | 2018 | 24 | 72 | 136 | - | - | - | - | - | - | - | - | - | | | |
| Ringed plover | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 221 | 96 | 204 |
| | 2015 | 0 | 0 | 0 | 12 | 46 | 25 | 47 | 101 | **234** | 48 | 110 | 138 | | | |
| | 2016 | 10 | 159 | 0 | 31 | 73 | - | - | - | - | - | - | - | | | |
| | 2017 | - | **-** | 7 | 75 | 51 | 42 | 31 | 105 | 33 | 31 | **173** | 95 | | | |
| | 2018 | 25 | 148 | 7 | **-** | - | - | - | - | - | - | - | - | | | |
| Shelduck | 2014 | - | - | - | - | - | - | - | - | - | - | - | 41 | 147 | 290 | 138 |
| | 2015 | **175** | 140 | 127 | 158 | 59 | 26 | 79 | 35 | 25 | 54 | 69 | **101** | | | |
| | 2016 | 86 | 65 | 74 | 72 | 47 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 77 | 85 | 37 | 29 | 55 | 40 | 49 | 45 | 61 | 97 | | | |
| | 2018 | 70 | 71 | 87- | - | - | - | - | - | - | - | - | - | | | |

**Notes:**
- = no survey
*Five year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS) except for light-bellied brent goose (Robinson et al., 2004).
**Five year mean peak for the period 2005/06 – 2009/10 (I-WeBS).
***Two year mean peak based on collected data (underlined and emboldened by species).

**Table A10.2: Estuarine walkover peak monthly population estimates for bird species listed as Special Conservation Interests (SCIs) on Baldoyle Bay SPA citation**

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black-tailed godwit | 2014 | - | - | - | - | - | - | - | - | - | - | - | 33 | 72 | 204 | 166 |
| | 2015 | 74 | 91 | **145** | 8 | 30 | 7 | 33 | 6 | 62 | 52 | 78 | 115 | | | |
| | 2016 | 61 | 77 | 61 | 29 | 16 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 116 | 12 | 34 | 6 | 30 | 10 | 47 | 58 | 121 | 92 | | | |
| | 2018 | 42 | 100 | **187** | - | - | - | - | - | - | - | - | - | | | |
| Curlew | 2014 | - | - | - | - | - | - | - | - | - | - | - | 16 | 61 | 204 | 164 |
| | 2015 | 12 | 28 | 58 | 34 | 36 | 31 | 60 | 58 | **238** | 93 | 125 | 49 | | | |
| | 2016 | 26 | **90** | 40 | 12 | 12 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 35 | 12 | 30 | 17 | 31 | 36 | 78 | 37 | 71 | 45 | | | |
| | 2018 | 21 | 42 | 31 | - | - | - | - | - | - | - | - | - | | | |
| Dunlin | 2014 | - | - | - | - | - | - | - | - | - | - | - | 81 | 879 | 185 | 525 |
| | 2015 | 109 | 393 | 279 | 24 | 166 | 0 | 32 | 98 | 623 | 409 | 472 | **618** | | | |
| | 2016 | 140 | 359 | 244 | 74 | 36 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 197 | 72 | 99 | 0 | 46 | 148 | 120 | 234 | 335 | **431** | | | |
| | 2018 | 72 | 253 | 199 | - | - | - | - | - | - | - | - | - | | | |
| Great crested grebe | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 42 | 29 | 44 |
| | 2015 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 0 | 12 | **55** | 17 | | | |
| | 2016 | 10 | 37 | 9 | 11 | 1 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 30 | 18 | 0 | 0 | 0 | 0 | 12 | 14 | 17 | 10 | | | |
| | 2018 | 11 | **32** | 30 | - | - | - | - | - | - | - | - | - | | | |
| Greenshank | 2014 | - | - | - | - | - | - | - | - | - | - | - | 1 | 11 | 20 | 20 |
| | 2015 | 1 | 1 | **14** | 4 | 0 | 1 | 1 | 7 | 5 | 5 | 5 | 9 | | | |

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 3 | 6 | 9 | 2 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 8 | 3 | 0 | 0 | 2 | 3 | **25** | 6 | 7 | 8 | | | |
| | 2018 | 3 | 6 | 8 | - | - | - | - | - | - | - | - | - | | | |
| Grey heron | 2014 | - | - | - | - | - | - | - | - | - | - | - | 1 | 16 | 16 | 15 |
| | 2015 | 2 | 1 | 4 | 5 | 5 | 6 | 6 | 11 | 11 | 11 | 16 | **17** | | | |
| | 2016 | 10 | 14 | 5 | 8 | 8 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 5 | 7 | 8 | 6 | 6 | 8 | 10 | 10 | **12** | 7 | | | |
| | 2018 | 8 | 9 | 8 | - | - | - | - | - | - | - | - | - | | | |
| Knot | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 115 | 111 | 126 |
| | 2015 | 0 | **102** | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 8 | | | |
| | 2016 | 6 | **150** | 56 | 0 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 32 | 0 | 0 | 0 | 5 | 0 | 0 | 12 | 12 | 8 | | | |
| | 2018 | 0 | 79 | 32 | - | - | - | - | - | - | - | - | - | | | |
| Lapwing | 2014 | - | - | - | - | - | - | - | - | - | - | - | 387 | 450 | 365 | 534 |
| | 2015 | 295 | 236 | 12 | 6 | 7 | 9 | 8 | 9 | 15 | 305 | 446 | 336 | | | |
| | 2016 | **607** | 512 | 71 | 26 | 7 | - | - | - | - | - | - | - | | | |
| | 2017 | **-** | - | 113 | 37 | 6 | 10 | 4 | 23 | 121 | 143 | 231 | 368 | | | |
| | 2018 | 424 | **461** | 256 | - | - | - | - | - | - | - | - | - | | | |
| Mallard | 2014 | - | - | - | - | - | - | - | - | - | - | - | 114 | 46 | 212 | 185 |
| | 2015 | **154** | 146 | 116 | 56 | 56 | 45 | 110 | 96 | **215** | 111 | 103 | 164 | | | |
| | 2016 | 99 | 78 | 75 | 85 | 68 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 108 | 73 | 90 | 68 | 104 | 97 | 100 | 105 | 75 | 110 | | | |

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2018 | 123 | 108 | 108 | - | - | - | - | - | - | - | - | - | | | |
| Oystercatcher | 2014 | - | - | - | - | - | - | - | - | - | - | - | 49 | 531 | 837 | 739 |
| | 2015 | 120 | 218 | **758** | 692 | 242 | 369 | 144 | 168 | **719** | 273 | 361 | 317 | | | |
| | 2016 | 197 | 216 | 320 | 257 | 96 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 181 | 171 | 162 | 95 | 118 | 174 | 217 | 168 | 221 | 305 | | | |
| | 2018 | 108 | 163 | 173 | - | - | - | - | - | - | - | - | - | | | |
| Pintail | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 22 | 26 | 1 |
| | 2015 | **2** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2016 | 0 | 0 | 0 | 0 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2018 | 0 | 0 | 0 | - | - | - | - | - | - | - | - | - | | | |
| Red-breasted merganser | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 14 | 17 | 26 |
| | 2015 | 1 | 1 | 7 | 5 | 0 | 0 | 0 | 10 | 16 | 28 | **30** | 15 | | | |
| | 2016 | 18 | 18 | 12 | 9 | 8 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 12 | **22** | 2 | 0 | 0 | 2 | 5 | 8 | 18 | 8 | | | |
| | 2018 | 12 | 8 | 12 | - | - | - | - | - | - | - | - | - | | | |
| Redshank | 2014 | - | - | - | - | - | - | - | - | - | - | - | 23 | 224 | 314 | 294 |
| | 2015 | 40 | 111 | 126 | 110 | 2 | 17 | 22 | 113 | 167 | 257 | 303 | **334** | | | |
| | 2016 | 111 | 146 | 137 | 61 | 7 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 105 | 54 | 8 | 9 | 67 | 57 | 207 | 87 | 142 | **254** | | | |
| | 2018 | 82 | 100 | 105 | - | - | - | - | - | - | - | - | - | | | |
| Sanderling | 2014 | - | - | - | - | - | - | - | - | - | - | - | 0 | 26 | 21 | 50 |

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA Citation* | Five Year Peak Mean** | Two Year Peak Mean*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 0 | 14 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 11 | 18 | 0 | | | |
| | 2016 | 0 | 16 | **<u>45</u>** | 8 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | 30 | 33 | 0 | 0 | 0 | 0 | 0 | 0 | **<u>55</u>** | 34 | | | |
| | 2018 | 0 | 0 | 30 | - | - | - | - | - | - | - | - | - | | | |
| Teal | 2014 | - | - | - | - | - | - | - | - | - | - | - | 161 | 124 | 238 | 328 |
| | 2015 | 194 | 146 | 192 | 52 | 5 | 11 | 45 | 36 | 198 | 110 | 111 | 248 | | | |
| | 2016 | 172 | **<u>367</u>** | 144 | 46 | 43 | - | - | - | - | - | - | - | | | |
| | 2017 | - | **<u>-</u>** | 96 | 47 | 8 | 6 | 46 | 46 | 46 | 87 | 133 | 156 | | | |
| | 2018 | 111 | **<u>288</u>** | 96 | - | - | - | - | - | - | - | - | - | | | |
| Turnstone | 2014 | - | - | - | - | - | - | - | - | - | - | - | 1 | 43 | 77 | 74 |
| | 2015 | 1 | 2 | 12 | 15 | 0 | 5 | 0 | 11 | 51 | 28 | 40 | **<u>74</u>** | | | |
| | 2016 | 19 | 38 | 62 | 32 | 0 | - | - | - | - | - | - | - | | | |
| | 2017 | - | - | **<u>74</u>** | 30 | 0 | 12 | 8 | 9 | 22 | 30 | 29 | 71 | | | |
| | 2018 | 17 | 28 | 74 | - | - | - | - | - | - | - | - | - | | | |

**Notes:**
- = no survey
*Five year mean peak counts for the period 1995/96 – 1999/00 (I-WeBS) with the exception of light-bellied brent goose (Robinson et al., 2004).
**Five year mean peak for the period 2005/06 – 2009/10 (I-WeBS).
***Two year mean peak based on collected data (underlined and emboldened by species).

**Table A10.3: Estuarine walkover peak monthly population estimates for other bird species (non-SCI) listed on Baldoyle Bay SPA citation**

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black guillemot** | Auks | 2 | 2 | 2 | 4 | 2 | 2 | 2 | 2 | 2 | 4 | 2 | 2 |
| Guillemot*,**** | | 2 | 4 | 0 | 1 | 0 | 2 | 2 | 6 | 1 | 9 | 3 | 20 |
| Razorbill*,**** | | 2 | 2 | 0 | 1 | 6 | 1 | 5 | 2 | 2 | 4 | 2 | 2 |
| Great northern diver | Divers | 3 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 6 | 2 |
| Red-throated diver | | 3 | 3 | 16 | 7 | 1 | 0 | 0 | 0 | 3 | 16 | 9 | 14 |
| Canada goose | Geese and Swans | 73 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 0 | 0 |
| Mute swan | | 6 | 7 | 13 | 5 | 5 | 13 | 13 | 15 | 10 | 9 | 10 | 12 |
| Pink-footed goose | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Black-necked grebe | Grebes, Ducks and Rails | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 | 0 |
| Common scoter | | 85 | 70 | 196 | 75 | 73 | 0 | 0 | 43 | 22 | 51 | 233 | 85 |
| Coot | | 2 | 2 | 0 | 4 | 3 | 1 | 2 | 0 | 1 | 1 | 1 | 0 |
| Eider | | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 |
| Goldeneye | | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Little grebe | | 1 | 1 | 4 | 2 | 1 | 5 | 4 | 4 | 1 | 2 | 2 | 1 |
| Long-tailed duck | | 4 | 3 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Moorhen | | 8 | 8 | 10 | 12 | 7 | 6 | 4 | 4 | 8 | 9 | 6 | 6 |
| Shoveler | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 2 |
| Tufted duck | | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 |
| Wigeon | | 138 | 166 | 67 | 25 | 0 | 4 | 0 | 16 | 16 | 124 | 228 | 257 |
| Black-headed gull | Gulls | 112 | 203 | 93 | 110 | 68 | 66 | 80 | 155 | 404 | 332 | 306 | 224 |
| Common gull | | 58 | 84 | 26 | 53 | 34 | 10 | 10 | 9 | 28 | 34 | 53 | 54 |
| Great black-backed gull** | | 6 | 27 | 24 | 26 | 27 | 32 | 28 | 14 | 69 | 27 | 10 | 18 |
| Herring gull* | | 84 | 181 | 111 | 131 | 154 | 292 | 167 | 114 | 331 | 216 | 190 | 95 |

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kittiwake*,*** | | 2 | 1 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| Lesser black-backed gull | | 12 | 3 | 24 | 29 | 26 | 46 | 42 | 25 | 17 | 13 | 23 | 2 |
| Mediterranean gull | | 0 | 2 | 0 | 0 | 0 | 0 | 4 | 3 | 4 | 1 | 2 | 0 |
| Ring-billed gull | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Blue tit | Other | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Fulmar | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Hooded crow | | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kingfisher | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Mistle thrush | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Little egret | | 8 | 7 | 11 | 11 | 12 | 9 | 9 | 9 | 20 | 13 | 13 | 10 |
| Pheasant | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Red-legged partridge | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Snow bunting | | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Song thrush | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Stonechat | | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wheatear | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Buzzard | Raptors | 1 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 0 | 1 | 1 | 1 |
| Kestrel | | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 1 | 0 | 0 | 0 |
| Peregrine**,**** | | 1 | 2 | 0 | 2 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| Sparrowhawk | | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Cormorant* | Shags and Cormorants | 17 | 20 | 10 | 28 | 14 | 27 | 24 | 20 | 16 | 42 | 39 | 34 |
| Shag** | | 3 | 8 | 6 | 7 | 6 | 5 | 7 | 7 | 10 | 11 | 10 | 2 |
| Arctic tern | Terns | 0 | 0 | 0 | 2 | 3 | 5 | 3 | 0 | 0 | 0 | 0 | 0 |

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black tern | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 |
| Common tern | | 0 | 0 | 0 | 14 | 9 | 12 | 29 | 34 | 0 | 0 | 0 | 0 |
| Roseate tern | | 0 | 0 | 0 | 0 | 1 | 2 | 4 | 11 | 7 | 0 | 0 | 0 |
| Sandwich tern | | 0 | 0 | 4 | 9 | 15 | 5 | 15 | 10 | 42 | 0 | 0 | 0 |
| Avocet | Waders | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Common sandpiper | | 2 | 1 | 0 | 3 | 1 | 0 | 3 | 2 | 3 | 2 | 1 | 0 |
| Snipe | | 7 | 35 | 5 | 6 | 1 | 0 | 0 | 2 | 4 | 5 | 3 | 6 |
| Curlew sandpiper | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 0 |
| Green sandpiper | | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Purple sandpiper | | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Ruff | | 0 | 1 | 0 | 0 | 0 | 0 | 4 | 7 | 8 | 2 | 0 | 0 |
| Little stint | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 |
| Whimbrel | | 0 | 0 | 62 | 53 | 76 | 3 | 5 | 5 | 4 | 5 | 6 | 0 |

**Notes:**
* SCI of Ireland's Eye SPA.
** Named bird species of Ireland's Eye SPA.
*** SCI of Howth Head Coast SPA.
**** Named bird species of Howth Head Coast SPA.

**Table A10.4: Estuarine walkover peak monthly population estimates for bird species not listed on Baldoyle Bay SPA citation**

# APPENDIX 3 – MARINE VP SURVEY EFFORT

| Date | VP ID | Surveyor* | Start Time | Finish Time | Survey Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** |
|---|---|---|---|---|---|---|---|---|---|---|
| 19/12/2014 | 2 | AMcC | 10:15 | 13:15 | 03:00 | 2.21 | 3.17 | 4.00 | 1.79 | T |
| 22/12/2014 | 1 | AMcC | 12:25 | 15:25 | 03:00 | 1.90 | 3.30 | 4.55 | 2.65 | T |
| 08/01/2015 | 2 | AMcC | 09:10 | 12:25 | 03:15 | 2.48 | 3.59 | 4.44 | 1.96 | H |
| 12/01/2015 | 1 | AMcC | 10:00 | 13:00 | 03:00 | 2.48 | 3.04 | 3.69 | 1.21 | H |
| 19/01/2015 | 1 | AMcC | 08:45 | 11:45 | 03:00 | 4.12 | 4.41 | 4.56 | 0.44 | H |
| 19/01/2015 | 2 | AMcC | 12:55 | 15:55 | 03:00 | 1.10 | 1.89 | 3.08 | 1.98 | L |
| 18/02/2015 | 2 | KM | 08:30 | 11:30 | 03:00 | 3.92 | 4.51 | 4.76 | 0.84 | H |
| 18/02/2015 | 1 | KM | 13:30 | 16:30 | 03:00 | 0.72 | 1.56 | 2.96 | 2.24 | L |
| 25/02/2015 | 2 | KM | 08:30 | 11:30 | 03:00 | 1.24 | 1.41 | 1.76 | 0.52 | L |
| 25/02/2015 | 1 | KM | 13:30 | 16:30 | 03:00 | 2.99 | 3.74 | 4.20 | 1.21 | H |
| 05/03/2015 | 2 | NV | 09:00 | 12:00 | 03:00 | 3.42 | 4.11 | 4.42 | 1 | H |
| 05/03/2015 | 1 | NV | 14:00 | 17:00 | 03:00 | 0.95 | 1.84 | 3.14 | 2.19 | L |
| 23/03/2015 | 2 | NV | 09:00 | 12:00 | 03:00 | 2.04 | 3.45 | 4.57 | 2.53 | T |
| 23/03/2015 | 1 | NV | 14:00 | 17:00 | 03:00 | 2.01 | 3.63 | 4.81 | 2.8 | T |
| 02/04/2015 | 2 | NV | 08:30 | 11:30 | 03:00 | 3.65 | 4.09 | 4.28 | 0.63 | H |
| 02/04/2015 | 1 | NV | 13:30 | 16:30 | 03:00 | 1.10 | 1.64 | 2.65 | 1.55 | L |
| 08/04/2015 | 2 | NV | 08:00 | 11:00 | 03:00 | 1.15 | 2.09 | 3.16 | 2.01 | L |
| 08/04/2015 | 1 | NV | 13:00 | 16:00 | 03:00 | 3.23 | 3.95 | 4.23 | 1 | H |
| 19/05/2015 | 1 | NV | 05:30 | 08:30 | 03:00 | 0.83 | 1.55 | 2.73 | 1.9 | L |
| 19/05/2015 | 2 | NV | 10:00 | 13:00 | 03:00 | 3.92 | 4.47 | 4.70 | 0.78 | H |
| 28/05/2015 | 2 | NV | 09:00 | 12:00 | 03:00 | 1.95 | 2.78 | 3.59 | 1.64 | L |
| 28/05/2015 | 1 | NV | 14:00 | 17:00 | 03:00 | 1.64 | 2.18 | 2.88 | 1.24 | L |
| 16/06/2015 | 2 | NV | 10:00 | 13:00 | 03:00 | 3.70 | 4.26 | 4.48 | 0.78 | H |
| 16/06/2015 | 1 | NV | 15:00 | 18:00 | 03:00 | 0.98 | 1.22 | 1.82 | 0.84 | L |
| 29/06/2015 | 2 | NV | 08:00 | 11:00 | 03:00 | 3.59 | 3.93 | 4.09 | 0.5 | H |
| 29/06/2015 | 1 | NV | 13:00 | 16:00 | 03:00 | 1.38 | 1.63 | 2.24 | 0.86 | L |
| 07/07/2015 | 1 | NV | 07:00 | 10:00 | 03:00 | 1.06 | 1.29 | 1.83 | 0.77 | L |
| 07/07/2015 | 2 | NV | 12:00 | 15:00 | 03:00 | 2.85 | 3.78 | 4.46 | 1.61 | H |
| 13/07/2015 | 1 | NV | 07:30 | 10:30 | 03:00 | 3.83 | 4.23 | 4.40 | 0.57 | H |
| 13/07/2015 | 2 | NV | 12:30 | 15:30 | 03:00 | 1.48 | 1.90 | 2.77 | 1.29 | L |
| 04/08/2015 | 2 | NV | 08:00 | 11:00 | 03:00 | 1.08 | 2.03 | 3.21 | 2.13 | L |
| 04/08/2015 | 1 | NV | 13:00 | 16:00 | 03:00 | 3.98 | 4.56 | 4.79 | 0.81 | H |
| 24/08/2015 | 2 | NV | 07:00 | 10:00 | 03:00 | 2.36 | 3.14 | 3.83 | 1.47 | H |
| 24/08/2015 | 1 | NV | 12:15 | 15:15 | 03:00 | 2.02 | 2.48 | 3.09 | 1.07 | L |
| 09/09/2015 | 1 | NV | 07:00 | 10:00 | 03:00 | 3.42 | 3.82 | 3.99 | 0.57 | H |
| 09/09/2015 | 2 | NV | 14:45 | 17:45 | 03:00 | 1.66 | 2.09 | 2.77 | 1.11 | L |
| 30/09/2015 | 1 | NV | 07:15 | 10:15 | 03:00 | 0.92 | 2.27 | 3.61 | 2.69 | L |
| 30/09/2015 | 2 | NV | 11:10 | 14:10 | 03:00 | 4.10 | 4.50 | 4.70 | 0.6 | H |

| Date | VP ID | Surveyor* | Start Time | Finish Time | Survey Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** |
|---|---|---|---|---|---|---|---|---|---|---|
| 01/10/2015 | 1 | NV | 08:00 | 11:00 | 03:00 | 1.02 | 2.32 | 3.59 | 2.57 | L |
| 01/10/2015 | 2 | NV | 13:00 | 16:00 | 03:00 | 4.00 | 4.44 | 4.63 | 0.63 | H |
| 22/10/2015 | 2 | NV | 11:45 | 14:45 | 03:00 | 2.04 | 2.33 | 2.83 | 0.79 | L |
| 22/10/2015 | 1 | NV | 15:30 | 18:30 | 03:00 | 3.20 | 3.77 | 4.16 | 0.96 | H |
| 05/11/2015 | 2 | NV | 08:00 | 11:00 | 03:00 | 2.65 | 3.28 | 3.88 | 1.23 | H |
| 06/11/2015 | 1 | NV | 12:10 | 15:10 | 03:00 | 2.26 | 2.41 | 2.66 | 0.4 | L |
| 23/11/2015 | 1 | NV | 07:45 | 10:45 | 03:00 | 3.84 | 4.29 | 4.47 | 0.63 | H |
| 23/11/2015 | 2 | NV | 11:30 | 14:30 | 03:00 | 1.26 | 2.01 | 3.19 | 1.93 | L |
| 03/12/2015 | 1 | NV | 09:00 | 12:00 | 03:00 | 2.06 | 2.19 | 2.45 | 0.39 | L |
| 04/12/2015 | 2 | NV | 10:00 | 13:00 | 03:00 | 2.23 | 2.33 | 2.53 | 0.3 | L |
| 09/12/2015 | 1 | NV | 10:30 | 13:30 | 03:00 | 2.76 | 3.79 | 4.46 | 1.7 | H |
| 10/12/2015 | 2 | NV | 09:30 | 12:30 | 03:00 | 3.83 | 4.31 | 4.50 | 0.67 | H |
| 15/12/2015 | 1 | NV | 09:00 | 12:00 | 03:00 | 2.03 | 3.17 | 4.22 | 2.19 | T |
| 16/12/2015 | 2 | NV | 09:30 | 12:30 | 03:00 | 1.99 | 3.02 | 4.06 | 2.07 | T |
| 06/01/2016 | 1 | NV | 09:00 | 12:00 | 03:00 | 3.01 | 3.77 | 4.24 | 1.23 | H |
| 08/01/2016 | 2 | NV | 10:00 | 13:00 | 03:00 | 3.35 | 4.28 | 4.73 | 1.38 | H |
| 19/01/2016 | 1 | NV | 09:00 | 12:00 | 03:00 | 1.79 | 2.68 | 3.66 | 1.87 | L |
| 23/01/2016 | 2 | NV | 10:00 | 13:00 | 03:00 | 3.77 | 4.39 | 4.65 | 0.88 | H |
| 06/02/2016 | 1 | NV | 13:45 | 16:45 | 03:00 | 1.78 | 2.05 | 2.64 | 0.86 | L |
| 10/02/2016 | 2 | NV | 12:30 | 15:30 | 03:00 | 2.87 | 4.22 | 4.93 | 2.06 | H |
| 17/02/2016 | 2 | NV | 11:00 | 14:00 | 03:00 | 1.54 | 1.71 | 2.07 | 0.53 | L |
| 18/02/2016 | 1 | NV | 10:30 | 13:30 | 03:00 | 1.56 | 2.30 | 3.27 | 1.71 | L |
| 08/03/2016 | 1 | NV | 09:00 | 12:00 | 03:00 | 4.24 | 4.68 | 4.87 | 0.63 | H |
| 15/03/2016 | 2 | NV | 14:30 | 17:30 | 03:00 | 3.48 | 3.95 | 4.14 | 0.66 | H |
| 18/03/2016 | 1 | NV | 12:00 | 15:00 | 03:00 | 1.40 | 1.56 | 1.99 | 0.59 | L |
| 21/03/2016 | 2 | NV | 14:30 | 17:30 | 03:00 | 1.04 | 1.26 | 1.82 | 0.78 | L |
| 04/04/2016 | 1 | NV | 08:00 | 11:00 | 03:00 | 3.55 | 4.19 | 4.43 | 0.88 | H |
| 04/04/2016 | 2 | NV | 13:30 | 16:30 | 03:00 | 1.38 | 1.55 | 1.90 | 0.52 | L |
| 12/04/2016 | 2 | NV | 12:00 | 15:00 | 03:00 | 3.01 | 3.93 | 4.55 | 1.54 | H |
| 17/04/2016 | 1 | NV | 07:30 | 10:30 | 03:00 | 3.49 | 3.97 | 4.14 | 0.65 | H |
| 04/05/2016 | 2 | NV | 13:00 | 16:00 | 03:00 | 1.03 | 1.29 | 1.96 | 0.93 | L |
| 09/05/2016 | 1 | NV | 06:30 | 09:30 | 03:00 | 0.78 | 1.55 | 2.79 | 2.01 | L |
| 25/05/2016 | 1 | NV | 15:00 | 18:00 | 03:00 | 1.67 | 2.81 | 3.91 | 2.24 | T |
| 26/05/2016 | 2 | NV | 14:30 | 17:30 | 03:00 | 2.58 | 3.57 | 4.19 | 1.61 | H |
| 14/06/2016 | 1 | NV | 06:30 | 09:30 | 03:00 | 3.15 | 3.79 | 4.08 | 0.93 | H |
| 14/06/2016 | 2 | NV | 12:30 | 15:30 | 03:00 | 1.70 | 1.97 | 2.50 | 0.8 | L |
| 30/06/2016 | 1 | NV | 05:00 | 08:00 | 03:00 | 3.69 | 4.21 | 4.43 | 0.74 | H |
| 30/06/2016 | 2 | NV | 08:45 | 11:45 | 03:00 | 1.79 | 2.87 | 3.95 | 2.16 | T |
| 08/07/2016 | 2 | NV | 14:00 | 17:00 | 03:00 | 2.86 | 3.88 | 4.39 | 1.53 | H |
| 12/07/2016 | 2 | NV | 11:15 | 14:15 | 03:00 | 1.61 | 2.11 | 2.79 | 1.18 | L |
| 17/07/2016 | 2 | NV | 12:30 | 15:30 | 03:00 | 1.46 | 2.02 | 2.92 | 1.46 | L |
| 22/07/2016 | 2 | NV | 11:00 | 14:00 | 03:00 | 3.76 | 4.27 | 4.48 | 0.72 | H |
| 15/03/2017 | 1 | NV | 06:40 | 09:40 | 03:00 | 0.84 | 1.53 | 2.61 | 1.77 | L |

| Date | VP ID | Surveyor* | Start Time | Finish Time | Survey Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** |
|---|---|---|---|---|---|---|---|---|---|---|
| 15/03/2017 | 2 | NV | 12:00 | 15:00 | 03:00 | 3.87 | 4.34 | 4.53 | 0.66 | H |
| 29/03/2017 | 2 | NV | 06:40 | 09:40 | 03:00 | 1.19 | 2.48 | 3.80 | 2.61 | T |
| 29/03/2017 | 1 | NV | 12:00 | 15:00 | 03:00 | 3.00 | 4.31 | 5.02 | 2.02 | H |
| 20/04/2017 | 1 | NV | 06:45 | 09:45 | 03:00 | 2.21 | 2.93 | 3.56 | 1.35 | T |
| 20/04/2017 | 2 | NV | 11:00 | 14:00 | 03:00 | 1.66 | 1.80 | 2.12 | 0.46 | L |
| 27/04/2017 | 1 | NV | 06:15 | 09:15 | 03:00 | 0.99 | 2.31 | 3.69 | 2.7 | L |
| 27/04/2017 | 2 | NV | 12:55 | 15:55 | 03:00 | 1.40 | 3.00 | 4.45 | 3.05 | T |
| 08/05/2017 | 1 | NV | 05:40 | 08:40 | 03:00 | 2.21 | 3.30 | 3.96 | 1.75 | T |
| 08/05/2017 | 2 | NV | 12:40 | 15:40 | 03:00 | 1.06 | 1.84 | 2.97 | 1.91 | L |
| 17/05/2017 | 1 | NV | 11:20 | 14:20 | 03:00 | 2.67 | 3.23 | 3.75 | 1.08 | H |
| 17/05/2017 | 2 | NV | 15:20 | 18:20 | 03:00 | 3.19 | 3.77 | 4.03 | 0.84 | H |
| 12/06/2017 | 2 | NV | 12:40 | 15:40 | 03:00 | 3.19 | 3.96 | 4.30 | 1.11 | H |
| 12/06/2017 | 1 | NV | 16:30 | 19:30 | 03:00 | 1.29 | 1.63 | 2.43 | 1.14 | L |
| 27/06/2017 | 2 | NV | 08:15 | 11:15 | 03:00 | 1.15 | 2.30 | 3.51 | 2.36 | L |
| 27/06/2017 | 1 | NV | 12:05 | 15:02 | 02:57 | 4.12 | 4.56 | 4.76 | 0.64 | H |
| 20/07/2017 | 2 | NV | 07:45 | 10:45 | 03:00 | 3.26 | 4.00 | 4.34 | 1.08 | H |
| 20/07/2017 | 1 | NV | 11:30 | 14:30 | 03:00 | 1.29 | 1.75 | 2.63 | 1.34 | L |
| 27/07/2017 | 1 | NV | 07:30 | 10:30 | 03:00 | 0.92 | 1.48 | 2.50 | 1.58 | L |
| 27/07/2017 | 2 | NV | 11:30 | 14:30 | 03:00 | 3.30 | 4.16 | 4.64 | 1.34 | H |
| 17/08/2017 | 1 | NV | 08:50 | 11:50 | 03:00 | 1.81 | 2.63 | 3.57 | 1.77 | T |
| 17/08/2017 | 2 | NV | 12:35 | 15:35 | 03:00 | 1.66 | 1.98 | 2.56 | 0.91 | L |
| 29/08/2017 | 2 | NV | 10:05 | 13:05 | 03:00 | 1.72 | 2.05 | 2.62 | 0.91 | L |
| 29/08/2017 | 1 | NV | 13:45 | 16:45 | 03:00 | 3.00 | 3.57 | 3.94 | 0.95 | H |
| 06/09/2017 | 2 | NV | 08:40 | 11:40 | 03:00 | 3.25 | 4.00 | 4.42 | 1.18 | H |
| 06/09/2017 | 1 | NV | 12:20 | 15:20 | 03:00 | 1.94 | 3.19 | 4.23 | 2.3 | T |
| 21/09/2017 | 1 | NV | 12:15 | 15:15 | 03:00 | 2.52 | 3.80 | 4.63 | 2.12 | T |
| 21/09/2017 | 2 | NV | 15:45 | 18:45 | 03:00 | 1.02 | 1.26 | 1.90 | 0.89 | L |
| 25/10/2017 | 2 | NV | 12:40 | 15:40 | 03:00 | 3.81 | 4.14 | 4.27 | 0.47 | H |
| 25/10/2017 | 1 | NV | 16:05 | 19:05 | 03:00 | 2.10 | 3.03 | 3.93 | 1.84 | T |
| 31/10/2017 | 1 | NV | 07:00 | 10:00 | 03:00 | 3.64 | 3.89 | 4.03 | 0.4 | H |
| 31/10/2017 | 2 | NV | 13:45 | 16:45 | 03:00 | 1.85 | 2.12 | 2.69 | 0.85 | L |
| 27/11/2017 | 1 | NV | 08:15 | 11:15 | 03:00 | 2.04 | 2.46 | 3.10 | 1.07 | T |
| 29/11/2017 | 1 | NV | 13:05 | 16:05 | 03:00 | 1.67 | 1.98 | 2.56 | 0.9 | L |
| 30/11/2017 | 2 | NV | 12:50 | 15:50 | 03:00 | 1.49 | 1.62 | 1.94 | 0.46 | L |
| 04/12/2017 | 1 | NV | 08:25 | 11:25 | 03:00 | 3.18 | 4.13 | 4.71 | 1.54 | H |
| 18/12/2017 | 2 | NV | 13:00 | 16:00 | 03:00 | 1.66 | 2.81 | 3.97 | 2.32 | T |
| 28/12/2017 | 1 | NV | 08:20 | 11:20 | 03:00 | 2.13 | 2.88 | 3.68 | 1.56 | T |
| 28/12/2017 | 2 | NV | 12:20 | 15:20 | 03:00 | 1.84 | 2.16 | 2.76 | 0.93 | T |
| 10/01/2018 | 1 | NV | 08:20 | 11:20 | 03:00 | 2.04 | 2.68 | 3.52 | 1.49 | T |
| 10/01/2018 | 2 | NV | 11:55 | 14:55 | 03:00 | 1.94 | 2.29 | 2.85 | 0.92 | T |
| 24/01/2018 | 2 | NV | 08:30 | 11:30 | 03:00 | 2.18 | 2.37 | 2.78 | 0.61 | T |
| 24/01/2018 | 1 | NV | 12:05 | 15:05 | 03:00 | 3.15 | 3.86 | 4.48 | 1.34 | H |
| 05/02/2018 | 1 | NV | 09:15 | 12:15 | 03:00 | 1.23 | 2.25 | 3.35 | 2.13 | T |

| Date | VP ID | Surveyor* | Start Time | Finish Time | Survey Effort | Minimum Tide (m) | Mean Tide (m) | Maximum Tide (m) | Survey Tidal Range (m) | Survey Tidal State** |
|---|---|---|---|---|---|---|---|---|---|---|
| 05/02/2018 | 2 | NV | 13:00 | 16:00 | 03:00 | 3.86 | 4.33 | 4.52 | 0.67 | H |
| 22/02/2018 | 1 | NV | 07:30 | 10:30 | 03:00 | 1.28 | 1.44 | 1.80 | 0.53 | L |
| 22/02/2018 | 2 | NV | 11:20 | 14:20 | 03:00 | 2.17 | 3.12 | 3.96 | 1.8 | T |
| 15/03/2018 | 1 | NV | 06:40 | 09:40 | 03:00 | 3.00 | 3.95 | 4.69 | 1.7 | H |
| 15/03/2018 | 2 | NV | 12:00 | 15:00 | 03:00 | 1.98 | 3.15 | 4.32 | 2.35 | T |
| 29/03/2018 | 2 | NV | 06:40 | 09:40 | 03:00 | 3.07 | 3.95 | 4.56 | 1.5 | H |
| 29/03/2018 | 1 | NV | 12:00 | 15:00 | 03:00 | 1.05 | 2.21 | 3.60 | 2.56 | T |

**Notes:**

* Surveyors: AMcC = Adam McClure, KM = Kevin Mawhinney, NV= Nick Veale.

** Tidal state for each survey is designated as follows. Surveys designated as 'high tide' (H) when survey mean tide >= mid height of the tide AND survey min tide >= highest low tide. Surveys designated as 'low tide'(L) when survey mean tide < the mid height of the tide AND survey max tide < lowest high tide. All other surveys are designate 'through the tide' 'T'

**Table A10.5: Coastal and marine VP survey effort December 2014 to March 2018**

# APPENDIX 4 – MARINE VP RECORDS

| Species | Ireland's Eye SPA | Howth Head Coast SPA | Number of Surveys Species Present (74 Surveys Total) | Total Number of Individuals Encountered on Sea During VP Surveys | Total Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|---|---|
| Guillemot | SCI | Yes | 60 | 1084 | 750 | 216 | 364 | 465 | March |
| Razorbill | SCI | Yes | 62 | 1557 | 771 | 388 | 188 | 453 | March |
| Guillemot or razorbill | SCI | Yes | 39 | 1089 | 218 | 400 | 33 | 424 | October |
| Kittiwake | SCI | SCI | 60 | 1207 | 1000 | 145 | 186 | 310 | October |
| Herring gull | SCI | No | 75 | 3709 | 1932 | 177 | 119 | 239 | February |
| Fulmar | Yes | Yes | 55 | 336 | 741 | 76 | 83 | 159 | December |
| Great black-backed gull | Yes | No | 74 | 746 | 746 | 61 | 43 | 97 | February |
| Cormorant | SCI | No | 73 | 476 | 472 | 47 | 34 | 69 | January |
| Gannet | Yes | No | 48 | 277 | 354 | 19 | 42 | 60 | February |
| Shag | Yes | No | 71 | 783 | 365 | 41 | 12 | 47 | September |
| Cormorant or shag | Yes | No | 3 | 31 | 3 | 29 | 3 | 29 | October |
| Black guillemot | Yes | No | 59 | 208 | 96 | 22 | 6 | 22 | October |
| Peregrine | Yes | Yes | 15 | 0 | 24 | 0 | 4 | 4 | October |
| Puffin | Yes | No | 4 | 2 | 4 | 1 | 2 | 2 | March |

**Table A10.6: Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (species named in Ireland's Eye and/or Howth Head Coast SPA citations), sorted by peak VP count**

| Species | Baldoyle Bay SPA Citation Status | Number of Surveys Species Present (74 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|---|
| Great crested grebe | Yes | 46 | 1846 | 32 | 253 | 3 | 255 | March |
| Oystercatcher | Yes | 63 | 1383 | 912 | 187 | 109 | 210 | January |
| Sanderling | Yes | 17 | 453 | 230 | 82 | 51 | 105 | December |
| Dunlin | Yes | 9 | 146 | 235 | 80 | 100 | 100 | January |
| Red-breasted merganser | Yes | 39 | 456 | 99 | 72 | 18 | 90 | March |
| Turnstone | Yes | 16 | 203 | 70 | 33 | 19 | 44 | March |
| Brent goose (LB) | SCI | 39 | 107 | 569 | 39 | 39 | 39 | February |
| Redshank | Yes | 5 | 84 | 4 | 36 | 4 | 36 | January |
| Ringed plover | SCI | 5 | 0 | 89 | 0 | 21 | 21 | March |
| Curlew | Yes | 18 | 49 | 61 | 13 | 11 | 16 | November |
| Lapwing | Yes | 1 | 0 | 15 | 0 | 15 | 15 | February |
| Bar-tailed godwit | SCI | 3 | 27 | 0 | 14 | 0 | 14 | October |
| Black-tailed godwit | Yes | 1 | 0 | 12 | 0 | 12 | 12 | November |
| Shelduck | SCI | 3 | 9 | 8 | 9 | 4 | 9 | November |
| Grey heron | Yes* | 10 | 2 | 14 | 1 | 6 | 7 | December |
| Mallard | Yes | 1 | 0 | 2 | 0 | 2 | 2 | February |

**Notes**

*Listed as 'other important species' of Baldoyle Bay SPA.

**Table A10.7: Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (species named in Baldoyle Bay SPA citation), sorted by peak VP count**

| Species | Number of Surveys Species Present (74 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|
| Common scoter | 64 | 5616 | 696 | 443 | 53 | 478 | January |
| Black-headed gull | 55 | 1759 | 753 | 121 | 102 | 223 | October |
| Canada goose | 2 | 204 | 3 | 203 | 3 | 203 | January |
| Red-throated diver | 63 | 617 | 73 | 112 | 5 | 112 | March |
| Sandwich tern | 8 | 77 | 89 | 37 | 23 | 58 | September |
| Pink-footed goose | 1 | 0 | 49 | 0 | 49 | 49 | March |
| Whimbrel | 4 | 3 | 80 | 3 | 38 | 38 | March |
| Manx shearwater | 1 | 0 | 35 | 0 | 35 | 35 | September |
| Bar-tailed godwit | 5 | 71 | 0 | 25 | 0 | 25 | October |
| Lesser black-backed gull | 28 | 97 | 33 | 18 | 7 | 25 | November |
| Common gull | 36 | 135 | 66 | 22 | 7 | 23 | November |
| Common or Arctic tern | 1 | 0 | 23 | 0 | 23 | 23 | September |
| Swallow | 2 | 0 | 36 | 0 | 18 | 18 | March |
| Goldcrest | 1 | 11 | 0 | 11 | 0 | 11 | March |
| Great northern diver | 37 | 85 | 9 | 8 | 2 | 9 | December |
| Black-throated diver | 6 | 11 | 0 | 5 | 0 | 5 | February |
| Common tern | 1 | 2 | 3 | 2 | 3 | 5 | September |
| Common eider | 1 | 4 | 0 | 4 | 0 | 4 | December |
| Little grebe | 2 | 0 | 8 | 0 | 4 | 4 | March |
| Long-tailed duck | 5 | 12 | 0 | 4 | 0 | 4 | January |
| Purple sandpiper | 2 | 0 | 8 | 0 | 4 | 4 | March |
| Mediterranean gull | 4 | 5 | 2 | 2 | 1 | 2 | September |
| Blackbird | 1 | 0 | 2 | 0 | 2 | 2 | November |
| Ring-billed gull | 1 | 2 | 0 | 2 | 0 | 2 | March |
| Slavonian grebe | 1 | 2 | 0 | 2 | 0 | 2 | March |
| Arctic skua | 1 | 0 | 1 | 0 | 1 | 1 | September |
| Black-necked grebe | 1 | 1 | 0 | 1 | 0 | 1 | March |

**Table A10.8: Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (non-SPA species), sorted by peak VP count**

| Species | Number of Surveys Species Present (74 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|
| Unidentified gull | 3 | 205 | 0 | 142 | 0 | 142 | January |
| Unidentified wader | 4 | 28 | 0 | 24 | 0 | 31 | November |

**Table A10.9: Number of partially identified bird encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season, sorted by peak VP count**

| Species | Ireland's Eye SPA | Howth Head Coast SPA | Number of Surveys Species Present (56 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|---|---|
| Guillemot | SCI | Yes | 51 | 7882 | 4541 | 1051 | 462 | 1513 | June |
| Razorbill | SCI | Yes | 55 | 6683 | 3571 | 705 | 333 | 1038 | May |
| Kittiwake | SCI | SCI | 56 | 2988 | 1773 | 477 | 87 | 557 | May |
| Guillemot or razorbill | Yes | Yes | 38 | 795 | 534 | 184 | 161 | 244 | July |
| Gannet | Yes | No | 54 | 1055 | 1268 | 143 | 133 | 225 | June |
| Herring Gull | SCI | No | 56 | 3070 | 1889 | 129 | 86 | 185 | June |
| Puffin | Yes | No | 33 | 740 | 322 | 151 | 55 | 173 | June |
| Shag | Yes | No | 56 | 1208 | 1075 | 60 | 84 | 129 | July |
| Great Black-backed Gull | Yes | No | 56 | 692 | 905 | 32 | 66 | 87 | June |
| Cormorant | SCI | No | 56 | 501 | 791 | 37 | 49 | 63 | June |
| Fulmar | Yes | Yes | 51 | 197 | 516 | 23 | 40 | 63 | May |
| Black Guillemot | Yes | No | 51 | 204 | 114 | 10 | 6 | 14 | June |
| Peregrine | Yes | Yes | 18 | 0 | 18 | 0 | 2 | 2 | May, July |
| Cormorant or shag | Yes | No | 4 | 3 | 1 | 1 | 1 | 1 | May, July, August |

**Table A10.10: Frequency and number of species encounters from VP surveys during breeding season (species named in Ireland's Eye/Howth Head Coast SPA citations), sorted by peak VP count**

| Species | Baldoyle Bay SPA Citation Status | Number of Surveys Species Present (56 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|---|
| Oystercatcher | Yes | 49 | 805 | 357 | 128 | 38 | 145 | May |
| Ringed Plover | SCI | 9 | 136 | 73 | 38 | 32 | 70 | June |
| Red-breasted Merganser | Yes | 15 | 117 | 22 | 37 | 7 | 44 | August |
| Dunlin | Yes | 4 | 80 | 37 | 40 | 26 | 40 | June |
| Black-tailed Godwit | Yes | 1 | 0 | 37 | 0 | 37 | 37 | July |
| Curlew | Yes | 9 | 21 | 20 | 7 | 10 | 16 | August |
| Redshank | Yes | 2 | 7 | 16 | 7 | 16 | 16 | April |
| Great Crested Grebe | Yes | 7 | 55 | 5 | 14 | 2 | 15 | April |
| Shelduck | SCI | 19 | 13 | 69 | 4 | 14 | 14 | July |
| Brent Goose (light-bellied) | SCI | 3 | 0 | 30 | 0 | 24 | 13 | April |
| Turnstone | Yes | 4 | 8 | 28 | 8 | 12 | 12 | July |
| Bar-tailed Godwit | Yes | 1 | 1 | 0 | 1 | 0 | 1 | May |
| Grey Heron | Yes* | 8 | 1 | 6 | 1 | 1 | 1 | April, May, June, July, August |

**Notes**

*Listed as 'other important species' of Baldoyle Bay SPA.

**Table A10.11: Frequency and number of species encounters from VP surveys during breeding season (species named in Baldoyle Bay SPA citation), sorted by peak VP count**

| Species | Number of Surveys Species Present (56 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|
| Black-headed gull | 42 | 757 | 501 | 96 | 60 | 156 | August |
| Manx shearwater | 29 | 318 | 637 | 53 | 100 | 128 | August |
| Common scoter | 16 | 445 | 57 | 119 | 18 | 124 | August |
| Common tern | 23 | 123 | 435 | 17 | 94 | 109 | August |
| Red-throated diver | 13 | 122 | 13 | 52 | 3 | 52 | April |
| Common gull | 42 | 176 | 113 | 38 | 10 | 40 | June |

| Species | Number of Surveys Species Present (56 Surveys Total) | Number of Individuals Encountered on Sea During VP Surveys | Number of Individuals Encountered in Flight During VP Surveys | Peak VP Count (Birds on Sea in a Single Survey) | Peak VP Count (Birds in Flight in a Single Survey) | Peak VP Count (All Birds in a Single Survey) | Peak VP Month |
|---|---|---|---|---|---|---|---|
| Sandwich tern | 49 | 295 | 455 | 19 | 32 | 37 | May |
| Common or Arctic tern | 26 | 84 | 185 | 18 | 17 | 24 | June |
| Lesser black-backed gull | 48 | 119 | 92 | 12 | 7 | 14 | May |
| Tufted duck | 2 | 0 | 20 | 0 | 11 | 14 | June |
| Whimbrel | 5 | 7 | 18 | 4 | 11 | 11 | April |
| Little tern | 2 | 1 | 10 | 1 | 10 | 10 | August |
| Mediterranean gull | 3 | 2 | 12 | 2 | 10 | 10 | July |
| Common eider | 2 | 16 | 0 | 8 | 0 | 8 | April |
| Roseate tern | 7 | 3 | 15 | 2 | 8 | 8 | August |
| Long-tailed duck | 1 | 6 | 0 | 6 | 0 | 6 | April |
| Mute swan | 1 | 0 | 4 | 0 | 4 | 4 | July |
| Arctic tern | 8 | 4 | 12 | 2 | 3 | 3 | May, June |
| Great skua | 9 | 2 | 13 | 1 | 3 | 3 | June, August |
| Kestrel | 7 | 3 | 4 | 3 | 3 | 3 | June |
| Blackbird | 1 | 0 | 2 | 0 | 2 | 2 | April |
| Feral pigeon | 4 | 0 | 8 | 0 | 2 | 2 | May, June |
| Greenfinch | 2 | 1 | 2 | 1 | 2 | 2 | July |
| Sparrowhawk | 1 | 0 | 2 | 0 | 2 | 2 | June |
| Arctic skua | 4 | 0 | 4 | 0 | 1 | 1 | July, August |
| Little stint | 1 | 0 | 1 | 0 | 1 | 1 | July |
| Great northern diver | 1 | 1 | 0 | 1 | 0 | 1 | August |
| Ring-billed gull | 1 | 1 | 0 | 1 | 0 | 1 | July |
| Storm petrel | 1 | 0 | 1 | 0 | 1 | 1 | May |

**Table A10.12: Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during breeding season (non-SPA species), sorted by peak VP count**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 2 | 0 | 2 |
| | DP | 0 | 0 | 55 | 95 | 150 |
| | FE | 0 | 0 | 7 | 0 | 7 |
| | LO | 0 | 15 | 85 | 219 | 319 |
| | PL | 0 | 0 | 0 | 2 | 2 |
| | RO | 0 | 4 | 15 | 29 | 48 |
| | SF | 0 | 0 | 5 | 0 | 5 |
| | SU | 0 | 0 | 3 | 32 | 35 |
| | **Total** | **0** | **19** | **172** | **377** | **568** |
| 2 | - | 0 | 0 | 17 | 7 | 24 |
| | DP | 98 | 32 | 156 | 187 | 473 |
| | FE | 0 | 0 | 0 | 12 | 12 |
| | LO | 132 | 1176 | 940 | 564 | 2812 |
| | PR | 5 | 16 | 0 | 1 | 22 |
| | RO | 15 | 30 | 54 | 58 | 157 |
| | SC | 0 | 2 | 0 | 0 | 2 |
| | SF | 0 | 20 | 25 | 41 | 86 |
| | SU | 0 | 6 | 15 | 18 | 39 |
| | **Total** | **250** | **1282** | **1207** | **888** | **3627** |
| **Grand Total** | | **250** | **1301** | **1379** | **1265** | **4195** |

**Table A10.13: Kittiwake behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 1 | 4 | 3 | 8 |
| | FE | 4 | 41 | 257 | 157 | 459 |
| | LO | 1 | 38 | 126 | 135 | 300 |
| | PR | 0 | 5 | 8 | 0 | 13 |
| | **Total** | **5** | **85** | **395** | **295** | **780** |
| 2 | - | 74 | 63 | | | 137 |
| | FE | 46 | 271 | 581 | 253 | 1151 |
| | LO | 4150 | 1331 | 795 | 278 | 6554 |
| | PL | 0 | 0 | 0 | 1 | 1 |
| | PR | 122 | 27 | 6 | 0 | 155 |
| | RO | 181 | 7 | 0 | 0 | 188 |
| | **Total** | **4573** | **1699** | **1382** | **532** | **8186** |
| **Grand Total** | | **4578** | **1784** | **1777** | **827** | **8966** |

**Table A10.14: Guillemot behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 0 | 6 | 6 |
| | FE | 4 | 55 | 187 | 314 | 560 |
| | LO | 1 | 15 | 62 | 129 | 207 |
| | PR | 0 | 5 | 8 | 5 | 18 |
| | **Total** | **5** | **75** | **257** | **454** | **791** |
| 2 | - | 52 | 18 | | | 70 |
| | FE | 26 | 233 | 490 | 231 | 980 |
| | LO | 3900 | 1177 | 659 | 190 | 5926 |
| | PR | 139 | 53 | 9 | 7 | 208 |
| | RO | 223 | 42 | 0 | 0 | 265 |
| | **Total** | **4340** | **1523** | **1158** | **428** | **7449** |
| **Grand Total** | | **4345** | **1598** | **1415** | **882** | **8240** |

**Table A10.15: Razorbill behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 13 | 6 | 5 | 42 | 66 |
| | DP | | | 35 | 83 | 118 |
| | FE | | | | 5 | 5 |
| | LO | 184 | 381 | 324 | 225 | 1114 |
| | PR | 10 | 3 | 0 | 2 | 15 |
| | RL | 40 | 26 | 65 | 84 | 215 |
| | RO | 394 | 374 | 527 | 443 | 1738 |
| | SC | 0 | 12 | 8 | 12 | 32 |
| | SF | 0 | 0 | 22 | 56 | 78 |
| | SU | 10 | 1 | 3 | 5 | 19 |
| | **Total** | **651** | **803** | **989** | **957** | **3400** |
| 2 | - | 28 | 12 | 6 | 7 | 53 |
| | FE | 10 | 1 | 0 | 6 | 17 |
| | LO | 970 | 590 | 205 | 182 | 1947 |
| | PR | 182 | 46 | 0 | 0 | 228 |
| | RL | 137 | 22 | 0 | 0 | 159 |
| | RO | 349 | 160 | 29 | 15 | 553 |
| | SC | 18 | 27 | 4 | 28 | 77 |
| | SF | 0 | 70 | 138 | 81 | 289 |
| | SU | 15 | 2 | 11 | 28 | 56 |
| | **Total** | **1709** | **930** | **393** | **347** | **3379** |
| **Grand Total** | | **2360** | **1733** | **1382** | **1304** | **6779** |

**Table A10.16: Herring gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 2 | 0 | 0 | 0 | 2 |
| | FE | 36 | 100 | 77 | 43 | 256 |
| | LO | 0 | 1 | 0 | 0 | 1 |
| | PR | 79 | 59 | 50 | 84 | 272 |
| | RL | 0 | 0 | 6 | 2 | 8 |
| | RO | 27 | 0 | 8 | 10 | 45 |
| | SU | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **144** | **160** | **141** | **140** | **585** |
| 2 | - | 0 | 2 | 0 | 1 | 3 |
| | FE | 34 | 54 | 49 | 62 | 199 |
| | LO | 3 | 1 | 0 | 9 | 13 |
| | PL | 1 | 0 | 0 | 0 | 1 |
| | PR | 100 | 26 | 0 | 0 | 126 |
| | RL | 50 | 0 | 0 | 0 | 50 |
| | **Total** | **188** | **83** | **49** | **72** | **392** |
| **Grand Total** | | **332** | **243** | **190** | **212** | **977** |

**Table A10.17: Cormorant behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 7 | 11 | 18 |
| | FE | 0 | 0 | 2 | 0 | 2 |
| | LO | 17 | 24 | 90 | 203 | 334 |
| | PR | 4 | 0 | 0 | 3 | 7 |
| | RL | 2 | 3 | 6 | 4 | 15 |
| | RO | 32 | 16 | 45 | 101 | 194 |
| | SC | 0 | 0 | 0 | 10 | 10 |
| | SF | 0 | 0 | 12 | 21 | 33 |
| | SU | 0 | 0 | 2 | 0 | 2 |
| | **Total** | **55** | **43** | **164** | **353** | **615** |
| 2 | - | 8 | 0 | 7 | 8 | 23 |
| | FE | 3 | 0 | 0 | 9 | 12 |
| | LO | 57 | 106 | 143 | 239 | 545 |
| | PR | 25 | 15 | 1 | 0 | 41 |
| | RL | 8 | 0 | 0 | 0 | 8 |
| | RO | 3 | 0 | 7 | 5 | 15 |
| | SC | 2 | 9 | 0 | 12 | 23 |
| | SF | 0 | 29 | 47 | 66 | 142 |
| | SU | 2 | 0 | 4 | 8 | 14 |
| | **Total** | **108** | **159** | **209** | **347** | **823** |
| **Grand Total** | | **163** | **202** | **373** | **700** | **1438** |

**Table A10.18: Great black-backed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 0 | 1 | 1 |
| | LO | 0 | 0 | 8 | 40 | 48 |
| | PR | 0 | 0 | 0 | 4 | 4 |
| | SU | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **0** | **0** | **8** | **46** | **54** |
| 2 | - | 1 | 0 | 4 | 1 | 6 |
| | LO | 73 | 88 | 100 | 72 | 333 |
| | PR | 20 | 15 | 3 | 0 | 38 |
| | RO | 1 | 49 | 43 | 6 | 99 |
| | SU | 0 | 0 | 0 | 3 | 3 |
| | **Total** | **95** | **152** | **150** | **82** | **479** |
| **Grand Total** | | **95** | **152** | **158** | **128** | **533** |

**Table A10.19: Fulmar behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 1 | 5 | 0 | 11 | 17 |
| | CN | 0 | 1 | 0 | 0 | 1 |
| | FE | 148 | 323 | 104 | 48 | 623 |
| | LO | 0 | 6 | 3 | 0 | 9 |
| | PR | 6 | 15 | 3 | 9 | 33 |
| | RL | 0 | 0 | 0 | 5 | 5 |
| | RO | 2 | 0 | 0 | 0 | 2 |
| | **Total** | **157** | **350** | **110** | **73** | **690** |
| 2 | - | 6 | 1 | 1 | 2 | 10 |
| | FE | 334 | 265 | 140 | 69 | 808 |
| | LO | 20 | 0 | 0 | 0 | 20 |
| | PR | 297 | 49 | 0 | 0 | 346 |
| | RL | 108 | 0 | 0 | 0 | 108 |
| | RO | 0 | 8 | 0 | 0 | 8 |
| | SF | 0 | 1 | 0 | 0 | 1 |
| | **Total** | **765** | **324** | **141** | **71** | **1301** |
| **Grand Total** | | **922** | **674** | **251** | **144** | **1991** |

**Table A10.20: Shag behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | LO | 0 | 0 | 7 | 43 | 50 |
| | PL | 0 | 0 | 20 | 66 | 86 |
| | RO | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **0** | **0** | **27** | **110** | **137** |
| 2 | - | 0 | 0 | 1 | 3 | 4 |
| | DP | 0 | 0 | 2 | 0 | 2 |
| | FE | 0 | 9 | 0 | 2 | 11 |
| | LO | 80 | 144 | 124 | 170 | 518 |
| | PL | 12 | 60 | 133 | 204 | 409 |
| | PR | 134 | 76 | 9 | 3 | 222 |
| | RO | 0 | 0 | 1 | 6 | 7 |
| | SF | 0 | 3 | 0 | 0 | 3 |
| | SU | 7 | 0 | 10 | 2 | 19 |
| | **Total** | **233** | **292** | **280** | **390** | **1195** |
| **Grand Total** | | **233** | **292** | **307** | **500** | **1332** |

**Table A10.21: Gannet behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 3 | 5 | 8 |
| | LO | 0 | 0 | 2 | 5 | 7 |
| | **Total** | **0** | **0** | **5** | **10** | **15** |
| 2 | - | 6 | 0 | 2 | 0 | 8 |
| | FE | 0 | 7 | 8 | 4 | 19 |
| | LO | 547 | 138 | 8 | 0 | 693 |
| | PR | 5 | 2 | 0 | 0 | 7 |
| | **Total** | **558** | **147** | **18** | **4** | **727** |
| **Grand Total** | | **558** | **147** | **23** | **14** | **742** |

**Table A10.22: Puffin behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 2 | 1 | 0 | 3 |
| | FE | 6 | 42 | 57 | 59 | 164 |
| | RL | 0 | 0 | 0 | 22 | 22 |
| | **Total** | **6** | **44** | **58** | **81** | **189** |
| 2 | - | 3 | 9 | 0 | 0 | 12 |
| | FE | 74 | 96 | 34 | 7 | 211 |
| | **Total** | **77** | **105** | **34** | **7** | **223** |
| **Grand Total** | | **83** | **149** | **92** | **88** | **412** |

**Table A10.23: Black guillemot behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 3 | 1 | 11 | 1 | 16 |
| | FE | 107 | 451 | 166 | 26 | 750 |
| | LO | 8 | 459 | 99 | 122 | 688 |
| | PR | 4 | 159 | 104 | 6 | 273 |
| | RO | 0 | 0 | 2 | 4 | 6 |
| | SU | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **122** | **1070** | **382** | **160** | **1734** |
| 2 | FE | 3 | 13 | 30 | 107 | 153 |
| | PR | 0 | 4 | 0 | 10 | 14 |
| | **Total** | **3** | **17** | **30** | **117** | **167** |
| **Grand Total** | | **125** | **1087** | **412** | **277** | **1901** |

**Table A10.24: Great crested grebe behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 11 | 0 | 0 | 0 | 11 |
| | FE | 121 | 78 | 13 | 97 | 309 |
| | LO | 11 | 0 | 0 | 12 | 23 |
| | RL | 74 | 16 | 46 | 121 | 257 |
| | RO | 554 | 100 | 182 | 689 | 1525 |
| | **Total** | **771** | **194** | **241** | **919** | **2125** |
| 2 | - | 2 | 0 | 0 | 0 | 2 |
| | FE | 20 | 0 | 0 | 0 | 20 |
| | LO | 0 | 2 | 0 | 0 | 2 |
| | RL | 8 | 0 | 0 | 0 | 8 |
| | RO | 31 | 0 | 0 | 0 | 31 |
| | **Total** | **61** | **2** | **0** | **0** | **63** |
| **Grand Total** | | **832** | **196** | **241** | **919** | **2188** |

**Table A10.25: Oystercatcher behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 163 | 23 | 53 | 152 | 391 |
| | RO | 0 | 0 | 0 | 18 | 18 |
| | SU | 0 | 22 | 0 | 22 | 44 |
| | **Total** | **163** | **45** | **53** | **192** | **453** |
| 2 | **Total** | **0** | **0** | **0** | **0** | **0** |
| **Grand Total** | | **163** | **45** | **53** | **192** | **453** |

**Table A10.26: Sanderling behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 8 | 0 | 0 | 86 | 94 |
| | RO | 22 | 0 | 12 | 98 | 132 |
| | **Total** | **30** | **0** | **12** | **184** | **226** |
| 2 | **Total** | **0** | **0** | **0** | **0** | **0** |
| **Grand Total** | | **30** | **0** | **12** | **184** | **226** |

**Table A10.27: Dunlin behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 4 | 17 | 0 | 21 |
| | FE | 24 | 349 | 70 | 12 | 455 |
| | LO | 3 | 7 | 6 | 29 | 45 |
| | PR | 0 | 17 | 22 | 0 | 39 |
| | **Total** | **27** | **377** | **115** | **41** | **560** |
| 2 | ED | 2 | 0 | 0 | 0 | 2 |
| | FE | 0 | 0 | 0 | 11 | 11 |
| | **Total** | **2** | **0** | **0** | **11** | **13** |
| **Grand Total** | | **29** | **377** | **115** | **52** | **573** |

**Table A10.28: Red-breasted merganser behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 0 | 12 | 12 |
| | FE | 6 | 22 | 0 | 12 | 40 |
| | PR | 0 | 0 | 0 | 11 | 11 |
| | RO | 53 | 0 | 33 | 36 | 122 |
| | **Total** | **59** | **22** | **33** | **71** | **185** |
| 2 | RL | 4 | 0 | 0 | 0 | 4 |
| | RO | 21 | 0 | 0 | 0 | 21 |
| | **Total** | **25** | **0** | **0** | **0** | **25** |
| **Grand Total** | | **84** | **22** | **33** | **71** | **210** |

**Table A10.29: Turnstone behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 8 | 8 |
| | RL | 0 | 0 | 0 | 27 | 27 |
| | RO | 0 | 0 | 4 | 52 | 56 |
| | **Total** | **0** | **0** | **4** | **87** | **91** |
| 2 | **Total** | **0** | **0** | **0** | **0** | **0** |
| **Grand Total** | | **0** | **0** | **4** | **87** | **91** |

**Table A10.30: Redshank behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 7 | 0 | 0 | 0 | 7 |
| | FE | 11 | 7 | 8 | 19 | 45 |
| | RO | 60 | 8 | 16 | 0 | 84 |
| | **Total** | **78** | **15** | **24** | **19** | **136** |
| 2 | **Total** | **0** | **0** | **0** | **0** | **0** |
| **Grand Total** | | **78** | **15** | **24** | **19** | **136** |

**Table A10.31: Ringed plover behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 7 | 6 | 2 | 0 | 15 |
| | DP | 2 | 0 | 0 | 0 | 2 |
| | LO | 192 | 165 | 82 | 75 | 514 |
| | PR | 5 | 0 | 0 | 0 | 5 |
| | RL | 22 | 34 | 80 | 93 | 229 |
| | RO | 338 | 317 | 438 | 428 | 1521 |
| | SC | 0 | 4 | 8 | 0 | 12 |
| | SF | 0 | 0 | 2 | 20 | 22 |
| | SU | 7 | 0 | 4 | 9 | 20 |
| | **Total** | **573** | **526** | **616** | **625** | **2340** |
| 2 | - | 0 | 1 | 0 | 0 | 1 |
| | LO | 4 | 7 | 63 | 40 | 114 |
| | PR | 0 | 0 | 3 | 0 | 3 |
| | RO | 0 | 0 | 15 | 27 | 42 |
| | SC | 0 | 6 | 0 | 0 | 6 |
| | SF | 0 | 0 | 7 | 3 | 10 |
| | **Total** | **4** | **14** | **88** | **70** | **176** |
| **Grand Total** | | **577** | **540** | **704** | **695** | **2516** |

**Table A10.32: Black-headed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 4 | 0 | 0 | 0 | 4 |
| | FE | 0 | 0 | 1 | 0 | 1 |
| | LO | 16 | 9 | 9 | 14 | 48 |
| | RL | 2 | 0 | 22 | 4 | 28 |
| | RO | 30 | 47 | 38 | 38 | 153 |
| | SC | 0 | 0 | 0 | 2 | 2 |
| | SF | 0 | 0 | 0 | 3 | 3 |
| | SU | 1 | 0 | 0 | 0 | 1 |
| | **Total** | **53** | **56** | **70** | **61** | **240** |
| 2 | LO | 5 | 16 | 11 | 10 | 42 |
| | RO | 2 | 0 | 2 | 0 | 4 |
| | SC | 2 | 4 | 0 | 0 | 6 |
| | SF | 0 | 2 | 7 | 10 | 19 |
| | **Total** | **9** | **22** | **20** | **20** | **71** |
| **Grand Total** | | **62** | **78** | **90** | **81** | **311** |

**Table A10.33: Common gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 2 | 0 | 2 |
| | LO | 7 | 24 | 14 | 4 | 49 |
| | RL | 0 | 4 | 5 | 6 | 15 |
| | RO | 15 | 22 | 36 | 31 | 104 |
| | SF | 0 | 0 | 1 | 0 | 1 |
| | **Total** | **22** | **50** | **58** | **41** | **171** |
| 2 | LO | 2 | 6 | 10 | 8 | 26 |
| | RL | 2 | 0 | 0 | 0 | 2 |
| | RO | 5 | 3 | 0 | 0 | 8 |
| | SF | 0 | 0 | 2 | 7 | 9 |
| | **Total** | **9** | **9** | **12** | **15** | **45** |
| **Grand Total** | | **31** | **59** | **70** | **56** | **216** |

**Table A10.34: Lesser black-backed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 2 | 1 | 2 | 5 |
| | FE | 17 | 102 | 184 | 38 | 341 |
| | LO | 0 | 39 | 93 | 87 | 219 |
| | PR | 0 | 5 | 15 | 14 | 34 |
| | **Total** | **17** | **148** | **293** | **141** | **599** |
| 2 | - | 0 | 0 | 1 | 2 | 3 |
| | FE | 1 | 6 | 34 | 87 | 128 |
| | LO | 0 | 1 | 0 | 5 | 6 |
| | PR | 0 | 2 | 0 | 1 | 3 |
| | **Total** | **1** | **9** | **35** | **95** | **140** |
| **Grand Total** | | **18** | **157** | **328** | **236** | **739** |

**Table A10.35: Red-throated diver behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 0 | 0 | 0 | 1 | 1 |
| | FE | 0 | 7 | 16 | 32 | 55 |
| | LO | 0 | 0 | 0 | 1 | 1 |
| | PR | 0 | 0 | 1 | 0 | 1 |
| | **Total** | **0** | **7** | **17** | **34** | **58** |
| 2 | FE | 0 | 3 | 10 | 14 | 27 |
| | LO | 0 | 0 | 1 | 0 | 1 |
| | **Total** | **0** | **3** | **11** | **14** | **28** |
| **Grand Total** | | **0** | **10** | **28** | **48** | **86** |

**Table A10.36: Great northern diver behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | - | 16 | 0 | 0 | 89 | 105 |
| | FE | 8 | 429 | 75 | 495 | 1294 |
| | LO | 99 | 1175 | 256 | 1792 | 3531 |
| | PR | 0 | 44 | 0 | 4 | 48 |
| | RO | 15 | 0 | 0 | 29 | 44 |
| | **Total** | **138** | **1648** | **331** | **2409** | **5022** |
| 2 | FE | 0 | 91 | 45 | 350 | 441 |
| | LO | 0 | 47 | 0 | 546 | 598 |
| | **Total** | **0** | **138** | **45** | **896** | **1039** |
| **Grand Total** | | **138** | **1786** | **376** | **3305** | **6061** |

**Table A10.37: Common scoter behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | DP | 0 | 5 | 5 | 0 | 10 |
| | PL | 9 | 51 | 13 | 16 | 89 |
| | **Total** | **9** | **56** | **18** | **16** | **99** |
| 2 | DP | 0 | 0 | 4 | 6 | 10 |
| | PL | 0 | 4 | 12 | 0 | 16 |
| | **Total** | **0** | **4** | **16** | **6** | **26** |
| **Grand Total** | | **9** | **60** | **34** | **22** | **125** |

**Table A10.38: Common tern behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

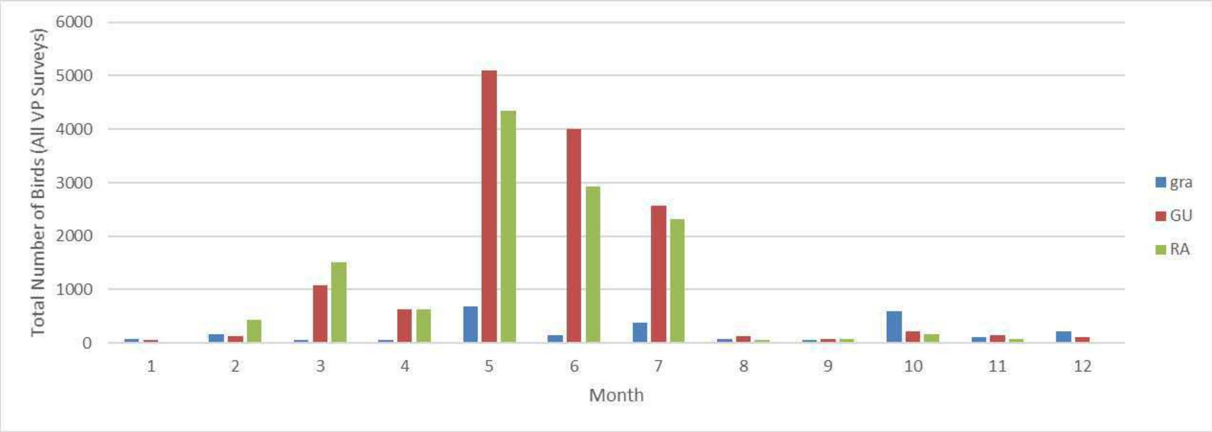
| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | DP | 0 | 15 | 13 | 0 | 28 |
| | LO | 0 | 1 | 0 | 0 | 1 |
| | PL | 23 | 49 | 27 | 14 | 113 |
| | RL | 0 | 3 | 0 | 52 | 55 |
| | RO | 19 | 20 | 6 | 32 | 77 |
| | **Total** | **42** | **88** | **46** | **98** | **274** |
| 2 | - | 0 | 0 | 0 | 6 | 6 |
| | DP | 0 | 0 | 18 | 11 | 29 |
| | PL | 0 | 3 | 19 | 41 | 63 |
| | **Total** | **0** | **3** | **37** | **58** | **98** |
| **Grand Total** | | **42** | **91** | **83** | **156** | **372** |

**Table A10.39: Sandwich tern behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

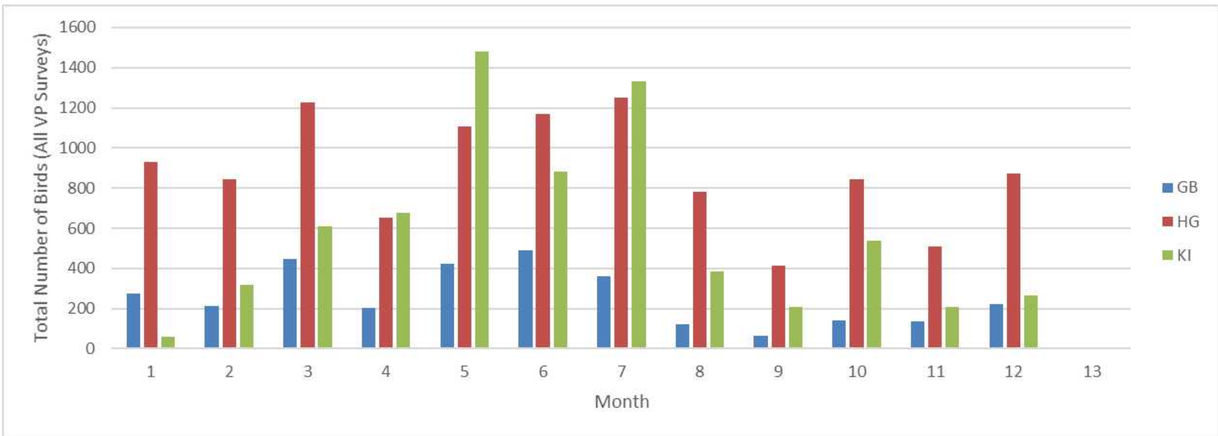
| VP Number | Behaviour Code | VP Band 1 | VP Band 2 | VP Band 3 | VP Band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | LO | 0 | 0 | 0 | 27 | 27 |
| | SU | 0 | 0 | 0 | 27 | 27 |
| | **Total** | **0** | **0** | **0** | **54** | **54** |
| 2 | FE | 0 | 0 | 0 | 7 | 7 |
| | LO | 0 | 0 | 25 | 114 | 139 |
| | RO | 0 | 0 | 11 | 10 | 21 |
| | SU | 0 | 0 | 27 | 70 | 97 |
| | **Total** | **0** | **0** | **63** | **201** | **264** |
| **Grand Total** | | **9** | **60** | **63** | **255** | **318** |

**Table A10.40: Manx shearwater behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

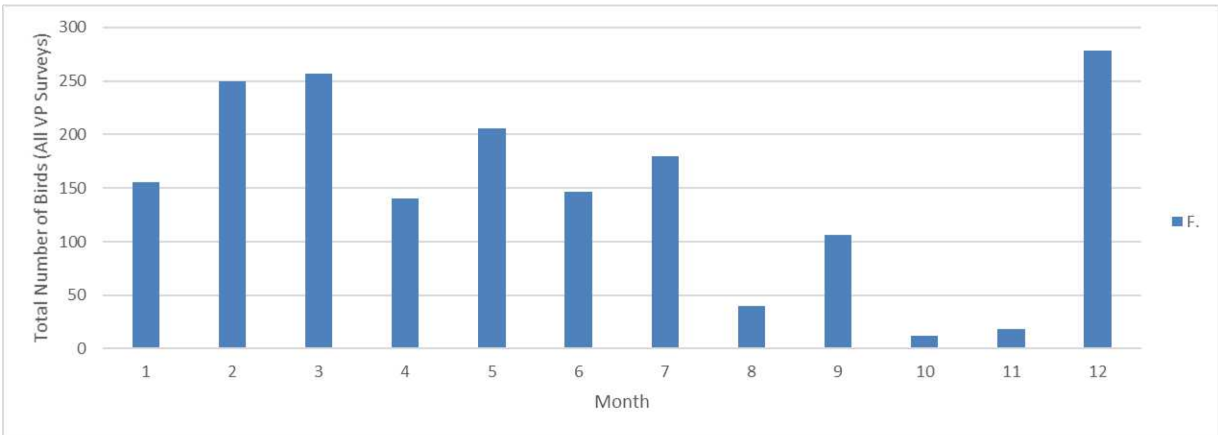
# APPENDIX 5 – MARINE VP GRAPHS



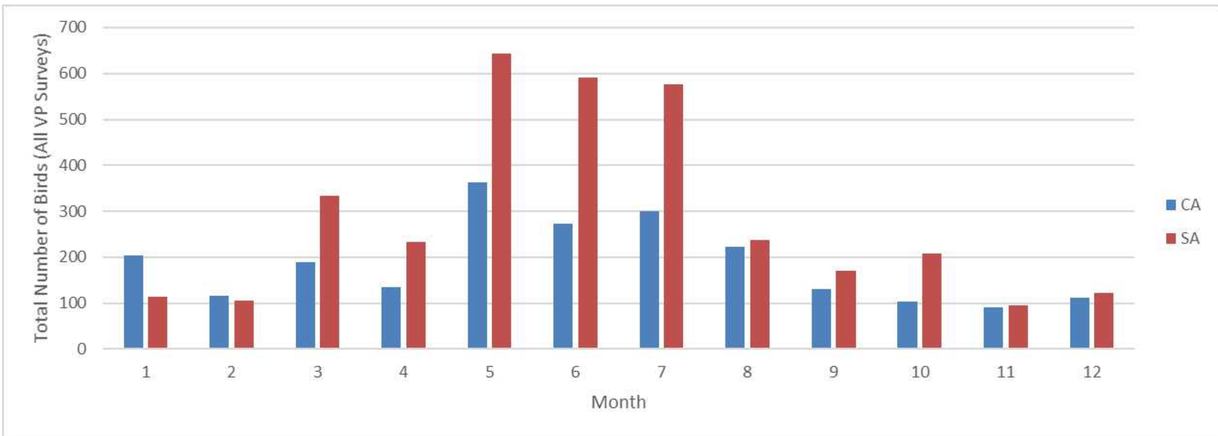

**Graph A10.1: Total number of guillemots or razorbills (gra), guillemots (GU) and razorbills (RA) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



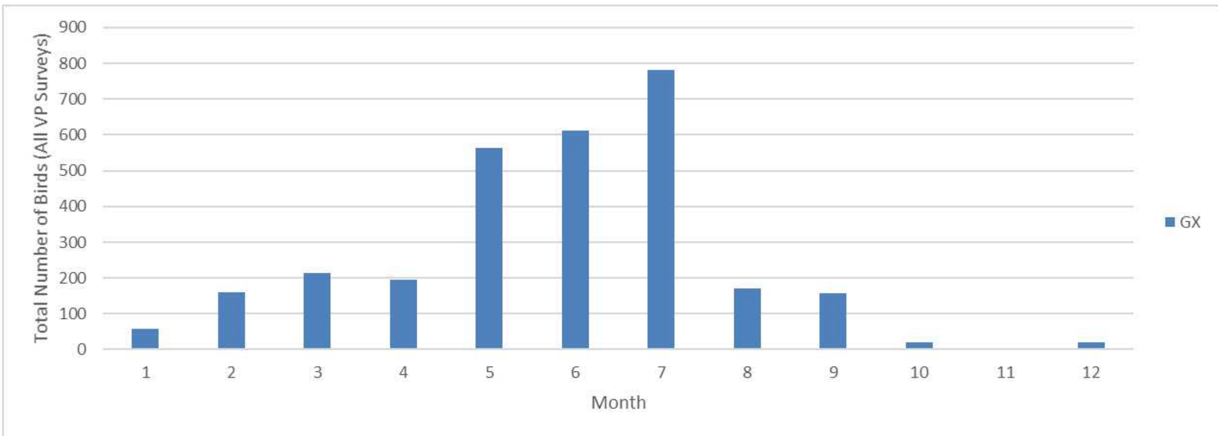

**Graph A10.2: Total number of great black-backed gulls (GB), herring gulls (HG) and kittiwakes (KI) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



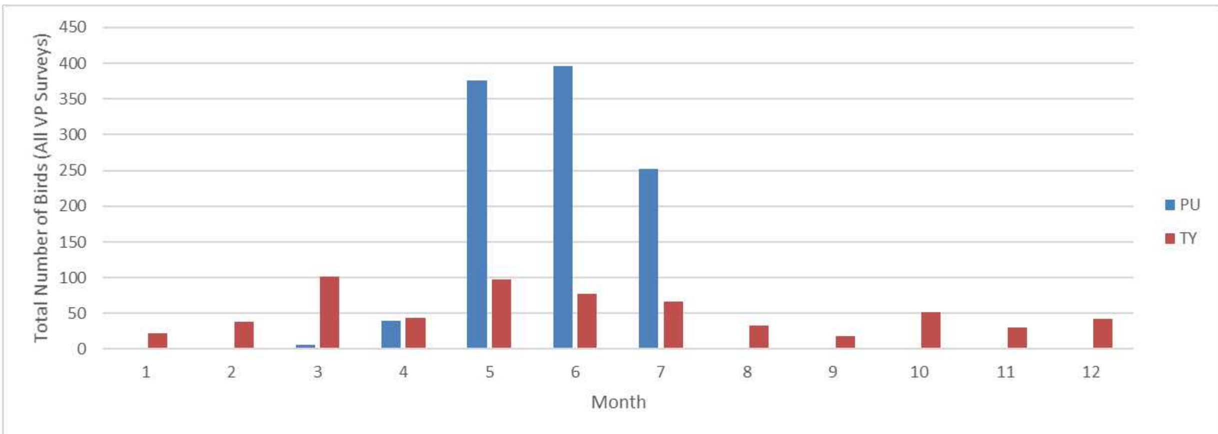

**Graph A10.3: Total number of fulmars (F.) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



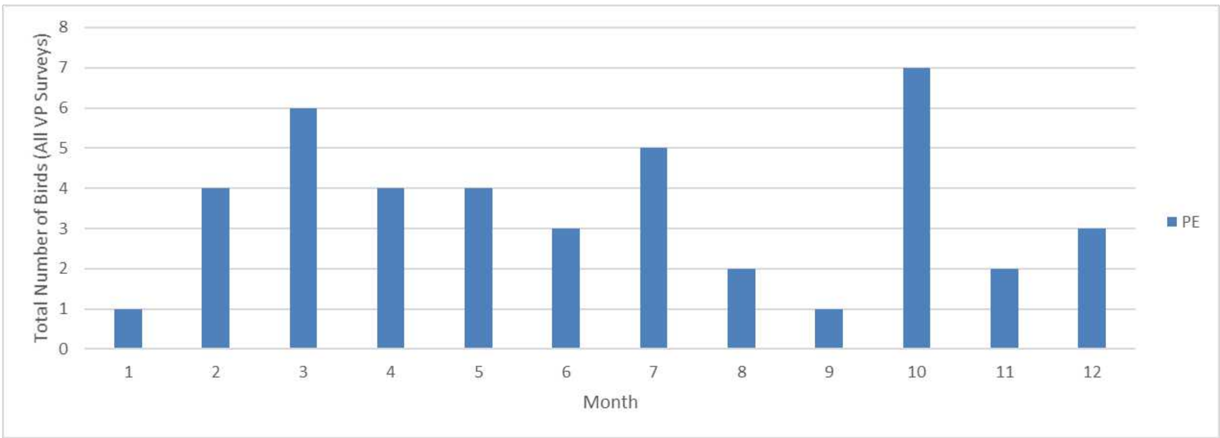

**Graph A10.4: Total number cormorants (CA) and shags (SA) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



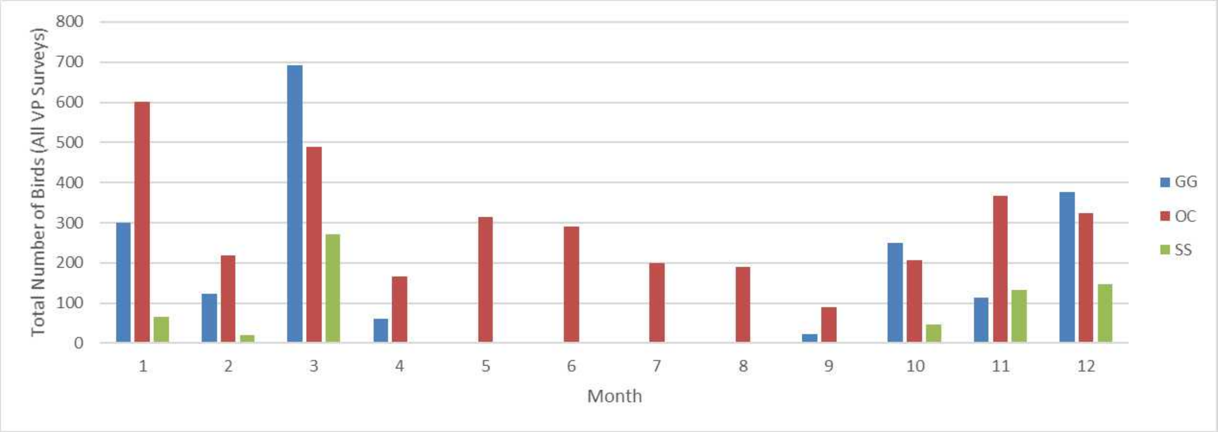

**Graph A10.5: Total number of gannets (GX) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



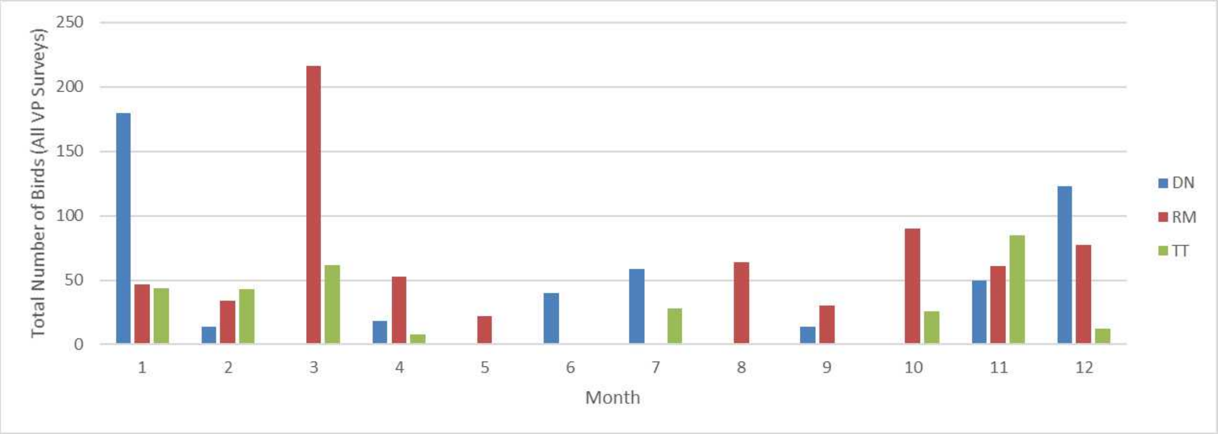

**Graph A10.6: Total number of puffins (PU) and black guillemots (TY) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



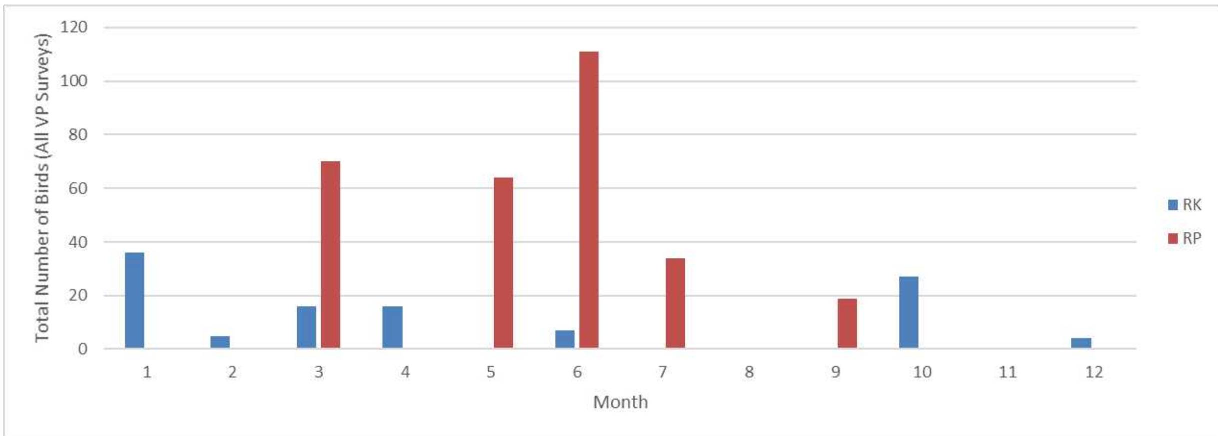

**Graph A10.7: Total number of peregrines (PE) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



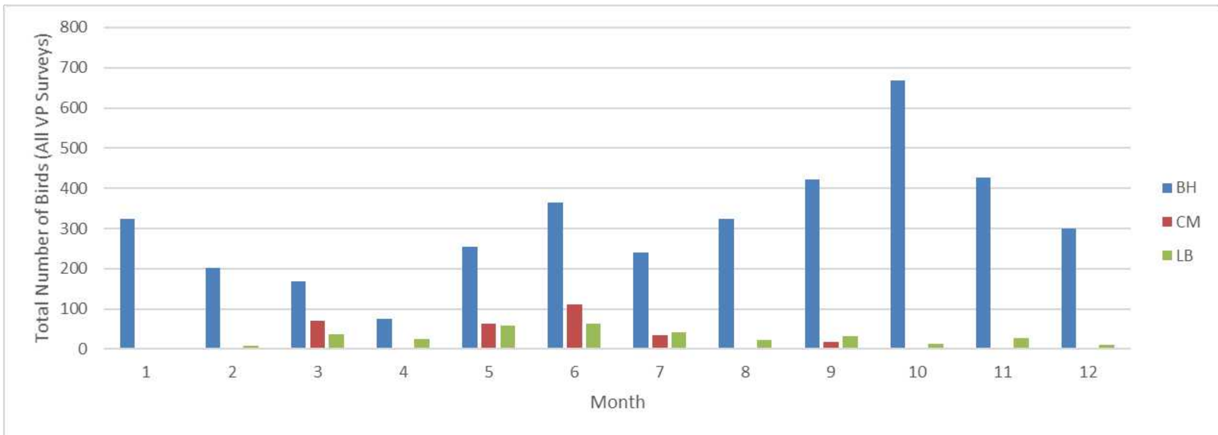

**Graph A10.8: Total number of great crested grebes (GG), oystercatchers (OC) and sanderlings (SS) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



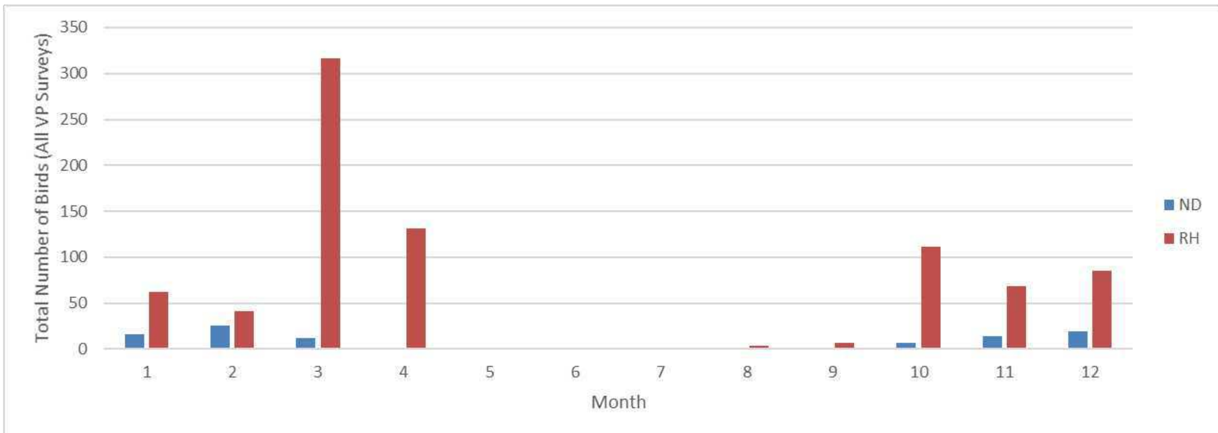

**Graph A10.9: Total number of dunlins (DN), red-breasted mergansers (RM) and turnstones (TT) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



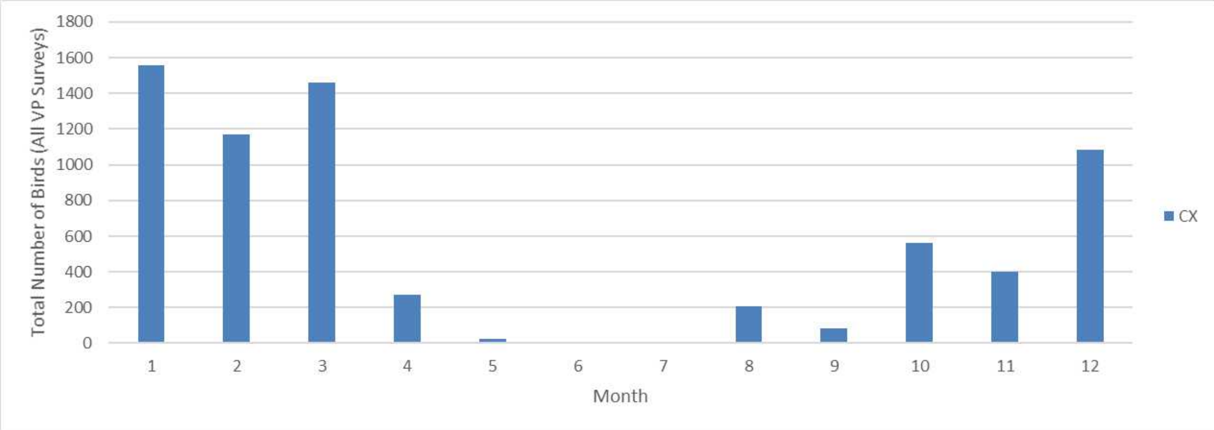

**Graph A10.10: Total number of redshanks (RK) and ringed plovers (RP) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



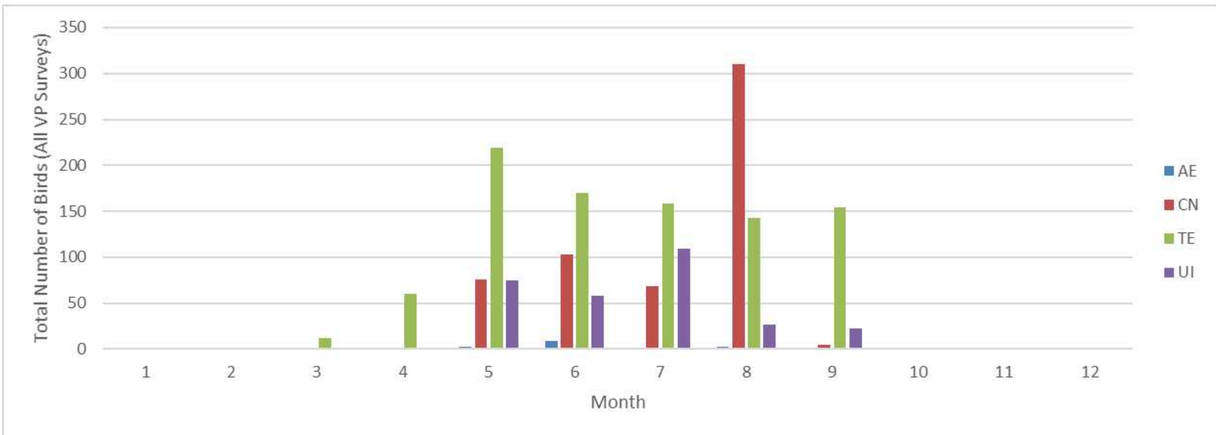

**Graph A10.11: Total number of black-headed gulls (BH), common gulls (CM) and lesser black-backed gulls (LB) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**



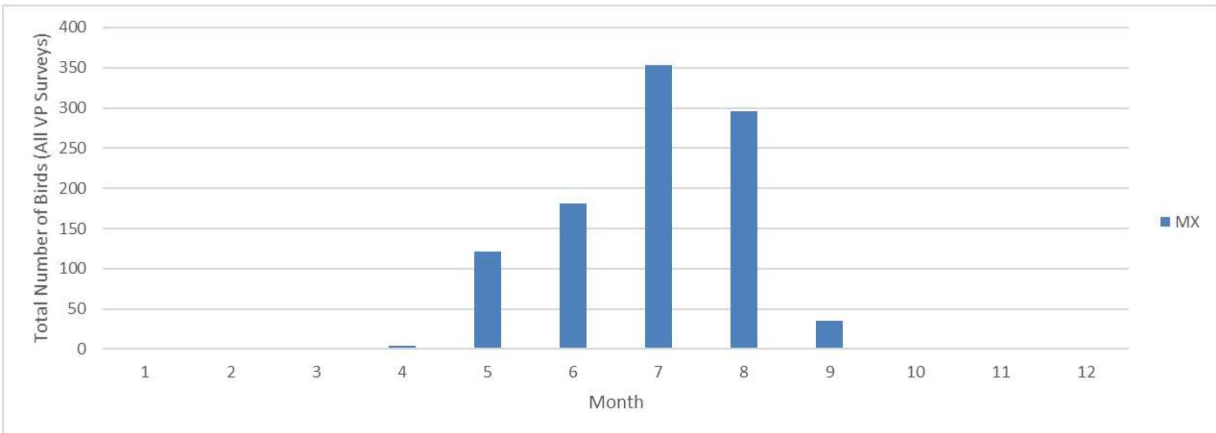

**Graph A10.12: Total number of great northern divers (ND) and red-throated divers (RH) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**




**Graph A10.13: Total number of common scoters (CX) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**




**Graph A10.14: Total number of Arctic terns (AE), common terns (CN), Sandwich terns (TE) and 'commic' (common or Arctic) terns (UI) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**




**Graph A10.15: Total number of Manx shearwaters (MX) recorded by month during VP surveys (Velvet Strand and Ireland's Eye) during entire survey programme**

# GREATER DUBLIN DRAINAGE

## Revised Natura Impact Statement
## Appendix A - Estuarine, Coastal and Marine Ornithology Technical Report - 2023

IE000258/ ECO02228
Final
October 2023

Page left intentionally blank

# Contents


1 INTRODUCTION ..... 1
- 1.1 Purpose of this Document ..... 1

2 ESTUARINE BIRD SURVEYS ..... 2
- 2.1 Survey Methodology ..... 2
- 2.2 Results ..... 2

3 VANTAGE POINT SURVEYS ..... 4
- 3.1 Survey Methodology ..... 4
- 3.2 Results ..... 6

4 KEY MATERIAL CHANGES IN BASELINE ..... 7

5 REFERENCES ..... 8

APPENDIX 1 – FIGURES ..... 0

APPENDIX 2 – ESTUARINE BIRD SURVEY EFFORT AND WEATHER ..... 12

APPENDIX 3 – ESTUARINE BIRD SURVEY DATA ..... 16

APPENDIX 4 – VP SURVEY EFFORT AND WEATHER ..... 23

APPENDIX 5 – VP RECORDS ..... 33

APPENDIX 6 – VP GRAPHS ..... 50

Page left intentionally blank

# 1 INTRODUCTION

## 1.1 Purpose of this Document

RPS was commissioned by Uisce Éireann (UÉ) to complete update ecology surveys to inform the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project) Environmental Impact Assessment Report (EIAR) Addendum Report.

An EIAR was prepared for the Proposed Project and was submitted in the 2018 planning application. Chapter 10 of the EIAR considered Biodiversity (Marine Ornithology).

As detailed in Chapter 1a (Introduction) in Volume 2A of the EIAR Addendum Report, we have reviewed Chapter 10 (Biodiversity (Marine Ornithology)) and the associated appendices of the EIAR submitted with the original 2018 planning application in light of:

- Changes to the baseline environment;
- The requirement for updated surveys; and
- Any changes to the law, policy, or industry standards and guidance in the intervening period.

This Appendix documents the findings of the update ecology surveys and informs Chapter 10A Biodiversity (Marine Ornithology) of the EIAR Addendum Report.

In updating the baseline ecology information for the Proposed Project this was completed cognisant of the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater, Coastal and Marine (hereafter referred to as the CIEEM Guideline) (CIEEM 2018), with respect to the validity of baseline data.

This Appendix is a factual account of the update surveys which have been completed for the Proposed Project between 2020 and 2023 (depending on the survey), and documents the methodology and findings of these surveys. The update surveys completed were:

- Coastal and Marine Vantage Point (VP) (Velvet Strand; VP1);
- Coastal and Marine VP (Ireland's Eye; VP2); and
- Estuarine Bird Surveys (Baldoyle Bay).

The data were collected between August 2020 and June 2023.

The bird species and designations related to land-based species are covered in the Appendix A11.2 (Terrestrial Ornithology Technical Report) in Volume 3A Part B of this EIAR Addendum. The coverage in this current Appendix is therefore for estuarine, coastal and marine based species only. The following ornithological elements of this Appendix therefore only consider these birds and their habitats.

In addition, the data have been compared with the relevant baseline in Chapter 10 (Biodiversity (Marine Ornithology)) in Volume 3 Part A of the EIAR submitted in the 2018 planning application, to identify any material changes to the baseline conditions in the intervening period. Any identified material changes have then been used to inform Chapter 10A (Biodiversity (Marine Ornithology)) in Volume 3A Part A of the EIAR Addendum.

# 2 ESTUARINE BIRD SURVEYS

## 2.1 Survey Methodology

### 2.1.1 Introduction

Estuarine walkover surveys were carried out based on the standard Wetland Bird Survey methods (Gilbert *et al*. 1998; BTO 2016a; BTO 2016b), using a more refined methodology involving the recording of locations of birds as well as their behaviour. Surveys aimed to count, map and record behaviour of wildfowl and waders using the estuarine habitat, in addition to other species of bird present.

### 2.1.2 Survey Location

The survey area covered the proposed outfall pipeline route to the proposed outfall where it will cross intertidal / estuarine habitat, and extended up to 1 km (kilometre) from the proposed outfall pipeline route across Baldoyle Bay Special Protection Area (SPA) and surrounding habitats. The size of the survey area was approximately 4.95km² (kilometres squared).

### 2.1.3 Target Species

The key species' groups were wildfowl, waders and seabirds. However, during the surveys, all birds were recorded. Priority was given to recording birds on the ground or on water within the survey area. Records of notable flying birds were made, for example raptors or flocks of waterfowl and waders.

### 2.1.4 Survey Timing and Effort

In each month, two estuarine survey counts were completed. Each survey was of six hours duration. If the survey area was covered before the allotted time had elapsed (which was possible at high tide), the remaining time was used to undertake repeat counts of any wader or wildfowl hotspots.

Timings of counts throughout the survey period were made so that the whole tidal cycle was equally covered. Counts were made during full daylight.

### 2.1.5 Field Recording

Species were recorded using standard British Trust for Ornithology (BTO) codes and the behaviour codes specified on the survey map. Information on the age and sex of target species was also considered, where notable and of assistance to the assessment. Notable observations that occurred outside the study area, but within sight of the surveyors inside the study area, were also recorded.

## 2.2 Results

### 2.2.1 Survey Effort

Survey effort and weather during the estuarine walkover surveys are presented in Appendix 2 (Table A10.1a and Table A10.1b).

### 2.2.2 Peak Counts

Peak counts from estuarine walkover surveys are presented in Appendix 3 (Table A10.2 to Table A10.4).

### 2.2.3 Figures

The distribution of the 77 species encountered during the estuarine walkover surveys is presented in Appendix 1, Figure A10.1 to Figure A10.74c. A figure was produced for species that were named on citations of the Baldoyle Bay, Ireland's Eye or Howth Head Coast SPAs or North-West Irish Sea candidate SPA (cSPA), or if more than 10 records of the species were made during the surveys.

# 3 VANTAGE POINT SURVEYS

## 3.1 Survey Methodology

### 3.1.1 Introduction

VP surveys were carried out as per the methodology described in Section 3.1 of the 2018 EIAR. Six hours of survey effort per month were carried out from August 2020 to July 2021, and from January to June 2023. A reduced effort was undertaken between October and December 2022, comprising three hours in October, nine hours in November and three hours in December. Due to surveyor illness and poor weather conditions, a reduced survey effort was undertaken between October and December 2022. This does not affect the robustness of the assessment undertaken.

Surveys were not undertaken at VP2 in February or April 2023 due to poor weather conditions. Data were collected during all other survey months providing a robust dataset to inform analysis. Therefore this is not considered to be a limitation to the assessment.

Survey protocol was designed to count birds on the water (primary focus) and in flight (through snapshot recording).

### 3.1.2 Survey Location

One location on the mainland and one location on Ireland’s Eye were used. The mainland coastal VP was positioned as in previous surveys for the 2018 EIAR, at the proposed landfall location at Portmarnock (IO250423, Lat. 53.41631, Long. -6.11966, mean viewing angle 70°). The Ireland’s Eye VP was positioned at IO287415 (Lat. 53.40792, Long. -6.06387, mean viewing angle 0°).

The mainland coastal VP covered the area of the proposed outfall pipeline route out to sea using a 2km viewing arc. The Ireland’s Eye VP covered the remaining proposed outfall pipeline route using a 2km viewing arc. In this way, a buffer around the proposed outfall pipeline route footprint and working area was achieved.

### 3.1.3 Target Species

Key species / species groups are as listed below. These are primarily seabirds which utilise the marine environment for breeding, foraging or roosting. All species listed were covered, but species marked in bold were considered priority as they are included as qualifying species of nearby SPAs.

At the time of the surveys, this did not include species cited as conservation objectives of the North-West Irish Sea cSPA, however reference is made to them in the results section.

- Seaducks;
- Divers;
- Grebes;
- **Fulmar** and other tubenoses (petrels, shearwaters);
- Gannet;
- **Cormorant**;
- **Shag;**
- Skuas;
- **Lesser black-backed gull**;
- **Herring gull**;
- Other large gulls;
- **Kittiwake**;
- Other small gulls (e.g. black-headed gull, common gull);

- **Roseate tern**;
- **Common tern**;
- **Arctic tern**; and
- **Auks**.

### 3.1.4 Survey Timings

From each VP, six hours of survey work were undertaken each month, timed to give coverage over a range of tide states, whilst ensuring a spread between neap and spring tides. Surveys commenced and ended no earlier than half an hour before sunrise and / or no later than half an hour after sunset. Each VP survey was three hours long, and a minimum of 30 minutes taken as a break between surveys.

### 3.1.5 Field Recording

The 2km 180° (degree) viewing arc was divided into six (30°) sections, labelled A to F. Each section was subdivided into 500m (metre) distance bands (numbered sequentially 1 to 4 away from the observer). Each section was identified using land features, rangefinders, and by measuring the compass bearing from the observer.

A full binocular / telescope (dependent on distance band) scan of the whole area was made every 10 minutes, with the surveyor working sequentially through the grid and distance bands and recording all birds observed on the water. Only birds on the sea surface, or birds in flight but using the sea (e.g. plunge diving or surface feeding, or clearly observing the sea surface in preparation to do so, or even, if not feeding, regularly dropping to the sea surface) were recorded during this scan. Flying birds were ignored as they are not interacting with the site. The location of each record was determined using bearings, angles of declination or with reference to static easily identifiable objects in the sea. Standardised protocols for dealing with recording of behaviours and associations were used.

At the end of each full scan, birds in flight were counted in each sector. To reduce / eliminate double counting, this was as near an instantaneous count as possible.

Throughout a day's observations, environmental conditions were recorded at hourly intervals using standard recording forms.

The following behaviour codes were used to describe birds on the water:

- SU: Surface feeding;
- PL: Plunge feeding;
- DP: Dip feeding;
- FE: Feeding (other);
- SC: Scavenging;
- SF: Scavenging at fishing vessel;
- KL: Kleptoparasitising;
- CN: Carrying nest material;
- CF: Carrying food;
- PR: Preening or bathing;
- ED: Escape diving from vessel;
- EF: Escape flight from vessel;
- RO: Roosting on water; and
- LO: Loafing.

## 3.2 Results

### 3.2.1 Survey Effort

Survey effort and weather during the VP surveys are presented in Appendix 4 (Table A10.5a and Table A10.5b).

### 3.2.2 Peak Counts

Peak counts from coastal and marine VP surveys are presented in Appendix 5 and 6. These are presented as tables and graphs which show:

- The species recorded during both the breeding (April to August) and passage / winter (September to March) seasons;
- The total number of times they were recorded during surveys (split by in flight or on sea); and
- The peak count of birds that were recorded during a single scan (split by in flight or on sea and combined).

Species have been split into tables based on SPA citation (i.e., Ireland's Eye SPA / Howth Head Coast SPA / North-West Irish Sea cSPA, Baldoyle Bay SPA and non-cited species).

# 4 KEY MATERIAL CHANGES IN BASELINE

The bird species present within the estuarine survey area during the surveys undertaken between 2020 and 2023 remain typical birds associated with the habitat types present, including wetted channels, the intertidal area and adjacent Velvet Strand beach and Portmarnock Golf Course. The species recorded, therefore, continue to be entirely in keeping with what would be anticipated, given the land uses and habitats.

Six species (bar-tailed godwit, Brent goose, golden plover, grey plover, ringed plover and shelduck) which are listed as Special Conservation Interests (SCIs) on the Baldoyle Bay SPA citation were recorded during the surveys undertaken between 2020 and 2023. Sixteen other named qualifying species of the Baldoyle Bay SPA were also recorded (black-tailed godwit, curlew, dunlin, great crested grebe, greenshank, grey heron, knot, lapwing, mallard, oystercatcher, pintail, red-breasted merganser, redshank, sanderling, teal and turnstone). The numbers and distribution of these species remains consistent with the findings reported in Chapter 10 (Biodiversity (Marine Ornithology)) in Volume 3 Part A of the EIAR in the 2018 planning application.

Other species of note, in conservation terms, are those listed under the Ireland's Eye SPA, Howth Head Coast SPA and North-West Irish Sea cSPA citations, which include herring gull, great black-backed gull, black guillemot, guillemot, kittiwake, shag, razorbill, peregrine falcon and fulmar. The numbers of species recorded between 2020 and 2023 are comparable, as would be expected given the relative consistency of habitats between these periods. Only fulmar, which was recorded as part of the baseline in Chapter 10 (Biodiversity (Marine Ornithology)) in Volume 3 Part A of the EIAR in the 2018 planning application, was not present during the surveys undertaken between 2020 and 2023.

The distribution of SPA qualifying marine bird species recorded from the Velvet Strand and Ireland's Eye VPs during the breeding season and wintering seasons are comparable to the results presented in Chapter 10 (Biodiversity (Marine Ornithology)) in Volume 3 Part A of the EIAR in the 2018 planning application. Species listed as SCIs of Ireland's Eye SPA, Howth Head Coast SPA and / or North-West Irish Sea cSPAs were observed during the breeding and wintering seasons, distributed across the VP viewing arcs.

The value of estuarine and marine bird features recorded along the Proposed Project therefore remains the same as presented in Chapter 10 (Biodiversity (Marine Ornithology)) in Volume 3 Part A of the EIAR in the 2018 planning application.

# 5 REFERENCES


BTO (2016a). WeBS Core Counts Method. Available at: http://www.bto.org/volunteer-surveys/webs/taking-part/core-counts-methods.

BTO (2016b). WeBS Low Tide Counts Method. Available at: http://www.bto.org/volunteer-surveys/webs/taking-part/low-tide-counts.

CIEEM (2018). Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

Gilbert G., Gibbons D.W. and Evans, J. (1998) Bird Monitoring Methods: A Manual of Techniques for Key UK Species. RSPB, Sandy.

# APPENDIX 1 – FIGURES


| | |
|---|---|
| Arctic Tern Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.1 |
| Bar-tailed Godwit Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.2 |
| Black Guillemot Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.3 |
| Black-headed Gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.4 |
| Black-tailed Godwit Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.5 |
| Brent Goose Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.6 |
| Buzzard Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.7 |
| Carrion Crow Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.8 |
| Chaffinch Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.9 |
| Common Gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.10 |
| Common Sandpiper Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.11 |
| Common Scoter Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.12 |
| Common Tern Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.13 |
| Coot Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.14 |
| Cormorant Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.15 |
| Curlew Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.16 |
| Dark-bellied Brent Goose Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.17 |
| Dunlin Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.18 |
| Feral Pigeon Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.19 |
| Gannet Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.20 |
| Golden Plover Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.21 |
| Goldfinch Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.22 |
| Great Black-backed gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.23 |
| Great Crested Grebe Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.24 |
| Greenshank Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.25 |
| Grey Heron Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.26 |
| Grey Plover Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.27 |
| Guillemot Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.28 |
| Herring Gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.29 |
| Hooded Crow Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.30 |
| House Martin Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.31 |
| Jackdaw Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.32 |
| Kestrel Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.33 |
| Knot Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.34 |
| Lapwing Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.35 |
| Lesser Black-backed Gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.36 |
| Linnet Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.37 |
| Little Egret Records in Baldoyle Bay (Sep 2020 to Jun 2023) | Figure A10.38 |

Little Grebe Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.39
Magpie Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.40
Mallard Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.41
Meadow Pipit Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.42
Mediterranean Gull Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.43
Moorhen Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.44
Mute Swan Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.45
Oystercatcher Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.46
Pale-bellied Brent Goose Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.47
Pied Wagtail Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.48
Pintail Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.49
Pochard Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.50
Raven Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.51
Razorbill Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.52
Red-breasted Merganser Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.53
Redshank Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.54
Red-throated Diver Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.55
Reed Bunting Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.56
Ringed Plover Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.57
Rook Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.58
Ruff Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.59
Sand Martin Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.60
Sanderling Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.61
Sandwich Tern Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.62
Shag Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.63
Shelduck Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.64
Skylark Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.65
Snipe Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.66
Starling Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.67
Stonechat Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.68
Swallow Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.69
Teal Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.70
Turnstone Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.71
Whimbrel Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.72
Wigeon Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.73
Wood Pigeon Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure A10.74
Arctic Tern Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure 10.74A
Great Northern Diver Records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure 10.74B
Roseate Tern records in Baldoyle Bay (Sep 2020 to Jun 2023) Figure 10.74C
Distribution of all on sea Black Guillemot records from Irelands' Eye VP during

breeding season (March 2021 – June 2023) Figure A10.75
Distribution of all on sea Cormorant records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.76
Distribution of all on sea Fulmar records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.77
Distribution of all on sea Gannet records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.78
Distribution of all on sea Great Black-backed gull records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.79
Distribution of all on sea Guillemot records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.80
Distribution of all on sea Guillemot/Razorbill records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.81
Distribution of all on sea Herring Gull records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.82
Distribution of all on sea Kittiwake records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.83
Distribution of all on sea Puffin records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.84
Distribution of all on sea Razorbill records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.85
Distribution of all on sea Shag records from Irelands' Eye VP during
breeding season (March 2021 – June 2023) Figure A10.86


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Arctic Tern


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.1**
**Arctic Tern**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.2**
**Bar-tailed Godwit**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

Title

**Figure A10.3**
**Black Guillemot**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

File Identifier: ECO02228-0023-01

| Status: | Rev: | Model File Identifier: | |
|---|---|---|---|
| S0 | P01 | | |
| Drawn: KAG | | Date: | 05/07/2023 |
| Checked: KT | | Scale: | 1:14,000 @A3 |
| Approved: KT | | Projection: | ITM |

NOTE:


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Black-headed Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.4**
**Black-headed Gull**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Black-tailed Godwit


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.5**
**Black-tailed Godwit Records in Baldoyle Bay (September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

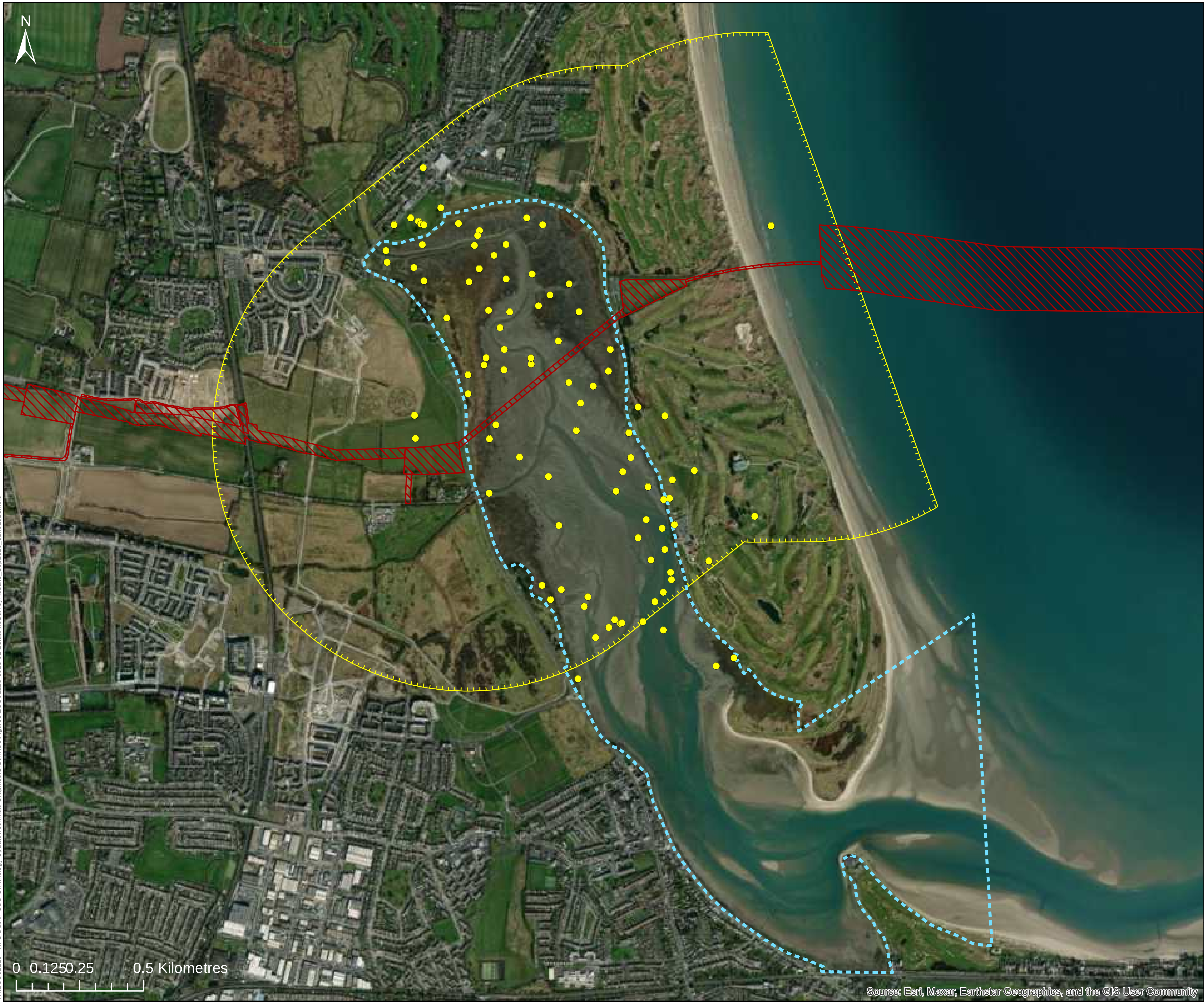
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Brent Goose


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.6**
**Brent Goose**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

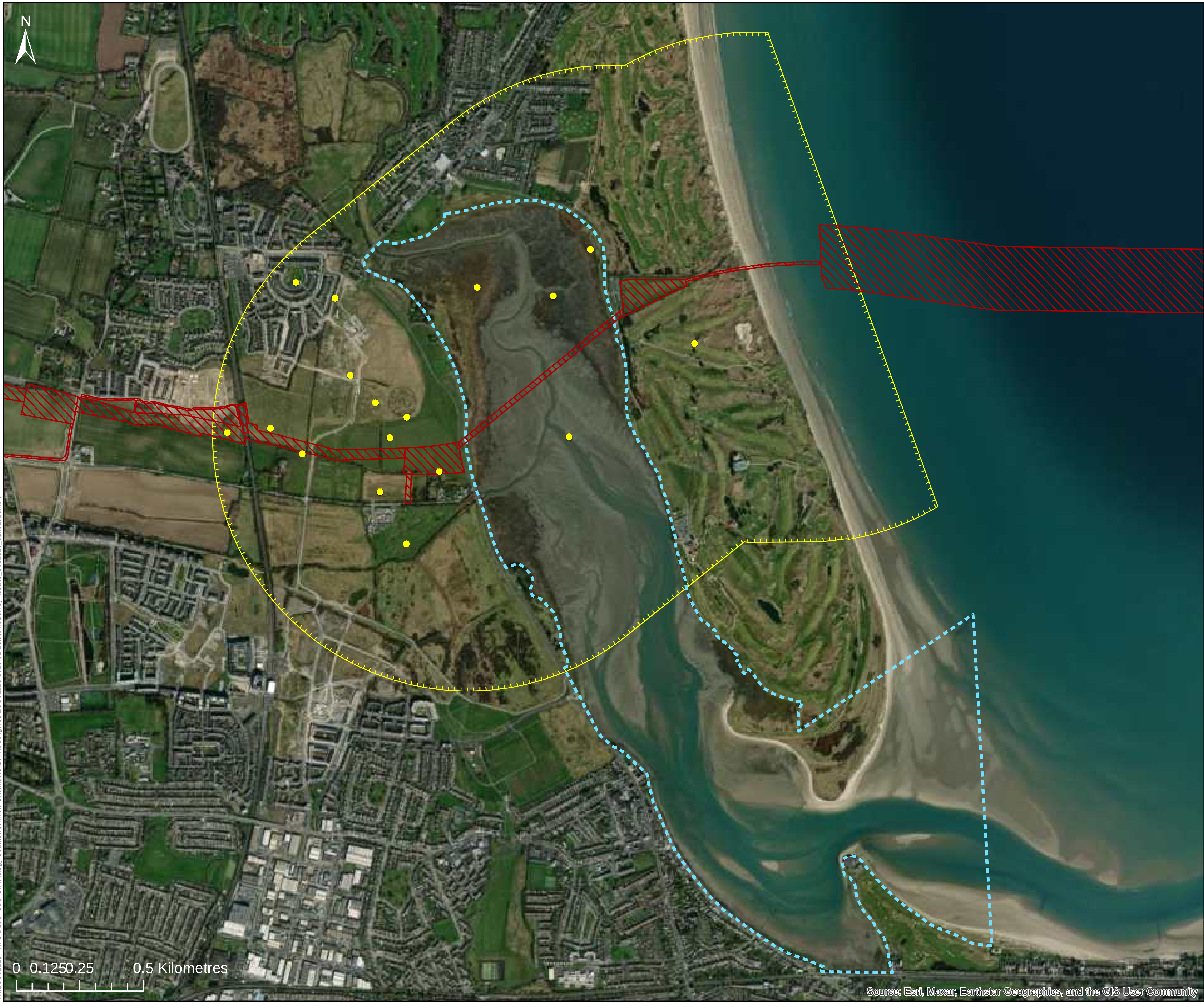
**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Buzzard

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.7**
**Buzzard**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Carrion Crow


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.8**
**Carrion Crow**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Chaffinch


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.9**
**Chaffinch**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Common Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.10**
**Common Gull**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Common Sandpiper

Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

Title

**Figure A10.11**
**Common Sandpiper Records in Baldoyle Bay (September 2020 to June 2023)**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: | |
|---|---|---|---|
| S0 | P01 | | |
| Drawn: KAG | | Date: | 05/07/2023 |
| Checked: KT | | Scale: | 1:14,000 @A3 |
| Approved: KT | | Projection: | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Common Scoter


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.12**
**Common Scoter**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:**
ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** KAG | | **Date:** | 05/07/2023 |
| **Checked:** KT | | **Scale:** | 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391
© Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Common Tern


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

Title

**Figure A10.13**
**Common Tern**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

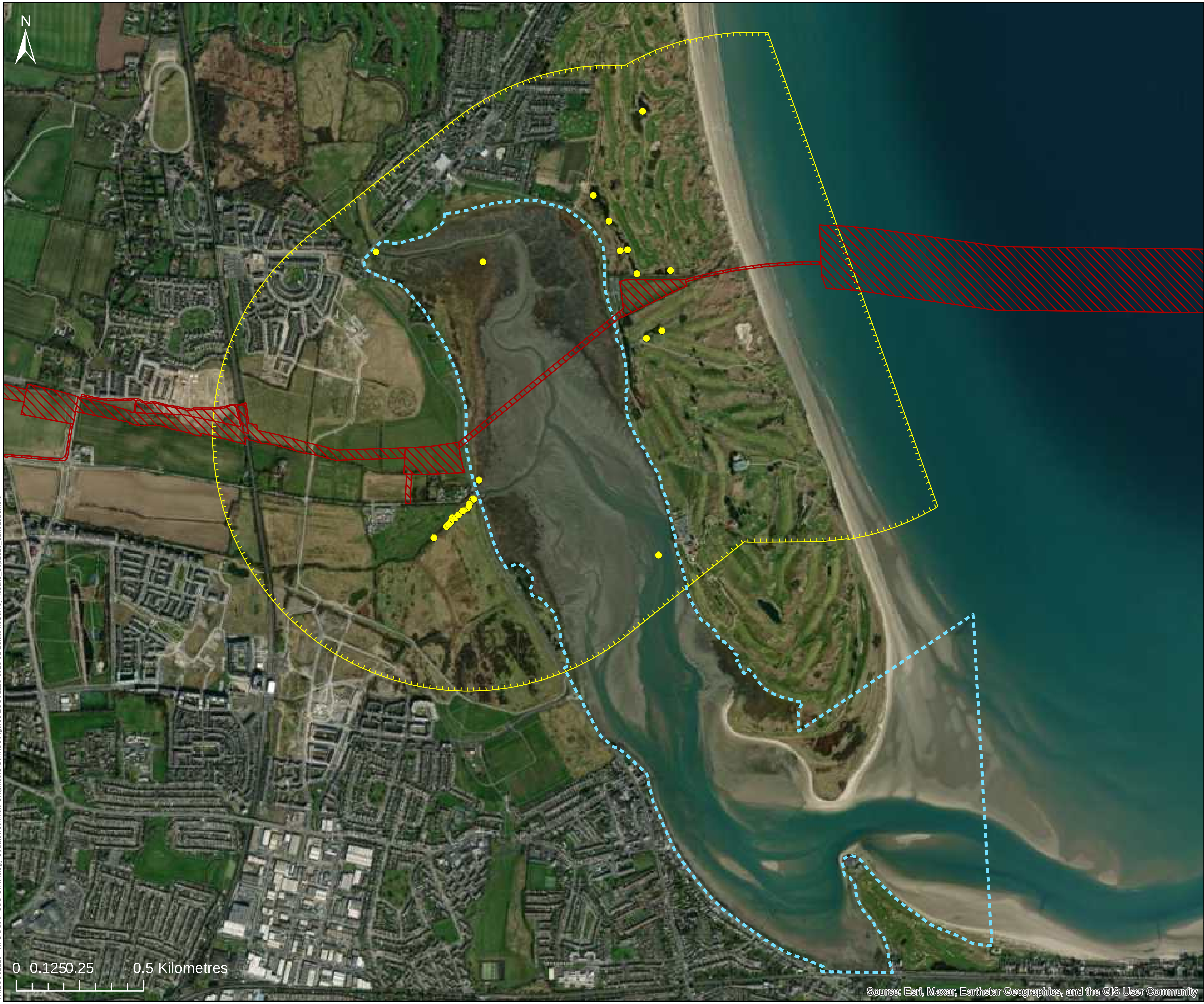
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Coot


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.14**
**Coot**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Cormorant


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.15**
**Cormorant**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

**File Identifier:**
ECO02228-0023-01

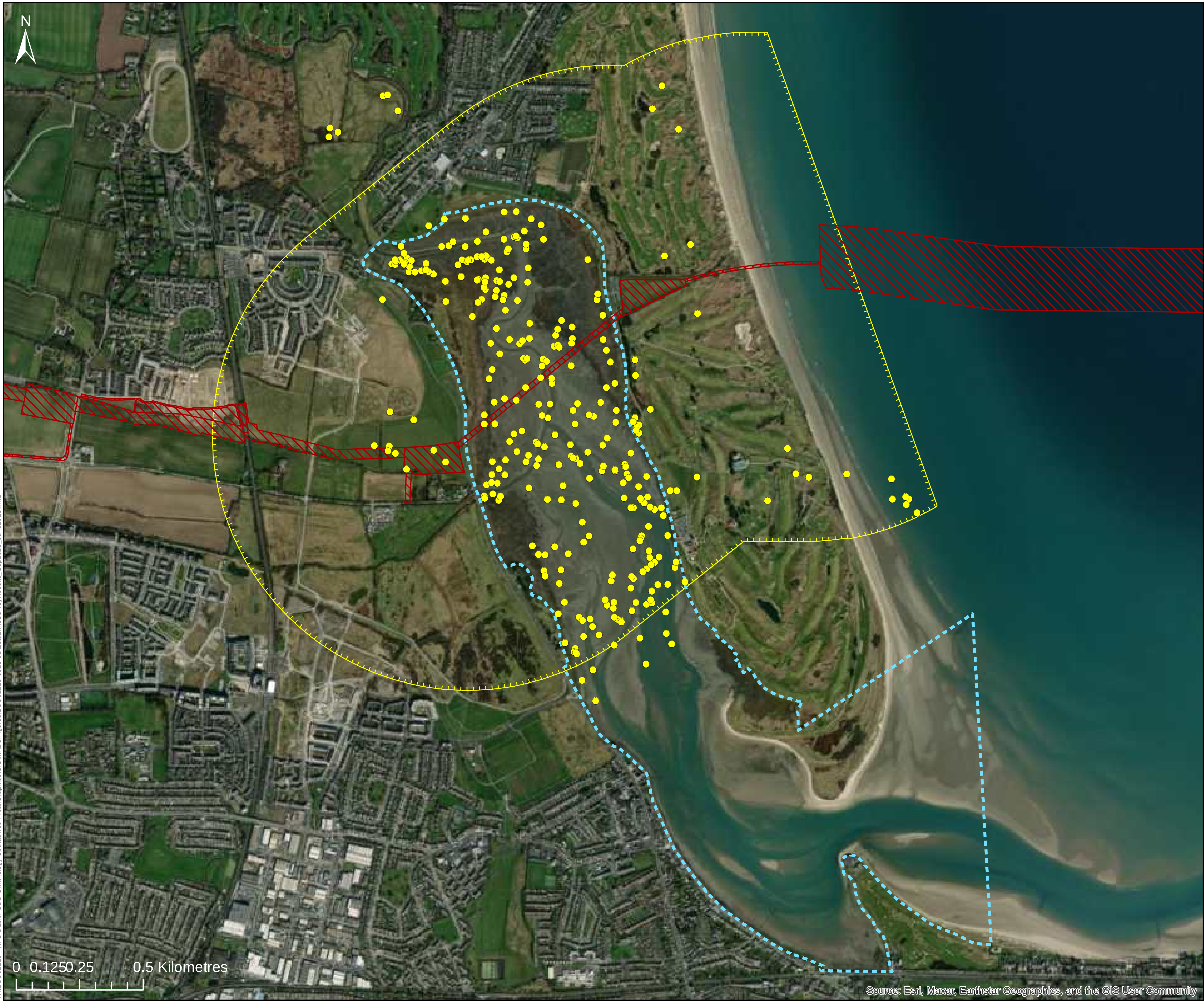
| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** KAG | | **Date:** | 05/07/2023 |
| **Checked:** KT | | **Scale:** | 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391
© Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Curlew


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.16**
**Curlew**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Dark-bellied Brent Goose


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.17**
**Dark-bellied Brent Goose Records in Baldoyle Bay (September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

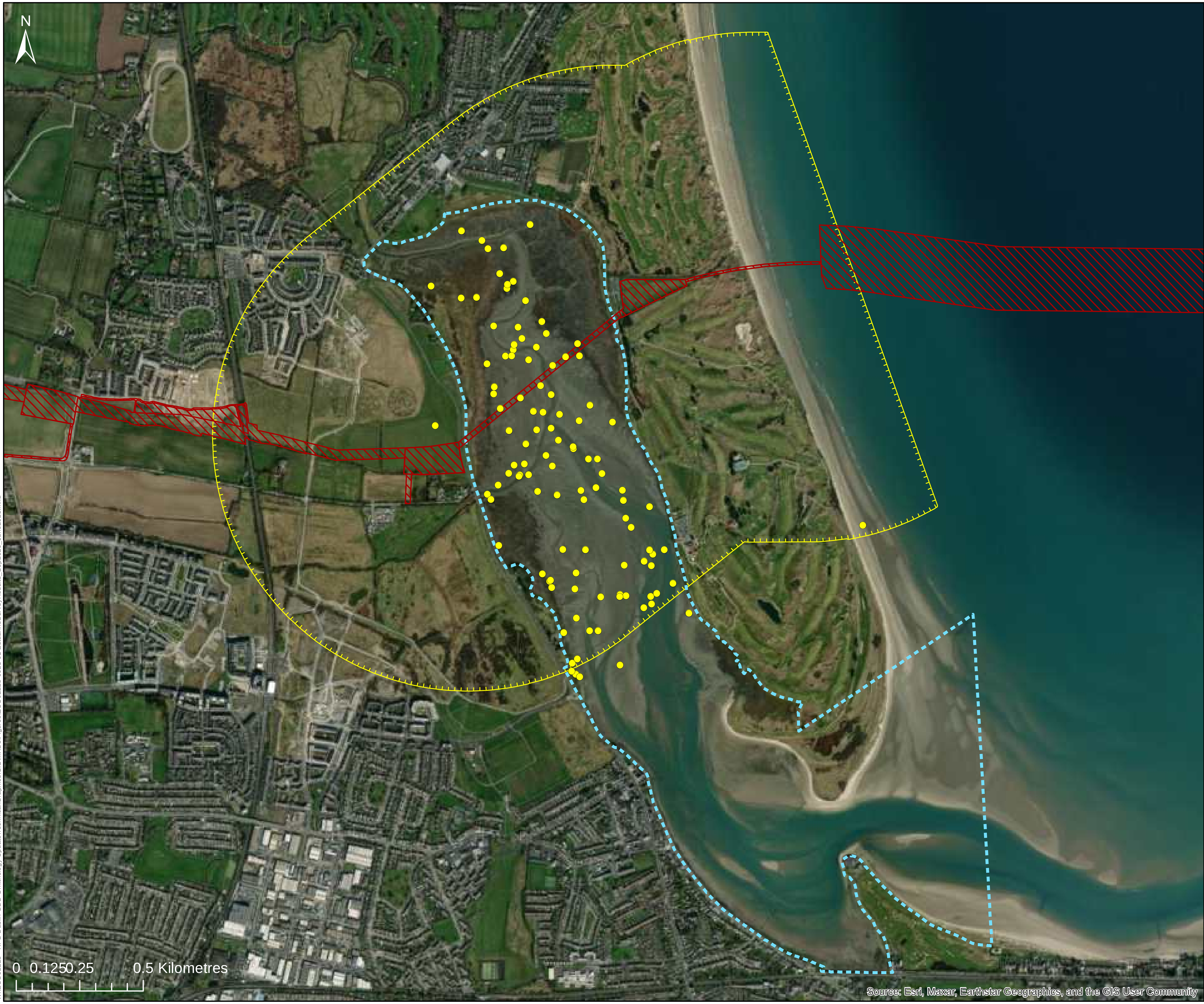
| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Dunlin


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.18**
**Dunlin**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Feral Pigeon


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.19**
**Feral Pigeon**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Gannet


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.20**
**Gannet**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**


Legend
- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Golden Plover

Client

Uisce Éireann

**Greater Dublin Drainage Project**

Title

**Figure A10.21**
**Golden Plover**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

Issue Details

| | | |
|---|---|---|
| File Identifier: ECO02228-0023-01 | | |
| Status: S0 | Rev: P01 | Model File Identifier: |
| Drawn: KAG | | Date: 05/07/2023 |
| Checked: KT | | Scale: 1:14,000 @A3 |
| Approved: KT | | Projection: ITM |

NOTE:
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

Title

**Figure A10.22**
**Goldfinch**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Great Black-backed Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.23**
**Great Black-backed Gull Records in Baldoyle Bay (September 2020 to June 2023)**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd



**Client**

## Uisce Éireann

**Greater Dublin Drainage Project**

**Title**

**Figure A10.24**
**Great Crested Grebe Records in Baldoyle Bay (September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Greenshank


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.25**
**Greenshank**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

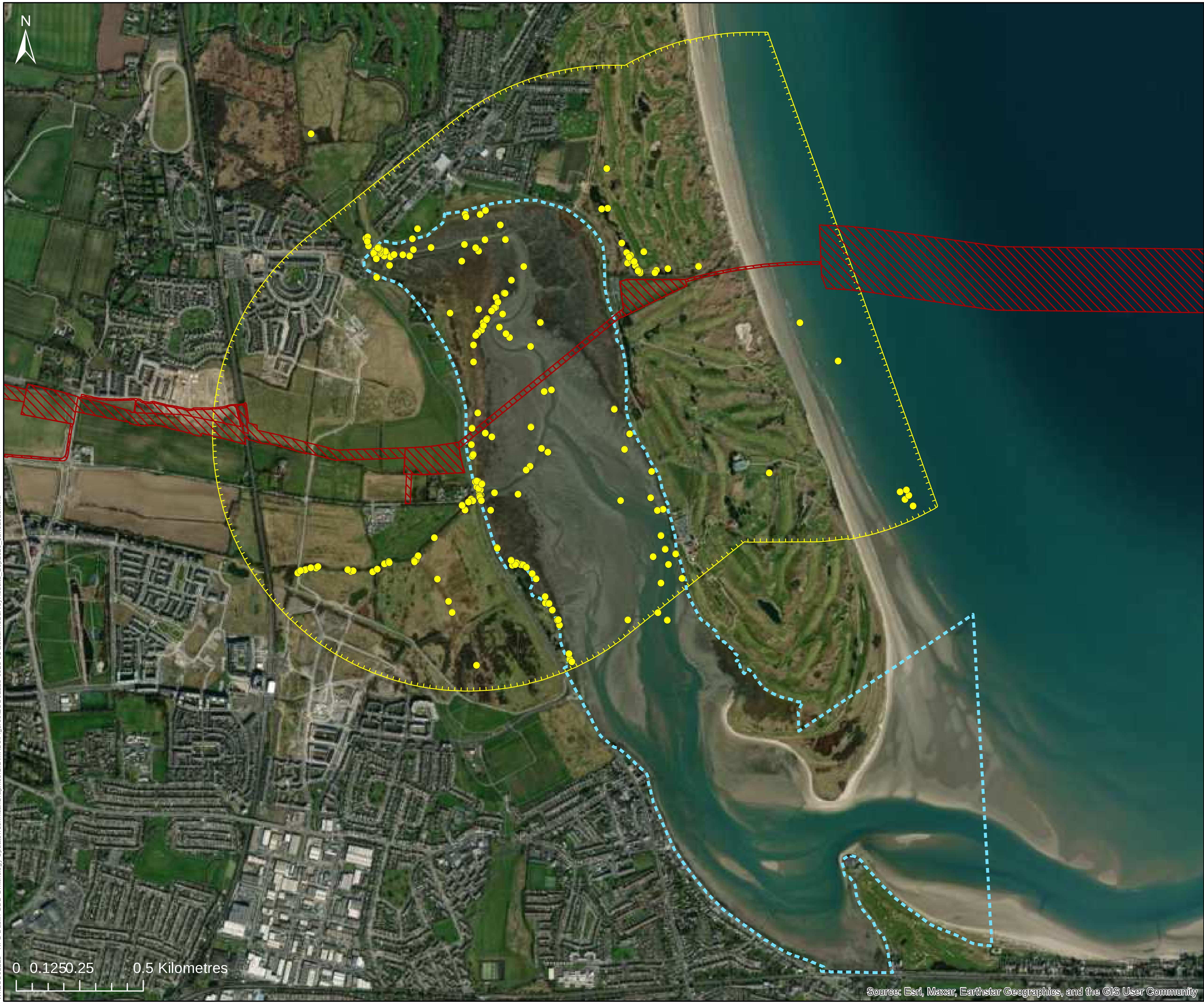
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Grey Heron


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.26**
**Grey Heron**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


rps

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd



## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Grey Plover

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.27**
**Grey Plover**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** KAG | | **Date:** 05/07/2023 | |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Guillemot

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.28**
**Guillemot**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

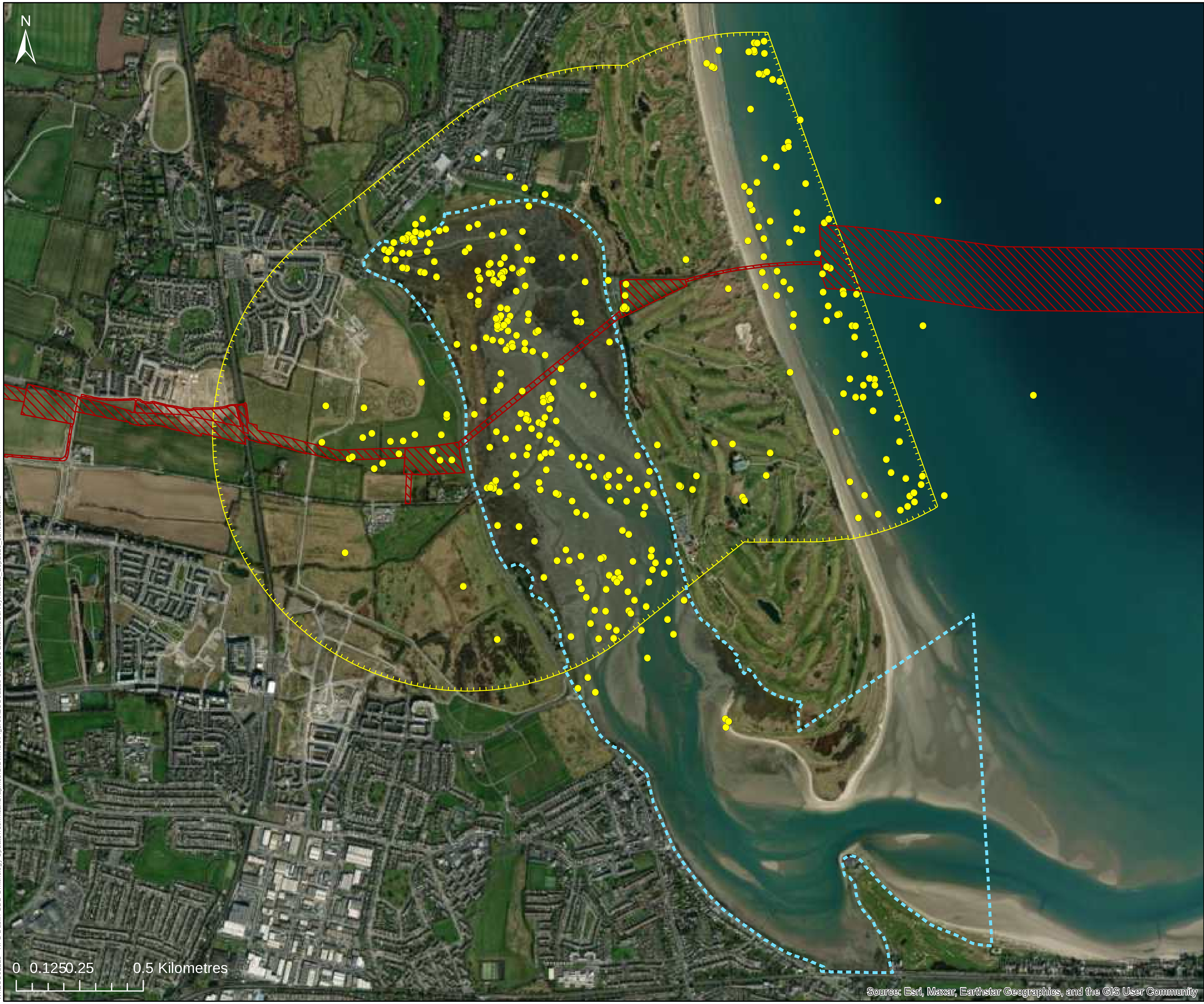
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Herring Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.29**
**Herring Gull**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

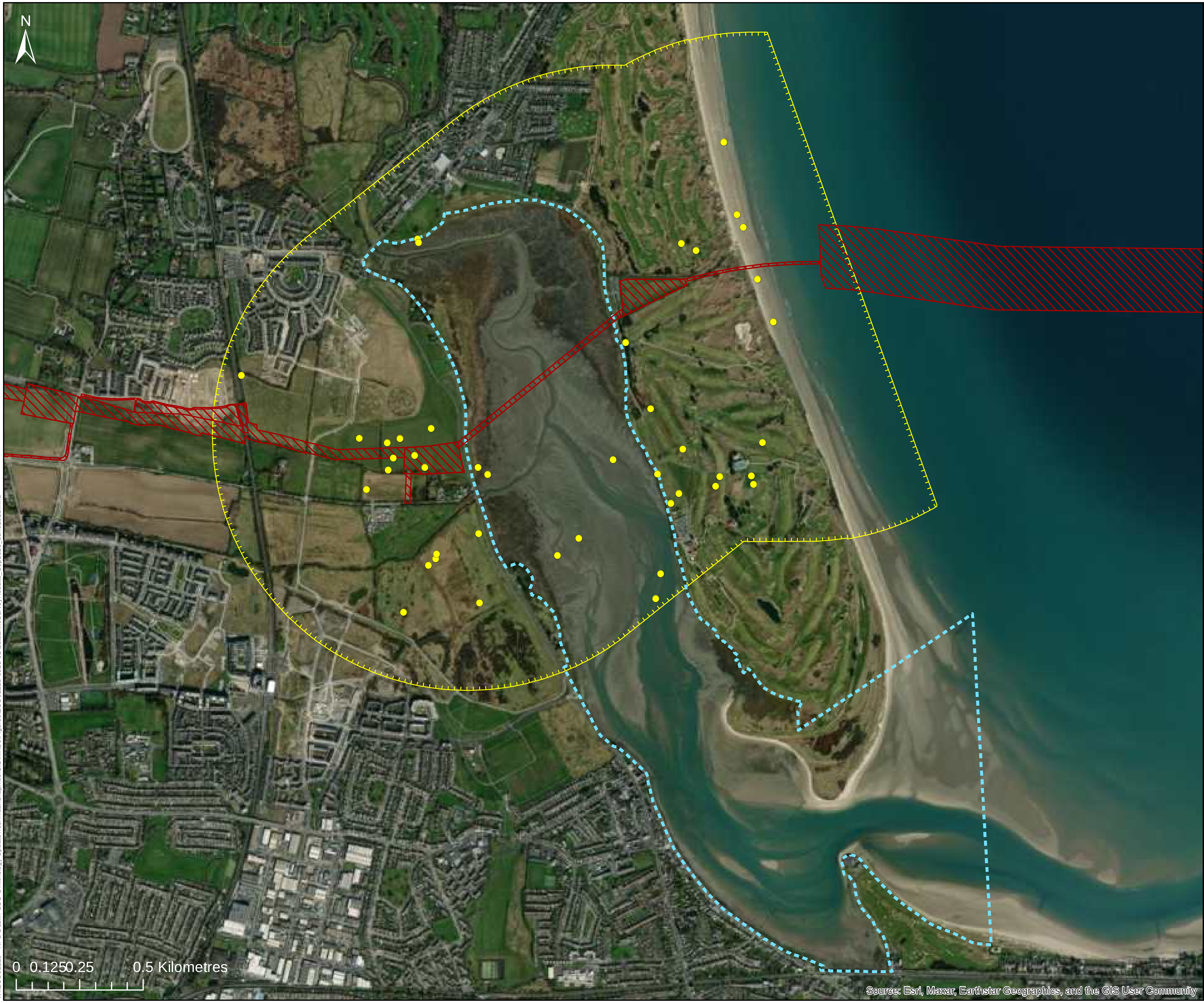
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Hooded Crow


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.30**
**Hooded Crow**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 05/07/2023 | |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- House Martin


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.31**
**House Martin**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Jackdaw

© OpenStreetMap (and) contributors, CC-BY-SA

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.32**
**Jackdaw**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
|---|---|---|
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Kestrel


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.33**
**Kestrel**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Knot


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.34**
**Knot**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

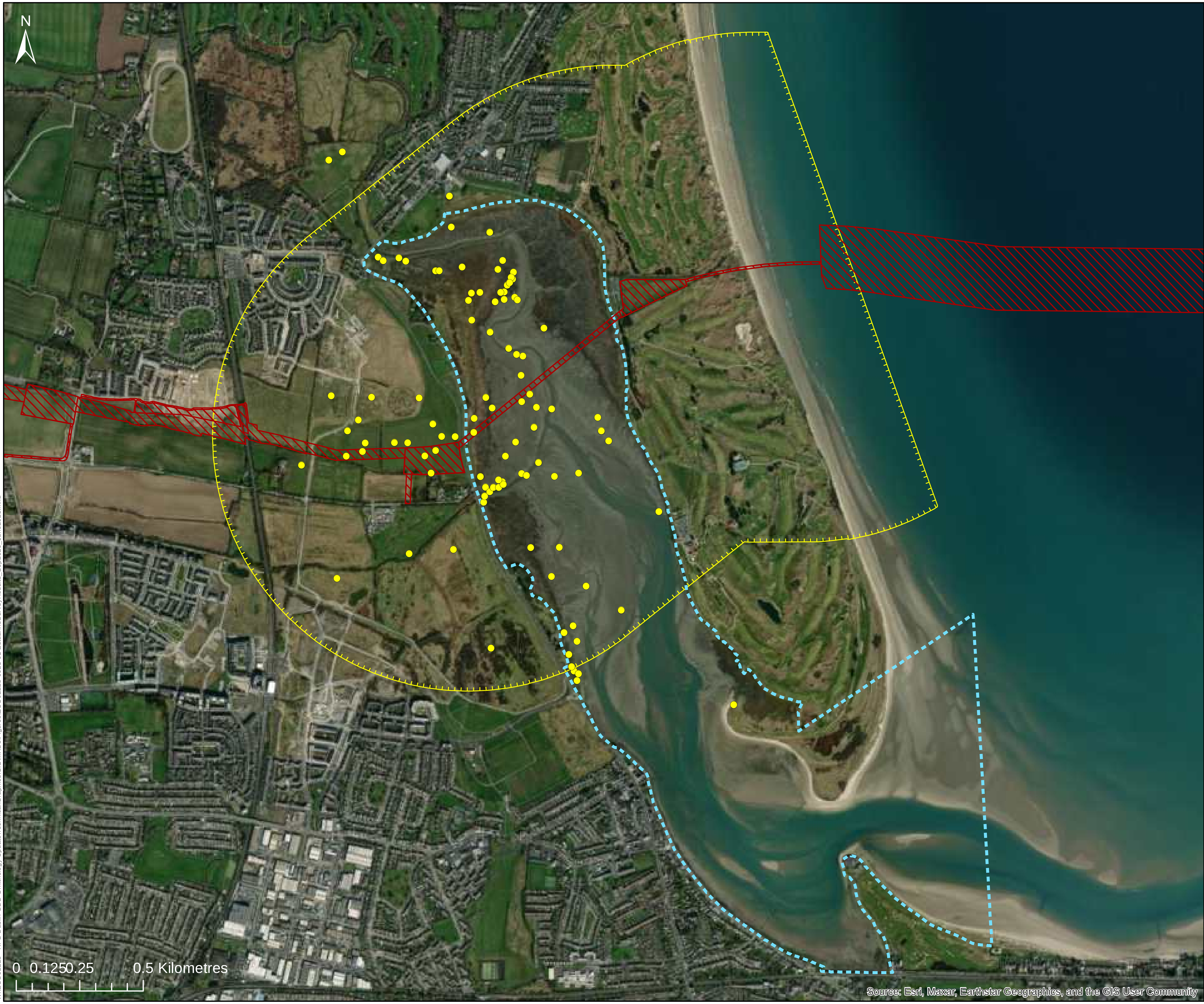
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:**
ECO02228-0023-01

| Status: | Rev: | Model File Identifier: | |
|---|---|---|---|
| S0 | P01 | | |
| Drawn: KAG | | Date: | 05/07/2023 |
| Checked: KT | | Scale: | 1:14,000 @A3 |
| Approved: KT | | Projection: | ITM |

**NOTE:**




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Lapwing


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.35**
**Lapwing**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Lesser Black-backed Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.36**
**Lesser Black-backed Gull Records in Baldoyle Bay (September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: | |
|---|---|---|---|
| S0 | P01 | | |
| Drawn: KAG | | Date: | 05/07/2023 |
| Checked: KT | | Scale: | 1:14,000 @A3 |
| Approved: KT | | Projection: | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.37**
**Linnet**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

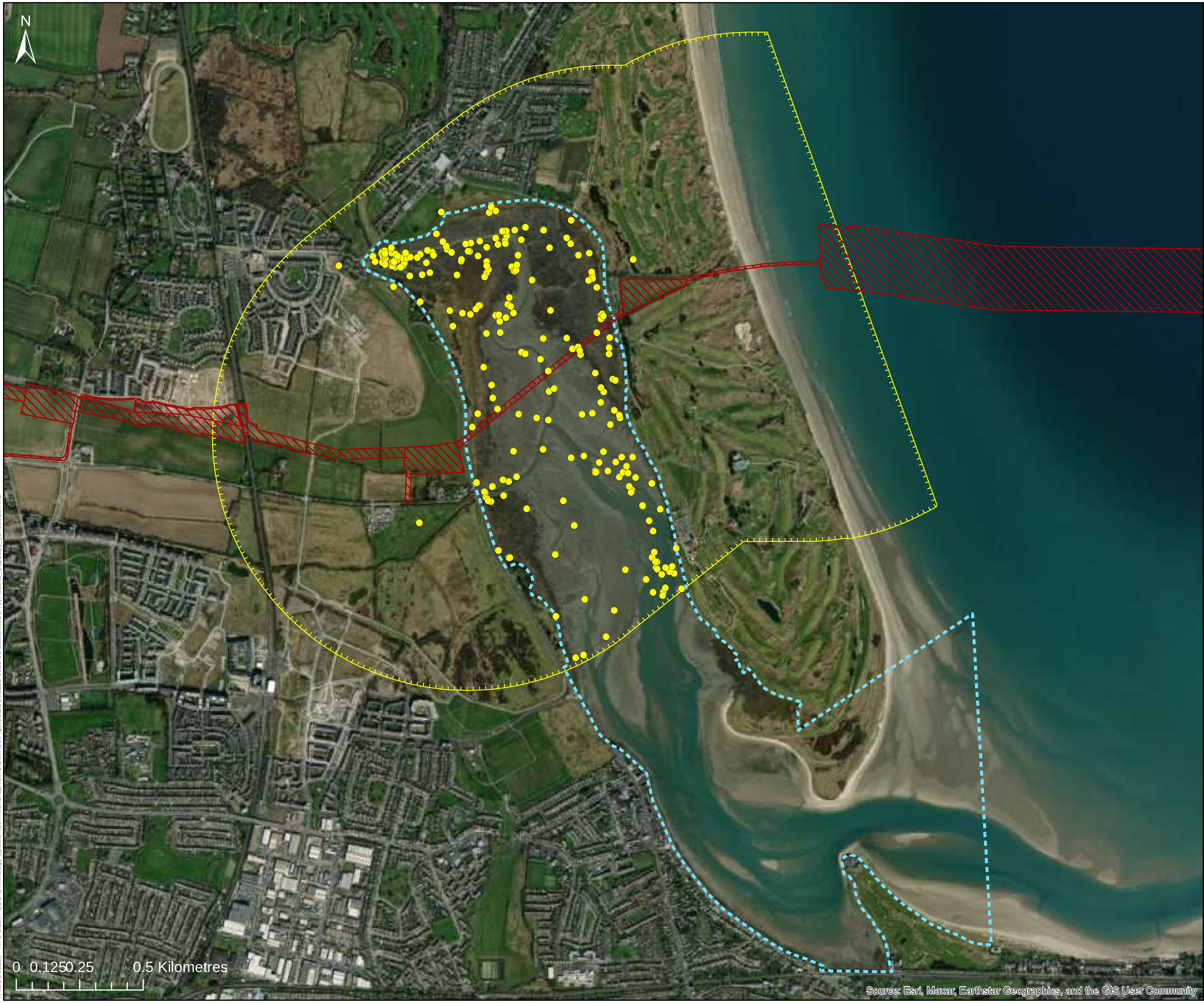
**File Identifier:** ECO02228-0023-01

| | | |
|---|---|---|
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Little Egret

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.38**
**Little Egret**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Little Grebe


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.39**
**Little Grebe**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391
© Ordnance Survey Ireland/Government of Ireland.


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Magpie


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.40**
**Magpie**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

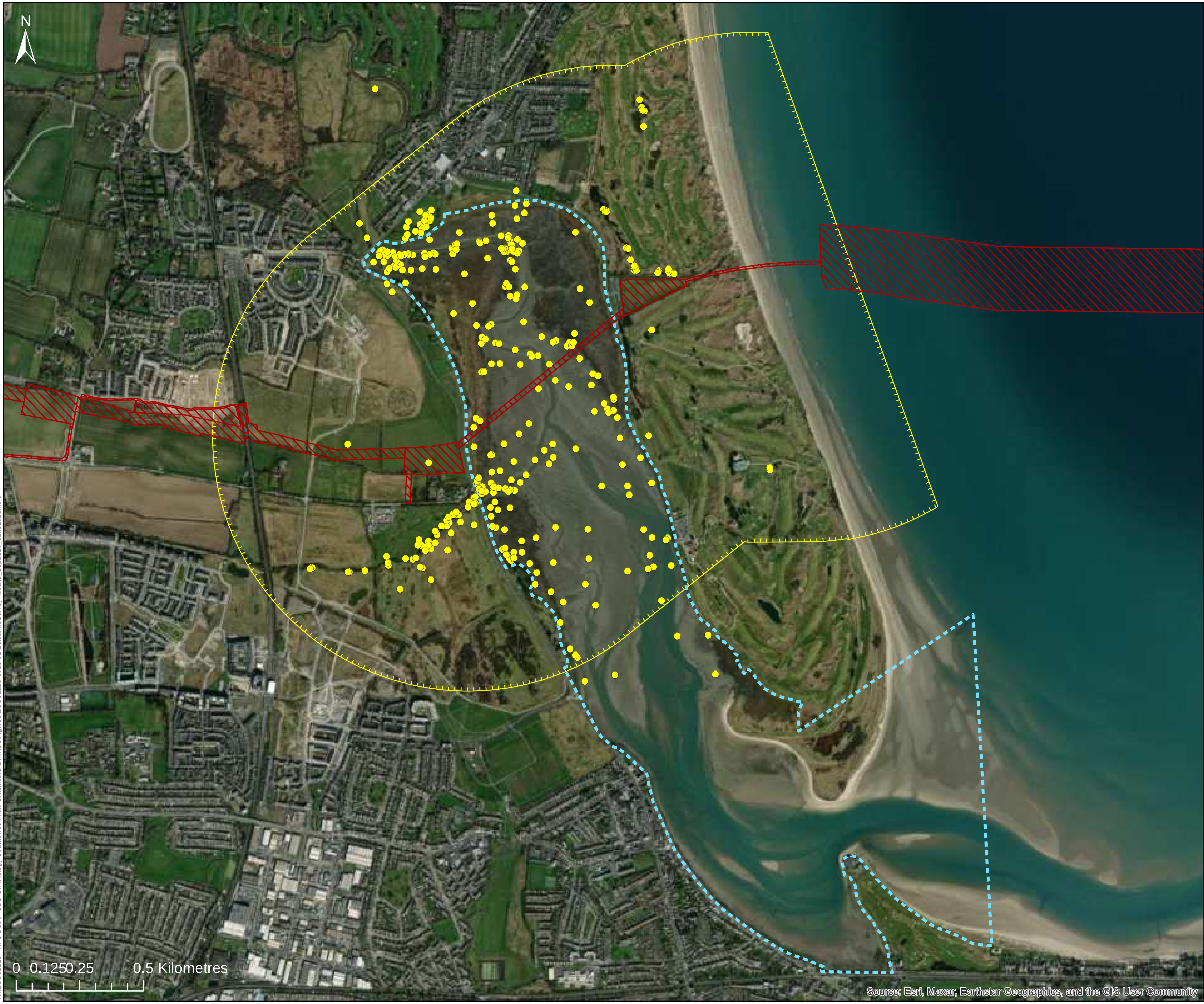
rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| | | |
|---|---|---|
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Mallard


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.41**
**Mallard**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

**T** +44(0)131 555 5011
**E** rpsed2@rpsgroup.com
**W** rpsgroup.com

**Issue Details**

**File Identifier:**
ECO02228-0023-01

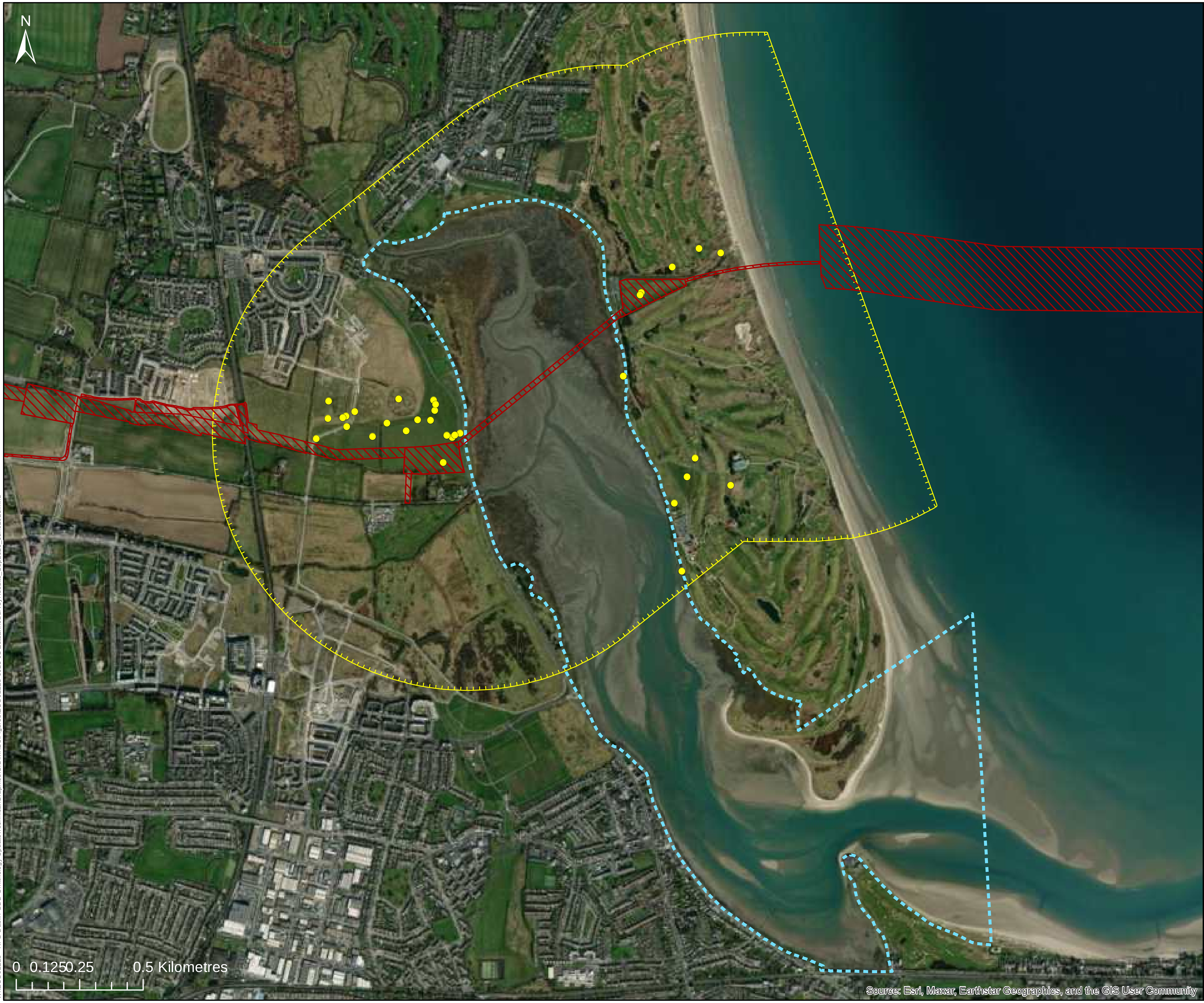
| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | |
|---|---|
| **Drawn:** KAG | **Date:** 05/07/2023 |
| **Checked:** KT | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Meadow Pipit

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.42**
**Meadow Pipit**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Mediterranean Gull


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.43**
**Mediterranean Gull**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

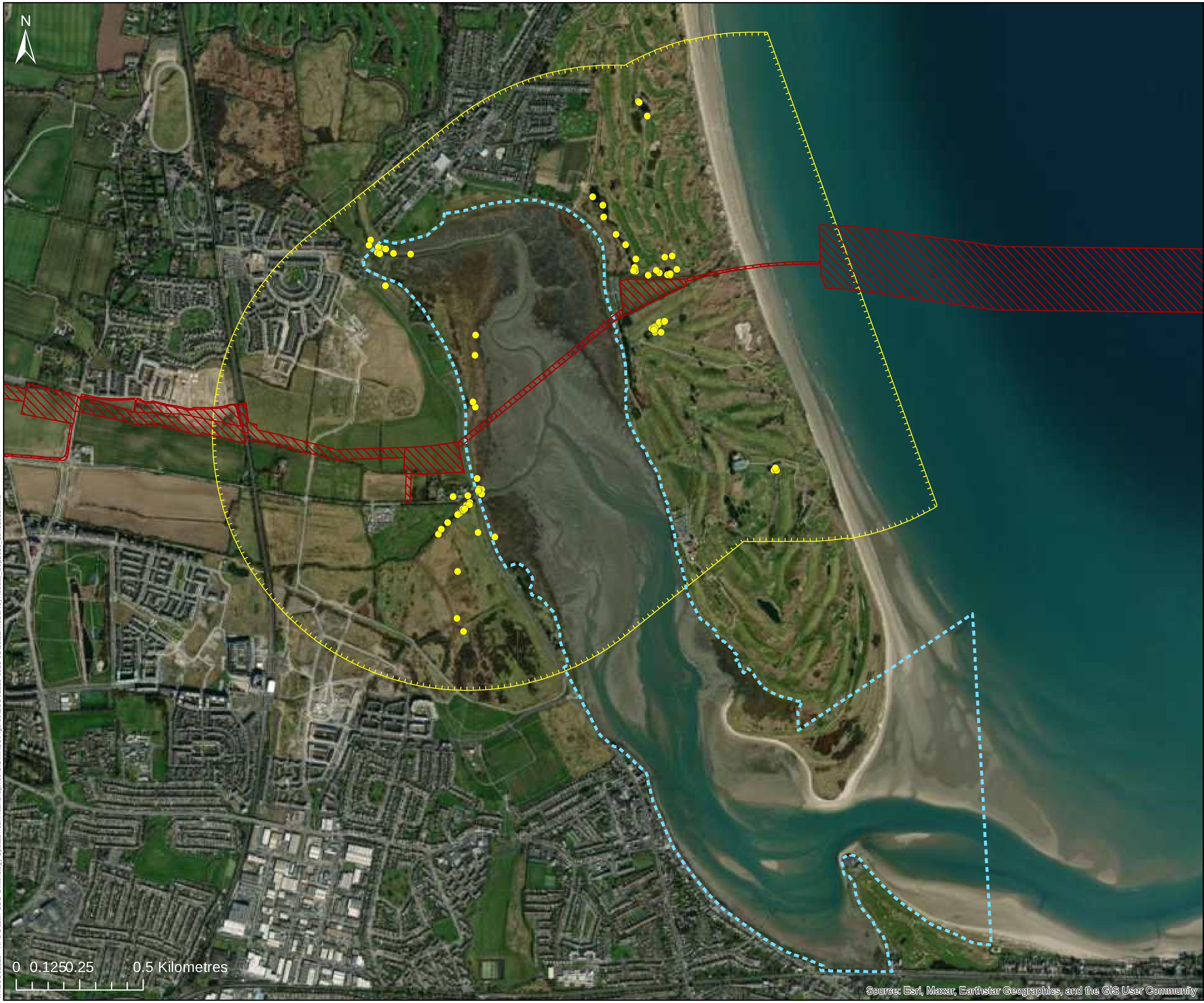
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Moorhen

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.44**
**Moorhen**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Mute Swan


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.45**
**Mute Swan**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

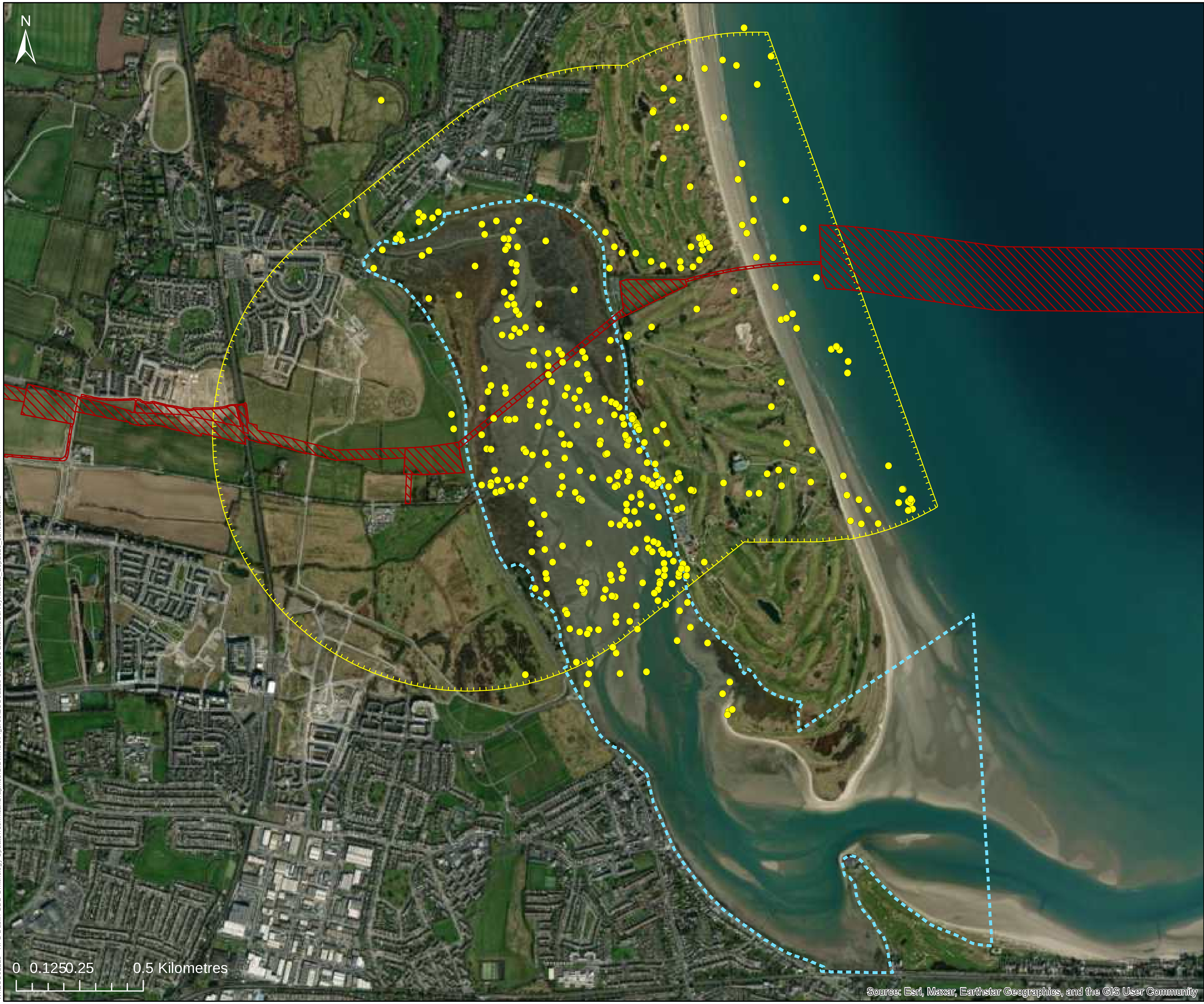

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Oystercatcher


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.46**
**Oystercatcher**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Pale-bellied Brent Goose


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.47 Pale-bellied Brent Goose Records in Baldoyle Bay (September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Pied Wagtail


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.48**
**Pied Wagtail**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Pintail

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.49**
**Pintail**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | |
|---|---|
| **Drawn:** KAG | **Date:** 05/07/2023 |
| **Checked:** KT | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Pochard


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.50**
**Pochard**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Raven


**Client**

## Uisce Éireann

**Greater Dublin Drainage Project**

**Title**

**Figure A10.51**
**Raven**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

**T** +44(0)131 555 5011
**E** rpsed2@rpsgroup.com
**W** rpsgroup.com

**Issue Details**

| | |
|---|---|
| **File Identifier:** ECO02228-0023-01 | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 |
| **Checked:** KT | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Razorbill


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.52**
**Razorbill**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:**
ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Red-breasted Merganser


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.53 Red-breasted Merganser Records in Baldoyle Bay (September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

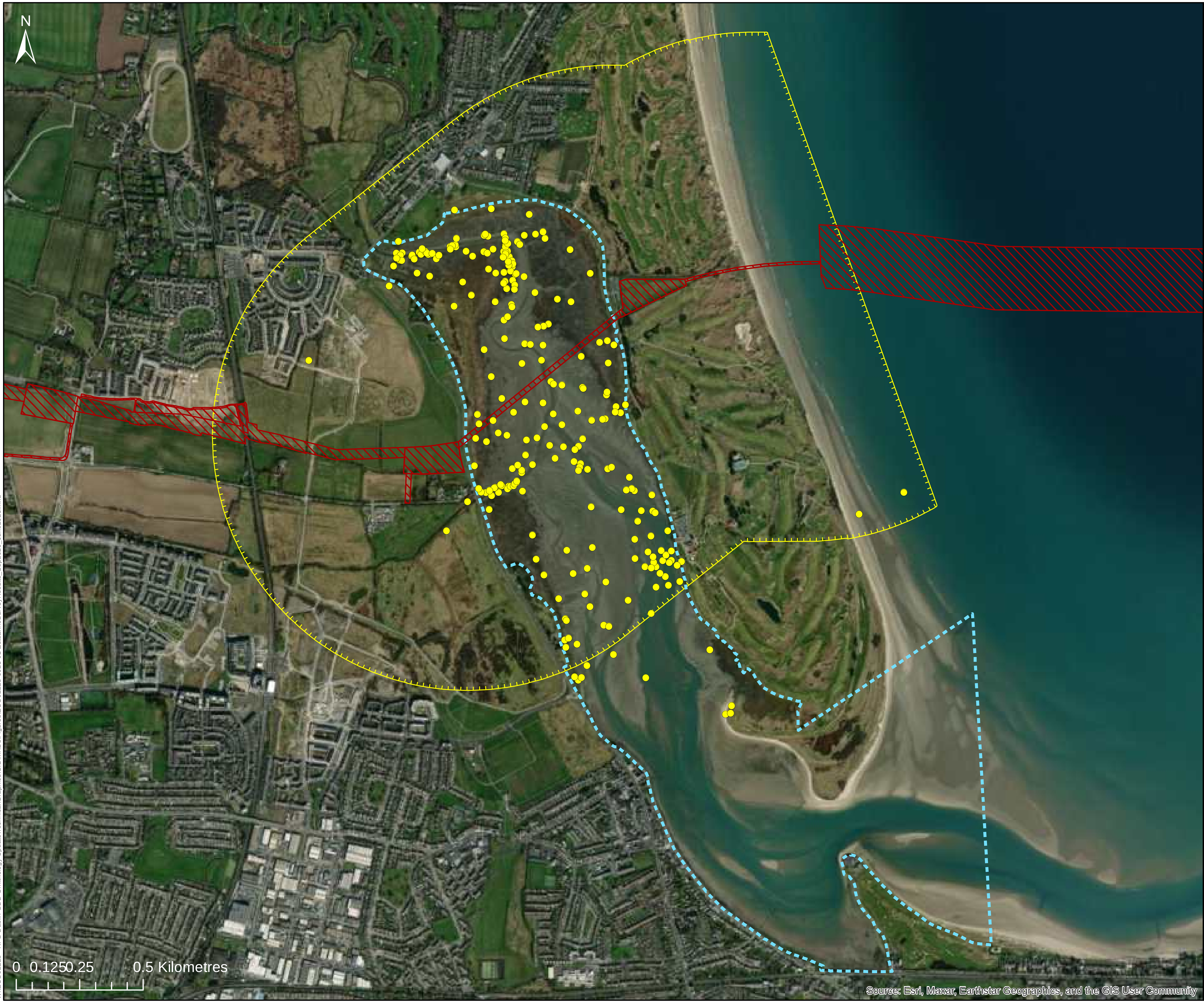
**File Identifier:** ECO02228-0023-01

| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
|---|---|---|
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Redshank


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.54**
**Redshank**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Red-throated Diver


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.55 Red-throated Diver Records in Baldoyle Bay (September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Reed Bunting


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.56**
**Reed Bunting**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

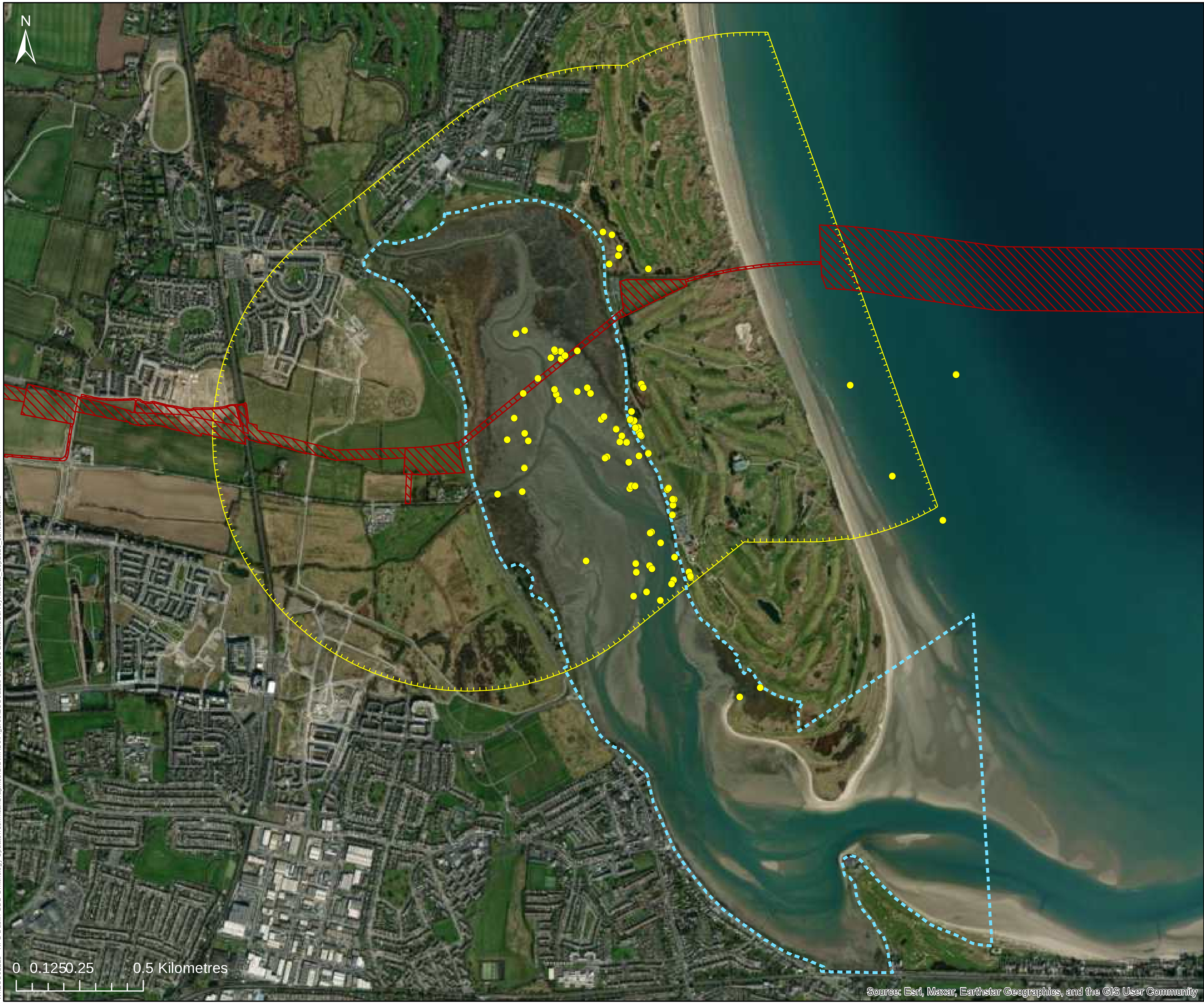
**Issue Details**

**File Identifier:** ECO02228-0023-01

| **Status:** | **Rev:** | **Model File Identifier:** | |
|---|---|---|---|
| S0 | P01 | | |
| **Drawn:** KAG | | **Date:** 05/07/2023 | |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Ringed Plover


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.57**
**Ringed Plover**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

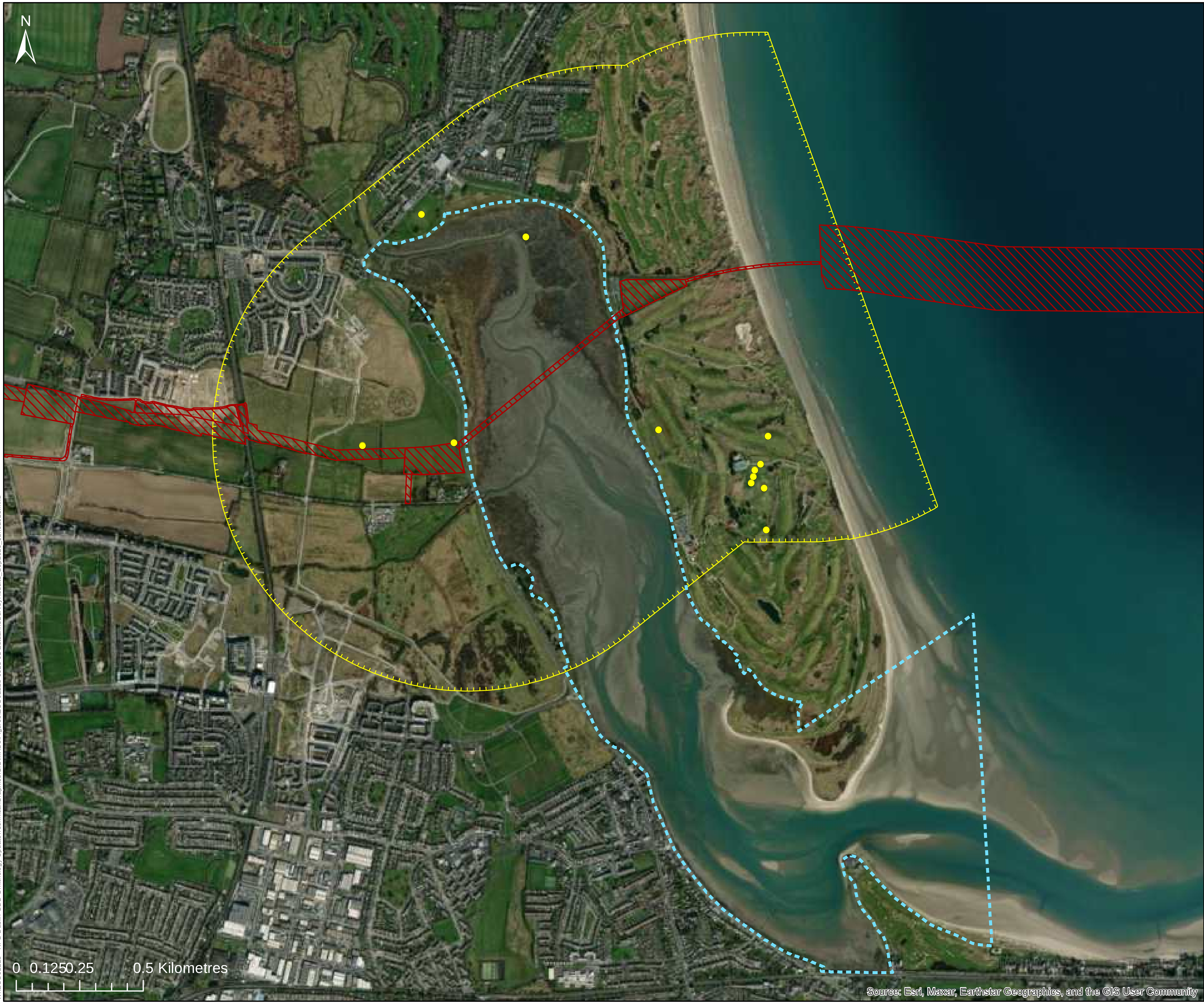
**File Identifier:** ECO02228-0023-01

| | | |
|---|---|---|
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd





**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.58**
**Rook**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: S0 | Rev: P01 | Model File Identifier: |
|---|---|---|
| Drawn: KAG | | Date: 05/07/2023 |
| Checked: KT | | Scale: 1:14,000 @A3 |
| Approved: KT | | Projection: ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Ruff


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.59**
**Ruff**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Sand Martin


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.60**
**Sand Martin**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391
© Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Sanderling


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.61**
**Sanderling**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Sandwich Tern


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.62**
**Sandwich Tern**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 05/07/2023 | |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**


## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Shag


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.63**
**Shag**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

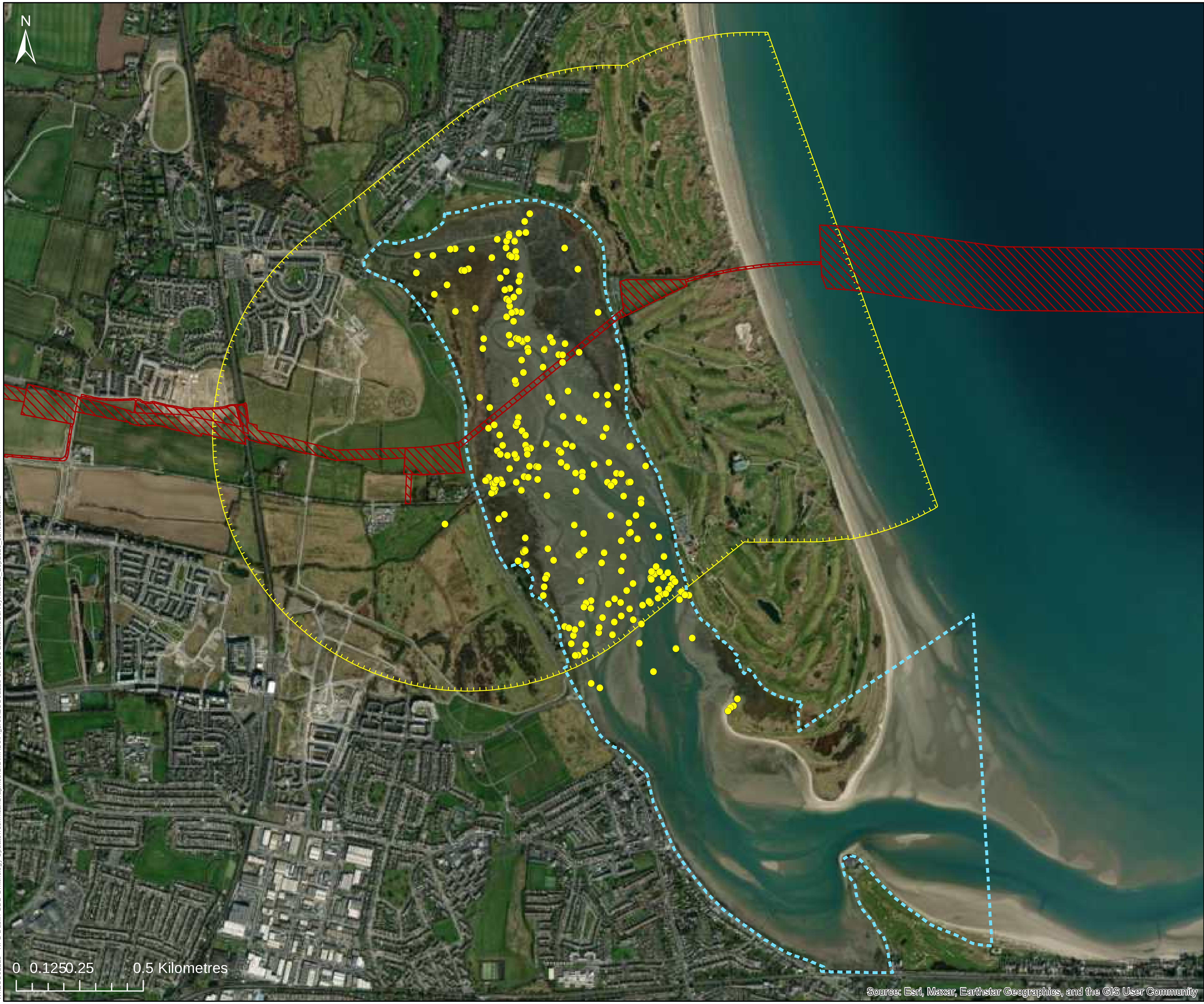
**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Shelduck


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.64**
**Shelduck**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Sky Lark
- Skylark


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.65**
**Sky Lark**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

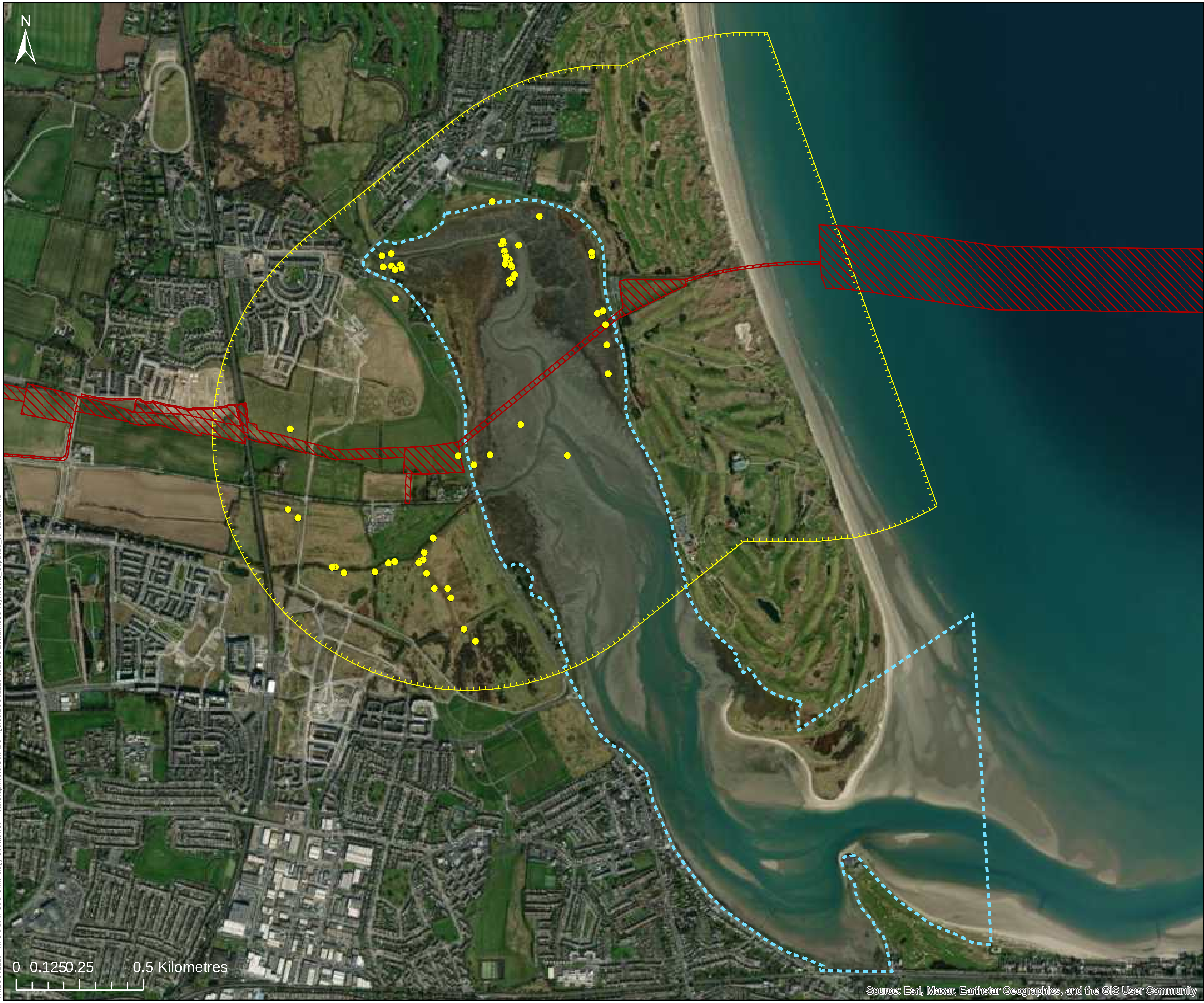
rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| | | |
|---|---|---|
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Snipe

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.66**
**Snipe**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

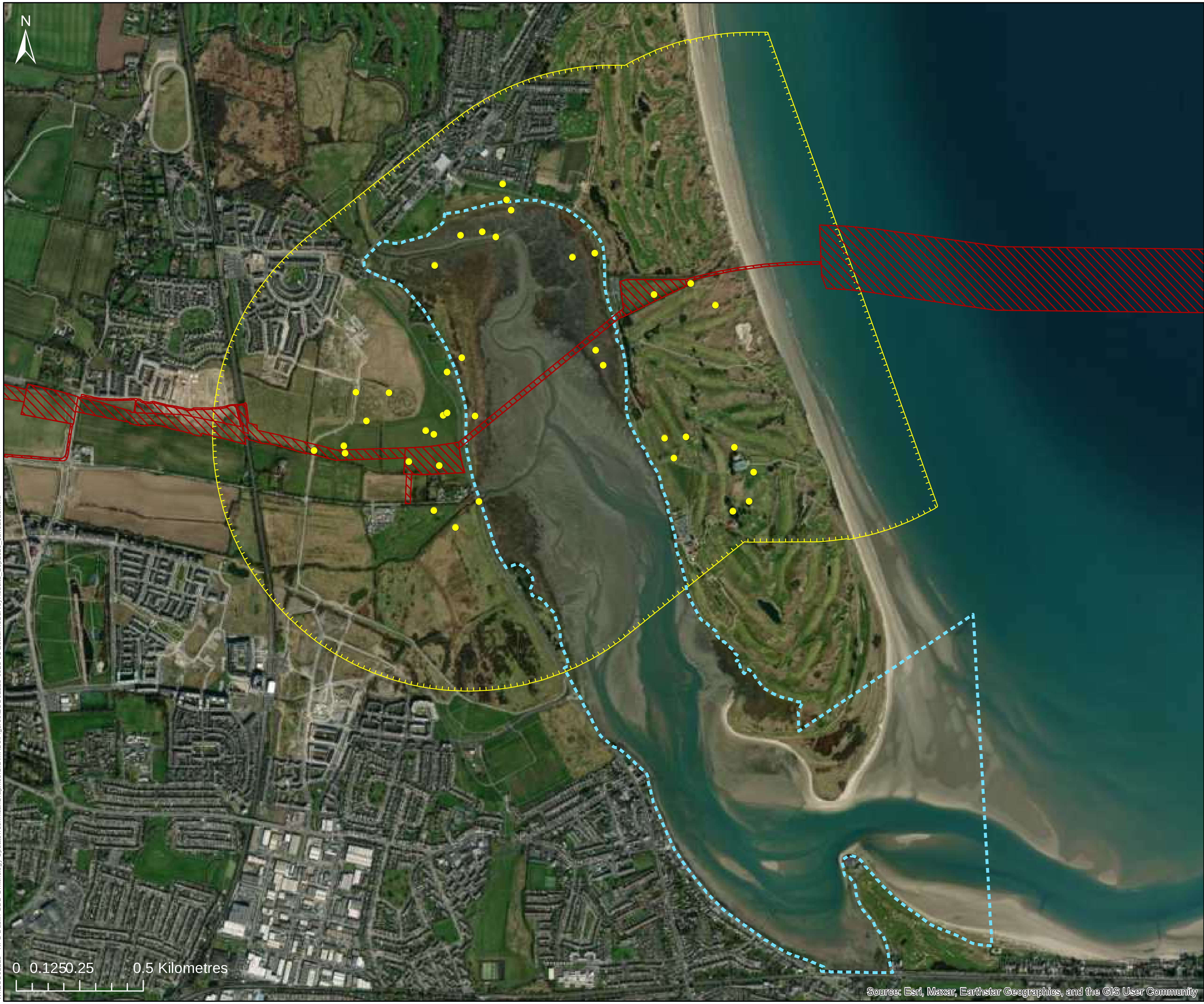
| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd

## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Starling


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

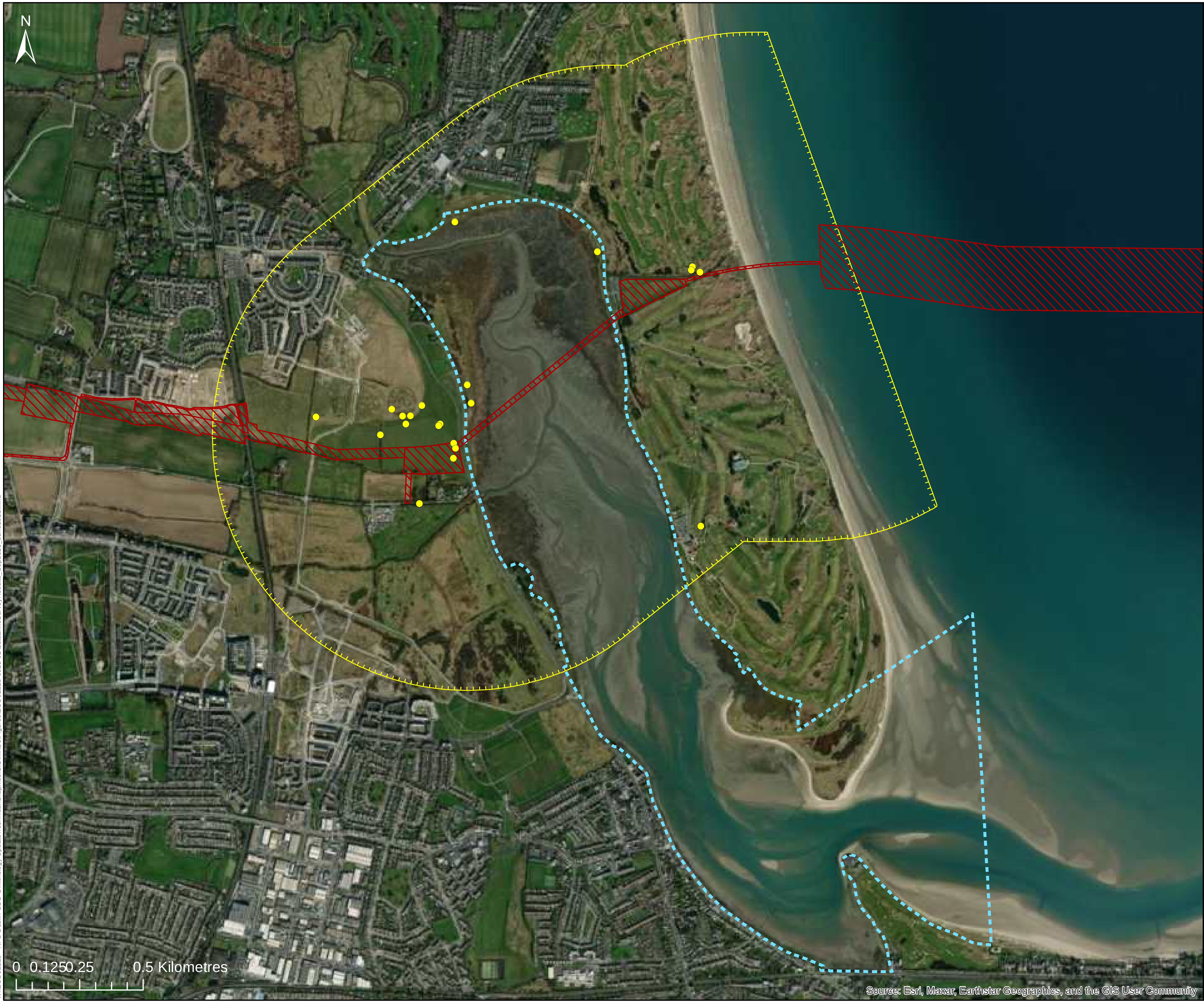
**Figure A10.67**
**Starling**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | **Date:** 05/07/2023 | |
| **Checked:** KT | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | **Projection:** ITM | |

**NOTE:**




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Stonechat

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.68**
**Stonechat**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

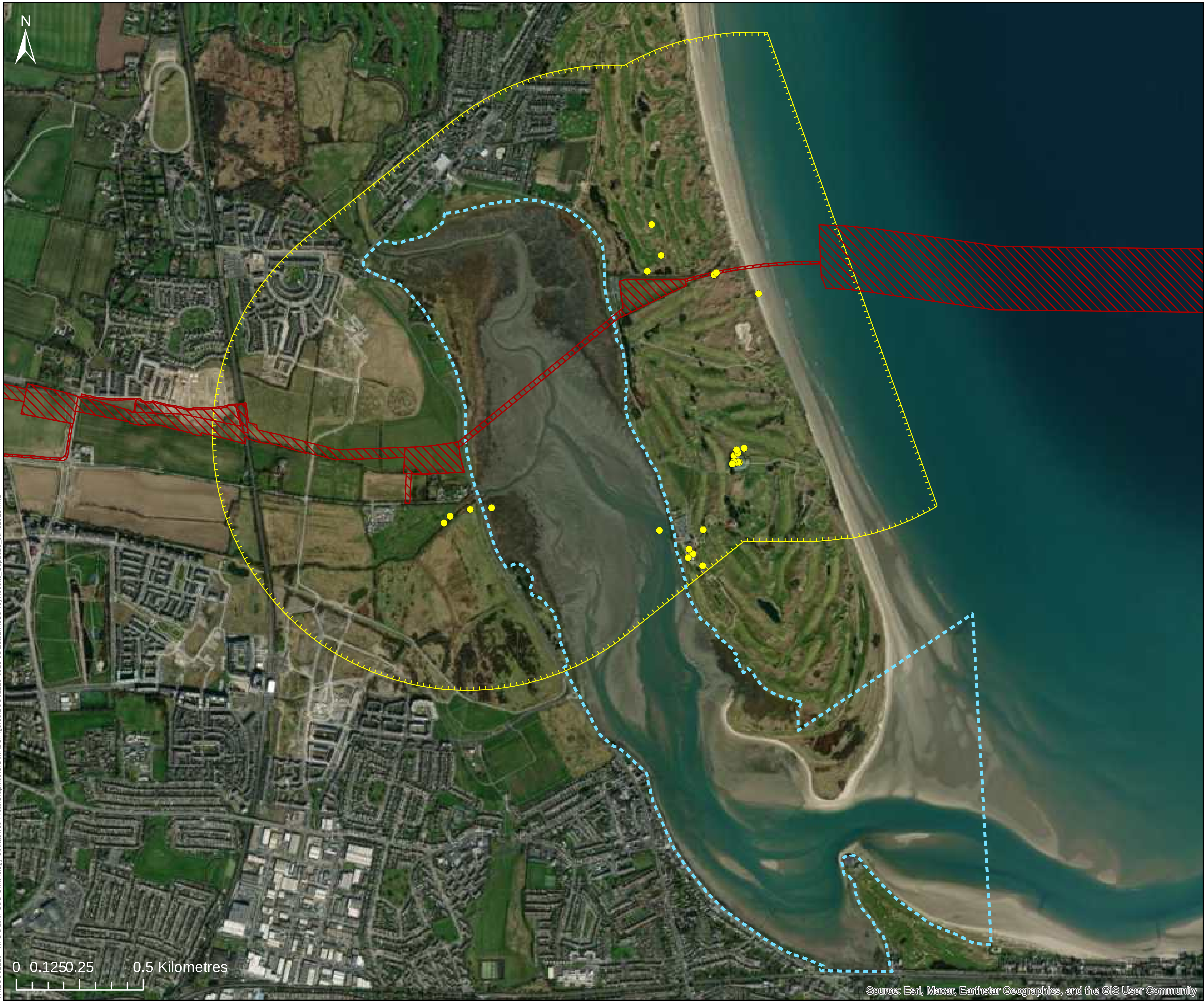
**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |
| Drawn: KAG | Date: 05/07/2023 | |
| Checked: KT | Scale: 1:14,000 @A3 | |
| Approved: KT | Projection: ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Swallow


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.69**
**Swallow**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

**T** +44(0)131 555 5011
**E** rpsed2@rpsgroup.com
**W** rpsgroup.com

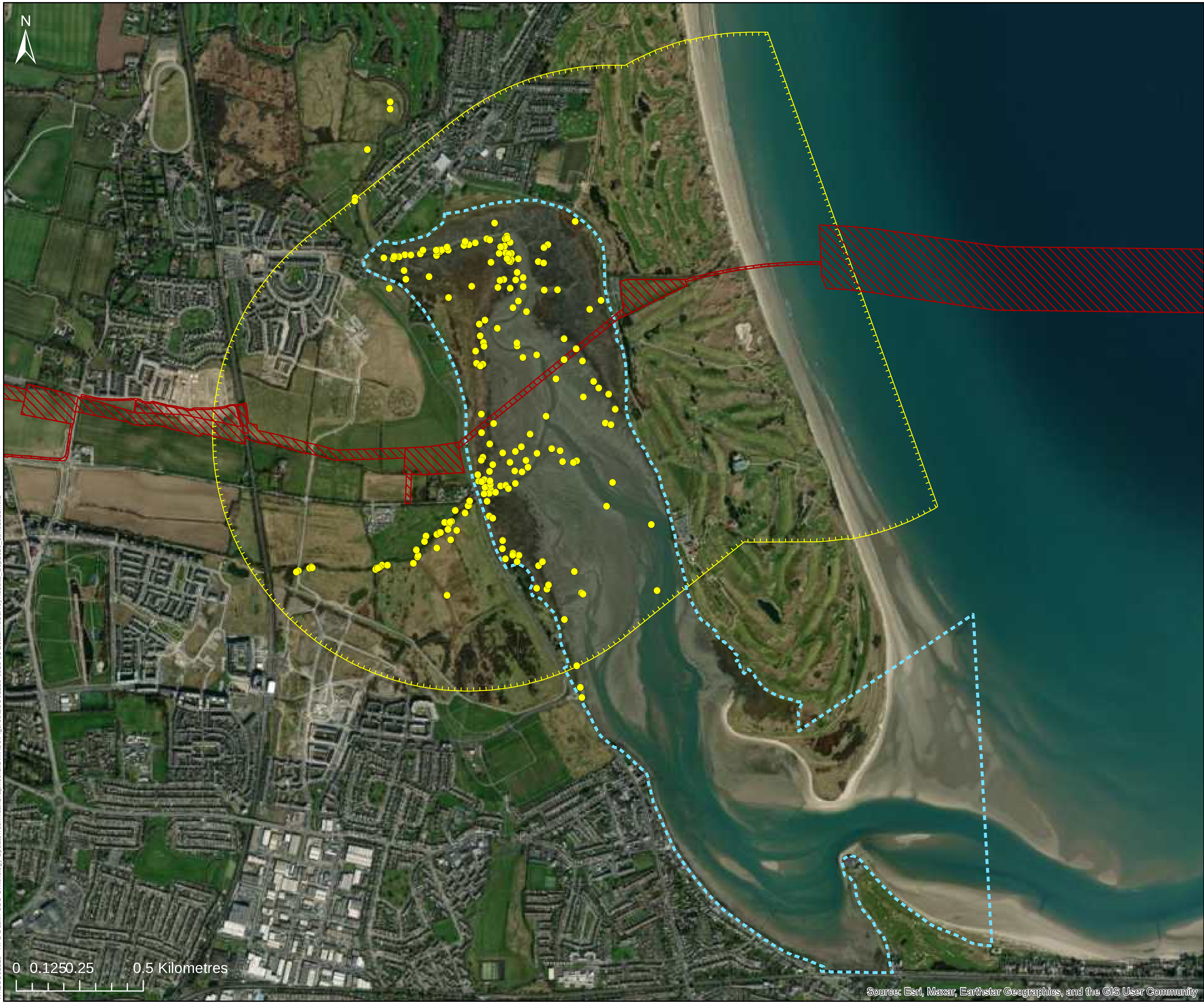
**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 05/07/2023 | |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Teal

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.70**
**Teal**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0023-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 05/07/2023 |
| **Checked:** | KT | **Scale:** | 1:14,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


## Legend
- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Turnstone

© OpenStreetMap (and) contributors, CC-BY-SA

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.71**
**Turnstone**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| File Identifier: | | |
|---|---|---|
| ECO02228-0023-01 | | |
| Status: S0 | Rev: P01 | Model File Identifier: |
| Drawn: KAG | | Date: 05/07/2023 |
| Checked: KT | | Scale: 1:14,000 @A3 |
| Approved: KT | | Projection: ITM |

**NOTE:**


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Whimbrel


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.72**
**Whimbrel**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Wigeon

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.73**
**Wigeon**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**


rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

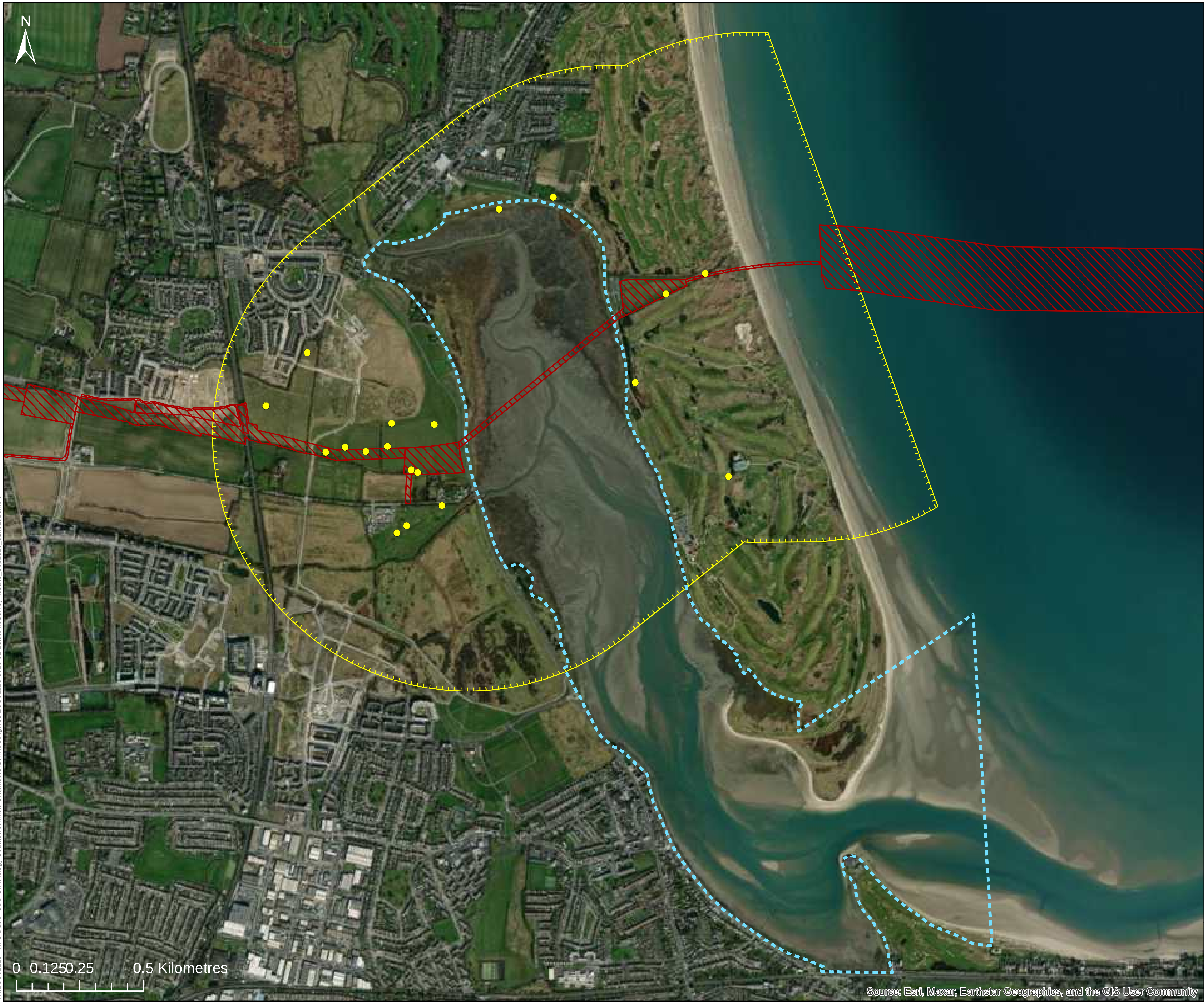

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd




## Legend

- Boundary
- Baldoyle Bay SPA
- RPS estuarine survey area
- Woodpigeon


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.74**
**Woodpigeon**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0023-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 05/07/2023 |
| **Checked:** KT | | **Scale:** 1:14,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0023-01 EstuarineSurveyResults_Sep2020_June2023.mxd


**Legend**

- Boundary
- Baldoyle Bay SPA
- North West Irish Sea cSPA
- RPS Estuarine Survey
- Arctic Tern


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**
**Figure A10.74A**
**Arctic Tern**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

**Issue Details**

**File Identifier:**
IE000258-RPS-AG-XX-D-Z-0027

| | | |
|---|---|---|
| **Status:** A1 | **Rev:** C01 | **Model File Identifier:** |
| **Drawn:** PK | | **Date:** 16/10/2023 |
| **Checked:** JF | | **Scale:** 1:14,000 @A3 |
| **Approved:** JF | | **Projection:** ITM |

**NOTE:**


**Legend**

- Boundary
- Baldoyle Bay SPA
- North West Irish Sea cSPA
- RPS Estuarine Survey Area
- Great Northern Diver


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**
**Figure A10.74B**
**Great Northern Diver**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

**Issue Details**

**File Identifier:**
IE000258-RPS-AG-XX-D-Z-0027

| **Status:** | **Rev:** | **Model File Identifier:** |
|---|---|---|
| A1 | C01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | PK | **Date:** | 16/10/2023 |
| **Checked:** | JF | **Scale:** | 1:14,000 @A3 |
| **Approved:** | JF | **Projection:** | ITM |

**NOTE:**


## Legend

- Boundary
- Baldoyle Bay SPA
- North West Irish Sea cSPA
- RPS Estuarine Survey Area
- Roseate Tern


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**
**Figure A10.74C**
**Roseate Tern**
**Records in Baldoyle Bay**
**(September 2020 to June 2023)**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

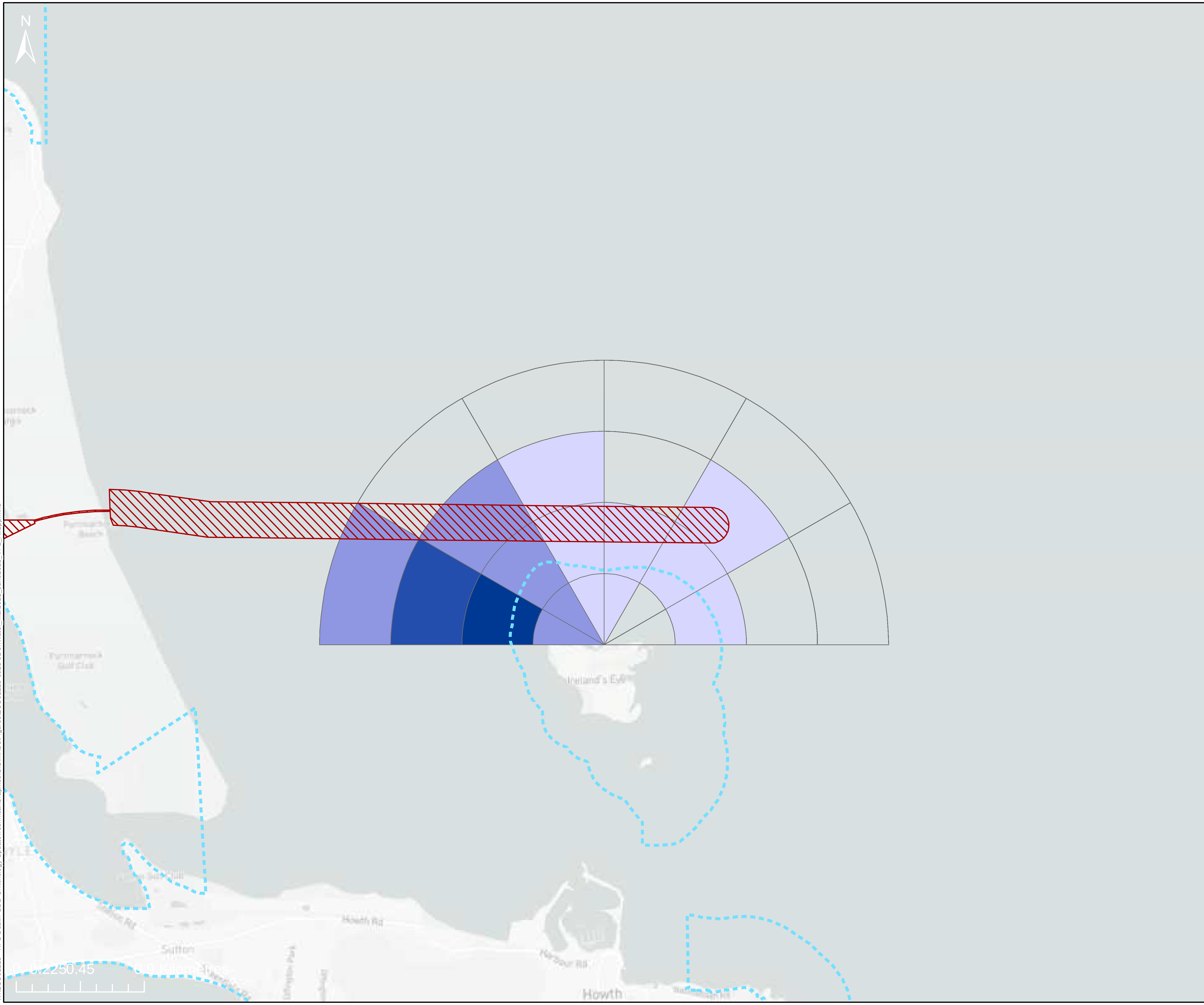
**Issue Details**

**File Identifier:** IE000258-RPS-AG-XX-D-Z-0027

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| A1 | C01 | |

| | | | |
|---|---|---|---|
| Drawn: | PK | Date: | 17/10/2023 |
| Checked: | JF | Scale: | 1:14,000 @A3 |
| Approved: | JF | Projection: | ITM |

**NOTE:**




**Legend**

Boundary

SPA boundaries

Index of abundance

Black guillemot - all behaviours

1 - 4

5 - 8

13 - 16

17 - 18




Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.75 Distribution of all on sea Black Guillemot records from Ireland's Eye VP during August 2020 - June 2023**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

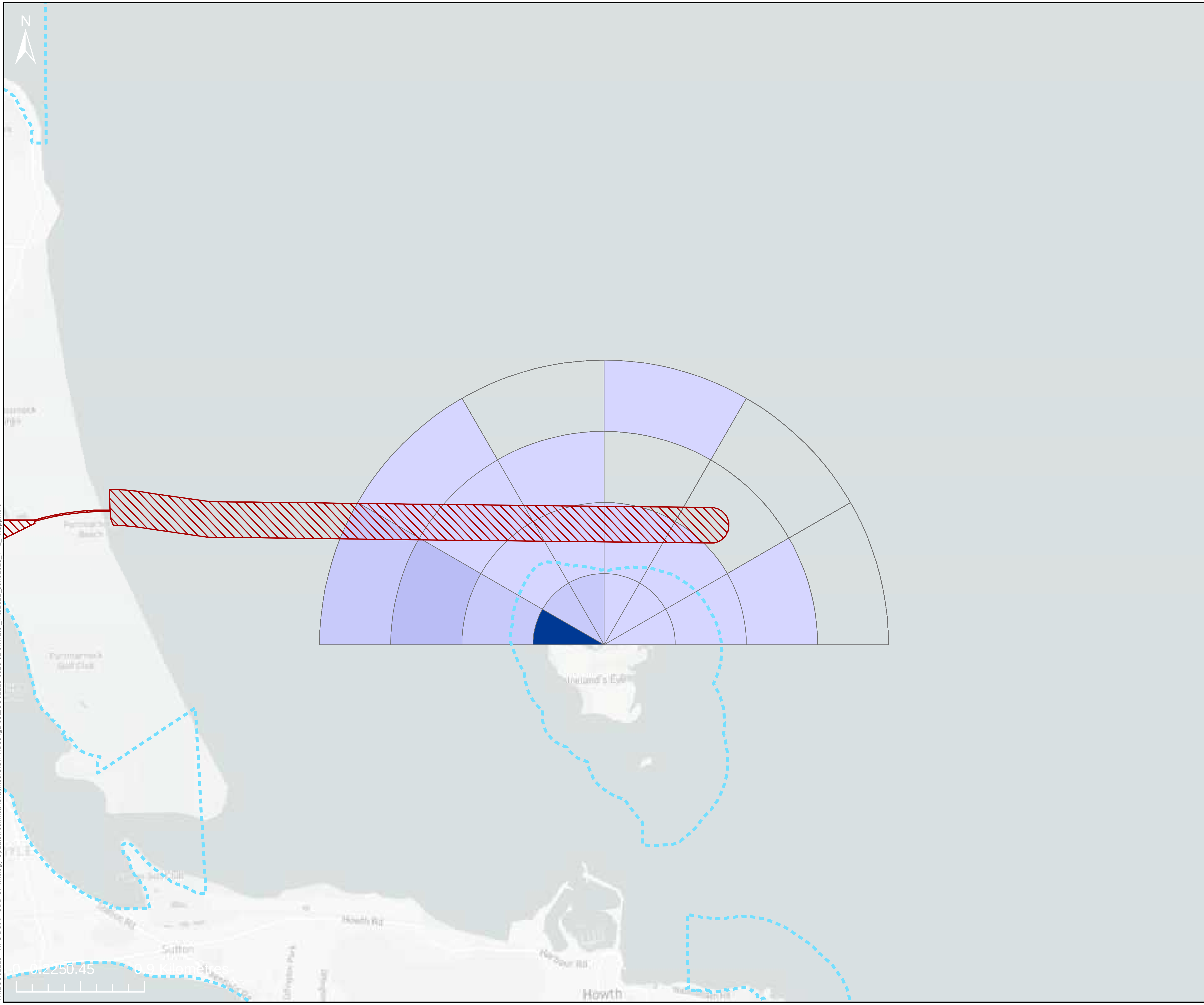
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 12/07/2023 |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




## Legend

Boundary
SPA boundaries

Index of abundance

Cormorant - all behaviours

1 - 5
6 - 10
11 - 15
106 - 110


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.76 Distribution of all on sea Cormorant records from Ireland's Eye VP during August 2020 - June 2023**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

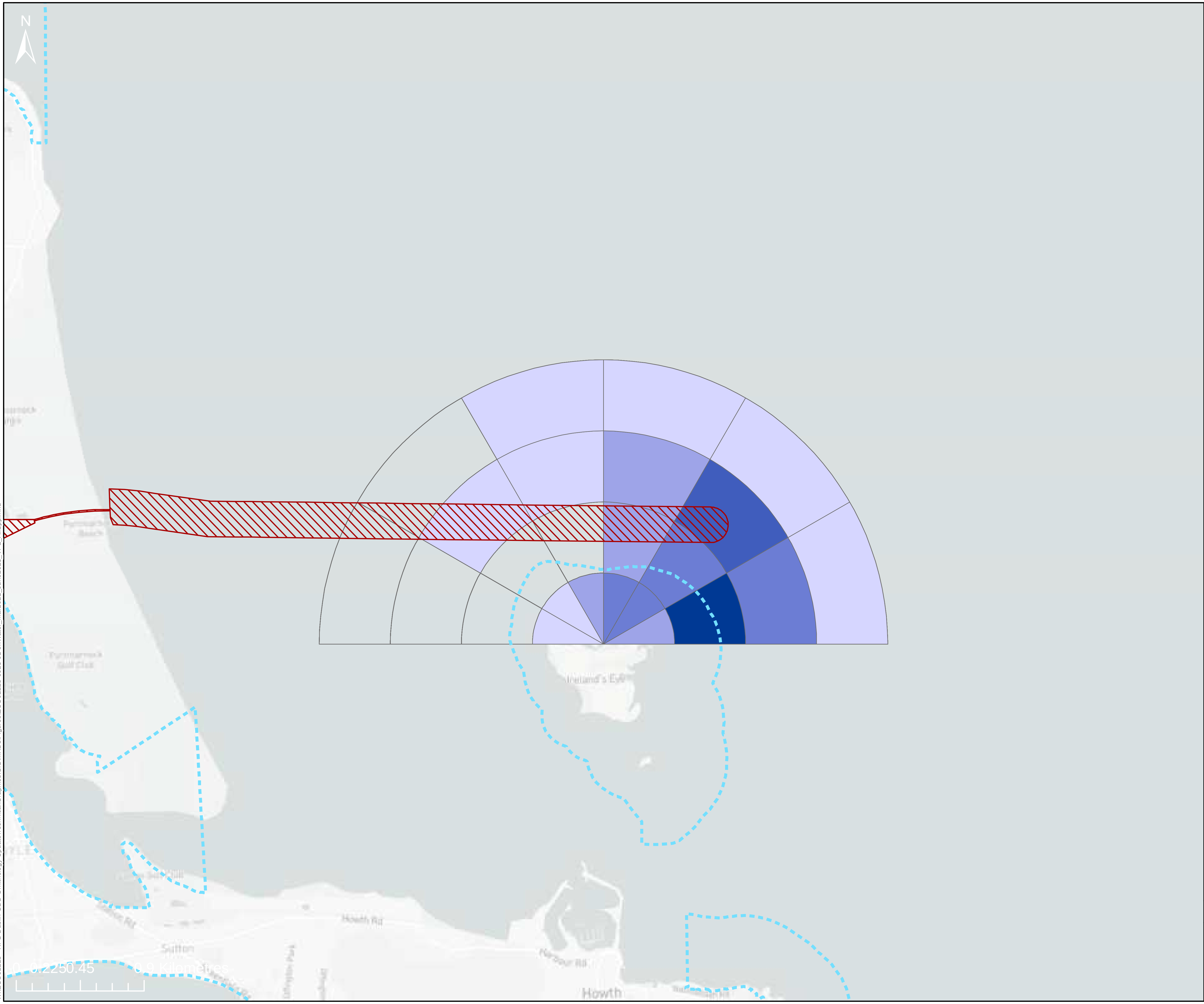
**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 12/07/2023 | |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd

**Legend**

Boundary

SPA boundaries

Index of abundance

Fulmar - all behaviours

- 1 - 10
- 11 - 20
- 21 - 30
- 31 - 40
- 51 - 60


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.77 Distribution of all on sea Fulmar records from Ireland's Eye VP during August 2020 - June 2023**


rps

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

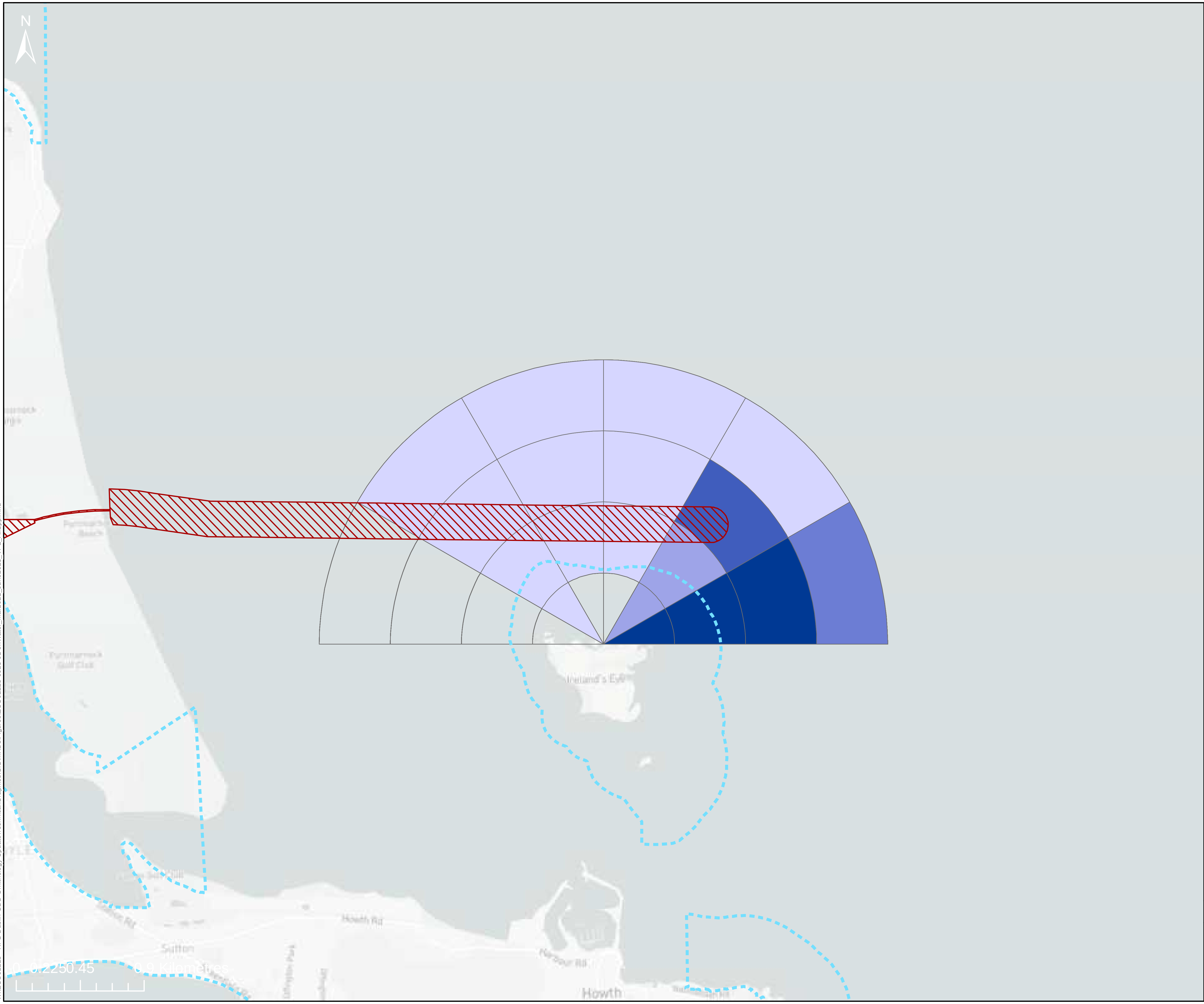
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

**File Identifier:** ECO02228-0025-01

| **Status:** | **Rev:** | **Model File Identifier:** | |
|---|---|---|---|
| S0 | P01 | | |
| **Drawn:** KAG | | **Date:** 12/07/2023 | |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**




## Legend

- Boundary
- SPA boundaries

Index of abundance

Gannet - all behaviours

- 1 - 25
- 26 - 50
- 51 - 75
- 76 - 100
- 126 - 150


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.78 Distribution of all on sea Gannet records from Ireland's Eye VP during August 2020 - June 2023**

rps
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

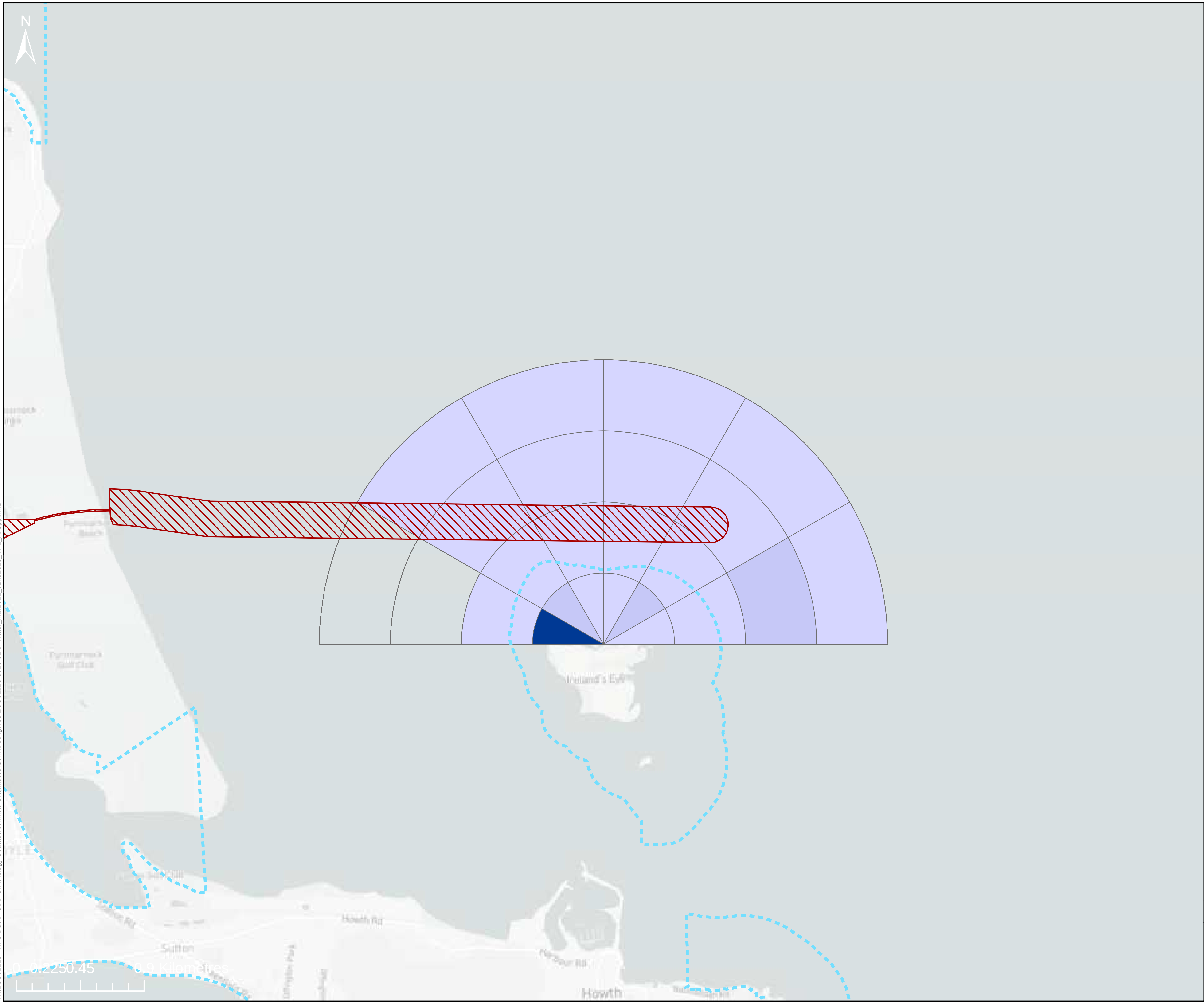
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 12/07/2023 |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




## Legend

Boundary

SPA boundaries

Index of abundance

Great Black-backed Gull - all behaviours

1 - 10

11 - 20

191 - 200


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.79 Distribution of all on sea Great Black-backed Gull records from Ireland's Eye VP during August 2020 - June 2023**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

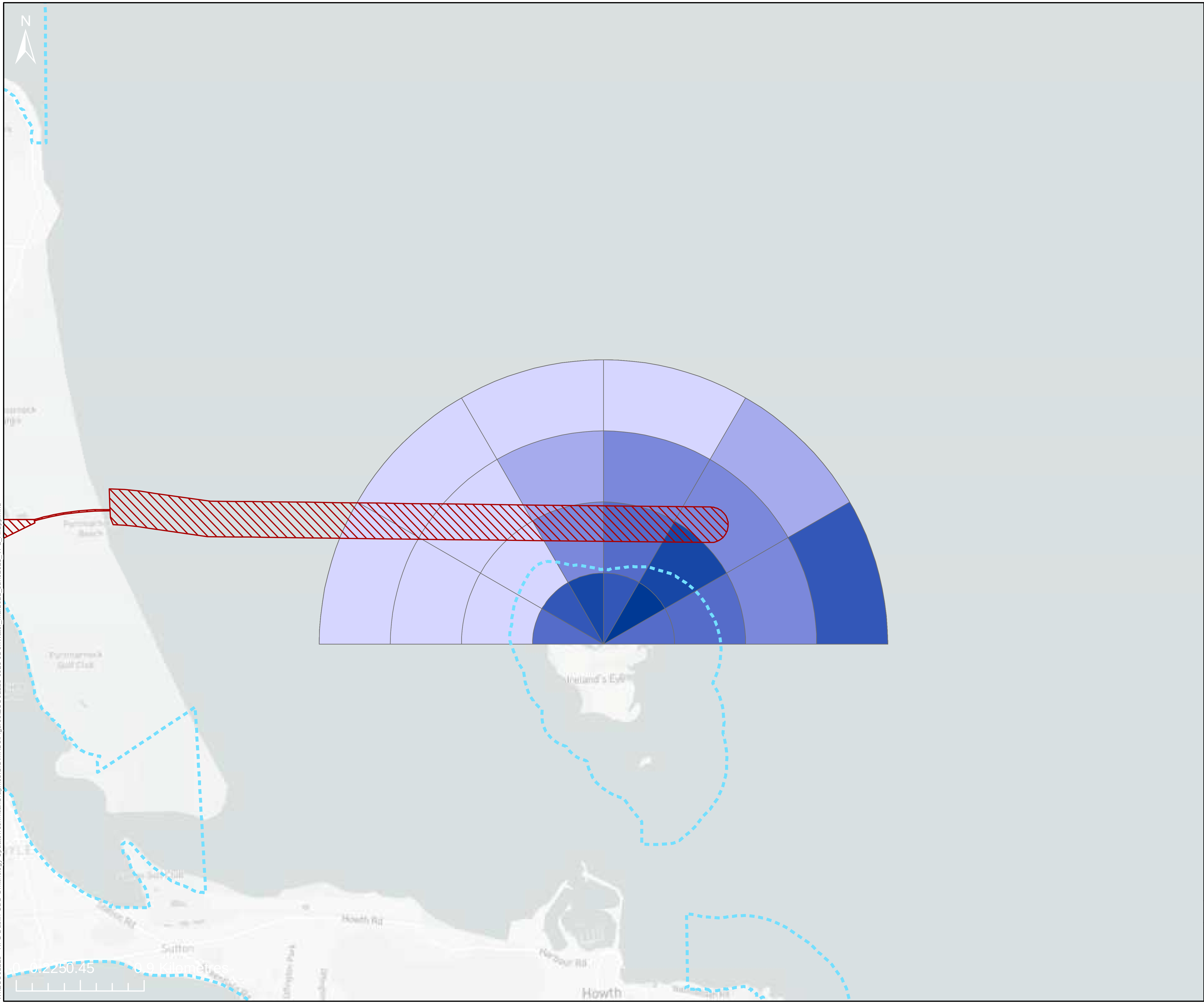

**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 12/07/2023 | |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




## Legend

- Boundary
- SPA boundaries

Index of abundance

Guillemot - all behaviours

- 1 - 125
- 126 - 250
- 251 - 375
- 376 - 500
- 501 - 625
- 626 - 750
- 751 - 875

**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.80 Distribution of all on sea Guillemot records from Ireland's Eye VP during August 2020 - June 2023**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

**T** +44(0)131 555 5011
**E** rpsed2@rpsgroup.com
**W** rpsgroup.com


**Issue Details**

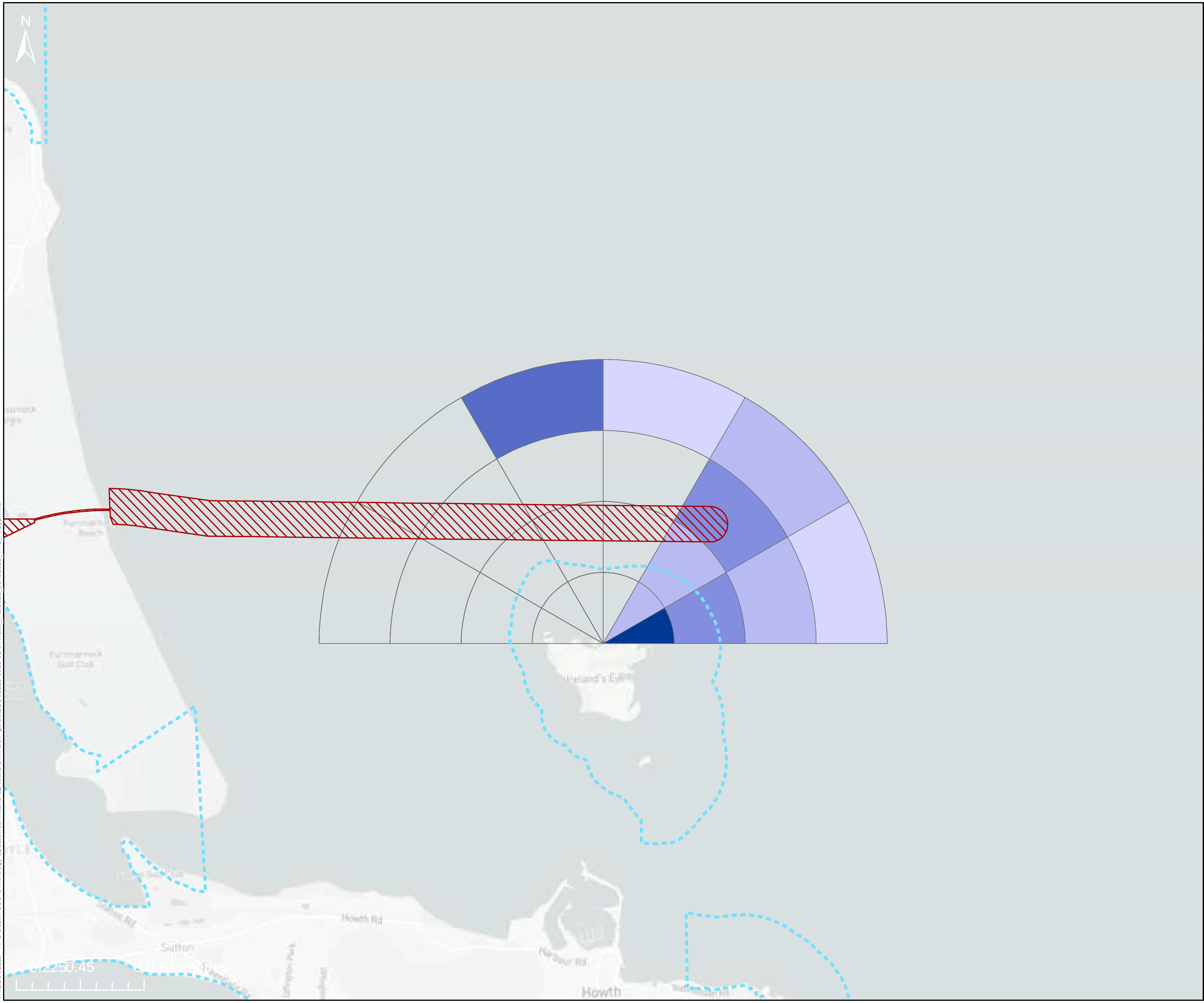
**File Identifier:** ECO02228-0025-01

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| S0 | P01 | |

| | | | |
|---|---|---|---|
| **Drawn:** | KAG | **Date:** | 12/07/2023 |
| **Checked:** | KT | **Scale:** | 1:25,000 @A3 |
| **Approved:** | KT | **Projection:** | ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.




## Legend

- Boundary
- SPA boundaries

Index of abundance

Guillemot/Razorbill - all behaviours

- 25 - 50
- 51 - 100
- 151 - 200
- 251 - 300
- 501 - 550




**Client**

## Uisce Éireann

**Greater Dublin Drainage Project**

**Title**

**Figure A10.81 Distribution of all on sea Guillemot/Razorbill records from Ireland's Eye VP during August 2020 - June 2023**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

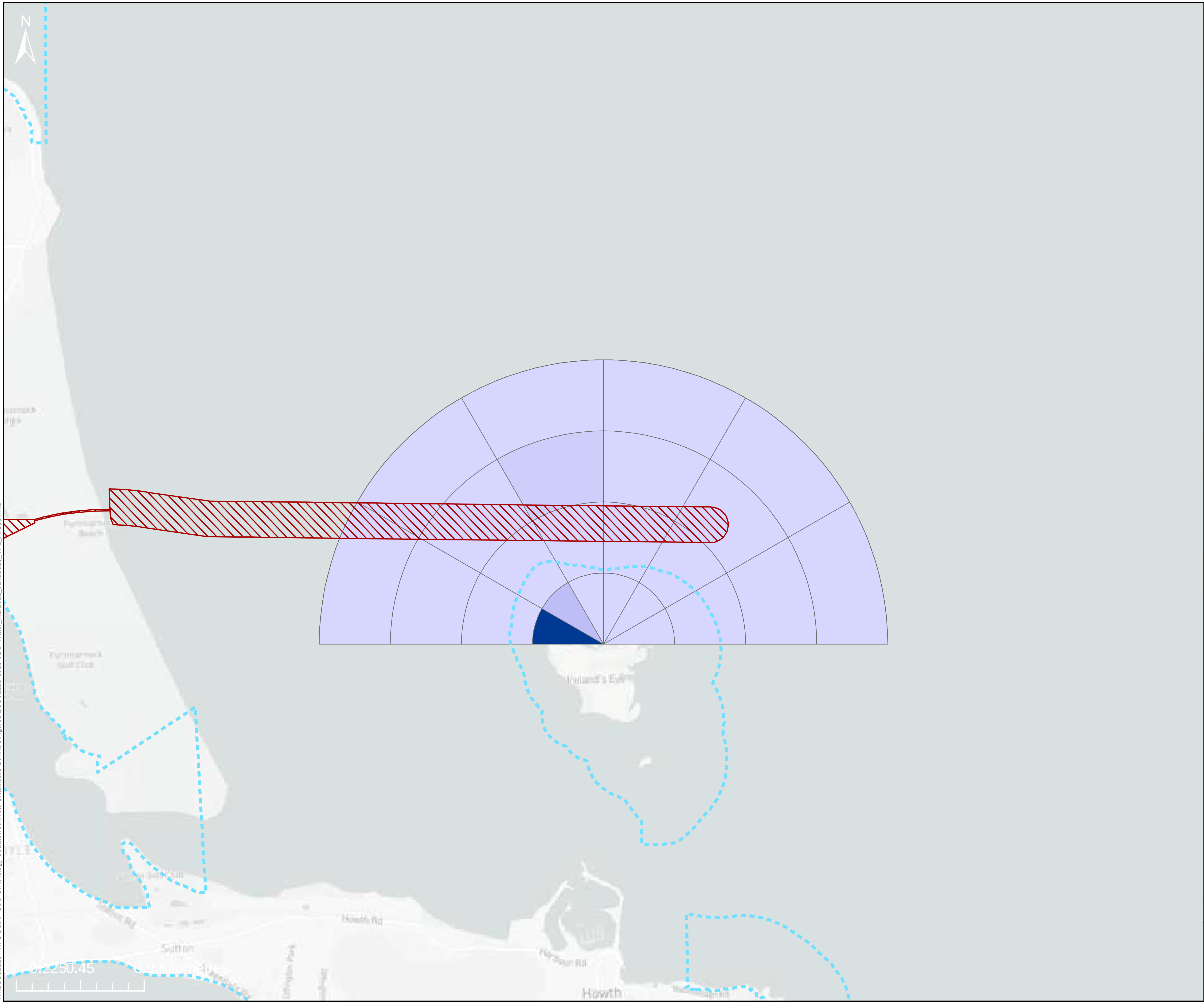
**Issue Details**

| | | | |
|---|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** | |
| **Drawn:** KAG | | **Date:** 12/07/2023 | |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 | |
| **Approved:** KT | | **Projection:** ITM | |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




**Legend**

Boundary

SPA boundaries

Index of abundance

Herring Gull - all behaviours

5 - 50

51 - 100

151 - 200

1751 - 1800

Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.82 Distribution of all on sea Herring Gull records from Ireland's Eye VP during August 2020 - June 2023**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

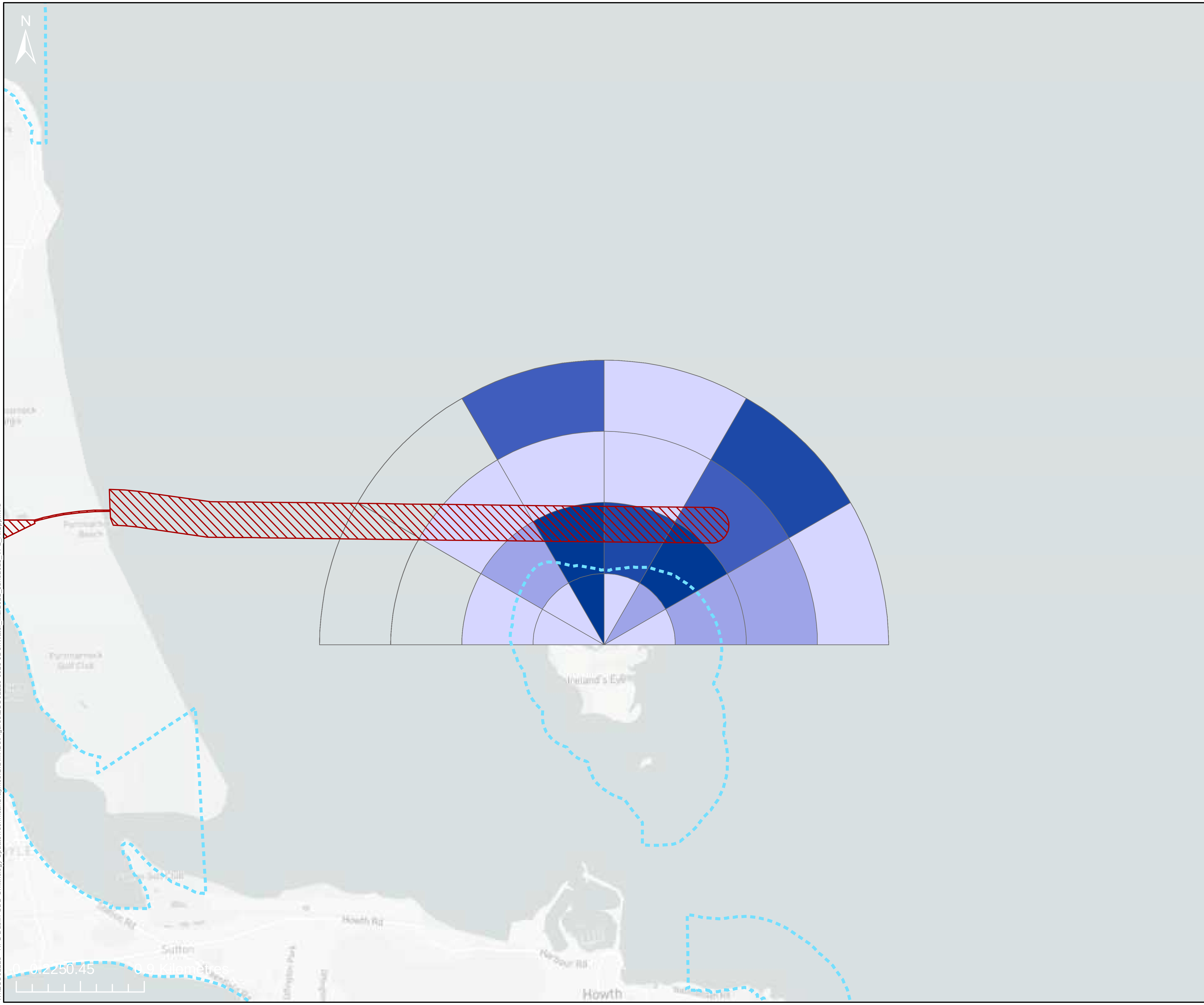
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0025-01

| **Status:** | **Rev:** | **Model File Identifier:** | |
|---|---|---|---|
| S0 | P01 | | |
| **Drawn:** KAG | | **Date:** | 12/07/2023 |
| **Checked:** KT | | **Scale:** | 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** | ITM |

**NOTE:**




## Legend

- Boundary
- SPA boundaries

Index of abundance

Kittiwake - all behaviours

- 2 - 50
- 51 - 100
- 151 - 200
- 201 - 250
- 251 - 300


Client

**Uisce Éireann**

**Greater Dublin Drainage Project**

Title

**Figure A10.83 Distribution of all on sea Kittiwake records from Ireland's Eye VP during August 2020 - June 2023**

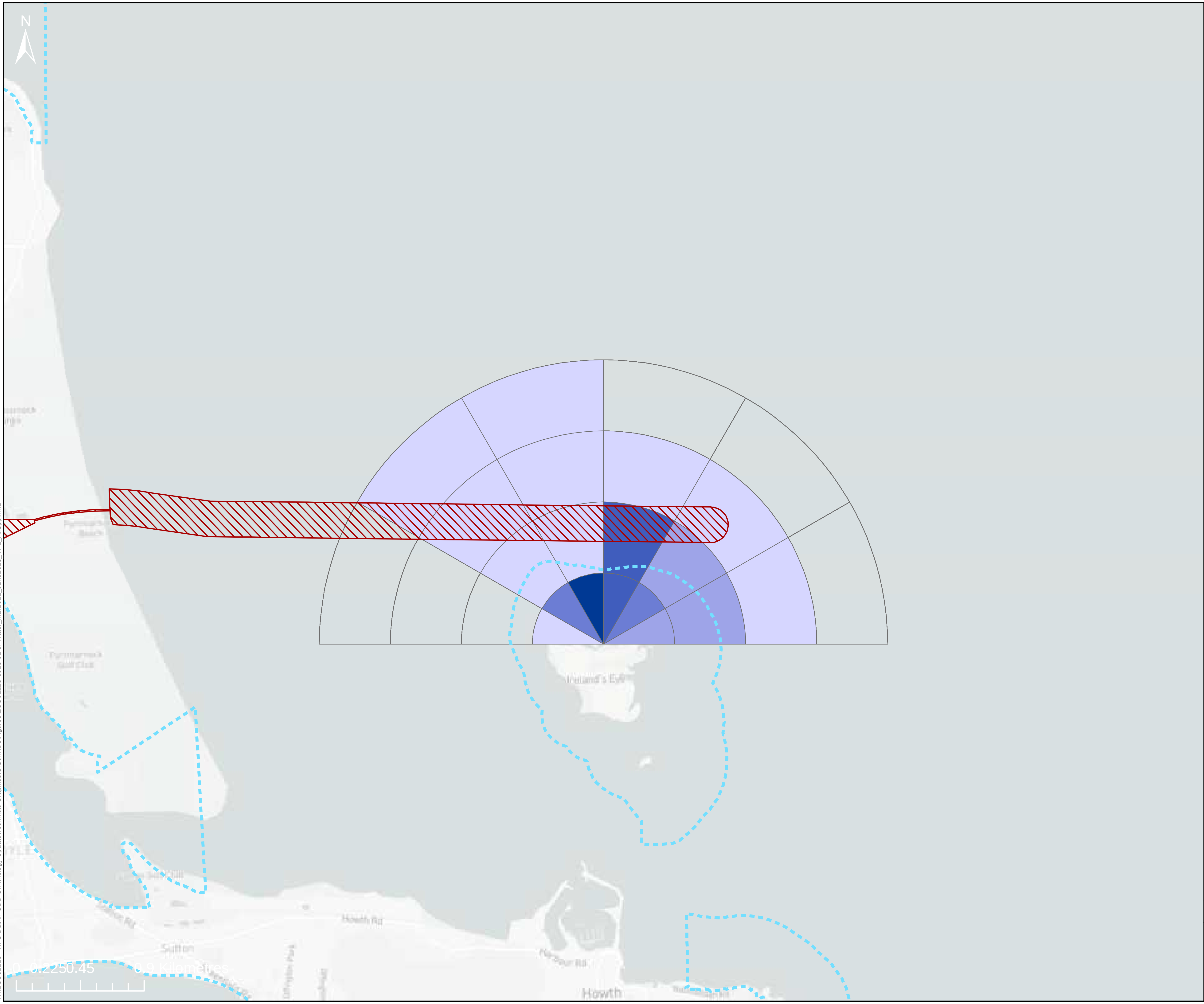
Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0025-01

| Status: | Rev: | Model File Identifier: | |
|---|---|---|---|
| S0 | P01 | | |
| Drawn: KAG | | Date: 12/07/2023 | |
| Checked: KT | | Scale: 1:25,000 @A3 | |
| Approved: KT | | Projection: ITM | |

**NOTE:**




**Legend**

Boundary

SPA boundaries

Index of abundance

Puffin - all behaviours

1 - 10

11 - 20

21 - 30

31 - 40

51 - 60


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.84 Distribution of all on sea Puffin records from Ireland's Eye VP during August 2020 - June 2023**


Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

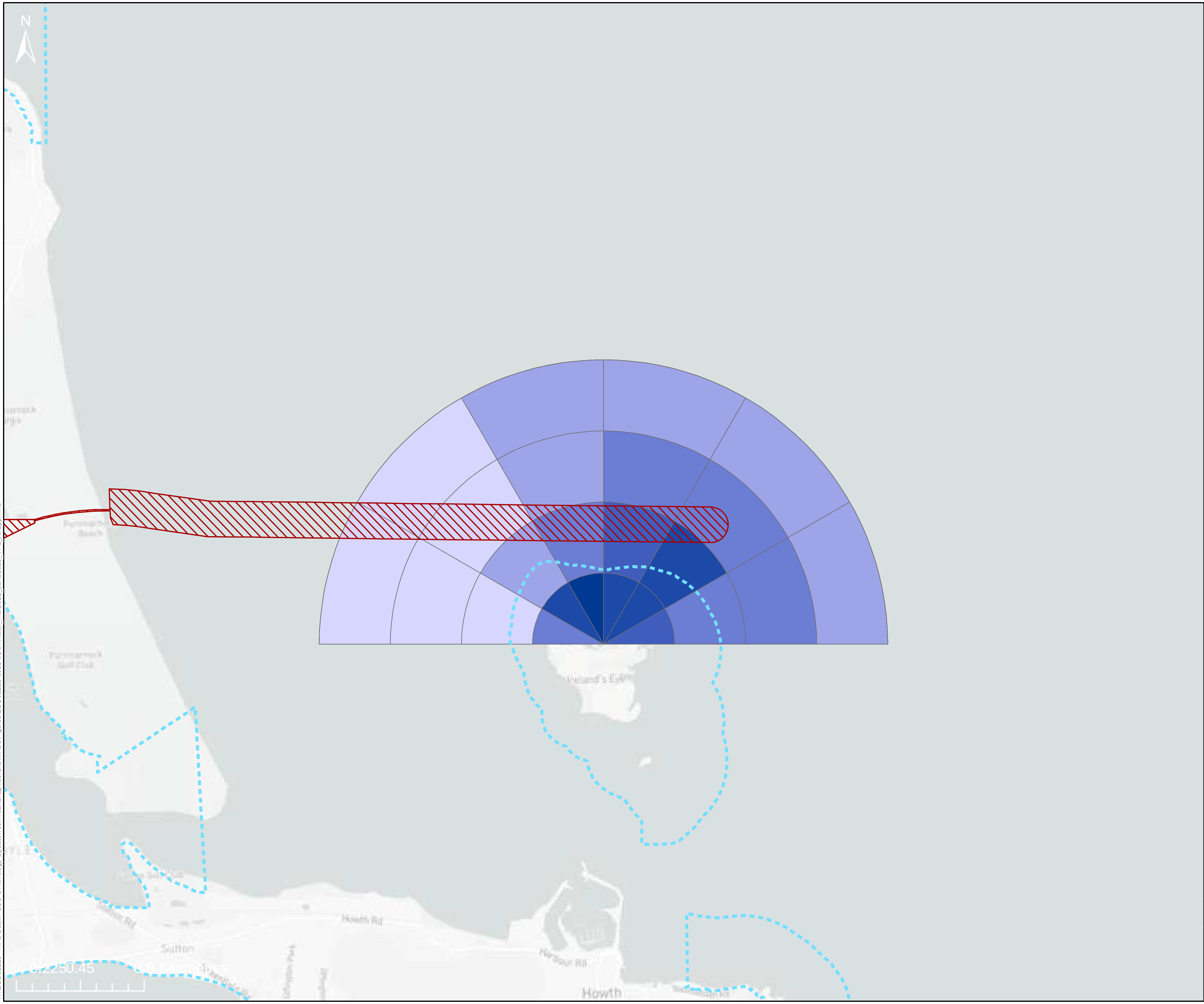
T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com


**Issue Details**

**File Identifier:** ECO02228-0025-01

| **Status:** | **Rev:** | **Model File Identifier:** | |
|---|---|---|---|
| S0 | P01 | | |
| **Drawn:** KAG | | **Date:** | 12/07/2023 |
| **Checked:** KT | | **Scale:** | 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** | ITM |

**NOTE:**




## Legend

- Boundary
- SPA boundaries

Index of abundance

Razorbill - all behaviours

- 1 - 125
- 126 - 250
- 251 - 375
- 376 - 500
- 501 - 625
- 626 - 750


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.85 Distribution of all on sea Razorbill records from Ireland's Eye VP during August 2020 - June 2023**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

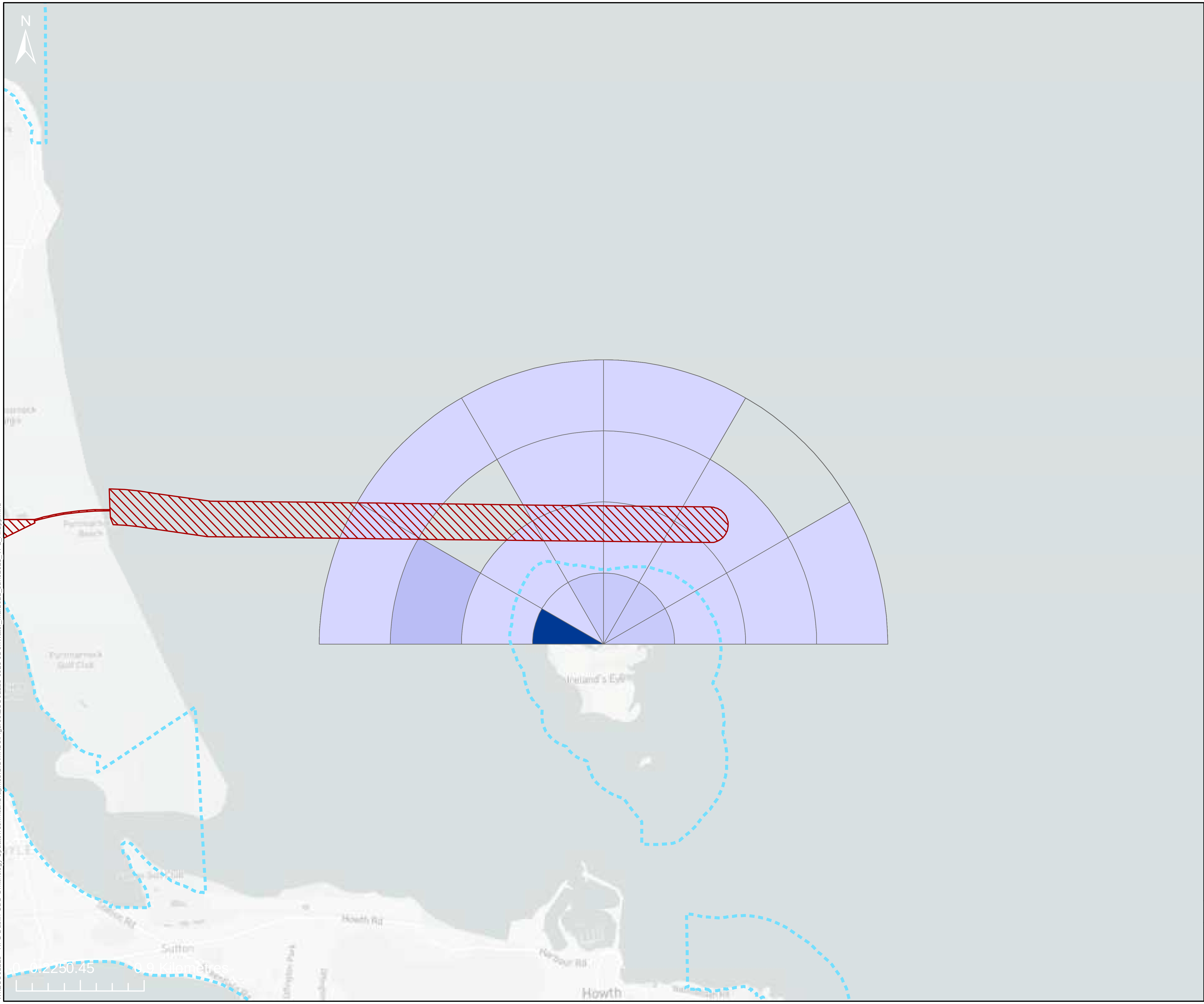
**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** ECO02228-0025-01 | | |
| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
| **Drawn:** KAG | | **Date:** 12/07/2023 |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**



W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd




## Legend

- Boundary
- SPA boundaries

Index of abundance

Shag - all behaviours

- 2 - 20
- 21 - 40
- 41 - 60
- 421 - 440


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure A10.86 Distribution of all on sea Shag records from Ireland's Eye VP during August 2020 - June 2023**

Atholl Exchange
6 Canning Street,
Edinburgh,
United Kingdom

T +44(0)131 555 5011
E rpsed2@rpsgroup.com
W rpsgroup.com

**Issue Details**

**File Identifier:** ECO02228-0025-01

| **Status:** S0 | **Rev:** P01 | **Model File Identifier:** |
|---|---|---|
| **Drawn:** KAG | | **Date:** 12/07/2023 |
| **Checked:** KT | | **Scale:** 1:25,000 @A3 |
| **Approved:** KT | | **Projection:** ITM |

**NOTE:**

1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. Ordnance Survey Ireland Licence CYAL50252391 © Ordnance Survey Ireland/Government of Ireland.

W:\ECO02228 - RPS Dublin GDD Ornithology Update\Technical\Graphics\GIS\MXDs\Figures\ECO02228-0025-01 onWater_Mar2021_June2023_VP2_AllSpp.mxd

# APPENDIX 2 – ESTUARINE BIRD SURVEY EFFORT AND WEATHER

**Table A10.1a. Survey effort during estuarine walkover surveys**

| Survey date | Survey type | Surveyor | Start time | End time | Total time |
|---|---|---|---|---|---|
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 06:00 |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 06:00 |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 05:45 |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 06:00 |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 05:00 |
| 11/11/20 | Estuarine survey | Nick Veale | 11:50 | 15:05 | 03:15 |
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 05:00 |
| 16/12/20 | Estuarine survey | Nick Veale | 11:15 | 14:40 | 03:25 |
| 14/01/21 | Estuarine survey | Nick Veale | 10:45 | 14:10 | 03:25 |
| 16/0121 | Estuarine survey | Nick Veale | 08:00 | 11:50 | 03:50 |
| 10/02/21 | Estuarine survey | Nick Veale | 09:30 | 13:40 | 04:10 |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 04:05 |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 04:15 |
| 22/03/21 | Estuarine survey | Nick Veale | 10:10 | 14:00 | 03:50 |
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 04:10 |
| 12/04/21 | Estuarine survey | Nick Veale | 11:30 | 15:05 | 03:35 |
| 04/05/21 | Estuarine survey | Nick Veale | 11:00 | 13:45 | 02:45 |
| 19/05/21 | Estuarine survey | Nick Veale | 05:05 | 08:20 | 03:15 |
| 07/06/21 | Estuarine survey | Nick Veale | 09:10 | 12:15 | 03:05 |
| 24/06/21 | Estuarine survey | Nick Veale | 04:40 | 08:15 | 03:35 |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 04:10 |
| 14/07/21 | Estuarine survey | Nick Veale | 08:05 | 12:05 | 04:00 |
| 02/08/21 | Estuarine survey | Nick Veale | 06:05 | 10:05 | 04:00 |
| 09/08/21 | Estuarine survey | Nick Veale | 06:00 | 09:45 | 03:45 |
| 25/11/21 | Estuarine survey Portmarnock project | Cian Cardiff | 15:00 | 18:00 | 03:00 |
| 29/11/21 | Estuarine survey Portmarnock project | Cian Cardiff | 12:45 | 15:45 | 03:00 |
| 06/12/21 | Estuarine survey Portmarnock project | Cian Cardiff | 12:15 | 15:15 | 03:00 |
| 09/12/21 | Estuarine survey Portmarnock project | Cian Cardiff | 08:30 | 11:30 | 03:00 |
| 04/01/22 | Estuarine survey Portmarnock project | Cian Cardiff | 12:15 | 15:15 | 03:00 |
| 14/01/22 | Estuarine survey Portmarnock project | Cian Cardiff | 15:20 | 18:20 | 03:00 |
| 03/02/22 | Estuarine survey Portmarnock project | Cian Cardiff | 12:45 | 15:45 | 03:00 |
| 28/02/22 | Estuarine survey Portmarnock project | Cian Cardiff | 15:30 | 18:30 | 03:00 |
| 25/03/22 | Estuarine survey Portmarnock project | Cian Cardiff | 10:20 | 13:20 | 03:00 |

| Survey date | Survey type | Surveyor | Start time | End time | Total time |
|---|---|---|---|---|---|
| 31/03/22 | Estuarine survey Portmarnock project | Cian Cardiff | 12:00 | 15:00 | 03:00 |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 06:00 |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 06:00 |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 06:00 |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 03:00 |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 06:00 |
| 13/12/22 | Estuarine survey | Conor Maloney | 13:06 | 16:06 | 03:00 |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 06:00 |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 06:00 |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 06:00 |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 06:00 |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 06:00 |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 06:00 |
| 21/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 06:30 | 12:30 | 06:00 |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:08 | 16:08 | 06:00 |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 06:00 |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 06:00 |
| 11/05/23 | Estuarine survey | Lorna Gill | 07:06 | 13:06 | 06:00 |
| 25/05/23 | Estuarine survey | Lorna Gill | 11:59 | 17:59 | 06:00 |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 06:00 |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 06:00 |

**Table A10.1b. Weather during estuarine walkover surveys**

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 1 | NE | 0 | 1 | 2 | 4 | 0 | 0 | L-M | - | - | - | New construction south of station road on maps 4-8. New greenway right through maps 5,9+14. (No physical access to either golf course by Erivia - gates shut. |
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 2 | NE | 0 | 2 | 2 | 4 | 0 | 0 | M-H | - | - | - | - |
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 1 | Various | 0 | 2 | 2 | 4 | 0 | 0 | M-H | - | - | - | - |
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 1 | Various | 0 | 2 | 2 | 4 | 0 | 0 | H | - | - | - | - |
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 2 | SE | 0 | 2 | 2 | 4 | 0 | 0 | H-M | - | - | - | - |
| 17/09/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 2 | E | 0 | 1 | 2 | 4 | 0 | 0 | H-M | - | - | - | - |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 1 | SW | 1 | 8 | 1 | 3 | 0 | 0 | M-H | - | - | - | Drizzle all day. |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 1 | SW | 1 | 8 | 1 | 3 | 0 | 0 | M-H | - | - | - | - |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 1 | SW | 1 | 8 | 1 | 3 | 0 | 0 | H | - | - | - | - |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 2 | W | 1 | 8 | 1 | 4 | 0 | 0 | H-M | - | - | - | - |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 2 | W | 0 | 8 | 1 | 4 | 0 | 0 | H-M | - | - | - | - |
| 28/09/20 | Estuarine survey | Nick Veale | 09:05 | 15:05 | 2 | W | 1 | 8 | 1 | 4 | 0 | 0 | M | - | - | - | - |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 3 | NW | 0 | 7 | 1 | 4 | 0 | 0 | H-M | - | - | - | - |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 4 | N | 2 | 7 | 1 | 4 | 0 | 0 | M-L | - | - | - | - |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 4 | N | 2 | 7 | 1 | 4 | 0 | 0 | M-L | - | - | - | - |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 3 | N | 0 | 6 | 1 | 4 | 0 | 0 | M-L | - | - | - | - |

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 4 | NE | 0 | 6 | 1 | 4 | 0 | 0 | L | - | - | - | - |
| 13/10/20 | Estuarine survey | Nick Veale | 11:00 | 16:45 | 3 | NE | 0 | 6 | 1 | 4 | 0 | 0 | L | - | - | - | Hundreds of people on greenway and beach. High tide at 09:37. Low tide at 15:20. |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 4 | SE | 2 | 8 | 1 | 3 | 0 | 0 | L-M | - | - | - | - |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 4 | S | 0 | 8 | 1 | 3 | 0 | 0 | L-M | - | - | - | - |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 4 | S | 0 | 7 | 1 | 3 | 0 | 0 | M | - | - | - | - |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 4 | S | 1 | 8 | 1 | 3 | 0 | 0 | M-H | - | - | - | - |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 4 | S | 1 | 8 | 1 | 3 | 0 | 0 | M-H | - | - | - | - |
| 20/10/20 | Estuarine survey | Nick Veale | 09:30 | 15:30 | 3 | S | 0 | 7 | 1 | 3 | 0 | 0 | H | - | - | - | High tide at 14:32 - 4.12m. |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 2 | SW | 0 | 6 | 1 | 2 | 0 | 0 | M-H | - | - | - | - |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 2 | SW | 0 | 6 | 1 | 2 | 0 | 0 | M-H | - | - | - | High tide at 12:14 |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 2 | SW | 0 | 8 | 1 | 2 | 0 | 0 | H | - | - | - | - |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 3 | SW | 0 | 8 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 02/11/20 | Estuarine survey | Nick Veale | 10:15 | 15:15 | 2 | SW | 1 | 8 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 11/11/20 | Estuarine survey | Nick Veale | 11:50 | 15:05 | 2 | SE | 0 | 7 | 2 | 2 | 0 | 0 | M-L | - | - | - | - |
| 11/11/20 | Estuarine survey | Nick Veale | 11:50 | 15:05 | 3 | SE | 1 | 8 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 11/11/20 | Estuarine survey | Nick Veale | 11:50 | 15:05 | 2 | SE | 0 | 6 | 0 | 2 | 0 | 0 | L-M | - | - | - | - |
| 11/11/20 | Estuarine survey | Nick Veale | 11:50 | 15:05 | 3 | SE | 2 | 8 | 0 | 2 | 0 | 0 | L-M | - | - | - | Low tide at 13:49 |
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 1 | NW | 0 | 3 | 2 | 2 | 0 | 0 | L | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 1 | NW | 0 | 3 | 2 | 2 | 0 | 0 | L-M | - | - | - | Low tide at 09:46 / 1.30m neap |
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 1 | NW | 0 | 2 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 2 | NW | 0 | 4 | 2 | 2 | 0 | 0 | M | - | - | - | - |
| 07/12/20 | Estuarine survey | Nick Veale | 09:15 | 14:15 | 1 | NW | 0 | 2 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 16/12/20 | Estuarine survey | Nick Veale | 11:15 | 14:40 | 3 | SW | 2 | 8 | 1 | 2 | 0 | 0 | M-H | - | - | - | - |
| 16/12/20 | Estuarine survey | Nick Veale | 11:15 | 14:40 | 3 | SW | 0 | 6 | 1 | 2 | 0 | 0 | H | - | - | - | 4.27m spring |
| 16/12/20 | Estuarine survey | Nick Veale | 11:15 | 14:40 | 3 | SW | 2 | 8 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 16/12/20 | Estuarine survey | Nick Veale | 11:15 | 14:40 | 3 | SW | 0 | 8 | 1 | 2 | 0 | 0 | H-M | - | - | - | High tide at 12:16 |
| 14/01/21 | Estuarine survey | Nick Veale | 10:45 | 14:10 | 2 | NW | 0 | 1 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 14/01/21 | Estuarine survey | Nick Veale | 10:45 | 14:10 | 3 | NW | 0 | 3 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 14/01/21 | Estuarine survey | Nick Veale | 10:45 | 14:10 | 3 | NW | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | - |
| 14/01/21 | Estuarine survey | Nick Veale | 10:45 | 14:10 | 3 | NW | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | High tide at 12:06 |
| 16/01/21 | Estuarine survey | Nick Veale | 08:00 | 11:50 | 3 | SW | 0 | 6 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 16/01/21 | Estuarine survey | Nick Veale | 08:00 | 11:50 | 3 | SW | 0 | 6 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 16/01/21 | Estuarine survey | Nick Veale | 08:00 | 11:50 | 3 | W | 0 | 5 | 1 | 2 | 0 | 0 | M | - | - | - | - |
| 16/01/21 | Estuarine survey | Nick Veale | 08:00 | 11:50 | 4 | W | 0 | 7 | 1 | 2 | 0 | 0 | M-H | - | - | - | - |
| 10/02/21 | Estuarine survey | Nick Veale | 09:30 | 13:40 | 3 | NE | 0 | 5 | 1 | 2 | 0 | 0 | H | - | - | - | - |
| 10/02/21 | Estuarine survey | Nick Veale | 09:30 | 13:40 | 2 | NE | 2 | 6 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 10/02/21 | Estuarine survey | Nick Veale | 09:30 | 13:40 | 2 | NE | 2 | 6 | 1 | 2 | 0 | 0 | H-M | - | - | - | Light snow flurries. Temperature 1°C all morning. |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/02/21 | Estuarine survey | Nick Veale | 09:30 | 13:40 | 3 | NE | 2 | 7 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 1 | 180 | 0 | 5 | 1 | 2 | 0 | 0 | L | - | - | - | 9-12°C. |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 3 | S | 0 | 7 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 3 | SW | 0 | 7 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 2 | SW | 0 | 6 | 1 | 2 | 0 | 0 | M | - | - | - | - |
| 15/02/21 | Estuarine survey | Nick Veale | 07:15 | 11:20 | 2 | SW | 1 | 6 | 1 | 2 | 0 | 0 | M-H | - | - | - | - |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 0 | Various | 0 | 3 | 2 | 2 | 0 | 0 | M | - | - | - | 0°C at 10:00. Wind direction varying in HR1. |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 2 | E | 0 | 6 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 1 | NE | 0 | 4 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 1 | NE | 0 | 4 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 02/03/21 | Estuarine survey | Nick Veale | 10:00 | 14:15 | 1 | NE | 0 | 4 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 22/03/21 | Estuarine survey | Nick Veale | 10:10 | 14:00 | 2 | SW | 0 | 8 | 1 | 2 | 0 | 0 | M-L | - | - | - | - |
| 22/03/21 | Estuarine survey | Nick Veale | 10:10 | 14:00 | 1 | SW | 0 | 7 | 1 | 2 | 0 | 0 | L | - | - | - | - |
| 22/03/21 | Estuarine survey | Nick Veale | 10:10 | 14:00 | 1 | W | 0 | 5 | 1 | 2 | 0 | 0 | L | - | - | - | Low tide at 11:41. 1.33m (neap). |
| 22/03/21 | Estuarine survey | Nick Veale | 10:10 | 14:00 | 2 | W | 0 | 8 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 3 | NE | 0 | 6 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 3 | NE | 0 | 5 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 4 | NE | 0 | 6 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 3 | NE | 0 | 5 | 2 | 2 | 0 | 0 | M | - | - | - | Cool 8°C all morning. |

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01/04/21 | Estuarine survey | Nick Veale | 08:05 | 12:15 | 4 | E | 0 | 5 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 12/04/21 | Estuarine survey | Nick Veale | 11:30 | 15:05 | 2 | NW | 2 | 7 | 1 | 2 | 0 | 0 | M-H | - | - | - | - |
| 12/04/21 | Estuarine survey | Nick Veale | 11:30 | 15:05 | 2 | NW | 0 | 6 | 1 | 2 | 0 | 0 | H | - | - | - | - |
| 12/04/21 | Estuarine survey | Nick Veale | 11:30 | 15:05 | 2 | W | 0 | 6 | 1 | 2 | 0 | 0 | H-M | - | - | - | - |
| 12/04/21 | Estuarine survey | Nick Veale | 11:30 | 15:05 | 2 | NW | 1 | 6 | 1 | 2 | 0 | 0 | H-M | - | - | - | Cold 5-8°C. Very quiet. |
| 04/05/21 | Estuarine survey | Nick Veale | 11:00 | 13:45 | 2 | SW | 0 | 4 | 2 | 2 | 0 | 0 | M-L | - | - | - | 15-17°C. Very quiet. |
| 04/05/21 | Estuarine survey | Nick Veale | 11:0 | 13:45 | 3 | SW | 0 | 3 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 04/05/21 | Estuarine survey | Nick Veale | 11:00 | 13:45 | 3 | SW | 0 | 4 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 19/05/21 | Estuarine survey | Nick Veale | 05:05 | 08:20 | 2 | W | 0 | 1 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 19/05/21 | Estuarine survey | Nick Veale | 05:05 | 08:20 | 2 | SW | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | - |
| 19/05/21 | Estuarine survey | Nick Veale | 05:05 | 08:20 | 2 | SW | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | - |
| 19/05/21 | Estuarine survey | Nick Veale | 05:05 | 08:20 | 2 | W | 0 | 0 | 0 | 2 | 0 | 0 | M | - | - | - | FAIR 14°C at dawn. Site very quiet - not much around. |
| 07/06/21 | Estuarine survey | Nick Veale | 09:10 | 12:15 | 1 | NW | 0 | 2 | 2 | 2 | 0 | 0 | M-H | - | - | - | - |
| 07/06/21 | Estuarine survey | Nick Veale | 09:10 | 12:15 | 1 | NW | 0 | 2 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 07/06/21 | Estuarine survey | Nick Veale | 09:10 | 12:15 | 1 | W | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | - |
| 07/06/21 | Estuarine survey | Nick Veale | 09:10 | 12:15 | 1 | W | 0 | 1 | 2 | 2 | 0 | 0 | H-M | - | - | - | Quiet. |
| 24/06/21 | Estuarine survey | Nick Veale | 04:40 | 08:15 | 3 | SW | 0 | 5 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 24/06/21 | Estuarine survey | Nick Veale | 04:40 | 08:15 | 2 | SW | 0 | 4 | 2 | 2 | 0 | 0 | L-M | - | - | - | Low-tide at 05:13 - 0.45m. Sunrise at 04:56. |
| 24/06/21 | Estuarine survey | Nick Veale | 04:40 | 08:15 | 3 | SW | 0 | 5 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24/06/21 | Estuarine survey | Nick Veale | 04:40 | 08:15 | 3 | SW | 0 | 7 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 0 | None | 0 | 1 | 2 | 1 | 0 | 0 | M-H | - | - | - | - |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 1 | Various | 0 | 1 | 2 | 2 | 0 | 0 | H | - | - | - | - |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 1 | Various | 0 | 2 | 2 | 2 | 0 | 0 | H-M | - | - | - | - |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 0 | None | 0 | 1 | 2 | 1 | 0 | 0 | H-M | - | - | - | High-tide at 05:09 - 3.79m. Sunrise at 05:01. Wind direction varying HRS 3/4. |
| 01/07/21 | Estuarine survey | Nick Veale | 04:40 | 08:50 | 1 | E | 0 | 1 | 2 | 2 | 0 | 0 | M | - | - | - | - |
| 14/07/21 | Estuarine survey | Nick Veale | 08:05 | 12:05 | 2 | SW | 0 | 3 | 2 | 2 | 0 | 0 | M-L | - | - | - | - |
| 14/07/21 | Estuarine survey | Nick Veale | 08:05 | 12:05 | 1 | W | 0 | 1 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 14/07/21 | Estuarine survey | Nick Veale | 08:05 | 12:05 | 1 | W | 0 | 0 | 0 | 2 | 0 | 0 | L-M | - | - | - | Fair weather, 19°C at 08:00. Low-tide at 08:54 - 0.57m (neap). |
| 14/07/21 | Estuarine survey | Nick Veale | 08:05 | 12:05 | 1 | W | 0 | 0 | 0 | 2 | 0 | 0 | L-M | - | - | - | - |
| 02/08/21 | Estuarine survey | Nick Veale | 06:05 | 10:05 | 1 | W | 0 | 2 | 2 | 2 | 0 | 0 | M-L | - | - | - | - |
| 02/08/21 | Estuarine survey | Nick Veale | 06:05 | 10:05 | 1 | W | 0 | 3 | 2 | 2 | 0 | 0 | L | - | - | - | - |
| 02/08/21 | Estuarine survey | Nick Veale | 06:05 | 10:05 | 1 | NW | 0 | 3 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 02/08/21 | Estuarine survey | Nick Veale | 06:05 | 10:05 | 1 | NW | 0 | 4 | 2 | 2 | 0 | 0 | L-M | - | - | - | - |
| 09/08/21 | Estuarine survey | Nick Veale | 06:00 | 09:45 | 2 | SW | 0 | 7 | 1 | 2 | 0 | 0 | M-L | - | - | - | 15-17°C. Light showers. |
| 09/08/21 | Estuarine survey | Nick Veale | 06:00 | 09:45 | 2 | SW | 0 | 6 | 1 | 2 | 0 | 0 | L | - | - | - | - |
| 09/08/21 | Estuarine survey | Nick Veale | 06:00 | 09:45 | 2 | SW | 2 | 7 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |
| 09/08/21 | Estuarine survey | Nick Veale | 06:00 | 09:45 | 2 | SW | 2 | 7 | 1 | 2 | 0 | 0 | L-M | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25/11/21 | Estuarine survey – Portmarnock project | Cian Cardiff | 15:00 | 18:00 | 3 | 315 | 0 | 6 | - | 3 | 0 | 0 | H-M | - | - | - | 6°C |
| 29/11/21 | Estuarine survey – Portmarnock project | Cian Cardiff | 12:45 | 15:45 | 4 | N | 0 | 6 | - | 3 | 0 | 0 | M-L | - | - | - | 9°C |
| 06/12/21 | Estuarine survey – Portmarnock project | Cian Cardiff | 12:15 | 15:15 | 2 | W | 0 | 6 | - | 3 | 0 | 0 | H-M | - | - | - | 3°C |
| 09/12/21 | Estuarine survey – Portmarnock project | Cian Cardiff | 08:30 | 11:30 | 4 | W | 2 | 7 | - | 3 | 0 | 0 | M-L | - | - | - | 9°C |
| 04/01/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 12:15 | 15:15 | 4 | NW | 0 | 4 | - | 2 | 0 | 0 | H-M | - | - | - | 6°C |
| 14/01/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 15:20 | 18:20 | 3 | E | 0 | 6 | - | 4 | 0 | 0 | M-L | - | - | - | 10°C |
| 03/02/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 12:45 | 15:45 | 4 | SW | 0 | 6 | - | 4 | 0 | 0 | H-M | - | - | - | 9°C |
| 28/02/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 15:30 | 18:30 | 4 | SW | 0 | 4 | - | 4 | 0 | 0 | M-L | - | - | - | 9°C |
| 25/03/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 10:20 | 13:20 | 2 | E | 0 | 4 | - | 3 | 0 | 0 | M-L | - | - | - | Heat haze. 13°C |
| 31/03/22 | Estuarine survey – Portmarnock project | Cian Cardiff | 12:00 | 15:00 | 4 | NE | 0 | 3 | - | 4 | 0 | 0 | H-M | - | - | - | 7°C |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 7 | - | 3 | 0 | 0 | H-L | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 3 | - | 3 | 0 | 0 | L | - | - | - | Low tide 13:30 |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 7 | - | 3 | 0 | 0 | L-H | - | - | - | - |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 7 | - | 3 | 0 | 0 | L-H | - | - | - | - |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 5 | - | 3 | 0 | 0 | L-H | - | - | - | - |
| 20/10/22 | Estuarine survey | Lorna Gill | 12:18 | 18:18 | 3 | SE | 0 | 3 | - | 3 | 0 | 0 | L-H | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 3 | S | 0 | 2 | - | 4 | 0 | 0 | L-H | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 3 | S | 0 | 2 | - | 4 | 0 | 0 | L-H | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 3 | S | 0 | 1 | - | 4 | 0 | 0 | H | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 4 | SW | 0 | 1 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 4 | SW | 0 | 2 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 22/10/22 | Estuarine survey | Lorna Gill | 08:03 | 14:03 | 4 | SW | 0 | 1 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 33 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 3 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 2 | - | 3 | 0 | 0 | H | - | - | - | - |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 1 | - | 3 | 0 | 0 | H-M | - | - | - | HT 10:35 |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 1 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 23/11/22 | Estuarine survey | Lorna Gill | 08:00 | 14:00 | 4 | SW | 0 | 1 | - | 3 | 0 | 0 | M | - | - | - | - |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 3 | NW | 0 | 8 | - | 4 | 0 | 0 | M-H | - | - | - | - |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 4 | NW | 0 | 6 | - | 4 | 0 | 0 | H | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 3 | NW | 0 | 8 | - | 4 | 0 | 0 | M-H | - | - | - | - |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 3 | NW | 0 | 8 | - | 4 | 0 | 0 | M-H | - | - | - | - |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 3 | NW | 0 | 8 | - | 4 | 0 | 0 | M-H | - | - | - | - |
| 28/11/22 | Estuarine survey | Lorna Gill | 12:00 | 15:00 | 4 | NW | 0 | 7 | - | 4 | 0 | 0 | H | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 4 | SE | 1 | 7 | - | 3 | 0 | 0 | M | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 4 | SE | 1 | 8 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 3 | SE | 1 | 8 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 3 | SE | 1 | 7 | - | 3 | 0 | 0 | M | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 3 | SE | 1 | 1 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 30/11/22 | Estuarine survey | Lorna Gill | 08:14 | 14:14 | 3 | SE | 1 | 7 | - | 3 | 0 | 0 | M | - | - | - | LT 09:54 |
| 13/12/22 | Estuarine survey | Conor Maloney | 13:06 | 16:06 | 2 | SW | 1 | 8 | 0 | 5 | 0 | 3 | M-H | - | - | - | - |
| 13/12/22 | Estuarine survey | Conor Maloney | 13:06 | 16:06 | 1 | SW | 2 | 8 | 0 | 6 | 0 | 3 | M-H | - | - | - | - |
| 13/12/22 | Estuarine survey | Conor Maloney | 13:06 | 16:06 | 1 | SW | 1 | 8 | 0 | 7 | 0 | 3 | H-M | - | - | - | - |
| 13/12/22 | Estuarine survey | Conor Maloney | 13:06 | 16:06 | 2 | SW | 2 | 8 | 0 | 7 | 0 | 2 | H-M | - | - | - | - |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 0 | 4 | M-L | - | - | - | - |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 1 | 4 | L | - | - | - | - |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 1 | 4 | L-M | - | - | - | - |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 1 | 4 | L-M | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 1 | 4 | L-M | - | - | - | - |
| 15/12/22 | Estuarine survey | Lorna Gill | 08:30 | 14:30 | 3 | W | 3 | 1 | 0 | 1 | 1 | 4 | L-M | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 4 | S | 4 | 6 | 1 | 6 | 0 | 2 | H-M | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 5 | SE | 5 | 8 | 2 | 8 | 0 | 2 | H-M | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 5 | SE | 5 | 7 | 3 | 7 | 0 | 3 | H-M | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 5 | SE | 5 | 6 | 2 | 6 | 0 | 4 | - | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 4 | SW | 4 | 5 | 1 | 5 | 0 | 4 | - | - | - | - | - |
| 19/12/22 | Estuarine survey | Lorna Gill | 08:36 | 14:36 | 4 | SW | 4 | 5 | 3 | 5 | 0 | 3 | L | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | SW | 2 | 8 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | SW | 1 | 5 | - | 3 | 0 | 0 | M | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | SW | 3 | 7 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | W | 1 | 5 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | SW | 0 | 2 | - | 3 | 0 | 0 | H | - | - | - | - |
| 11/01/23 | Estuarine survey | Lorna Gill | 10:29 | 16:29 | 5 | W | 0 | 7 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | W | 0 | 3 | - | 3 | 1 | 0 | H-M | - | - | - | Constant activity from dogs and walkers on Velvet Strand. Dogs on Portmarnock side of estuary off-lead |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | W | 0 | 6 | - | 3 | 1 | 0 | M | - | - | - | - |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | W | 0 | 5 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | NW | 0 | 2 | - | 3 | 0 | 0 | M-L | - | - | - | - |

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | NW | 0 | 7 | - | 3 | 0 | 0 | L | - | - | - | - |
| 18/01/23 | Estuarine survey | Lorna Gill | 09:47 | 15:47 | 4 | NW | 0 | 4 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 3 | W | 0 | 8 | - | 3 | 0 | 0 | M | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 4 | W | 0 | 7 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 4 | W | 0 | 4 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 4 | W | 0 | 7 | - | 3 | 0 | 0 | L | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 3 | SW | 0 | 8 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 16/02/23 | Estuarine survey | Lorna Gill | 10:26 | 16:26 | 4 | SW | 0 | 8 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 3 | - | 3 | 0 | 0 | M | - | - | - | Constant aircraft and dogwalkers |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 4 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 7 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 7 | - | 3 | 0 | 0 | H | - | - | - | - |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 4 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 22/02/23 | Estuarine survey | Lorna Gill | 09:46 | 15:46 | 4 | NW | 0 | 4 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 21/03/23 | Estuarine survey | Emma Ní Dhonncha dha | 06:30 | 12:30 | 3 | SW | 0 | 8 | - | 2 | 0 | 0 | - | - | - | - | 9°C |
| 21/03/23 | Estuarine survey | Emma Ní Dhonncha dha | 06:30 | 12:30 | 3 | SW | 0 | 8 | - | 2 | 0 | 0 | - | - | - | - | 9°C |
| 21/03/23 | Estuarine survey | Emma Ní Dhonncha dha | 06:30 | 12:30 | 3 | SW | 2 | 8 | - | 2 | 0 | 0 | - | - | - | - | 10°C |

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 21/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 06:30 | 12:30 | 3 | SW | 1 | 8 | - | 2 | 0 | 0 | - | - | - | - | 10°C |
| 21/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 06:30 | 12:30 | 4 | SW | 0 | 6 | - | 2 | 0 | 0 | - | - | - | - | 11°C |
| 21/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 06:30 | 12:30 | 4 | SW | 0 | 5 | - | 2 | 0 | 0 | - | - | - | - | 12°C |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 4 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 6 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 3 | - | 4 | 0 | 0 | H-L | - | - | - | - |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 3 | - | 4 | 0 | 0 | L-M | - | - | - | - |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 4 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 30/03/23 | Estuarine survey | Emma Ní Dhonnchadha | 10:11 | 16:11 | 4 | SW | 0 | 4 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | SE | 0 | 7 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | S | 1 | 7 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | S | 0 | 7 | - | 3 | 0 | 0 | M-H | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | S | 0 | 7 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | S | 0 | 8 | - | 3 | 0 | 0 | H-M | - | - | - | - |
| 04/04/23 | Estuarine survey | Conor Maloney | 07:26 | 13:26 | 5 | S | 0 | 8 | - | 3 | 0 | 0 | M-L | - | - | - | - |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 2 | SW | 0 | 5 | 2 | 2 | 0 | 0 | - | - | - | - | Cool 6°C |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 2 | SW | 0 | 3 | 2 | 2 | 0 | 0 | - | - | - | - | - |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 2 | SW | 0 | 3 | 2 | 2 | 0 | 0 | - | - | - | - | - |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 3 | SW | 0 | 4 | 2 | 2 | 0 | 0 | - | - | - | - | - |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 3 | SW | 0 | 4 | 2 | 2 | 0 | 0 | - | - | - | - | - |
| 26/04/23 | Estuarine survey | William Lishman | 07:30 | 13:30 | 4 | SW | 0 | 5 | 2 | 2 | 0 | 0 | - | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 3 | W | 0 | 7 | - | 3 | 0 | 0 | M | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 3 | W | 2 | 7 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 3 | W | 1 | 7 | - | 3 | 0 | 0 | M-L | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 3 | W | 2 | 6 | - | 3 | 0 | 0 | L | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 2 | W | 0 | 5 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 11/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 07:06 | 13:06 | 2 | NW | 0 | 4 | - | 3 | 0 | 0 | L-M | - | - | - | - |
| 25/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 11:59 | 17:59 | 3 | N | 0 | 0 | - | 2 | 0 | 0 | - | - | - | - | 15°C |
| 25/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 11:59 | 17:59 | 3 | N | 0 | 0 | - | 2 | 0 | 0 | - | - | - | - | 16°C |
| 25/05/23 | Estuarine survey | Emma Ní Dhonnchadha | 11:59 | 17:59 | 3 | NE | 0 | 0 | - | 2 | 0 | 0 | - | - | - | - | 17°C |

## APPENDIX A

| Survey date | Survey type | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 25/05/23 | Estuarine survey | Emma Ní Dhonncha dha | 11:59 | 17:59 | 2 | NE | 0 | 1 | 2 | 2 | 0 | 0 | - | - | - | - | 18°C |
| 25/05/23 | Estuarine survey | Emma Ní Dhonncha dha | 11:59 | 17:59 | 2 | NE | 0 | 3 | 1 | 2 | 0 | 0 | - | - | - | - | 17°C |
| 25/05/23 | Estuarine survey | Emma Ní Dhonncha dha | 11:59 | 17:59 | 3 | NE | 0 | 3 | 1 | 2 | 0 | 0 | - | - | - | - | 18°C |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | S | 1 | 7 | - | 2 | 0 | 0 | M-H | - | - | - | - |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | S | 2 | 7 | - | 2 | 0 | 0 | M-H | - | - | - | - |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | S | 0 | 8 | - | 2 | 0 | 0 | M-H | - | - | - | - |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | S | 2 | 8 | - | 2 | 0 | 0 | H | - | - | - | - |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | SW | 0 | 7 | - | 2 | 0 | 0 | H-M | - | - | - | - |
| 23/06/23 | Estuarine survey | Lorna Gill | 12:55 | 18:55 | 3 | SW | 1 | 8 | - | 2 | 0 | 0 | H-M | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | SW | 0 | 4 | - | 4 | 0 | 0 | M-L | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | SW | 0 | 5 | - | 4 | 0 | 0 | M-L | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | W | 1 | 6 | - | 4 | 0 | 0 | L | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | SW | 1 | 5 | - | 4 | 0 | 0 | L-M | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | W | 0 | 6 | - | 4 | 0 | 0 | L-M | - | - | - | - |
| 26/06/23 | Estuarine survey | Lorna Gill | 09:58 | 15:58 | 4 | W | 0 | 7 | - | 4 | 0 | 0 | L-M | - | - | - | - |

Abbreviations used in Table A10.1b: NE: North east; NW: North west; N: North; E: East; SE: South east; SW: South west; S: South; W: West; H: High; M: Medium; L: Low.

# APPENDIX 3 – ESTUARINE BIRD SURVEY DATA

**Table A10.2. Estuarine walkover peak monthly population estimates for bird species listed as Special Conservation Interests (SCIs) on Baldoyle Bay SPA citation**

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA citation* | Five-year peak mean** | Peak count*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bar-tailed Godwit | 2020 | | | | | | | | | 74 | **205** | 202 | 177 | 353 | 61 | 205 |
| | 2021 | 131 | 115 | 53 | 13 | 0 | 0 | 1 | 20 | 0 | 0 | 19 | 0 | | | |
| | 2022 | | | | | | | | | | 129 | 33 | 5 | | | |
| | 2023 | 6 | 8 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Brent Goose (LB) | 2020 | | | | | | | | | 0 | 282 | 315 | 277 | 726 | 521 | 321 |
| | 2021 | **321** | 254 | 231 | 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 318 | 0 | 0 | | | |
| | 2023 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Golden Plover | 2020 | | | | | | | | | 46 | 750 | 285 | 725 | 1810 | 707 | 945 |
| | 2021 | **945** | 800 | 135 | 0 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 0 | 0 | 176 | | | |
| | 2023 | 400 | 32 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Grey Plover | 2020 | | | | | | | | | 2 | 26 | 15 | **31** | 200 | 102 | 31 |
| | 2021 | 7 | 12 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 2 | 0 | 5 | | | |
| | 2023 | 6 | 8 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Ringed Plover | 2020 | | | | | | | | | 54 | **86** | 63 | 53 | 221 | 1 | 86 |
| | 2021 | 24 | 53 | 39 | 32 | 17 | 24 | 14 | 75 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 0 | 0 | 0 | | | |
| | 2023 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Shelduck | 2020 | | | | | | | | | 52 | 52 | 26 | 30 | 147 | 140 | 305 |
| | 2021 | 53 | 43 | 24 | 38 | 3 | 9 | 12 | 14 | 0 | 0 | 77 | 98 | | | |
| | 2022 | | | | | | | | | | 32 | 64 | 59 | | | |
| | 2023 | **305** | 148 | 55 | 55 | 23 | 5 | | | | | | | | | |

*Five year mean peak counts for the period 1995/6-1999/00 (I-WeBS) except for light-bellied brent goose (Robinson *et al*., 2004).

**Five year mean peak for the period 20016/17-2020/21 (I-WeBS). ***Peak count based on collected data (underlined and in bold by species).

**Table A10.3. Estuarine walkover peak monthly population estimates for other bird species (non-SCI) listed on Baldoyle Bay SPA citation**

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA citation* | Five-year peak mean** | Peak count*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black-tailed Godwit | 2020 | | | | | | | | | 62 | **250** | 154 | 228 | 72 | 172 | 250 |
| | 2021 | 214 | 186 | 142 | 17 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 19 | | | |
| | 2022 | | | | | | | | | | 181 | 126 | 121 | | | |
| | 2023 | 84 | 108 | 62 | 5 | 0 | 0 | | | | | | | | | |
| Curlew | 2020 | | | | | | | | | 42 | 41 | 61 | 36 | 61 | 70 | 115 |
| | 2021 | 41 | 38 | 43 | 9 | 3 | 6 | 12 | 11 | 0 | 0 | 38 | **115** | | | |
| | 2022 | | | | | | | | | | 84 | 44 | 7 | | | |
| | 2023 | 23 | 49 | 29 | 24 | 5 | 79 | | | | | | | | | |
| Dunlin | 2020 | | | | | | | | | 110 | 543 | 468 | 323 | 879 | 271 | 1006 |
| | 2021 | 336 | 205 | 113 | 60 | 14 | 0 | 0 | 43 | 0 | 0 | 60 | 112 | | | |
| | 2022 | | | | | | | | | | 165 | 187 | 732 | | | |
| | 2023 | **1006** | 372 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Great Crested Grebe | 2020 | | | | | | | | | **25** | 14 | 11 | 14 | 42 | 0 | 25 |
| | 2021 | 10 | 13 | 9 | 4 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 0 | 3 | 6 | | | |
| | 2023 | 3 | 7 | 20 | 4 | 0 | 0 | | | | | | | | | |
| Greenshank | 2020 | | | | | | | | | 5 | 16 | 9 | 8 | 11 | 6 | 54 |
| | 2021 | 11 | 7 | 6 | 1 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 29 | | | |
| | 2022 | | | | | | | | | | 3 | 3 | 2 | | | |
| | 2023 | 12 | 15 | **54** | 41 | 0 | 0 | | | | | | | | | |
| Grey Heron | 2020 | | | | | | | | | 10 | **17** | 15 | 15 | 16 | 5 | 17 |
| | 2021 | 14 | 7 | 7 | 10 | 5 | 6 | 5 | 8 | 0 | 0 | 10 | 0 | | | |
| | 2022 | | | | | | | | | | 4 | 2 | 1 | | | |
| | 2023 | 2 | 4 | 2 | 4 | 2 | 4 | | | | | | | | | |
| Knot | 2020 | | | | | | | | | 0 | **267** | 202 | 48 | 115 | 320 | 267 |
| | 2021 | 51 | 121 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 | 0 | | | |
| | 2022 | | | | | | | | | | 0 | 7 | 8 | | | |

## APPENDIX A

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA citation* | Five-year peak mean** | Peak count*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | 3 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Lapwing | 2020 | | | | | | | | | 38 | **<u>263</u>** | 119 | 218 | 450 | 225 | 263 |
| | 2021 | 127 | 179 | 36 | 8 | 0 | 0 | 2 | 2 | 0 | 0 | 13 | 80 | | | |
| | 2022 | | | | | | | | | | 135 | 166 | 131 | | | |
| | 2023 | 229 | 65 | 0 | 0 | 0 | 55 | | | | | | | | | |
| Mallard | 2020 | | | | | | | | | **<u>131</u>** | 62 | 94 | **<u>131</u>** | 46 | 93 | 131 |
| | 2021 | 112 | 53 | 61 | 53 | 23 | 36 | 46 | 57 | 0 | 0 | 12 | 13 | | | |
| | 2022 | | | | | | | | | | 68 | 39 | 33 | | | |
| | 2023 | 49 | 103 | 62 | 40 | 39 | 42 | | | | | | | | | |
| Oystercatcher | 2020 | | | | | | | | | 302 | 284 | 200 | 212 | 531 | 235 | 348 |
| | 2021 | 139 | 224 | 193 | 33 | 2 | 62 | 39 | 38 | 0 | 0 | 0 | 57 | | | |
| | 2022 | | | | | | | | | | 107 | 169 | 164 | | | |
| | 2023 | 128 | **<u>348</u>** | 125 | 247 | 135 | 25 | | | | | | | | | |
| Pintail | 2020 | | | | | | | | | 0 | 0 | **<u>2</u>** | **<u>2</u>** | 22 | 0 | 2 |
| | 2021 | **<u>2</u>** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 0 | 0 | 0 | | | |
| | 2023 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Red-breasted Merganser | 2020 | | | | | | | | | **<u>26</u>** | 14 | 13 | 11 | 14 | 5 | 26 |
| | 2021 | 13 | 13 | 6 | 6 | 0 | 0 | 2 | 3 | 0 | 0 | 12 | 13 | | | |
| | 2022 | | | | | | | | | | 0 | 2 | 0 | | | |
| | 2023 | 1 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |
| Redshank | 2020 | | | | | | | | | 159 | 141 | 117 | **<u>197</u>** | 224 | 123 | 197 |
| | 2021 | 79 | 88 | 57 | 36 | 5 | 8 | 10 | 34 | 0 | 0 | 47 | 97 | | | |
| | 2022 | | | | | | | | | | 71 | 75 | 21 | | | |
| | 2023 | 70 | 92 | 211 | 38 | 0 | 0 | | | | | | | | | |
| Sanderling | 2020 | | | | | | | | | 0 | 15 | **<u>76</u>** | 14 | 26 | 0 | 76 |
| | 2021 | 30 | 45 | 31 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 2 | 55 | 5 | | | |
| | 2023 | 39 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | |

## APPENDIX A

| Species | Year | J | F | M | A | M | J | J | A | S | O | N | D | Original SPA citation* | Five-year peak mean** | Peak count*** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Teal | 2020 | | | | | | | | | 53 | 68 | 69 | 168 | 124 | 126 | 303 |
| | 2021 | 49 | 92 | 57 | 16 | 2 | 2 | 13 | 32 | 0 | 0 | 46 | 127 | | | |
| | 2022 | | | | | | | | | | 39 | 132 | 147 | | | |
| | 2023 | 144 | **303** | 88 | 40 | 0 | 0 | | | | | | | | | |
| Turnstone | 2020 | | | | | | | | | 11 | 20 | 2 | 23 | 43 | 11 | 29 |
| | 2021 | 15 | **29** | 21 | 15 | 0 | 13 | 8 | 11 | 0 | 0 | 0 | 0 | | | |
| | 2022 | | | | | | | | | | 11 | 12 | 5 | | | |
| | 2023 | 3 | 0 | 1 | 0 | 0 | 0 | | | | | | | | | |

*Five year mean peak counts for the period 1995/6-1999/00 (I-WeBS) except for light-bellied brent goose (Robinson *et al.*, 2004).

**Five year mean peak for the period 2016/17-2020/21 (I-WeBS).

***Peak count based on collected data (underlined and in bold by species).

## APPENDIX A

**Table 10.4. Estuarine walkover peak monthly population estimates for bird species not listed on Baldoyle Bay SPA citation**

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Black Guillemot** | Auks | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 7 | 6 | 0 | 2 | 0 |
| Guillemot*, ****, ***** | | 3 | 4 | 2 | 2 | 1 | 0 | 1 | 1 | 2 | 7 | 3 | 2 |
| Razorbill*, ****, ***** | | 1 | 0 | 1 | 2 | 3 | 2 | 0 | 1 | 3 | 0 | 2 | 1 |
| Great Northern Diver***** | Divers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Red-throated Diver***** | | 2 | 2 | 2 | 1 | 0 | 1 | 1 | 1 | 11 | 4 | 2 | 1 |
| Dark-bellied Brent Goose | Geese and Swans | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 2 |
| Mute Swan | | 6 | 6 | 4 | 6 | 2 | 6 | 5 | 6 | 8 | 13 | 15 | 7 |
| Common Scoter***** | Grebes, Ducks and Rails | 6 | 30 | 6 | 0 | 0 | 0 | 0 | 0 | 11 | 18 | 24 | 0 |
| Coot | | 1 | 0 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 0 |
| Eider | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Goldeneye | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 0 |
| Little Grebe | | 1 | 2 | 2 | 4 | 2 | 6 | 2 | 2 | 2 | 1 | 4 | 2 |
| Moorhen | | 2 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 2 |
| Pochard | | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Shoveler | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Water Rail | | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Wigeon | | 21 | 27 | 32 | 4 | 0 | 0 | 0 | 0 | 10 | 141 | 247 | 103 |
| Black-headed Gull***** | Gulls | 31 | 87 | 34 | 26 | 3 | 45 | 18 | 32 | 27 | 175 | 112 | 122 |
| Common Gull***** | | 18 | 31 | 22 | 5 | 6 | 8 | 5 | 16 | 8 | 14 | 11 | 28 |
| Great Black-backed Gull**, ***** | | 18 | 12 | 11 | 14 | 9 | 9 | 9 | 15 | 29 | 9 | 5 | 6 |
| Herring Gull*, ***** | | 53 | 42 | 139 | 39 | 203 | 67 | 33 | 47 | 30 | 105 | 152 | 52 |
| Kittiwake*, ***, ***** | | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| Lesser Black-backed Gull***** | | 6 | 2 | 4 | 2 | 2 | 4 | 5 | 5 | 3 | 8 | 2 | 1 |
| Mediterranean Gull | | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 5 | 6 | 0 | 0 | 2 |
| Blackbird | Other | 0 | 2 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue tit | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Carrion Crow | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11 |
| Chaffinch | | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 25 | 0 | 0 |

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Corn Bunting | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Dunnock | | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Goldfinch | | 0 | 3 | 3 | 8 | 0 | 32 | 0 | 0 | 0 | 15 | 3 | 0 |
| Grasshopper warbler | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Great tit | | 0 | 1 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Grey Wagtail | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 |
| Hooded Crow | | 0 | 11 | 11 | 2 | 7 | 13 | 0 | 0 | 0 | 0 | 2 | 6 |
| House martin | | 0 | 0 | 0 | 0 | 13 | 15 | 0 | 0 | 0 | 0 | 0 | 0 |
| House sparrow | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Jackdaw | | 0 | 3 | 0 | 0 | 7 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Linnet | | 0 | 7 | 0 | 0 | 2 | 1 | 0 | 0 | 0 | 9 | 0 | 0 |
| Little Egret | | 5 | 9 | 9 | 8 | 6 | 21 | 1 | 2 | 3 | 9 | 4 | 7 |
| Long-tailed tit | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Magpie | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Meadow Pipit | | 0 | 0 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 1 | 5 | 5 |
| Mistle Thrush | | 0 | 0 | 1 | 0 | 7 | 1 | 0 | 0 | 0 | 0 | 1 | 0 |
| Pheasant | | 0 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| Pied Wagtail | | 0 | 1 | 0 | 0 | 3 | 7 | 0 | 0 | 0 | 0 | 2 | 0 |
| Raven | | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 1 | 0 |
| Red-legged Partridge | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Redwing | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Reed Bunting | | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 4 |
| Robin | | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| Rock Pipit | | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Rook | | 0 | 5 | 2 | 0 | 5 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sand martin | | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sedge warbler | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Skylark | | 1 | 3 | 12 | 0 | 6 | 3 | 0 | 0 | 0 | 2 | 7 | 0 |
| Song thrush | | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Starling | | 3 | 75 | 17 | 0 | 213 | 132 | 0 | 0 | 0 | 11 | 36 | 43 |

## APPENDIX A

| Species | Category | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stonechat | | 3 | 3 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 1 |
| Swallow | | 0 | 0 | 0 | 0 | 8 | 30 | 0 | 0 | 0 | 0 | 0 | 0 |
| Woodpigeon | | 0 | 52 | 13 | 0 | 6 | 32 | 0 | 0 | 0 | 0 | 0 | 53 |
| Wren | | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| Buzzard | Raptors | 4 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| Kestrel | | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| Peregrine Falcon**, **** | | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| Cormorant*, ***** | Shags and Cormorants | 2 | 2 | 1 | 3 | 4 | 1 | 1 | 1 | 11 | 26 | 1 | 2 |
| Shag**, ***** | | 2 | 1 | 2 | 0 | 0 | 1 | 1 | 1 | 2 | 2 | 3 | 1 |
| Arctic Tern***** | Terns | 0 | 0 | 0 | 0 | 0 | 3 | 3 | 2 | 0 | 0 | 0 | 0 |
| Common Tern***** | | 0 | 0 | 0 | 0 | 6 | 4 | 2 | 5 | 0 | 0 | 0 | 0 |
| Roseate Tern***** | | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 |
| Sandwich Tern | | 0 | 0 | 0 | 0 | 3 | 3 | 5 | 6 | 0 | 0 | 0 | 0 |
| Common Sandpiper | Waders | 1 | 0 | 1 | 0 | 0 | 6 | 1 | 1 | 1 | 1 | 1 | 1 |
| Common Snipe | | 3 | 4 | 3 | 2 | 0 | 0 | 2 | 1 | 3 | 3 | 6 | 6 |
| Ruff | | 36 | 0 | 0 | 4 | 0 | 0 | 1 | 1 | 6 | 2 | 0 | 0 |
| Whimbrel | | 4 | 0 | 12 | 29 | 0 | 0 | 0 | 4 | 2 | 2 | 2 | 0 |

*SCI of Ireland's Eye SPA

**Named bird species of Ireland's Eye SPA

***SCI of Howth Head Coast SPA

****Named bird species of Howth Head Coast SPA

***** SCI of North-West Irish Sea cSPA

# APPENDIX 4 – VP SURVEY EFFORT AND WEATHER

**Table A10.5a. VP survey effort August 2020 to June 2023**

| Survey date | Survey type | VP | Surveyor | Start time | End time | Total time |
|---|---|---|---|---|---|---|
| 24/08/20 | Coastal VP survey | 2 | Nick Veale | 09:30 | 12:30 | 03:00 |
| 24/08/20 | Coastal VP survey | 1 | Nick Veale | 13:15 | 16:15 | 03:00 |
| 26/08/20 | Coastal VP survey | 2 | Nick Veale | 11:30 | 14:30 | 03:00 |
| 26/08/20 | Coastal VP survey | 1 | Nick Veale | 07:45 | 10:45 | 03:00 |
| 10/09/20 | Coastal VP survey | 1 | Nick Veale | 06:20 | 09:20 | 03:00 |
| 10/09/20 | Coastal VP survey | 2 | Nick Veale | 10:15 | 13:15 | 03:00 |
| 29/09/20 | Coastal VP survey | 2 | Nick Veale | 11:00 | 14:00 | 03:00 |
| 29/09/20 | Coastal VP survey | 1 | Nick Veale | 14:40 | 17:40 | 03:00 |
| 12/10/20 | Coastal VP survey | 2 | Nick Veale | 09:15 | 12:15 | 03:00 |
| 12/10/20 | Coastal VP survey | 1 | Nick Veale | 12:50 | 15:50 | 03:00 |
| 22/10/20 | Coastal VP survey | 2 | Nick Veale | 09:45 | 12:45 | 03:00 |
| 22/10/20 | Coastal VP survey | 1 | Nick Veale | 13:30 | 16:30 | 03:00 |
| 23/11/20 | Coastal VP survey | 2 | Nick Veale | 09:10 | 12:10 | 03:00 |
| 23/11/20 | Coastal VP survey | 1 | Nick Veale | 12:45 | 15:45 | 03:00 |
| 30/11/20 | Coastal VP survey | 1 | Nick Veale | 08:20 | 11:20 | 03:00 |
| 30/11/20 | Coastal VP survey | 2 | Nick Veale | 12:00 | 15:00 | 03:00 |
| 11/12/20 | Coastal VP survey | 1 | Nick Veale | 11:05 | 14:05 | 03:00 |
| 12/12/20 | Coastal VP survey | 2 | Nick Veale | 10:15 | 13:15 | 03:00 |
| 13/12/20 | Coastal VP survey | 1 | Nick Veale | 08:45 | 11:45 | 03:00 |
| 17/12/20 | Coastal VP survey | 2 | Nick Veale | 10:30 | 13:30 | 03:00 |
| 17/01/21 | Coastal VP survey | 1 | Nick Veale | 09:45 | 12:45 | 03:00 |
| 18/01/21 | Coastal VP survey | 2 | Nick Veale | 12:10 | 15:10 | 03:00 |
| 25/01/21 | Coastal VP survey | 2 | Nick Veale | 10:30 | 13:30 | 03:00 |
| 27/01/21 | Coastal VP survey | 1 | Nick Veale | 09:20 | 12:20 | 03:00 |
| 04/02/21 | Coastal VP survey | 2 | Nick Veale | 09:40 | 12:40 | 03:00 |
| 04/02/21 | Coastal VP survey | 1 | Nick Veale | 13:10 | 16:10 | 03:00 |
| 22/02/21 | Coastal VP survey | 2 | Nick Veale | 09:15 | 12:15 | 03:00 |
| 22/02/21 | Coastal VP survey | 1 | Nick Veale | 12:40 | 15:40 | 03:00 |
| 26/03/21 | Coastal VP survey | 2 | Nick Veale | 08:40 | 11:40 | 03:00 |
| 26/03/21 | Coastal VP survey | 1 | Nick Veale | 12:20 | 15:20 | 03:00 |
| 31/03/21 | Coastal VP survey | 2 | Nick Veale | 08:25 | 11:25 | 03:00 |
| 31/03/21 | Coastal VP survey | 1 | Nick Veale | 12:10 | 15:10 | 03:00 |
| 21/04/21 | Coastal VP survey | 1 | Nick Veale | 07:45 | 10:45 | 03:00 |
| 21/04/21 | Coastal VP survey | 2 | Nick Veale | 11:20 | 14:20 | 03:00 |
| 28/04/21 | Coastal VP survey | 1 | Nick Veale | 09:00 | 12:00 | 03:00 |
| 28/04/21 | Coastal VP survey | 2 | Nick Veale | 13:00 | 16:00 | 03:00 |
| 17/05/21 | Coastal VP survey | 2 | Nick Veale | 07:50 | 10:50 | 03:00 |
| 17/05/21 | Coastal VP survey | 1 | Nick Veale | 11:40 | 14:40 | 03:00 |
| 31/05/21 | Coastal VP survey | 1 | Nick Veale | 06:30 | 09:30 | 03:00 |
| 31/05/21 | Coastal VP survey | 2 | Nick Veale | 10:15 | 13:15 | 03:00 |
| 17/06/21 | Coastal VP survey | 1 | Nick Veale | 05:45 | 08:45 | 03:00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 17/06/21 | Coastal VP survey | 2 | Nick Veale | 09:30 | 12:30 | 03:00 |
| 28/06/21 | Coastal VP survey | 1 | Nick Veale | 05:05 | 08:05 | 03:00 |
| 28/06/21 | Coastal VP survey | 2 | Nick Veale | 09:10 | 12:10 | 03:00 |
| 08/07/21 | Coastal VP survey | 1 | Nick Veale | 04:35 | 07:35 | 03:00 |
| 08/07/21 | Coastal VP survey | 2 | Nick Veale | 08:30 | 11:30 | 03:00 |
| 13/07/21 | Coastal VP survey | 1 | Nick Veale | 06:20 | 09:20 | 03:00 |
| 13/07/21 | Coastal VP survey | 2 | Nick Veale | 10:20 | 13:20 | 03:00 |
| 20/10/22 | Coastal VP survey | 1 | Lorna Gill | 08:30 | 11:30 | 03:00 |
| 25/10/22 | Coastal VP survey | 1 | Lorna Gill | 15:07 | 18:07 | 03:00 |
| 28/10/22 | Coastal VP survey | 2 | Lorna Gill | 10:45 | 13:45 | 03:00 |
| 03/11/22 | Coastal VP survey | 2 | Lorna Gill | 10:00 | 13:00 | 03:00 |
| 09/11/22 | Coastal VP survey | 2 | Lorna Gill | 10:30 | 13:30 | 03:00 |
| 16/11/22 | Coastal VP survey | 1 | Lorna Gill | 09:10 | 12:10 | 03:00 |
| 18/11/22 | Coastal VP survey | 2 | Lorna Gill | 10:15 | 13:15 | 03:00 |
| 22/11/22 | Coastal VP survey | 1 | Lorna Gill | 08:30 | 11:30 | 03:00 |
| 02/12/22 | Coastal VP survey | 1 | Lorna Gill | 10:48 | 13:48 | 03:00 |
| 14/12/22 | Coastal VP survey | 1 | Lorna Gill | 13:00 | 16:00 | 03:00 |
| 16/12/22 | Coastal VP survey | 2 | Lorna Gill | 10:15 | 13:15 | 03:00 |
| 16/01/23 | Coastal VP survey | 1 | Lorna Gill | 13:05 | 16:05 | 03:00 |
| 20/01/23 | Coastal VP survey | 2 | Lorna Gill | 12:15 | 15:15 | 03:00 |
| 24/01/23 | Coastal VP survey | 1 | Lorna Gill | 13:05 | 16:05 | 03:00 |
| 27/01/23 | Coastal VP survey | 2 | Lorna Gill | 09:45 | 12:45 | 03:00 |
| 13/02/23 | Coastal VP survey | 1 | Lorna Gill | 08:21 | 11:21 | 03:00 |
| 23/02/23 | Coastal VP survey | 1 | Lorna Gill | 11:59 | 14:59 | 03:00 |
| 06/03/23 | Coastal VP survey | 2 | Lorna Gill | 08:30 | 11:30 | 03:00 |
| 13/03/23 | Coastal VP survey | 1 | Lorna Gill | 10:00 | 13:00 | 03:00 |
| 20/03/23 | Coastal VP survey | 1 | Lorna Gill | 10:00 | 13:00 | 03:00 |
| 24/03/23 | Coastal VP survey | 2 | Lorna Gill | 08:30 | 11:30 | 03:00 |
| 14/04/23 | Coastal VP survey | 1 | Lorna Gill | 11:14 | 14:14 | 03:00 |
| 20/04/23 | Coastal VP survey | 1 | Lorna Gill | 10:58 | 13:58 | 03:00 |
| 04/05/23 | Coastal VP survey | 1 | Lorna Gill | 10:02 | 13:02 | 03:00 |
| 08/05/23 | Coastal VP survey | 2 | Lorna Gill | 09:30 | 12:30 | 03:00 |
| 23/05/23 | Coastal VP survey | 2 | Lorna Gill | 09:10 | 12:10 | 03:00 |
| 26/05/23 | Coastal VP survey | 1 | Lorna Gill | 09:26 | 12:26 | 03:00 |
| 09/06/23 | Coastal VP survey | 1 | Lorna Gill | 08:31 | 11:31 | 03:00 |
| 16/06/23 | Coastal VP survey | 2 | Lorna Gill | 13:50 | 16:50 | 03:00 |
| 29/06/23 | Coastal VP survey | 2 | Lorna Gill | 12:45 | 15:45 | 03:00 |
| 30/06/23 | Coastal VP survey | 1 | Lorna Gill | 08:07 | 11:07 | 03:00 |

**Table A10.5b. VP survey weather August 2020 to June 2023**

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24/08/20 | 2 | Nick Veale | 09:30 | 12:30 | 2 | SW | 0 | 2 | 2 | 4 | 0 | 0 | L | 0 | 1 | 0 | - |
| 24/08/20 | 2 | Nick Veale | 09:30 | 12:30 | 2 | SW | 0 | 2 | 2 | 4 | 0 | 0 | L-M | 0 | 1 | 0 | - |
| 24/08/20 | 2 | Nick Veale | 09:30 | 12:30 | 3 | SW | 0 | 3 | 2 | 4 | 0 | 0 | L-M | 0 | 1 | 0 | - |
| 24/08/20 | 1 | Nick Veale | 13:15 | 16:15 | 3 | SW | 0 | 4 | 2 | 4 | 0 | 0 | M | 0 | 2 | 0.25 | - |
| 24/08/20 | 1 | Nick Veale | 13:15 | 16:15 | 3 | SE | 0 | 5 | 2 | 4 | 0 | 0 | M-H | 0 | 2 | 0.25 | - |
| 24/08/20 | 1 | Nick Veale | 13:15 | 16:15 | 3 | SE | 0 | 5 | 2 | 4 | 0 | 0 | M-H | 0 | 2 | 0.25 | - |
| 26/08/20 | 2 | Nick Veale | 07:45 | 10:45 | 3 | W | 1 | 8 | 1 | 4 | 0 | 0 | H-M | 0 | 2 | 0.25 | - |
| 26/08/20 | 2 | Nick Veale | 07:45 | 10:45 | 3 | W | 0 | 8 | 1 | 4 | 0 | 0 | H-M | 0 | 2 | 0.25 | - |
| 26/08/20 | 2 | Nick Veale | 07:45 | 10:45 | 3 | SW | 0 | 8 | 1 | 4 | 0 | 0 | M | 0 | 2 | 0.25 | - |
| 26/08/20 | 1 | Nick Veale | 11:30 | 14:30 | 3 | SW | 0 | 8 | 1 | 4 | 0 | 0 | M-L | 0 | 2 | 0.25 | - |
| 26/08/20 | 1 | Nick Veale | 11:30 | 14:30 | 3 | W | 0 | 7 | 1 | 4 | 0 | 0 | M-L | 0 | 2 | 0.25 | - |
| 26/08/20 | 1 | Nick Veale | 11:30 | 14:30 | 3 | W | 0 | 7 | 1 | 4 | 0 | 0 | M-L | 0 | 2 | 0.25 | - |
| 10/09/20 | 1 | Nick Veale | 06:20 | 09:20 | 1 | - | 0 | 5 | 2 | 4 | 0 | 0 | M-L | 1 | 1 | 0 | - |
| 10/09/20 | 1 | Nick Veale | 06:20 | 09:20 | 1 | - | 0 | 4 | 2 | 4 | 0 | 0 | M-L | 1 | 1 | 0 | - |
| 10/09/20 | 1 | Nick Veale | 06:20 | 09:20 | 2 | SW | 0 | 4 | 2 | 4 | 0 | 0 | L | 0 | 1 | 0 | - |
| 10/09/20 | 2 | Nick Veale | 10:15 | 13:15 | 2 | SW | 0 | 4 | 2 | 4 | 0 | 0 | M-L | 0 | 1 | 0 | - |
| 10/09/20 | 2 | Nick Veale | 10:15 | 13:15 | 2 | SW | 0 | 4 | 2 | 4 | 0 | 0 | L | 0 | 1 | 0 | - |
| 10/09/20 | 2 | Nick Veale | 10:15 | 13:15 | 2 | SW | 0 | 6 | 2 | 4 | 0 | 0 | L-M | 0 | 1 | 0 | - |
| 29/09/20 | 2 | Nick Veale | 11:00 | 14:00 | 2 | SE | 0 | 0 | - | 4 | 0 | 0 | H | - | - | - | - |
| 29/09/20 | 2 | Nick Veale | 11:00 | 14:00 | 2 | SE | 0 | 0 | - | 4 | 0 | 0 | H-M | - | - | - | - |
| 29/09/20 | 2 | Nick Veale | 11:00 | 14:00 | 2 | S | 0 | 1 | 2 | 4 | 0 | 0 | H-M | - | - | - | - |
| 29/09/20 | 1 | Nick Veale | 14:40 | 17:40 | 2 | S | 0 | 1 | 2 | 4 | 0 | 0 | M-L | 0 | 1 | 0 | - |
| 29/09/20 | 1 | Nick Veale | 14:40 | 17:40 | 2 | SE | 0 | 2 | 2 | 4 | 0 | 0 | M-L | 0 | 1 | 0 | - |
| 29/09/20 | 1 | Nick Veale | 14:40 | 17:40 | 2 | SE | 0 | 1 | 2 | 4 | 0 | 0 | L | 0 | 1 | 0 | - |
| 12/10/20 | 2 | Nick Veale | 09:15 | 12:15 | 3 | W | 0 | 6 | 2 | 4 | 0 | 0 | H | 1 | 3 | 1 | - |
| 12/10/20 | 2 | Nick Veale | 09:15 | 12:15 | 3 | W | 0 | 5 | 2 | 4 | 0 | 0 | H-M | 0 | 3 | 1 | - |
| 12/10/20 | 2 | Nick Veale | 09:15 | 12:15 | 4 | NW | 0 | 4 | 2 | 4 | 0 | 0 | H-M | 0 | 3 | 1 | - |

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/10/20 | 1 | Nick Veale | 12:50 | 15:50 | 4 | NW | 0 | 4 | 2 | 4 | 0 | 0 | M | 0 | 3 | 1 | - |
| 12/10/20 | 1 | Nick Veale | 12:50 | 15:50 | 4 | NW | 0 | 5 | 2 | 4 | 0 | 0 | M-L | 0 | 3 | 1.25 | - |
| 12/10/20 | 1 | Nick Veale | 12:50 | 15:50 | 4 | NW | 2 | 5 | 1 | 4 | 0 | 0 | M-L | 0 | 3 | 1.25 | - |
| 22/10/20 | 2 | Nick Veale | 09:45 | 12:45 | 2 | W | 0 | 4 | 2 | 4 | 0 | 0 | L | 0 | 2 | 0.5 | - |
| 22/10/20 | 2 | Nick Veale | 09:45 | 12:45 | 3 | W | 0 | 3 | 2 | 4 | 0 | 0 | L-M | 0 | 3 | 0.5 | - |
| 22/10/20 | 2 | Nick Veale | 09:45 | 12:45 | 3 | W | 0 | 5 | 2 | 4 | 0 | 0 | L-M | 0 | 3 | 0.5 | - |
| 22/10/20 | 1 | Nick Veale | 13:30 | 16:30 | 3 | W | 0 | 6 | 2 | 4 | 0 | 0 | M-H | 0 | 2 | 0 | - |
| 22/10/20 | 1 | Nick Veale | 13:30 | 16:30 | 3 | W | 0 | 6 | 2 | 4 | 0 | 0 | M-H | 0 | 2 | 0 | - |
| 22/10/20 | 1 | Nick Veale | 13:30 | 16:30 | 3 | W | 0 | 5 | 2 | 4 | 0 | 0 | H | 0 | 2 | 0 | - |
| 23/11/20 | 2 | Nick Veale | 09:10 | 12:10 | 2 | SW | 0 | 6 | 2 | 4 | 0 | 0 | - | 0 | 1 | 0.1 | - |
| 23/11/20 | 2 | Nick Veale | 09:10 | 12:10 | 3 | SW | 0 | 5 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.1 | - |
| 23/11/20 | 2 | Nick Veale | 09:10 | 12:10 | 3 | SW | 0 | 5 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.1 | - |
| 23/11/20 | 1 | Nick Veale | 12:45 | 15:45 | 3 | SW | 0 | 5 | 2 | 4 | 0 | 0 | - | 1 | 1 | - | - |
| 23/11/20 | 1 | Nick Veale | 12:45 | 15:45 | 3 | SW | 0 | 6 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 23/11/20 | 1 | Nick Veale | 12:45 | 15:45 | 3 | SW | 0 | 6 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 30/11/20 | 1 | Nick Veale | 08:20 | 11:20 | 2 | SW | 0 | 5 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 30/11/20 | 1 | Nick Veale | 08:20 | 11:20 | 2 | SW | 0 | 7 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 30/11/20 | 1 | Nick Veale | 08:20 | 11:20 | 2 | SW | 2 | 7 | 1 | 4 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 30/11/20 | 2 | Nick Veale | 12:00 | 15:00 | 2 | SW | 0 | 7 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 30/11/20 | 2 | Nick Veale | 12:00 | 15:00 | 3 | SW | 2 | 7 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 30/11/20 | 2 | Nick Veale | 12:00 | 15:00 | 3 | SW | 2 | 6 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 11/12/20 | 1 | Nick Veale | 11:05 | 14:05 | 1 | SW | 0 | 4 | 2 | 4 | 0 | 0 | - | 1 | 1 | - | - |
| 11/12/20 | 1 | Nick Veale | 11:05 | 14:05 | 1 | SW | 0 | 5 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 11/12/20 | 1 | Nick Veale | 11:05 | 14:05 | 2 | SW | 0 | 7 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 12/12/20 | 2 | Nick Veale | 10:15 | 13:15 | 2 | W | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 12/12/20 | 2 | Nick Veale | 10:15 | 13:15 | 3 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 12/12/20 | 2 | Nick Veale | 10:15 | 13:15 | 3 | SW | 0 | 1 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 13/12/20 | 1 | Nick Veale | 08:45 | 11:45 | 2 | SE | 2 | 8 | 1 | 3 | 0 | 0 | - | 1 | 2 | 0.5 | - |
| 13/12/20 | 1 | Nick Veale | 08:45 | 11:45 | 3 | SE | 2 | 8 | 1 | 3 | 0 | 0 | - | 1 | 3 | 0.5 | - |

## APPENDIX A

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13/12/20 | 1 | Nick Veale | 08:45 | 11:45 | 3 | SE | 2 | 8 | 1 | 3 | 0 | 0 | - | 0 | 3 | 0.5 | - |
| 17/12/20 | 2 | Nick Veale | 10:30 | 13:30 | 1 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 17/12/20 | 2 | Nick Veale | 10:30 | 13:30 | 2 | SW | 0 | 1 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 17/12/20 | 2 | Nick Veale | 10:30 | 13:30 | 2 | S | 0 | 2 | 2 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 17/01/21 | 1 | Nick Veale | 09:45 | 12:45 | 2 | SW | 0 | 1 | 2 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 17/01/21 | 1 | Nick Veale | 09:45 | 12:45 | 2 | SW | 0 | 2 | 2 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 17/01/21 | 1 | Nick Veale | 09:45 | 12:45 | 3 | SW | 0 | 2 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0 | - |
| 18/01/21 | 2 | Nick Veale | 12:10 | 15:10 | 1 | SW | 0 | 7 | 1 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 18/01/21 | 2 | Nick Veale | 12:10 | 15:10 | 1 | SW | 0 | 7 | 1 | 4 | 0 | 0 | - | 0 | 1 | - | - |
| 18/01/21 | 2 | Nick Veale | 12:10 | 15:10 | 2 | SW | 1 | 8 | 1 | 3 | 0 | 0 | - | 0 | 1 | - | - |
| 25/01/21 | 2 | Nick Veale | 10:30 | 13:30 | 2 | W | 0 | 0 | - | 4 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 25/01/21 | 2 | Nick Veale | 10:30 | 13:30 | 2 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 25/01/21 | 2 | Nick Veale | 10:30 | 13:30 | 2 | SW | 0 | 1 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 27/01/21 | 1 | Nick Veale | 09:20 | 12:20 | 1 | - | 0 | 5 | 2 | 4 | 0 | 0 | - | 2 | 1 | 0.25 | - |
| 27/01/21 | 1 | Nick Veale | 09:20 | 12:20 | 1 | - | 0 | 4 | 2 | 4 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 27/01/21 | 1 | Nick Veale | 09:20 | 12:20 | 1 | - | 0 | 5 | 2 | 4 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 04/02/21 | 2 | Nick Veale | 09:40 | 12:40 | 3 | SW | 0 | 5 | 1 | 4 | 0 | 0 | - | 1 | 2 | 0.25 | - |
| 04/02/21 | 2 | Nick Veale | 09:40 | 12:40 | 2 | SW | 2 | 6 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 04/02/21 | 2 | Nick Veale | 09:40 | 12:40 | 2 | SW | 0 | 6 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 04/02/21 | 1 | Nick Veale | 13:10 | 16:10 | 2 | SW | 0 | 6 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 04/02/21 | 1 | Nick Veale | 13:10 | 16:10 | 2 | SW | 2 | 7 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0 | - |
| 04/02/21 | 1 | Nick Veale | 13:10 | 16:10 | 2 | SW | 0 | 5 | 1 | 4 | 0 | 0 | - | 0 | 2 | 0 | - |
| 22/02/21 | 2 | Nick Veale | 09:15 | 12:15 | 1 | S | 0 | 0 | - | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 22/02/21 | 2 | Nick Veale | 09:15 | 12:15 | 2 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 1 | 0 | - |
| 22/02/21 | 2 | Nick Veale | 09:15 | 12:15 | 2 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 22/02/21 | 1 | Nick Veale | 12:40 | 15:40 | 2 | SW | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 22/02/21 | 1 | Nick Veale | 12:40 | 15:40 | 2 | SW | 0 | 1 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 22/02/21 | 1 | Nick Veale | 12:40 | 15:40 | 3 | SW | 0 | 3 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 26/03/21 | 2 | Nick Veale | 08:40 | 11:40 | 3 | SW | 1 | 5 | 2 | 4 | 0 | 0 | - | 0 | 2 | 0.5 | - |

## APPENDIX A

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26/03/21 | 2 | Nick Veale | 08:40 | 11:40 | 3 | SW | 2 | 4 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 26/03/21 | 2 | Nick Veale | 08:40 | 11:40 | 3 | SW | 2 | 5 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 26/03/21 | 1 | Nick Veale | 12:20 | 15:20 | 3 | SW | 2 | 8 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 26/03/21 | 1 | Nick Veale | 12:20 | 15:20 | 3 | SW | 2 | 7 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 26/03/21 | 1 | Nick Veale | 12:20 | 15:20 | 3 | SW | 2 | 7 | 1 | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 31/03/21 | 2 | Nick Veale | 08:25 | 11:25 | 2 | W | 0 | 5 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 31/03/21 | 2 | Nick Veale | 08:25 | 11:25 | 2 | W | 0 | 6 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 31/03/21 | 2 | Nick Veale | 08:25 | 11:25 | 2 | SW | 0 | 6 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 31/03/21 | 1 | Nick Veale | 12:10 | 15:10 | 2 | W | 0 | 6 | 1 | 4 | 0 | 0 | - | 1 | 1 | 0 | - |
| 31/03/21 | 1 | Nick Veale | 12:10 | 15:10 | 2 | W | 0 | 7 | 1 | 4 | 0 | 0 | - | 0 | 1 | 0 | - |
| 31/03/21 | 1 | Nick Veale | 12:10 | 15:10 | 2 | SW | 0 | 7 | 1 | 4 | 0 | 0 | - | 0 | 1 | 0 | - |
| 21/04/21 | 1 | Nick Veale | 12:10 | 10:45 | 2 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 1 | 2 | 0.25 | - |
| 21/04/21 | 1 | Nick Veale | 12:10 | 10:45 | 2 | NW | 0 | 5 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 21/04/21 | 1 | Nick Veale | 12:10 | 10:45 | 2 | NE | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 21/04/21 | 2 | Nick Veale | 11:20 | 14:20 | 2 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.5 | Quiet some auks on cliffs mainly RA. |
| 21/04/21 | 2 | Nick Veale | 11:20 | 14:20 | 2 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 21/04/21 | 2 | Nick Veale | 11:20 | 14:20 | 2 | NE | 0 | 7 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 28/04/21 | 1 | Nick Veale | 09:00 | 12:00 | 3 | NE | 0 | 3 | 2 | 2 | 0 | 0 | M | 0 | 2 | 0.5 | - |
| 28/04/21 | 1 | Nick Veale | 09:00 | 12:00 | 3 | NE | 0 | 4 | 2 | 2 | 0 | 0 | M-H | 0 | 3 | 0.5 | - |
| 28/04/21 | 1 | Nick Veale | 09:00 | 12:00 | 3 | NE | 0 | 5 | 2 | 2 | 0 | 0 | M-H | 0 | 3 | 0.5 | - |
| 28/04/21 | 2 | Nick Veale | 13:00 | 16:00 | 3 | NE | 0 | 3 | 2 | 2 | 0 | 0 | - | 0 | 3 | 0.5 | High tide at 13:01. Very quiet. No auks on island despite 100s last visit. |
| 28/04/21 | 2 | Nick Veale | 13:00 | 16:00 | 3 | NE | 0 | 3 | 2 | 2 | 0 | 0 | - | 0 | 3 | 0.5 | - |
| 28/04/21 | 2 | Nick Veale | 13:00 | 16:00 | 3 | NE | 0 | 4 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 17/05/21 | 2 | Nick Veale | 07:50 | 10:50 | 2 | NW | 0 | 2 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 17/05/21 | 2 | Nick Veale | 07:50 | 10:50 | 2 | NW | 0 | 3 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 17/05/21 | 2 | Nick Veale | 07:50 | 10:50 | 3 | NW | 0 | 3 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 17/05/21 | 1 | Nick Veale | 11:40 | 14:40 | 3 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 17/05/21 | 1 | Nick Veale | 11:40 | 14:40 | 3 | NW | 0 | 5 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |

## APPENDIX A

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17/05/21 | 1 | Nick Veale | 11:40 | 14:40 | 2 | W | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 31/05/22 | 1 | Nick Veale | 06:30 | 09:30 | 1 | SE | 0 | 0 | 0 | 2 | 0 | 0 | - | 1 | 1 | 0 | - |
| 31/05/22 | 1 | Nick Veale | 06:30 | 09:30 | 1 | SE | 0 | 0 | 0 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 31/05/22 | 1 | Nick Veale | 06:30 | 09:30 | 2 | SE | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 31/05/22 | 2 | Nick Veale | 10:15 | 13:15 | 2 | SE | 0 | 2 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 31/05/22 | 2 | Nick Veale | 10:15 | 13:15 | 2 | SE | 0 | 4 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 31/05/22 | 2 | Nick Veale | 10:15 | 13:15 | 3 | SE | 0 | 4 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 17/06/21 | 1 | Nick Veale | 05:45 | 08:45 | 1 | W | 0 | 1 | 2 | 2 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 17/06/21 | 1 | Nick Veale | 05:45 | 08:45 | 2 | NW | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 17/06/21 | 1 | Nick Veale | 05:45 | 08:45 | 2 | NW | 0 | 2 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 17/06/21 | 2 | Nick Veale | 09:30 | 12:30 | 2 | W | 0 | 0 | 2 | 2 | 0 | 0 | - | 0 | 1 | - | - |
| 17/06/21 | 2 | Nick Veale | 09:30 | 12:30 | 1 | W | 0 | 0 | 2 | 2 | 0 | 0 | - | 0 | 1 | - | - |
| 17/06/21 | 2 | Nick Veale | 09:30 | 12:30 | 2 | NW | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 1 | - | - |
| 28/06/21 | 1 | Nick Veale | 05:05 | 08:05 | 1 | W | 0 | 5 | 2 | 2 | 0 | 0 | - | 2 | 1 | 0 | - |
| 28/06/21 | 1 | Nick Veale | 05:05 | 08:05 | 1 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 28/06/21 | 1 | Nick Veale | 05:05 | 08:05 | 1 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 28/06/21 | 2 | Nick Veale | 09:10 | 12:10 | 2 | W | 0 | 5 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 28/06/21 | 2 | Nick Veale | 09:10 | 12:10 | 1 | NW | 0 | 5 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 28/06/21 | 2 | Nick Veale | 09:10 | 12:10 | 1 | NW | 0 | 6 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 08/07/21 | 1 | Nick Veale | 04:35 | 07:35 | 1 | W | 0 | 0 | 0 | 2 | 0 | 0 | - | 2 | 1 | 0 | - |
| 08/07/21 | 1 | Nick Veale | 04:35 | 07:35 | 1 | W | 0 | 0 | 0 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 08/07/21 | 1 | Nick Veale | 04:35 | 07:35 | 2 | W | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 08/07/21 | 2 | Nick Veale | 08:30 | 11:30 | 2 | W | 0 | 2 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0 | - |
| 08/07/21 | 2 | Nick Veale | 08:30 | 11:30 | 2 | W | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 2 | 0 | - |
| 08/07/21 | 2 | Nick Veale | 08:30 | 11:30 | 2 | W | 0 | 1 | 2 | 2 | 0 | 0 | - | 0 | 1 | 0 | - |
| 13/07/21 | 1 | Nick Veale | 06:20 | 09:20 | 2 | W | 0 | 7 | 1 | 2 | 0 | 0 | - | 1 | 1 | 0.25 | - |
| 13/07/21 | 1 | Nick Veale | 06:20 | 09:20 | 2 | W | 0 | 7 | 1 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 13/07/21 | 1 | Nick Veale | 06:20 | 09:20 | 2 | NW | 0 | 6 | 1 | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 13/07/21 | 2 | Nick Veale | 10:20 | 13:20 | 2 | W | 0 | 5 | 1 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |

## APPENDIX A

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13/07/21 | 2 | Nick Veale | 10:20 | 13:20 | 2 | W | 0 | 6 | 1 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 13/07/21 | 2 | Nick Veale | 10:20 | 13:20 | 2 | NW | 0 | 6 | 1 | 2 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 20/10/22 | 1 | Lorna Gill | 08:30 | 11:30 | 2 | SE | 0 | 5 | - | 4 | 0 | 0 | - | 0 | 3 | 0.8 | - |
| 20/10/22 | 1 | Lorna Gill | 08:30 | 11:30 | 3 | SE | 0 | 6 | - | 4 | 0 | 0 | - | 0 | 3 | 0.5 | - |
| 20/10/22 | 1 | Lorna Gill | 08:30 | 11:30 | 3 | SE | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 2 | 0.4 | - |
| 25/10/22 | 1 | Lorna Gill | 15:07 | 18:07 | 3 | SE | 2 | 8 | - | 3 | 0 | 0 | - | 0 | 3 | 0.7 | - |
| 25/10/22 | 1 | Lorna Gill | 15:07 | 18:07 | 3 | SE | 2 | 8 | - | 3 | 0 | 0 | - | 0 | 3 | 0.6 | - |
| 25/10/22 | 1 | Lorna Gill | 15:07 | 18:07 | 3 | SE | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | - |
| 28/10/22 | 2 | Lorna Gill | 10:45 | 13:45 | 4 | S | 0 | 1 | - | 3 | 0 | 0 | - | 0 | 1 | 0.2 | - |
| 28/10/22 | 2 | Lorna Gill | 10:45 | 13:45 | 4 | S | 0 | 1 | - | 3 | 0 | 0 | - | 0 | 1 | 0.2 | - |
| 28/10/22 | 2 | Lorna Gill | 10:45 | 13:45 | 4 | S | 0 | 2 | - | 3 | 0 | 0 | - | 0 | 1 | 0.1 | - |
| 03/11/22 | 2 | Lorna Gill | 10:00 | 13:00 | 2 | SE | 0 | 2 | - | 4 | 0 | 0 | - | 0 | - | - | - |
| 03/11/22 | 2 | Lorna Gill | 10:00 | 13:00 | 2 | SE | 0 | 2 | - | 4 | 0 | 0 | - | 0 | - | - | - |
| 03/11/22 | 2 | Lorna Gill | 10:00 | 13:00 | 2 | S | 0 | 1 | - | 4 | 0 | 0 | - | 0 | - | - | - |
| 09/11/22 | 2 | Lorna Gill | 10:30 | 13:30 | 3 | SW | 0 | 1 | - | 4 | 0 | 0 | - | 0 | 1 | 0.1 | - |
| 09/11/22 | 2 | Lorna Gill | 10:30 | 13:30 | 4 | SW | 0 | 2 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | LT 12:52 |
| 09/11/22 | 2 | Lorna Gill | 10:30 | 13:30 | 3 | SW | 0 | 2 | - | 4 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 16/11/22 | 1 | Lorna Gill | 09:10 | 12:10 | 2 | SW | 0 | 1 | - | 3 | 0 | 0 | - | 1 | 1 | 0.1 | - |
| 16/11/22 | 1 | Lorna Gill | 09:10 | 12:10 | 1 | W | 0 | 1 | - | 3 | 0 | 0 | - | 0 | 1 | 0.1 | - |
| 16/11/22 | 1 | Lorna Gill | 09:10 | 12:10 | 2 | SW | 0 | 1 | - | 3 | 0 | 0 | - | 1 | 1 | 0.1 | - |
| 18/11/22 | 2 | Lorna Gill | 10:15 | 13:15 | 4 | W | 0 | 2 | - | 3 | 0 | 0 | - | 0 | 3 | 1.1 | - |
| 18/11/22 | 2 | Lorna Gill | 10:15 | 13:15 | 4 | W | 0 | 3 | - | 3 | 0 | 0 | - | 0 | 3 | 1 | - |
| 18/11/22 | 2 | Lorna Gill | 10:15 | 13:15 | 4 | W | 0 | 2 | - | 3 | 0 | 0 | - | 0 | 4 | 1.3 | LT 12:46 |
| 22/11/22 | 1 | Lorna Gill | 08:30 | 11:30 | 2 | NW | 0 | 8 | - | 3 | 0 | 0 | - | 0 | 2 | 0.1 | |
| 22/11/22 | 1 | Lorna Gill | 08:30 | 11:30 | 2 | NW | 1 | 7 | - | 3 | 0 | 0 | - | 0 | 3 | 0.5 | |
| 22/11/22 | 1 | Lorna Gill | 08:30 | 11:30 | 3 | W | 0 | 7 | - | 3 | 0 | 0 | - | 0 | 3 | 0.5 | |
| 02/12/21 | 1 | Lorna Gill | 10:48 | 13:48 | 2 | SE | 0 | 4 | 0 | 4 | 0 | 0 | - | 1 | 1 | 0.1 | - |
| 02/12/21 | 1 | Lorna Gill | 10:48 | 13:48 | 2 | SE | 0 | 5 | 0 | 4 | 0 | 0 | - | 0 | 1 | 0.1 | - |
| 02/12/21 | 1 | Lorna Gill | 10:48 | 13:48 | 2 | SE | 0 | 7 | 0 | 4 | 0 | 0 | - | 0 | 1 | 0.1 | - |

## APPENDIX A

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14/12/21 | 1 | Lorna Gill | 13:00 | 16:00 | 5 | SW | 0 | 5 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 14/12/21 | 1 | Lorna Gill | 13:00 | 16:00 | 5 | SW | 0 | 4 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 14/12/21 | 1 | Lorna Gill | 13:00 | 16:00 | 5 | SW | 0 | 6 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 16/12/22 | 2 | Lorna Gill | 10:15 | 13:15 | 2 | W | 2 | 2 | 0 | 3 | 0 | 3 | - | 0 | 1 | 0.1 | - |
| 16/12/22 | 2 | Lorna Gill | 10:15 | 13:15 | 2 | W | 2 | 4 | 0 | 2 | 0 | 3 | - | 0 | 1 | 0.1 | - |
| 16/12/22 | 2 | Lorna Gill | 10:15 | 13:15 | 2 | W | 2 | 3 | 0 | 4 | 0 | 3 | - | 0 | 1 | 0.1 | - |
| 16/01/23 | 1 | Lorna Gill | 11:45 | 14:45 | 3 | NW | 0 | 1 | - | 4 | 0 | 0 | L | 0 | 4 | 1.25 | - |
| 16/01/23 | 1 | Lorna Gill | 11:45 | 14:45 | 3 | NW | 0 | 2 | - | 4 | 0 | 0 | L-M | 0 | 3 | 1 | - |
| 16/01/23 | 1 | Lorna Gill | 11:45 | 14:45 | 3 | NW | 0 | 2 | - | 4 | 0 | 0 | L-M | 0 | 3 | 1 | - |
| 20/01/23 | 2 | Lorna Gill | 12:15 | 15:15 | 2 | SE | 0 | 1 | - | 4 | 0 | 0 | H-M | 0 | 2 | 0.5 | - |
| 20/01/23 | 2 | Lorna Gill | 12:15 | 15:15 | 2 | SE | 0 | 0 | - | 4 | 0 | 0 | M-L | 0 | 2 | 0.5 | - |
| 20/01/23 | 2 | Lorna Gill | 12:15 | 15:15 | 2 | SE | 0 | 0 | - | 4 | 0 | 0 | M-L | 0 | 2 | 0.5 | - |
| 24/01/23 | 1 | Lorna Gill | 13:05 | 16:05 | 2 | SW | 0 | 3 | - | 4 | 0 | 0 | H | 0 | 1 | 0.1 | - |
| 24/01/23 | 1 | Lorna Gill | 13:05 | 16:05 | 2 | SW | 0 | 4 | - | 4 | 0 | 0 | H-M | 0 | 1 | 0.1 | - |
| 24/01/23 | 1 | Lorna Gill | 13:05 | 16:05 | 2 | SW | 0 | 4 | - | 4 | 0 | 0 | H-M | 0 | 1 | 0.1 | - |
| 27/01/23 | 2 | Lorna Gill | 09:45 | 12:45 | 2 | W | 0 | 8 | - | 3 | 0 | 0 | L-M | 0 | 2 | 0.2 | - |
| 27/01/23 | 2 | Lorna Gill | 09:45 | 12:45 | 2 | W | 0 | 7 | - | 3 | 0 | 0 | L-M | 0 | 2 | 0.2 | - |
| 27/01/23 | 2 | Lorna Gill | 09:45 | 12:45 | 2 | W | 0 | 7 | - | 3 | 0 | 0 | L-M | 0 | 2 | 0.2 | - |
| 13/02/23 | 1 | Lorna Gill | 08:21 | 11:21 | 3 | S | 0 | 6 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 13/02/23 | 1 | Lorna Gill | 08:21 | 11:21 | 3 | S | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 13/02/23 | 1 | Lorna Gill | 08:21 | 11:21 | 3 | S | 0 | 8 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 23/02/23 | 1 | Lorna Gill | 11:59 | 14:59 | 3 | N | 0 | 2 | - | 4 | 0 | 0 | M-H | 0 | 1 | 0.5 | - |
| 23/02/23 | 1 | Lorna Gill | 11:59 | 14:59 | 3 | N | 0 | 3 | - | 4 | 0 | 0 | M-H | 0 | 3 | 0.8 | - |
| 23/02/23 | 1 | Lorna Gill | 11:59 | 14:59 | 2 | N | 0 | 3 | - | 4 | 0 | 0 | H-M | 0 | 3 | 0.6 | - |
| 06/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 3 | W | 0 | 6 | - | 4 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 06/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 3 | W | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 2 | 0.5 | - |
| 06/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 3 | W | 1 | 8 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 13/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 4 | SW | 0 | 7 | - | 3 | 0 | 0 | - | 0 | - | 0.5 | - |
| 13/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 4 | SW | 0 | 8 | - | 3 | 0 | 0 | - | 0 | - | 0.5 | - |

| Survey date | VP ID | Surveyor | Start time | End time | Wind speed | Wind direction | Rain | Cloud cover | Cloud height | Visibility | Frost | Snow | Tidal cycle | Glare | Sea state | Swell height (m) | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 13/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 5 | SW | 0 | 5 | - | 3 | 0 | 0 | - | 0 | - | 0.7 | - |
| 20/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 3 | S | 0 | 6 | - | 4 | 0 | 0 | - | 0 | 2 | 0.2 | - |
| 20/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 3 | SW | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | - |
| 20/03/23 | 1 | Lorna Gill | 10:00 | 13:00 | 3 | SW | 0 | 7 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | - |
| 24/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 4 | SW | 0 | 3 | - | 3 | 0 | 0 | - | 0 | 2 | 0.4 | VP too close to FU and CA nests. VP stepped in by ~4m - peripheral view obstructed by rocks |
| 24/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 5 | SW | 0 | 3 | - | 3 | 0 | 0 | - | 0 | 3 | 0.5 | - |
| 24/03/23 | 2 | Lorna Gill | 08:30 | 11:30 | 5 | SW | 0 | 7 | - | 3 | 0 | 0 | - | 0 | 3 | 0.6 | - |
| 14/04/23 | 1 | Lorna Gill | 11:14 | 14:14 | 3 | NW | 0 | 1 | - | 4 | 0 | 0 | - | 1 | 2 | 0.2 | - |
| 14/04/23 | 1 | Lorna Gill | 11:14 | 14:14 | 3 | NW | 0 | 2 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | - |
| 14/04/23 | 1 | Lorna Gill | 11:14 | 14:14 | 3 | NW | 0 | 2 | - | 4 | 0 | 0 | - | 0 | 2 | 0.3 | - |
| 20/04/23 | 1 | Lorna Gill | 10:58 | 13:58 | 4 | E | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 20/04/23 | 1 | Lorna Gill | 10:58 | 13:58 | 4 | E | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 20/04/23 | 1 | Lorna Gill | 10:58 | 13:58 | 4 | E | 0 | 0 | - | 4 | 0 | 0 | - | 0 | 3 | 1 | - |
| 04/05/23 | 1 | Lorna Gill | 10:02 | 13:02 | 3 | E | 0 | 8 | - | 3 | 0 | 0 | - | 0 | - | 1 | - |
| 04/05/23 | 1 | Lorna Gill | 10:02 | 13:02 | 4 | E | 0 | 8 | - | 3 | 0 | 0 | - | 1 | - | 1 | - |
| 04/05/23 | 1 | Lorna Gill | 10:02 | 13:02 | 4 | E | 0 | 8 | - | 3 | 0 | 0 | - | 0 | - | 1.25 | - |
| 08/05/23 | 2 | Lorna Gill | 09:30 | 12:30 | 3 | SW | 0 | 7 | - | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 08/05/23 | 2 | Lorna Gill | 09:30 | 12:30 | 3 | SW | 1 | 8 | - | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 08/05/23 | 2 | Lorna Gill | 09:30 | 12:30 | 3 | SW | 0 | 7 | - | 3 | 0 | 0 | - | 0 | 2 | 0.25 | - |
| 23/05/23 | 2 | Lorna Gill | 09:10 | 12:10 | 2 | NW | 0 | 4 | - | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 23/05/23 | 2 | Lorna Gill | 09:10 | 12:10 | 2 | NW | 0 | 4 | - | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 23/05/23 | 2 | Lorna Gill | 09:10 | 12:10 | 2 | NW | 0 | 4 | - | 2 | 0 | 0 | - | 0 | 1 | 0.25 | - |
| 26/05/23 | 1 | Lorna Gill | 09:26 | 12:26 | 3 | N | 0 | 0 | - | 4 | 0 | 0 | M-L | 1 | 3 | 0.6 | 14°C |
| 26/05/23 | 1 | Lorna Gill | 09:26 | 12:26 | 3 | NE | 0 | 0 | - | 4 | 0 | 0 | M-L | 1 | 3 | 0.6 | - |
| 26/05/23 | 1 | Lorna Gill | 09:26 | 12:26 | 2 | NE | 0 | 0 | - | 4 | 0 | 0 | L-M | 0 | 2 | 0.5 | - |

Abbreviations used in Table A10.1b: NE: North east; NW: North west; N: North; E: East; SE: South east; SW: South west; S: South; W: West; H: High; M: Medium; L: Low; m: metres.

# APPENDIX 5 – VP RECORDS

**Table A10.6. Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (species named in Ireland's Eye and/or Howth Head Coast SPA and/or North-West Irish Sea cSPA citations), sorted by peak VP count**

| Species | Number of surveys species present (49 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Herring Gull | 45 | 3577 | 709 | 996 | 112 | 1108 | Jan |
| Guillemot | 29 | 1382 | 299 | 917 | 182 | 1099 | Jan |
| Kittiwake | 19 | 802 | 125 | 761 | 22 | 783 | Mar |
| Razorbill | 23 | 485 | 49 | 286 | 20 | 316 | Mar |
| Black-headed Gull | 27 | 669 | 188 | 258 | 41 | 299 | Oct |
| Fulmar | 20 | 149 | 220 | 79 | 87 | 166 | Jan |
| Common Scoter | 26 | 402 | 214 | 93 | 65 | 151 | Nov |
| Great Black-backed Gull | 42 | 463 | 257 | 64 | 47 | 111 | Jan |
| Shag | 45 | 592 | 191 | 93 | 23 | 104 | Jan |
| Common Gull | 19 | 126 | 12 | 72 | 4 | 72 | Oct |
| Red-throated Diver | 33 | 227 | 27 | 62 | 4 | 62 | Nov |
| Cormorant | 44 | 243 | 283 | 34 | 53 | 55 | Mar |
| Guillemot/razorbill | 2 | 44 | 0 | 44 | 0 | 44 | Jan |
| Gannet | 17 | 109 | 151 | 42 | 34 | 42 | Mar |
| Black Guillemot | 26 | 91 | 41 | 34 | 4 | 34 | Mar |
| Lesser Black-backed Gull | 13 | 40 | 3 | 11 | 2 | 11 | Nov |
| Black-throated Diver | 1 | 3 | 0 | 3 | 0 | 3 | Jan |
| Peregrine Falcon | 8 | 0 | 13 | 0 | 3 | 3 | Mar |
| Great northern diver | 8 | 7 | 4 | 2 | 1 | 2 | Dec |

**Table A10.7. Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (species named in Baldoyle Bay SPA citation), sorted by peak VP count**

| Species | Number of surveys species present (49 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Oystercatcher | 29 | 5879 | 289 | 4137 | 44 | 4139 | Oct |
| Great Crested Grebe | 33 | 4199 | 32 | 1648 | 15 | 1648 | Dec |
| Dunlin | 11 | 165 | 341 | 45 | 85 | 85 | Mar |
| Bar-tailed godwit | 12 | 293 | 46 | 77 | 32 | 77 | Dec |
| Sanderling | 9 | 114 | 113 | 27 | 65 | 65 | Mar |
| Turnstone | 12 | 124 | 33 | 43 | 11 | 43 | Nov |
| Knot | 1 | 0 | 32 | 0 | 32 | 32 | Oct |
| Red-breasted Merganser | 19 | 148 | 16 | 32 | 2 | 32 | Nov |

| Species | Number of surveys species present (49 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Curlew | 14 | 59 | 19 | 21 | 5 | 21 | Oct |
| Redshank | 3 | 20 | 1 | 17 | 1 | 17 | Sep |
| Shelduck | 9 | 24 | 22 | 12 | 6 | 12 | Mar |
| Brent Goose (LB) | 13 | 40 | 3 | 11 | 2 | 11 | Sep |
| Ringed plover | 4 | 30 | 24 | 24 | 18 | 6 | Nov |
| Grey heron* | 6 | 3 | 3 | 3 | 3 | 1 | Sep |
| *Listed as 'other important species' of Baldoyle Bay SPA | | | | | | | |

**Table A10.8. Frequency and number of species encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season (non-SPA species), sorted by peak VP count**

| Species | Number of surveys species present (49 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Sandwich tern | 3 | 25 | 51 | 18 | 29 | 40 | Sep |
| Hooded Crow | 4 | 0 | 15 | 0 | 7 | 7 | Jan |
| Linnet | 1 | 0 | 5 | 0 | 5 | 5 | Oct |
| Meadow pipit | 1 | 0 | 4 | 0 | 4 | 4 | Mar |
| Purple sandpiper | 4 | 8 | 0 | 8 | 0 | 4 | Nov |
| Wren | 1 | 0 | 2 | 0 | 2 | 2 | Oct |
| Eider | 3 | 3 | 2 | 2 | 1 | 2 | Mar |
| Little grebe | 1 | 1 | 0 | 1 | 0 | 1 | Nov |
| Buzzard | 1 | 0 | 1 | 0 | 1 | 1 | Jan |

**Table A10.9. Number of partially identified bird encounters and on sea/in flight/total peak counts from VP surveys during winter/passage season, sorted by peak VP count**

There were no partially identified bird encounters

**Table A10.10. Frequency and number of species encounters from VP surveys during breeding season (species named in Ireland's Eye/Howth Head Coast SPA citations), sorted by peak VP count**

| Species | Number of surveys species present (30 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Razorbill | 20 | 6107 | 589 | 2562 | 86 | 2626 | May |
| Herring Gull | 30 | 3079 | 471 | 1638 | 55 | 1693 | Jun |
| Guillemot | 20 | 6021 | 567 | 1541 | 110 | 1572 | May |
| Guillemot/Razorbill | 7 | 1442 | 874 | 667 | 462 | 727 | May |
| Kittiwake | 15 | 1346 | 713 | 389 | 296 | 685 | Jun |

| Species | Number of surveys species present (30 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Gannet | 21 | 640 | 664 | 170 | 209 | 379 | Jun |
| Common tern | 6 | 121 | 23 | 103 | 19 | 122 | May |
| Puffin | 9 | 245 | 23 | 103 | 14 | 103 | Jun |
| Shag | 29 | 471 | 148 | 43 | 16 | 45 | May |
| Fulmar | 18 | 90 | 117 | 29 | 23 | 45 | Jun |
| Black-headed gull | 10 | 53 | 28 | 16 | 12 | 27 | Aug |
| Great Black-backed Gull | 25 | 168 | 85 | 26 | 16 | 27 | Jun |
| Cormorant | 30 | 195 | 131 | 14 | 17 | 21 | May |
| Black Guillemot | 20 | 88 | 21 | 12 | 6 | 14 | May |
| Manx Shearwater | 2 | 7 | 8 | 7 | 6 | 9 | Jun |
| Lesser black-backed gull | 9 | 24 | 1 | 7 | 1 | 7 | Jul |
| Common gull | 7 | 18 | 2 | 6 | 2 | 6 | Aug |
| Common tern or Sandwich tern | 1 | 5 | 0 | 5 | 0 | 5 | Jun |
| Red-throated Diver | 4 | 6 | 2 | 2 | 2 | 2 | Apr |
| Roseate tern | 2 | 3 | 0 | 2 | 0 | 2 | May |
| Peregrine Falcon | 4 | 0 | 6 | 0 | 2 | 2 | Apr |

**Table A10.11. Frequency and number of species encounters from VP surveys during breeding season (species named in Baldoyle Bay SPA citation), sorted by peak VP count**

| Species | Number of surveys species present (30 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Oystercatcher | 22 | 1993 | 177 | 945 | 42 | 945 | Jun |
| Great crested grebe | 4 | 48 | 7 | 35 | 7 | 42 | Apr |
| Ringed plover | 5 | 25 | 28 | 10 | 21 | 31 | Aug |
| Bar-tailed godwit | 3 | 41 | 0 | 24 | 0 | 24 | Aug |
| Dunlin | 1 | 23 | 0 | 23 | 0 | 23 | Apr |
| Turnstone | 2 | 11 | 18 | 11 | 12 | 17 | Aug |
| Shelduck | 12 | 12 | 23 | 4 | 4 | 6 | Jun |
| Curlew | 5 | 19 | 4 | 10 | 2 | 10 | Aug |
| Grey heron* | 6 | 4 | 5 | 2 | 1 | 2 | Jun |
| Red-breasted merganser | 2 | 4 | 0 | 2 | 0 | 2 | Apr |

*Listed as ‘other important species’ of Baldoyle Bay SPA

**Table A10.12. Frequency and number of species encounters from VP surveys during breeding season (non-SPA species), sorted by peak VP count**

| Species | Number of surveys species present (30 surveys total) | Total number of individuals encountered on sea during VP surveys | Total number of individuals encountered in flight during VP surveys | Peak VP count (birds on sea in a single survey) | Peak VP count (birds in flight in a single survey) | Peak VP count (all birds in a single survey) | Peak VP month |
|---|---|---|---|---|---|---|---|
| Blackcap | 1 | 0 | 47 | 0 | 47 | 47 | May |
| Sandwich Tern | 14 | 89 | 39 | 34 | 18 | 35 | Apr |
| Sanderling | 1 | 12 | 0 | 12 | 0 | 12 | Apr |
| Greenfinch | 1 | 0 | 4 | 0 | 4 | 4 | May |
| Sand martin | 1 | 0 | 4 | 0 | 4 | 4 | Jun |
| Whimbrel | 1 | 4 | 0 | 4 | 0 | 4 | Sep |
| Canada goose | 1 | 1 | 2 | 1 | 2 | 3 | Jun |
| Lapwing | 1 | 0 | 1 | 0 | 1 | 1 | Jun |

**Table A10.13. Black guillemot behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 8 | 25 | 37 | 70 |
| | FL | 0 | 15 | 16 | 17 | 48 |
| | LO | 0 | 0 | 0 | 28 | 28 |
| | RL | 0 | 0 | 2 | 0 | 2 |
| | **Total** | **0** | **23** | **43** | **82** | **148** |
| 2 | FE | 8 | 26 | 18 | 8 | 60 |
| | FL | 2 | 8 | 2 | 2 | 14 |
| | LO | 7 | 4 | 7 | 0 | 18 |
| | RO | 0 | 1 | 0 | 0 | 1 |
| | **Total** | **17** | **39** | **27** | **10** | **93** |
| **Grand total** | | **17** | **62** | **70** | **92** | **241** |

**Table A10.14. Black-headed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | DP | 7 | 1 | 0 | 0 | 8258 |
| | FE | 258 | 31 | 22 | 28 | 339 |
| | FL | 66 | 92 | 23 | 29 | 210 |
| | LO | 51 | 43 | 12 | 27 | 133 |
| | RL | 11 | 0 | 0 | 19 | 30 |
| | RO | 11 | 18 | 28 | 116 | 173 |
| | SF | 0 | 0 | 0 | 35 | 35 |
| | **Total** | **404** | **185** | **85** | **254** | **928** |
| 2 | FL | 1 | 0 | 1 | 4 | 6 |
| | R | 0 | 0 | 0 | 2 | 2 |
| | SF | 2 | 0 | 0 | 0 | 2 |
| | **Total** | **3** | **0** | **1** | **6** | **10** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Grand total** | | **407** | **185** | **86** | **260** | **938** |

**Table A10.15. Black-throated diver behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 2 | FE | 0 | 0 | 2 | 0 | 2 |
| | LO | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **0** | **0** | **2** | **1** | **3** |
| **Grand total** | | **0** | **0** | **2** | **1** | **3** |

**Table A10.16. Brent goose (LB) behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FL | 0 | 29 | 0 | 12 | 41 |
| | RO | 0 | 0 | 0 | 7 | 7 |
| | **Total** | **0** | **29** | **0** | **19** | **48** |
| 2 | FE | 18 | 0 | 0 | 0 | 18 |
| | FL | 14 | 9 | 0 | 0 | 23 |
| | SI | 9 | 0 | 0 | 0 | 9 |
| | **Total** | **41** | **9** | **0** | **0** | **50** |
| **Grand total** | | **41** | **38** | **0** | **19** | **98** |

**Table A10.17. Common gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 76 | 5 | 4 | 1 | 86 |
| | FL | 0 | 0 | 2 | 2 | 4 |
| | KL | 4 | 0 | 0 | 0 | 4 |
| | LO | 3 | 6 | 6 | 4 | 19 |
| | RO | 0 | 0 | 7 | 16 | 23 |
| | **Total** | **83** | **11** | **19** | **23** | **136** |
| 2 | FL | 0 | 0 | 10 | 0 | 10 |
| | LO | 0 | 0 | 0 | 1 | 1 |
| | RL | 4 | 0 | 0 | 0 | 4 |
| | RO | 2 | 0 | 0 | 0 | 2 |
| | SI | 3 | 2 | 0 | 0 | 5 |
| | **Total** | **9** | **2** | **10** | **1** | **22** |
| **Grand total** | | **92** | **13** | **29** | **24** | **158** |

**Table A10.18. Common scoter behaviour and distance band distribution recorded during VP surveys (all months, all survey years),**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 80 | 80 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | FL | 0 | 0 | 3 | 169 | 172 |
| | LO | 0 | 0 | 32 | 144 | 176 |
| | PL | 0 | 0 | 0 | 1 | 1 |
| | RO | 0 | 0 | 14 | 13 | 27 |
| | **Total** | **0** | **0** | **49** | **407** | **456** |
| 2 | | 0 | 0 | 0 | 4 | 4 |
| | FE | 0 | 0 | 19 | 0 | 19 |
| | FL | 0 | 5 | 12 | 25 | 42 |
| | LO | 0 | 7 | 46 | 40 | 93 |
| | **Total** | **0** | **12** | **77** | **69** | **158** |
| **Grand total** | | **0** | **12** | **126** | **476** | **614** |

**Table A10.19. Common tern behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 0 | 7 | 7 |
| | DP | 0 | 8 | 0 | 0 | 8 |
| | FL | 0 | 1 | 11 | 8 | 20 |
| | PL | 1 | 1 | 16 | 88 | 106 |
| | **Total** | **1** | **10** | **27** | **103** | **141** |
| 2 | FL | 0 | 2 | 0 | 1 | 3 |
| | **Total** | **0** | **2** | **0** | **1** | **3** |
| **Grand total** | | **1** | **12** | **27** | **104** | **144** |

**Table A10.20. Cormorant behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | CF | 1 | 0 | 0 | 0 | 1 |
| | FE | 15 | 47 | 39 | 50 | 151 |
| | FL | 7 | 38 | 56 | 59 | 160 |
| | LO | 0 | 0 | 1 | 11 | 12 |
| | PL | 0 | 6 | 6 | 3 | 15 |
| | PR | 0 | 0 | 0 | 28 | 28 |
| | RO | 0 | 0 | 0 | 6 | 6 |
| | SF | 0 | 0 | 6 | 0 | 6 |
| | **Total** | **23** | **92** | **112** | **173** | **400** |
| 2 | | 0 | 0 | 0 | 1 | 1 |
| | CF | 4 | 0 | 0 | 0 | 4 |
| | CN | 5 | 1 | 0 | 0 | 6 |
| | ED | 0 | 0 | 1 | 0 | 1 |
| | EF | 4 | 0 | 0 | 0 | 4 |
| | FE | 16 | 20 | 17 | 15 | 68 |
| | FL | 130 | 76 | 25 | 23 | 254 |
| | LO | 8 | 1 | 0 | 0 | 9 |
| | PL | 1 | 0 | 2 | 0 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | PR | 9 | 0 | 0 | 0 | 9 |
| | RL | 3 | 0 | 0 | 0 | 3 |
| | RO | 59 | 0 | 0 | 0 | 59 |
| | SI | 31 | 0 | 0 | 0 | 31 |
| | **Total** | **270** | **98** | **45** | **39** | **452** |
| **Grand total** | | **293** | **190** | **157** | **212** | **852** |

**Table A10.21. Curlew behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 0 | 1 | 1 |
| | FE | 19 | 0 | 3 | 40 | 62 |
| | FL | 13 | 1 | 4 | 5 | 23 |
| | RL | 0 | 0 | 0 | 2 | 2 |
| | RO | 0 | 0 | 1 | 12 | 13 |
| | **Total** | **32** | **1** | **8** | **60** | **101** |
| **Grand total** | | **32** | **1** | **8** | **60** | **101** |

**Table A10.22. Dunlin behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 0 | 6 | 6 |
| | FE | 0 | 0 | 0 | 159 | 159 |
| | FL | 86 | 45 | 26 | 207 | 364 |
| | **Total** | **86** | **45** | **26** | **372** | **529** |
| **Grand total** | | **86** | **45** | **26** | **372** | **529** |

**Table A10.23. Fulmar behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FL | 0 | 2 | 1 | 3 | 6 |
| | LO | 0 | 0 | 1 | 1 | 2 |
| | R | 0 | 0 | 0 | 7 | 7 |
| | **Total** | **0** | **2** | **2** | **11** | **15** |
| 2 | EF | 0 | 1 | 0 | 0 | 1 |
| | FE | 0 | 5 | 0 | 0 | 5 |
| | FL | 284 | 18 | 13 | 16 | 331 |
| | LO | 29 | 90 | 47 | 9 | 175 |
| | PR | 0 | 3 | 2 | 0 | 5 |
| | R | 1 | 5 | 38 | 0 | 44 |
| | **Total** | **314** | **122** | **100** | **25** | **561** |
| **Grand total** | | **314** | **124** | **102** | **36** | **576** |

**Table A10.24. Gannet behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 1 | 1 |
| | FL | 0 | 3 | 18 | 47 | 68 |
| | LO | 0 | 0 | 2 | 23 | 25 |
| | PL | 0 | 0 | 25 | 51 | 76 |
| | **Total** | **0** | **3** | **45** | **122** | **170** |
| 2 | CN | 2 | 0 | 0 | 0 | 2 |
| | FE | 0 | 20 | 0 | 0 | 20 |
| | FL | 347 | 141 | 109 | 150 | 747 |
| | LO | 95 | 137 | 231 | 52 | 515 |
| | PF | 0 | 11 | 0 | 0 | 11 |
| | PL | 15 | 12 | 13 | 23 | 63 |
| | PR | 5 | 2 | 0 | 1 | 8 |
| | R | 0 | 0 | 0 | 21 | 21 |
| | RO | 0 | 0 | 0 | 1 | 1 |
| | SC | 6 | 0 | 0 | 0 | 0 |
| | **Total** | **470** | **323** | **353** | **248** | **1394** |
| **Grand total** | | **470** | **326** | **398** | **370** | **1564** |

**Table A10.25. Great black-backed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 38 | 22 | 5 | 10 | 75 |
| | FL | 6 | 16 | 36 | 51 | 109 |
| | LO | 4 | 32 | 27 | 37 | 100 |
| | R | 0 | 0 | 0 | 3 | 3 |
| | RL | 0 | 0 | 0 | 44 | 44 |
| | RO | 3 | 0 | 6 | 64 | 73 |
| | SC | 0 | 0 | 0 | 7 | 7 |
| | SF | 0 | 0 | 0 | 13 | 13 |
| | **Total** | **51** | **70** | **74** | **229** | **424** |
| 2 | EF | 2 | 0 | 0 | 0 | 2 |
| | FE | 2 | 1 | 0 | 0 | 3 |
| | FL | 149 | 25 | 33 | 26 | 233 |
| | KL | 0 | 1 | 0 | 0 | 1 |
| | LO | 43 | 12 | 19 | 24 | 98 |
| | PL | 1 | 0 | 0 | 0 | 1 |
| | R | 0 | 0 | 2 | 2 | 4 |
| | RL | 2 | 0 | 0 | 0 | 2 |
| | RO | 7 | 5 | 2 | 0 | 14 |
| | SC | 6 | 1 | 1 | 1 | 9 |
| | SF | 34 | 0 | 4 | 4 | 42 |
| | SI | 133 | 6 | 0 | 1 | 140 |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | **Total** | **379** | **51** | **61** | **58** | **549** |
| **Grand total** | | | | | | |

**Table A10.26. Great crested grebe behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 20 | 99 | 84 | 142 | 245 |
| | FL | 1 | 25 | 4 | 6 | 36 |
| | LO | 1 | 413 | 517 | 1685 | 2616 |
| | PL | 0 | 2 | 1 | 10 | 13 |
| | PR | 0 | 24 | 5 | 13 | 42 |
| | R | 0 | 0 | 1 | 449 | 450 |
| | RO | 0 | 10 | 113 | 607 | 730 |
| | SI | 0 | 0 | 2 | 8 | 10 |
| | **Total** | **22** | **573** | **727** | **2920** | **4242** |
| 2 | FE | 0 | 0 | 3 | 22 | 25 |
| | FL | 0 | 0 | 2 | 1 | 3 |
| | LO | 0 | 0 | 0 | 13 | 13 |
| | PL | 0 | 1 | 0 | 0 | 1 |
| | RO | 0 | 0 | 0 | 0 | 2 |
| | **Total** | **0** | **1** | **5** | **2** | **44** |
| **Grand total** | | **22** | **574** | **732** | **2958** | **4286** |

**Table A10.27. Grey heron behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 1 | 1 |
| | FL | 0 | 0 | 2 | 6 | 8 |
| | RL | 0 | 0 | 0 | 1 | 1 |
| | RO | 0 | 0 | 0 | 2 | 2 |
| | **Total** | **0** | **0** | **2** | **10** | **12** |
| 2 | EF | 1 | 0 | 0 | 0 | 1 |
| | **Total** | **1** | **0** | **0** | **0** | **1** |
| **Grand total** | | **1** | **0** | **2** | **10** | **13** |

**Table A10.28. Great northern diver behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 3 | 3 |
| | **Total** | **0** | **0** | **0** | **3** | **3** |
| 2 | FE | 0 | 0 | 2 | 2 | 4 |
| | FL | 0 | 0 | 2 | 2 | 4 |
| | **Total** | **0** | **0** | **4** | **4** | **8** |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| **Grand total** | | **0** | **0** | **4** | **7** | **11** |

**Table A10.29. Guillemot behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 1 | 0 | 0 | 1 |
| | FE | 0 | 2 | 6 | 6 | 14 |
| | FL | 0 | 1 | 20 | 1 | 22 |
| | LO | 0 | 0 | 8 | 15 | 23 |
| | PL | 0 | 0 | 3 | 0 | 3 |
| | RO | 0 | 8 | 16 | 12 | 36 |
| | **Total** | **0** | **12** | **53** | **34** | **99** |
| 2 | EF | 13 | 4 | 2 | 0 | 19 |
| | FE | 1 | 214 | 11 | 1 | 227 |
| | FL | 592 | 54 | 70 | 128 | 844 |
| | LO | 3356 | 1674 | 1146 | 825 | 7001 |
| | PL | 0 | 0 | 1 | 1 | 2 |
| | PR | 1 | 9 | 6 | 3 | 19 |
| | R | 0 | 2 | 17 | 30 | 49 |
| | RO | 2 | 0 | 5 | 1 | 8 |
| | **Total** | **3965** | **1957** | **1258** | **989** | **8169** |
| **Grand total** | | **3965** | **1970** | **1311** | **1023** | **8268** |

**Table A10.30. Guillemot/razorbill behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 2 | EF | 28 | 0 | 0 | 0 | 28 |
| | FL | 447 | 247 | 80 | 100 | 847 |
| | LO | 560 | 255 | 247 | 352 | 1414 |
| | R | 0 | 0 | 0 | 44 | 44 |
| | **Total** | **1035** | **502** | **327** | **496** | **2360** |
| **Grand total** | | **1035** | **502** | **327** | **496** | **2360** |

**Table A10.31. Herring gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 2 | 0 | 2 |
| | CF | 0 | 0 | 1 | 0 | 1 |
| | DP | 0 | 0 | 7 | 14 | 21 |
| | EF | 12 | 0 | 0 | 0 | 12 |
| | FE | 1680 | 418 | 379 | 249 | 2726 |
| | FL | 166 | 123 | 147 | 139 | 575 |
| | KL | 5 | 3 | 0 | 0 | 8 |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | LO | 79 | 267 | 180 | 174 | 700 |
| | PR | 0 | 0 | 1 | 0 | 1 |
| | R | 0 | 0 | 1 | 0 | 1 |
| | RL | 18 | 0 | 0 | 142 | 160 |
| | RO | 15 | 5 | 41 | 285 | 346 |
| | SC | 23 | 0 | 0 | 32 | 55 |
| | SF | 0 | 0 | 0 | 127 | 127 |
| | SI | 0 | 0 | 0 | 6 | 6 |
| | **Total** | **1998** | **816** | **759** | **1168** | **4741** |
| 2 | EF | 12 | 1 | 0 | 0 | 13 |
| | FE | 5 | 2 | 3 | 18 | 28 |
| | FL | 292 | 148 | 72 | 93 | 605 |
| | KL | 0 | 1 | 0 | 0 | 1 |
| | LO | 648 | 90 | 129 | 67 | 934 |
| | PR | 5 | 1 | 3 | 0 | 9 |
| | R | 2 | 0 | 4 | 0 | 6 |
| | RL | 35 | 0 | 0 | 0 | 35 |
| | RO | 96 | 1 | 1 | 4 | 102 |
| | SC | 92 | 3 | 2 | 24 | 121 |
| | SF | 11 | 2 | 36 | 28 | 77 |
| | SI | 1147 | 16 | 1 | 0 | 1164 |
| | **Total** | **2345** | **265** | **251** | **234** | **3095** |
| **Grand total** | | **4343** | **1081** | **1010** | **1402** | **7836** |

**Table A10.32. Kittiwake behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | FL | 8 | 3 | 1 | 5 | 17 |
| | **Total** | **8** | **3** | **1** | **5** | **17** |
| 2 | | 0 | 0 | 5 | 0 | 5 |
| | DF | 0 | 0 | 0 | 11 | 11 |
| | DP | 0 | 16 | 10 | 14 | 40 |
| | EF | 4 | 1 | 0 | 0 | 5 |
| | FE | 1 | 132 | 109 | 22 | 264 |
| | FL | 417 | 76 | 186 | 142 | 821 |
| | LO | 416 | 773 | 193 | 203 | 1585 |
| | PR | 11 | 10 | 7 | 0 | 28 |
| | RE | 0 | 0 | 0 | 210 | 210 |
| | **Total** | **849** | **1008** | **510** | **602** | **2969** |
| **Grand total** | | **857** | **1011** | **511** | **607** | **2986** |

**Table A10.33. Knot behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | FL | 0 | 0 | 0 | 32 | 32 |
| | **Total** | **0** | **0** | **0** | **32** | **32** |
| **Grand total** | | **0** | **0** | **0** | **32** | **32** |

**Table A10.34. Lesser black-backed gull behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 1 | 3 | 2 | 1 | 7 |
| | FL | 0 | 0 | 1 | 0 | 1 |
| | LO | 5 | 3 | 0 | 1 | 9 |
| | RO | 0 | 0 | 7 | 21 | 28 |
| | SC | 0 | 0 | 0 | 1 | 1 |
| | SF | 0 | 0 | 0 | 2 | 2 |
| | **Total** | **6** | **6** | **10** | **26** | **48** |
| 2 | FL | 0 | 0 | 1 | 2 | 3 |
| | LO | 0 | 6 | 2 | 0 | 8 |
| | RO | 1 | 0 | 0 | 0 | 1 |
| | SC | 2 | 0 | 0 | 0 | 2 |
| | SF | 2 | 0 | 0 | 0 | 2 |
| | SI | 3 | 1 | 0 | 0 | 4 |
| | **Total** | **8** | **7** | **3** | **2** | **20** |
| **Grand total** | | **14** | **13** | **13** | **28** | **68** |

**Table A10.35. Manx shearwater behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FL | 0 | 0 | 0 | 2 | 2 |
| | PL | 0 | 0 | 1 | 6 | 7 |
| | **Total** | **0** | **0** | **1** | **8** | **9** |
| 2 | FL | 0 | 0 | 6 | 11 | 17 |
| | **Total** | **0** | **0** | **6** | **11** | **17** |
| **Grand total** | | **0** | **0** | **7** | **19** | **26** |

**Table A10.36. Oystercatcher behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 0 | 12 | 12 |
| | FE | 3803 | 2056 | 774 | 827 | 7460 |
| | FL | 182 | 76 | 34 | 119 | 411 |
| | LO | 0 | 0 | 6 | 0 | 6 |
| | RL | 0 | 0 | 14 | 91 | 105 |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | RO | 5 | 5 | 50 | 211 | 271 |
| | SI | 0 | 0 | 0 | 6 | 6 |
| | **Total** | **3990** | **2137** | **878** | **1266** | **8271** |
| 2 | FE | 5 | 0 | 0 | 0 | 5 |
| | FL | 45 | 8 | 0 | 2 | 55 |
| | RO | 7 | 0 | 0 | 0 | 7 |
| | **Total** | **57** | **8** | **0** | **2** | **67** |
| **Grand total** | | **4047** | **2145** | **878** | **1268** | **8338** |

**Table A10.37. Peregrine behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | FL | 18 | 1 | 0 | 0 | 19 |
| | **Total** | **18** | **1** | **0** | **0** | **19** |
| **Grand total** | | **18** | **1** | **0** | **0** | **19** |

**Table A10.38. Puffin behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 2 | FE | 0 | 5 | 0 | 0 | 5 |
| | FL | 14 | 0 | 9 | 0 | 23 |
| | LO | 151 | 72 | 11 | 4 | 238 |
| | PR | 0 | 0 | 2 | 0 | 2 |
| | **Total** | **165** | **77** | **22** | **4** | **268** |
| **Grand total** | | **165** | **77** | **22** | **4** | **268** |

**Table A10.39. Razorbill behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 14 | 3 | 17 |
| | FL | 0 | 4 | 3 | 6 | 13 |
| | LO | 0 | 0 | 27 | 40 | 67 |
| | PR | 0 | 2 | 0 | 0 | 2 |
| | RO | 0 | 0 | 4 | 5 | 9 |
| | **Total** | **0** | **6** | **48** | **54** | **108** |
| 2 | | 0 | 0 | 28 | 0 | 28 |
| | EF | 17 | 9 | 3 | 7 | 29 |
| | FE | 1 | 222 | 0 | 82 | 230 |
| | FL | 47 | 54 | 42 | 584 | 625 |
| | LO | 2943 | 1676 | 948 | 0 | 6154 |
| | PR | 5 | 0 | 0 | 0 | 5 |
| | R | 0 | 1 | 4 | 0 | 5 |
| | SI | 0 | 2 | 0 | 0 | 2 |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| | **Total** | **3413** | **1964** | **1025** | **676** | **7078** |
| **Grand total** | | **3413** | **1970** | **1073** | **730** | **7186** |

**Table A10.40. Redshank behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 3 | 0 | 19 | 22 |
| | FL | 1 | 0 | 0 | 0 | 1 |
| | **Total** | **1** | **3** | **0** | **19** | **23** |
| **Grand total** | | **1** | **3** | **0** | **19** | **23** |

**Table A10.41. Red-breasted merganser behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 0 | 4 | 4 |
| | FE | 0 | 52 | 36 | 24 | 112 |
| | FL | 2 | 2 | 2 | 6 | 12 |
| | LO | 0 | 0 | 6 | 8 | 14 |
| | **Total** | **2** | **54** | **44** | **42** | **142** |
| 2 | FE | 0 | 0 | 0 | 22 | 22 |
| | FL | 0 | 0 | 2 | 2 | 4 |
| | **Total** | **0** | **0** | **2** | **24** | **26** |
| **Grand total** | | **2** | **54** | **46** | **46** | **168** |

**Table A10.42. Red-throated diver behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | | 0 | 0 | 1 | 0 | 1 |
| | FE | 0 | 19 | 58 | 33 | 110 |
| | FL | 0 | 0 | 8 | 8 | 16 |
| | LO | 0 | 4 | 8 | 17 | 29 |
| | PL | 0 | 0 | 4 | 0 | 4 |
| | PR | 0 | 0 | 0 | 7 | 7 |
| | RO | 0 | 6 | 25 | 13 | 44 |
| | **Total** | **0** | **29** | **104** | **78** | **211** |
| 2 | FE | 1 | 1 | 6 | 27 | 35 |
| | FL | 0 | 0 | 5 | 8 | 13 |
| | LO | 0 | 0 | 3 | 0 | 3 |
| | **Total** | **1** | **1** | **14** | **35** | **51** |
| **Grand total** | | **1** | **30** | **118** | **113** | **262** |

**Table A10.43. Ringed plover behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 45 | 45 |
| | FL | 10 | 20 | 4 | 18 | 52 |
| | RL | 0 | 0 | 0 | 6 | 6 |
| | RO | 0 | 0 | 0 | 4 | 4 |
| | **Total** | **10** | **20** | **4** | **73** | **107** |
| **Grand total** | | **10** | **20** | **4** | **73** | **107** |

**Table A10.44. Roseate tern and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | PL | 0 | 0 | 2 | 0 | 2 |
| | **Total** | **0** | **0** | **2** | **0** | **2** |
| 2 | PL | 0 | 0 | 0 | 1 | 1 |
| | **Total** | **0** | **0** | **0** | **1** | **1** |
| **Grand total** | | **0** | **0** | **2** | **1** | **3** |

**Table A10.45. Sanderling behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 23 | 4 | 8 | 79 | 114 |
| | FL | 1 | 0 | 80 | 44 | 125 |
| | **Total** | **24** | **4** | **88** | **123** | **239** |
| **Grand total** | | **24** | **4** | **88** | **123** | **239** |

**Table A10.46. Sandwich tern behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | DP | 0 | 21 | 11 | 5 | 37 |
| | FE | 0 | 0 | 0 | 6 | 6 |
| | FL | 0 | 11 | 18 | 35 | 64 |
| | LO | 0 | 0 | 0 | 2 | 2 |
| | PL | 0 | 0 | 6 | 35 | 41 |
| | RO | 0 | 0 | 0 | 22 | 22 |
| | **Total** | **0** | **32** | **35** | **105** | **172** |
| 2 | DP | 0 | 0 | 6 | 0 | 6 |
| | FL | 0 | 0 | 8 | 18 | 26 |
| | **Total** | **0** | **0** | **14** | **18** | **32** |
| **Grand total** | | **0** | **32** | **49** | **123** | **204** |

**Table A10.47. Shag behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 23 | 97 | 69 | 70 | 259 |
| | FL | 7 | 27 | 46 | 25 | 105 |
| | LO | 0 | 0 | 4 | 0 | 4 |
| | RO | 0 | 1 | 0 | 5 | 6 |
| | SF | 0 | 0 | 7 | 0 | 7 |
| | **Total** | **30** | **125** | **126** | **100** | **381** |
| 2 | CF | 0 | 1 | 0 | 0 | 1 |
| | CN | 4 | 0 | 0 | 0 | 4 |
| | EF | 15 | 0 | 0 | 0 | 15 |
| | FE | 99 | 76 | 70 | 27 | 272 |
| | FL | 113 | 66 | 33 | 22 | 234 |
| | LO | 48 | 11 | 9 | 3 | 71 |
| | PL | 2 | 0 | 0 | 0 | 2 |
| | PR | 23 | 3 | 2 | 0 | 28 |
| | RL | 25 | 0 | 0 | 0 | 25 |
| | RO | 215 | 0 | 0 | 0 | 215 |
| | SC | 12 | 0 | 1 | 0 | 13 |
| | SI | 141 | 0 | 0 | 0 | 141 |
| | **Total** | **697** | **157** | **115** | **51** | **1021** |
| **Grand total** | | **727** | **282** | **241** | **152** | **1402** |

**Table A10.48. Shelduck behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

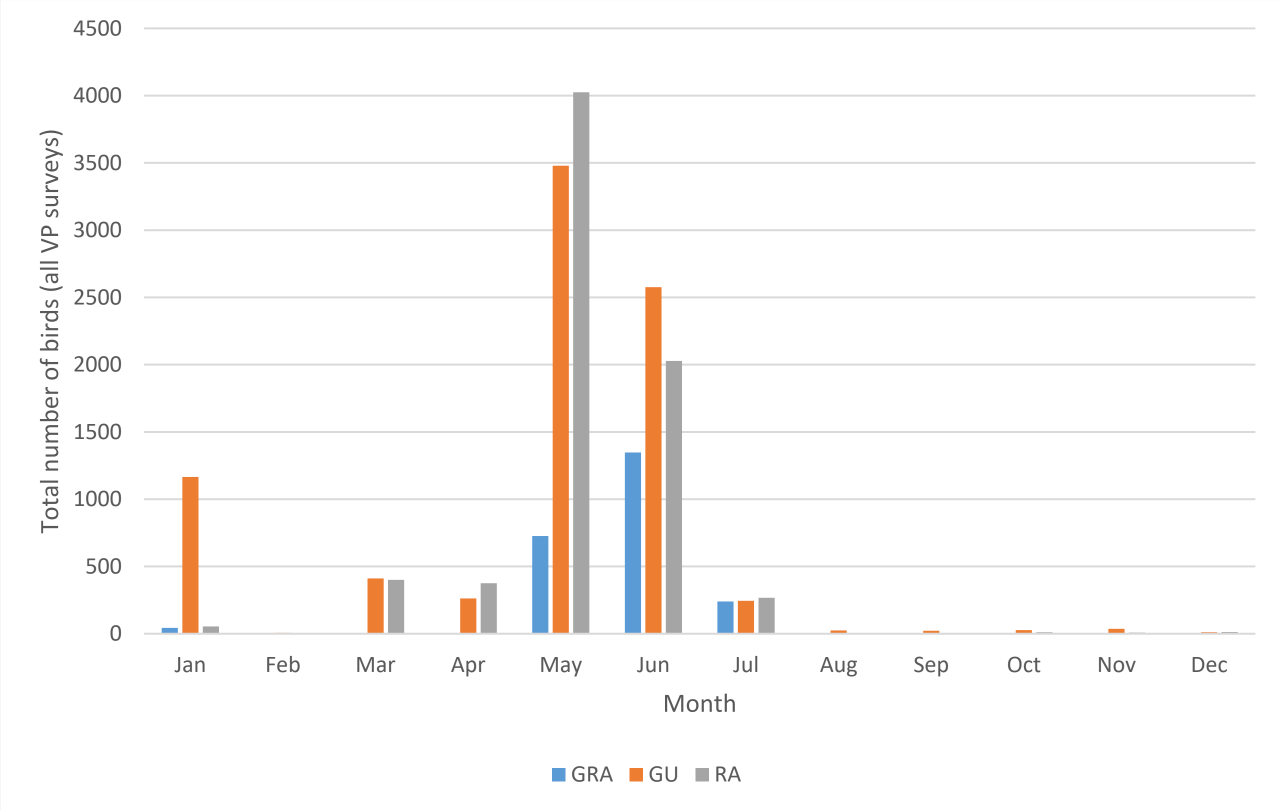
| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 0 | 0 | 0 | 4 | 4 |
| | FL | 0 | 6 | 2 | 32 | 40 |
| | LO | 0 | 0 | 0 | 2 | 2 |
| | RL | 0 | 0 | 0 | 6 | 6 |
| | RO | 0 | 0 | 0 | 4 | 4 |
| | **Total** | **0** | **6** | **2** | **48** | **56** |
| 2 | FE | 8 | 0 | 0 | 0 | 8 |
| | FL | 4 | 1 | 0 | 0 | 5 |
| | LO | 12 | 0 | 0 | 0 | 12 |
| | **Total** | **24** | **1** | **0** | **0** | **25** |
| **Grand total** | | **24** | **7** | **2** | **48** | **81** |

**Table A10.49. Turnstone behaviour and distance band distribution recorded during VP surveys (all months, all survey years)**

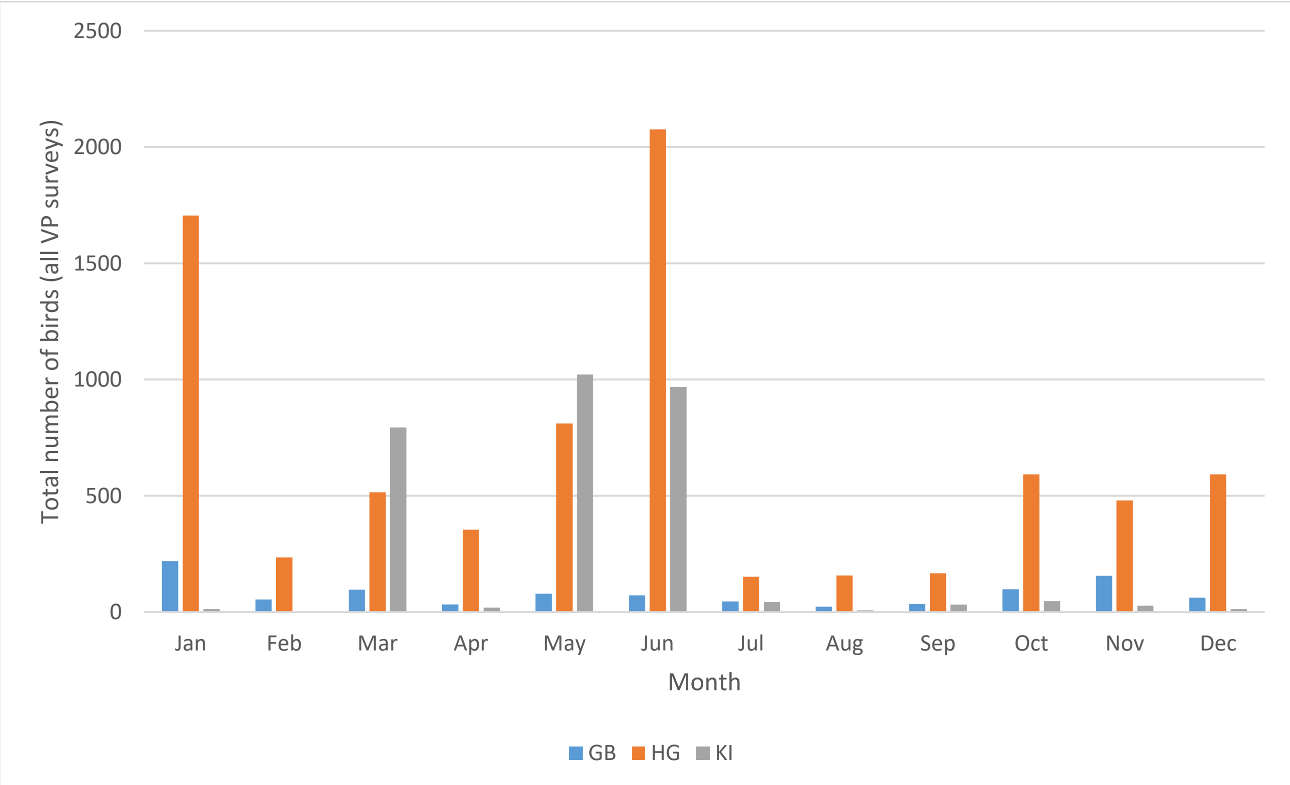
| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 1 | FE | 24 | 0 | 0 | 229 | 253 |
| | FL | 5 | 14 | 6 | 12 | 37 |
| | **Total** | **29** | **14** | **6** | **248** | **297** |

| VP number | Behaviour code | VP band 1 | VP band 2 | VP band 3 | VP band 4 | Total |
|---|---|---|---|---|---|---|
| 2 | FE | 14 | 0 | 0 | 0 | 14 |
| | FL | 14 | 0 | 0 | 0 | 14 |
| | **Total** | **28** | **0** | **0** | **0** | **28** |
| **Grand total** | | **57** | **14** | **6** | **248** | **325** |

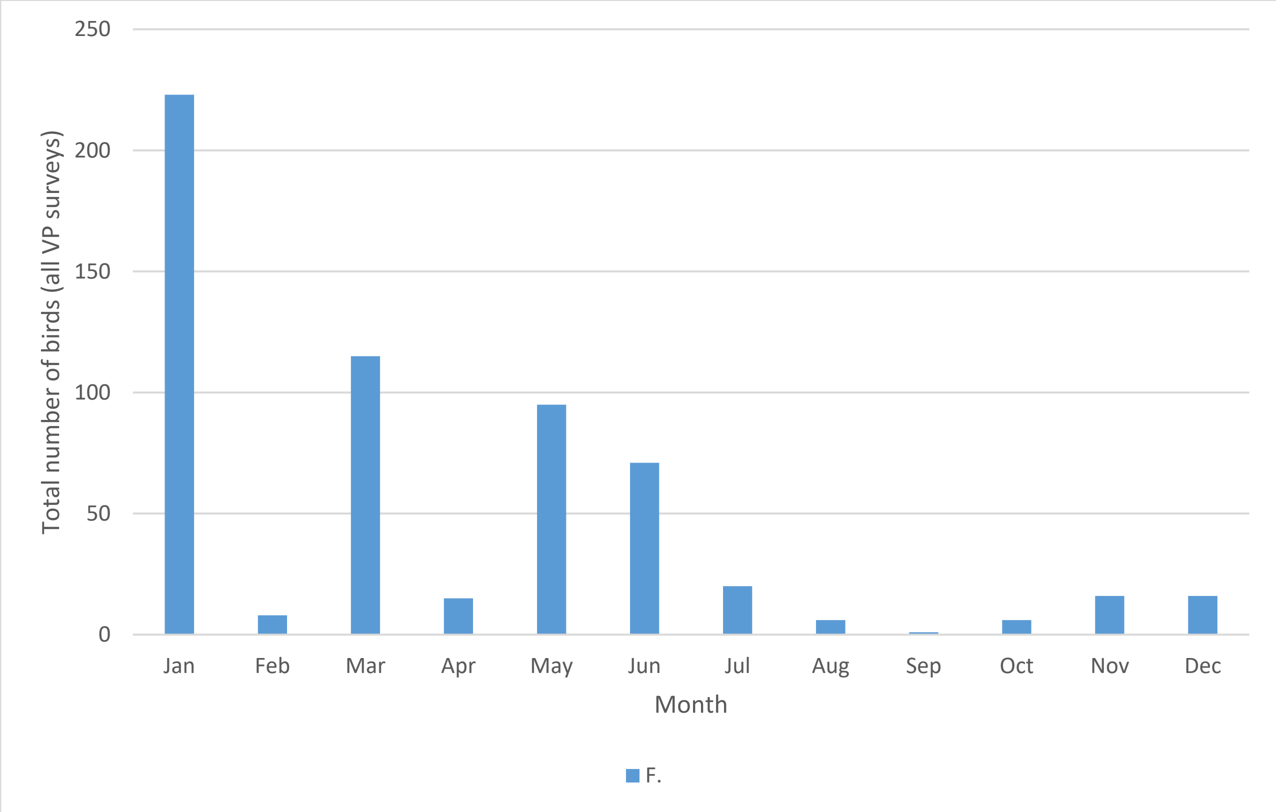
# APPENDIX 6 – VP GRAPHS



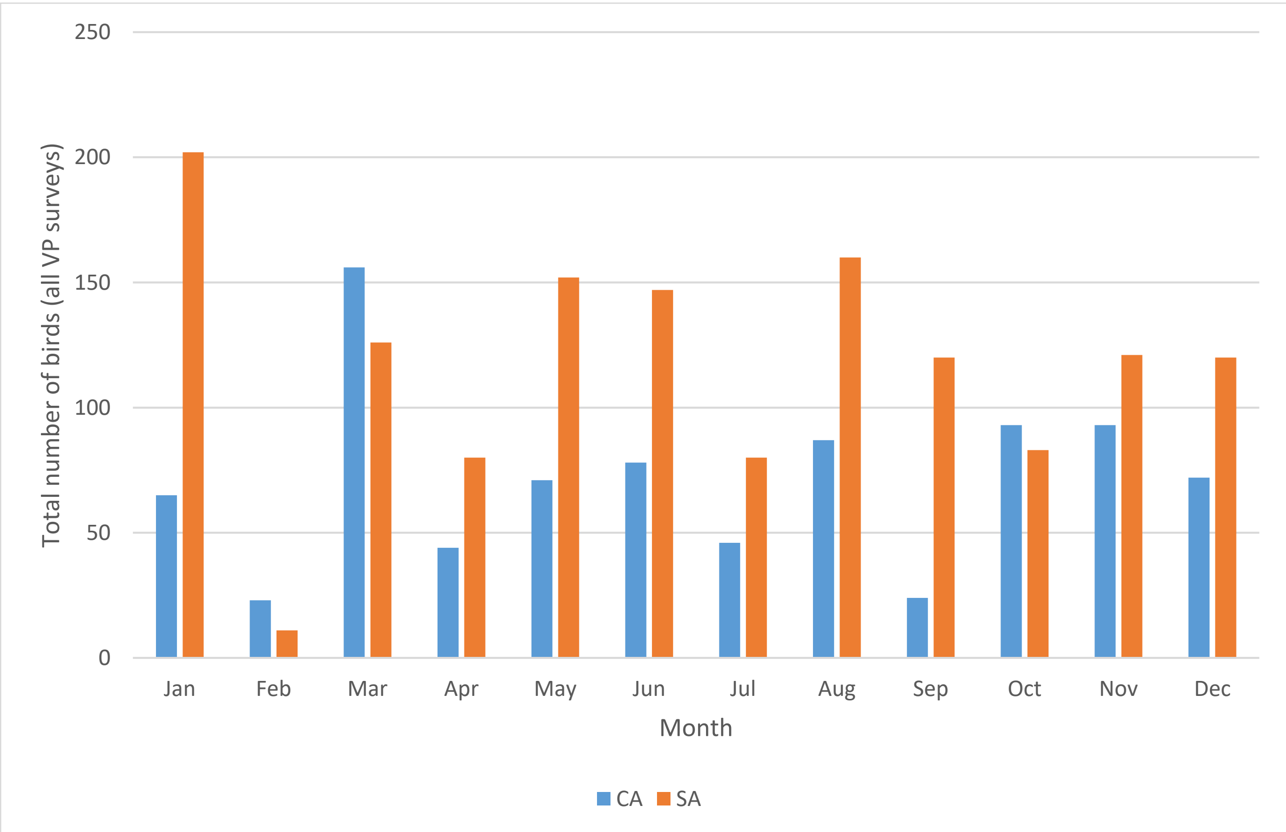

**Graph A10.1: Total number of guillemots or razorbills (GRA), guillemots (GU) and razorbills (RA) recorded by month during VP surveys during entire survey programme**



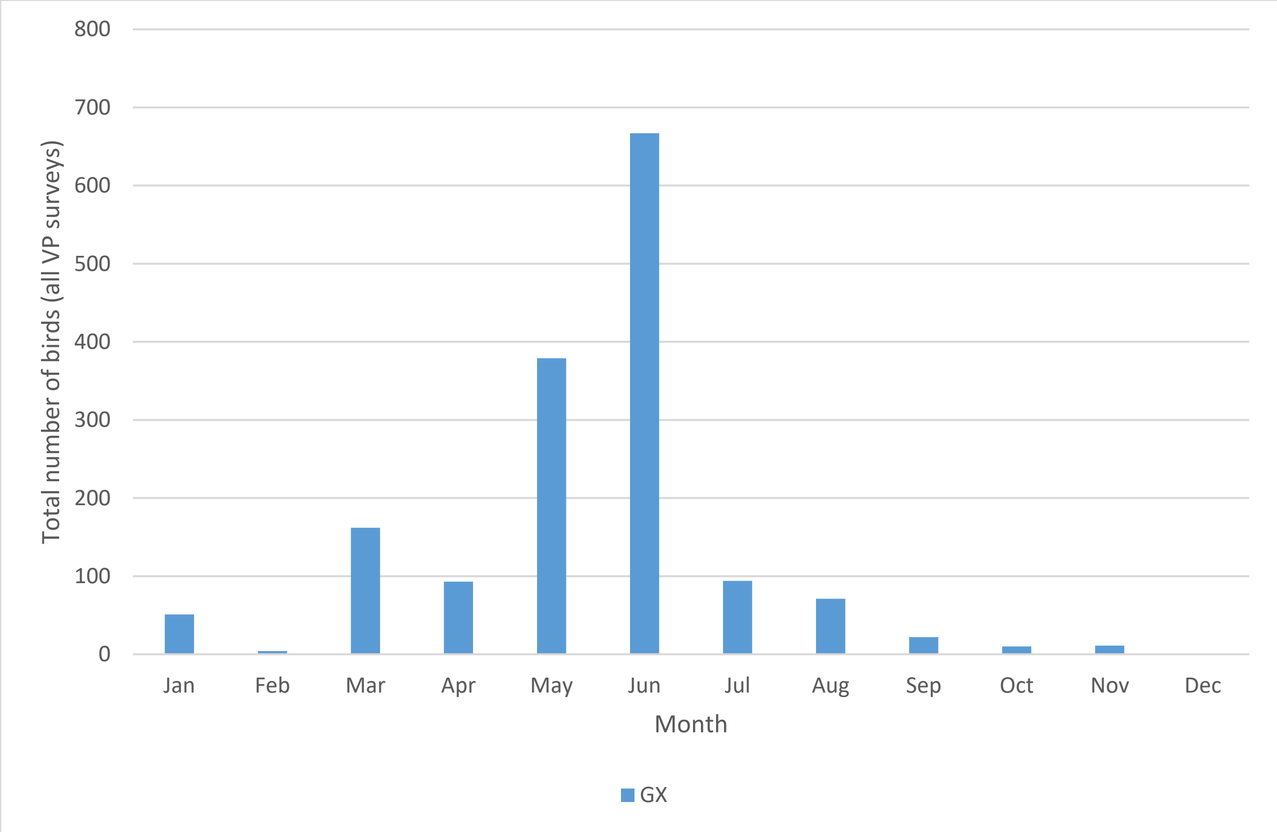

**Graph A10.2: Total number of great black-backed gulls (GB), herring gulls (HG) and kittiwakes (KI) recorded by month during VP surveys during entire survey programme**



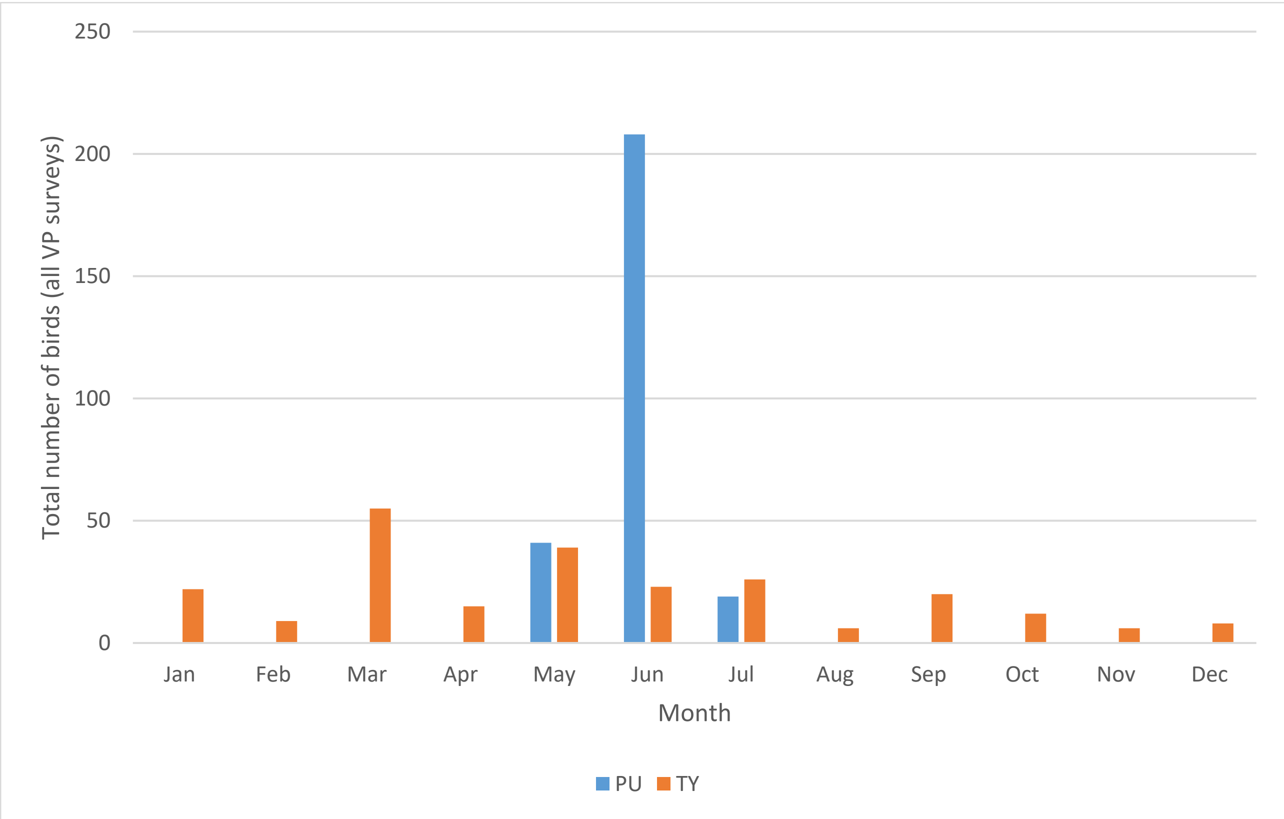

**Graph A10.3: Total number of fulmars (F.) recorded by month during VP surveys during entire survey programme**



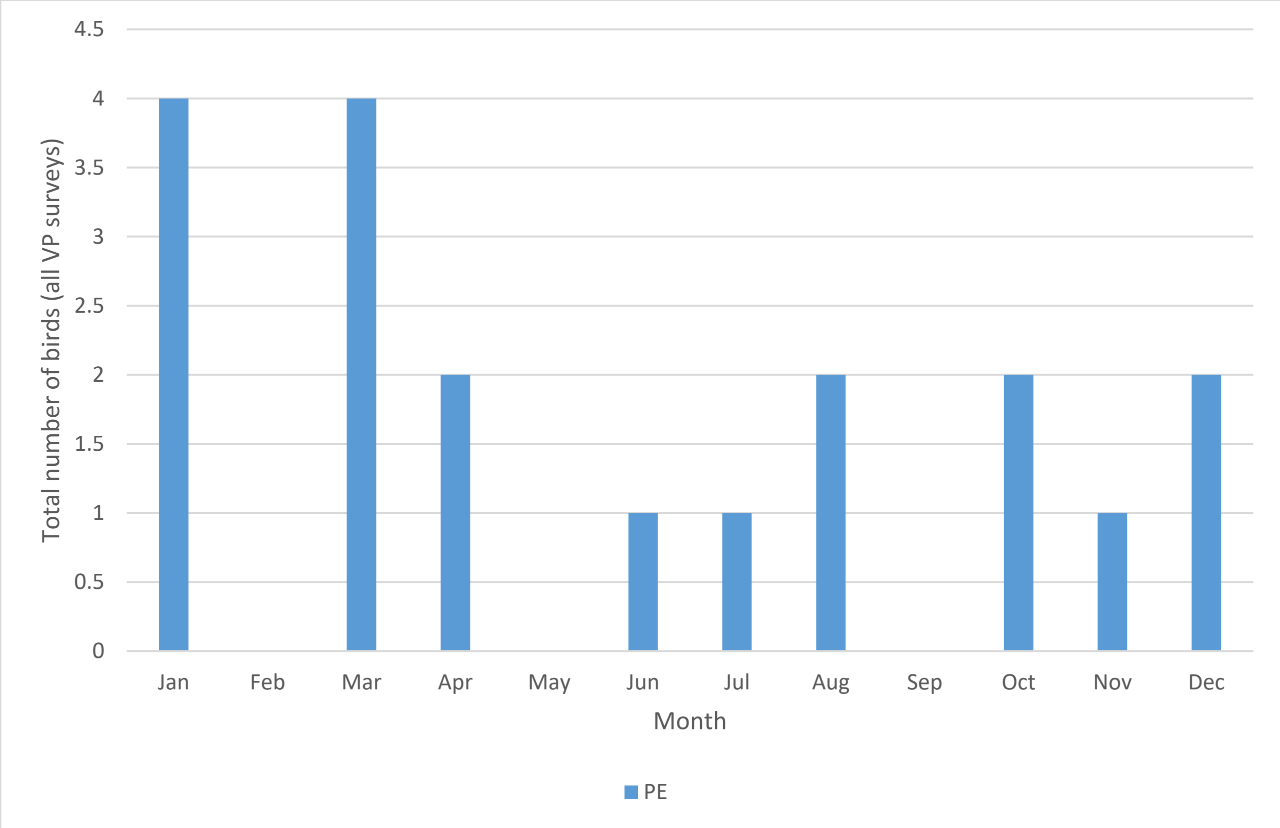

**Graph A10.4: Total number of cormorants (CA) and shags (SA) recorded by month during VP surveys during entire survey programme**



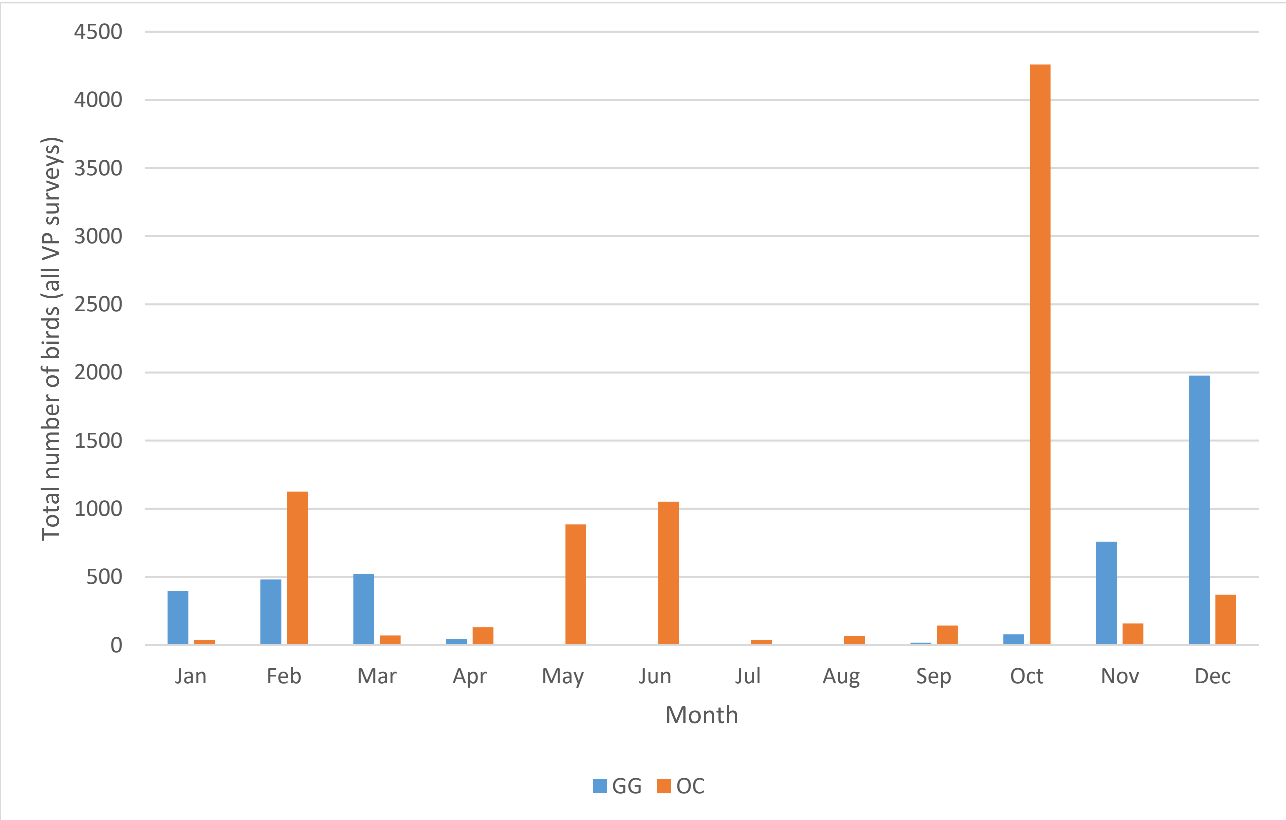

**Graph A10.5: Total number of gannets (GX) recorded by month during VP surveys during entire survey programme**



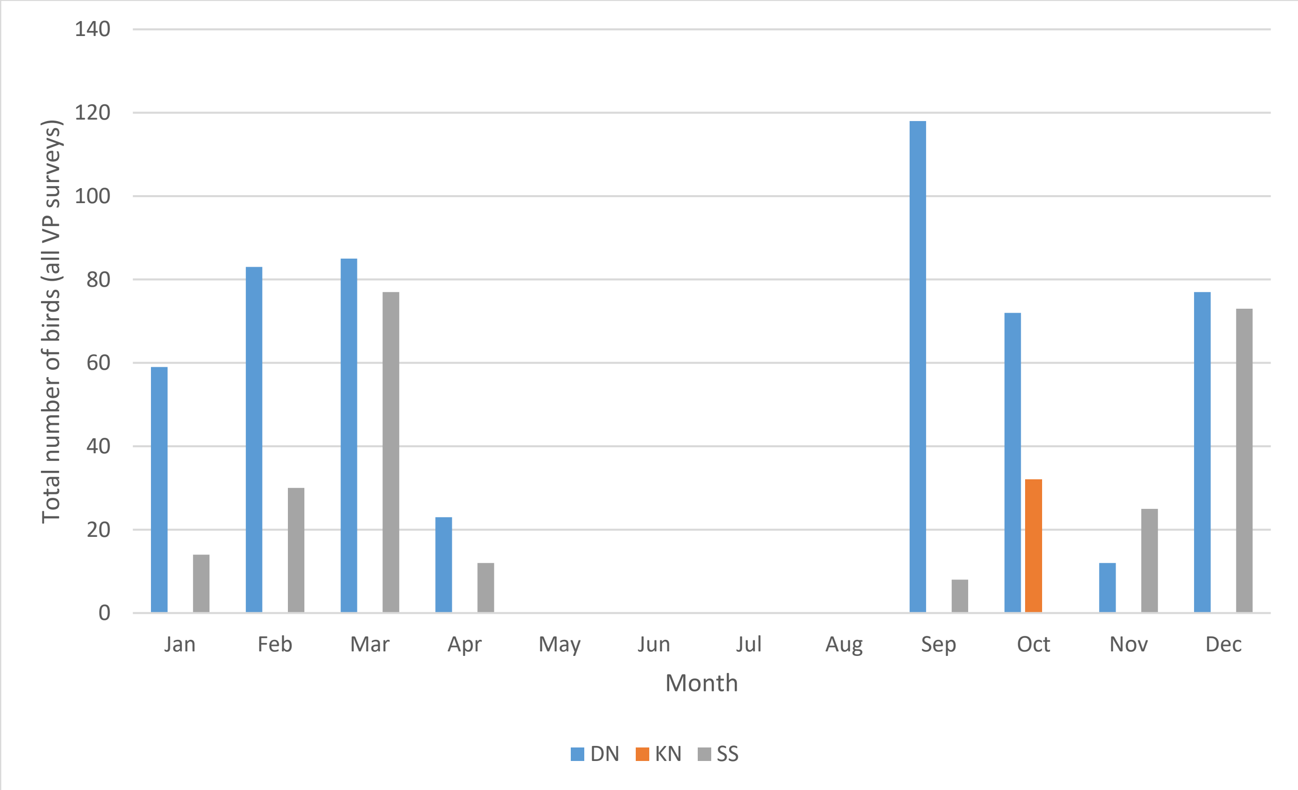

**Graph A10.6: Total number of puffins (PU) and black guillemots (TY) recorded by month during VP surveys during entire survey programme**



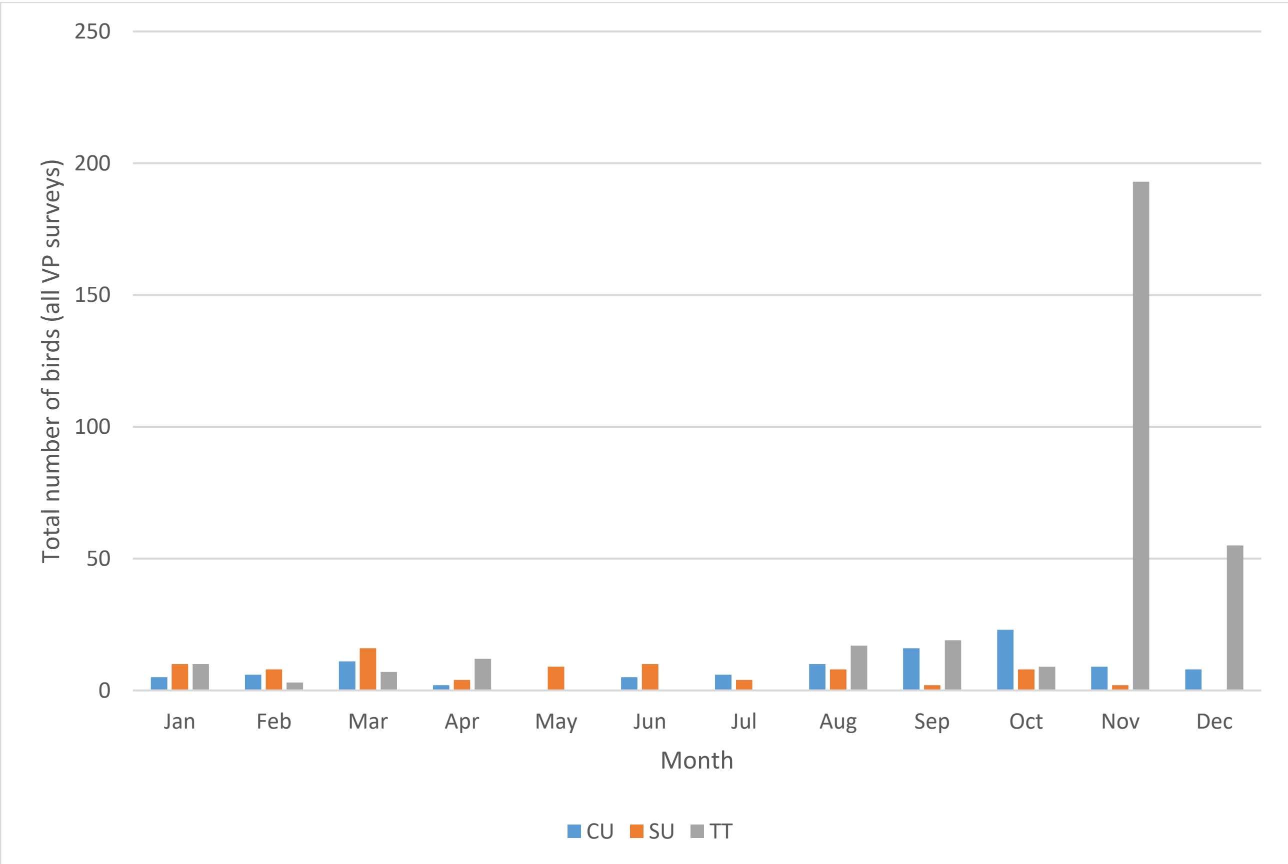

**Graph A10.7: Total number of peregrines (PE) recorded by month during VP surveys during entire survey programme**



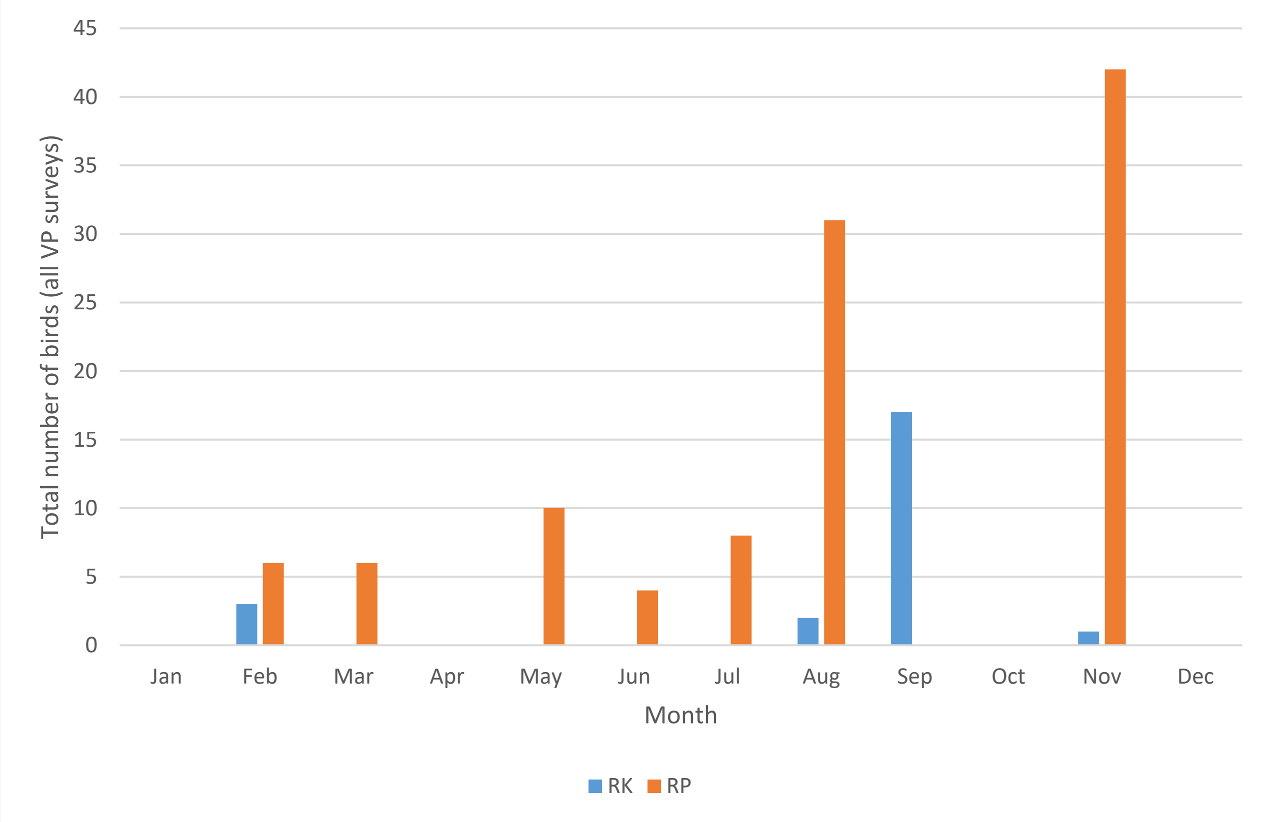

**Graph A10.8: Total number of great crested grebes (GG) and oystercatchers (OC) recorded by month during VP surveys during entire survey programme**



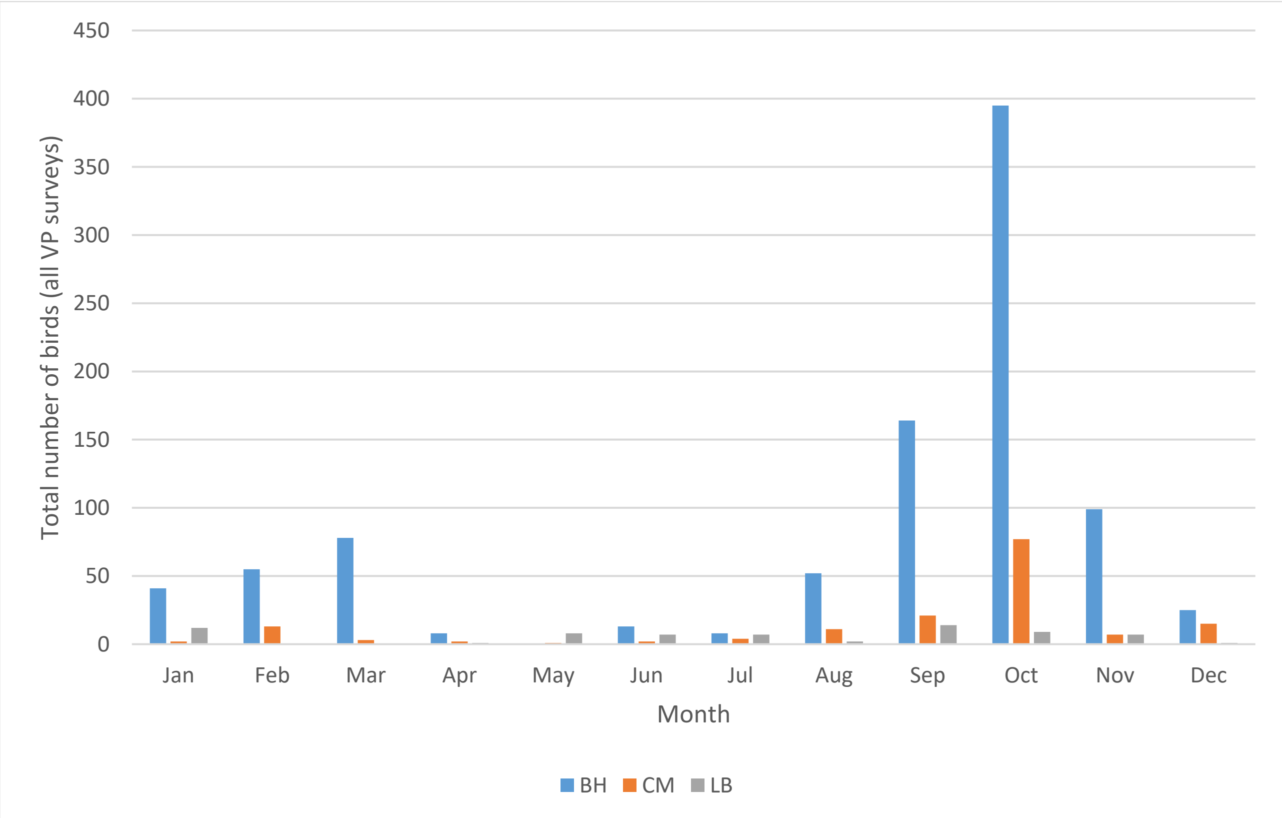

**Graph A10.9: Total number of dunlins (DN), knot (KN) and sanderlings (SS) recorded by month during VP surveys during entire survey programme**



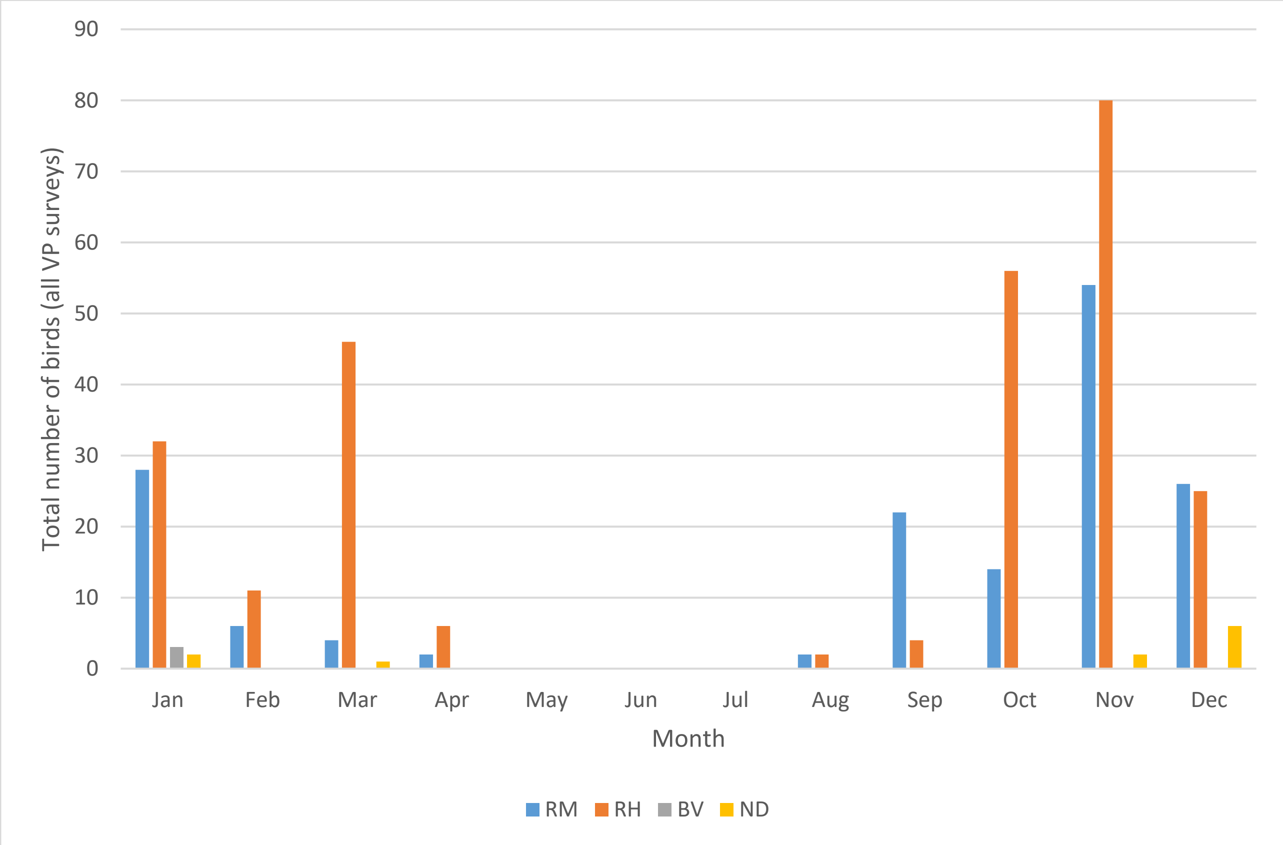

**Graph A10.10: Total number of shelduck (SU) and turnstones (TT) recorded by month during VP surveys during entire survey programme**



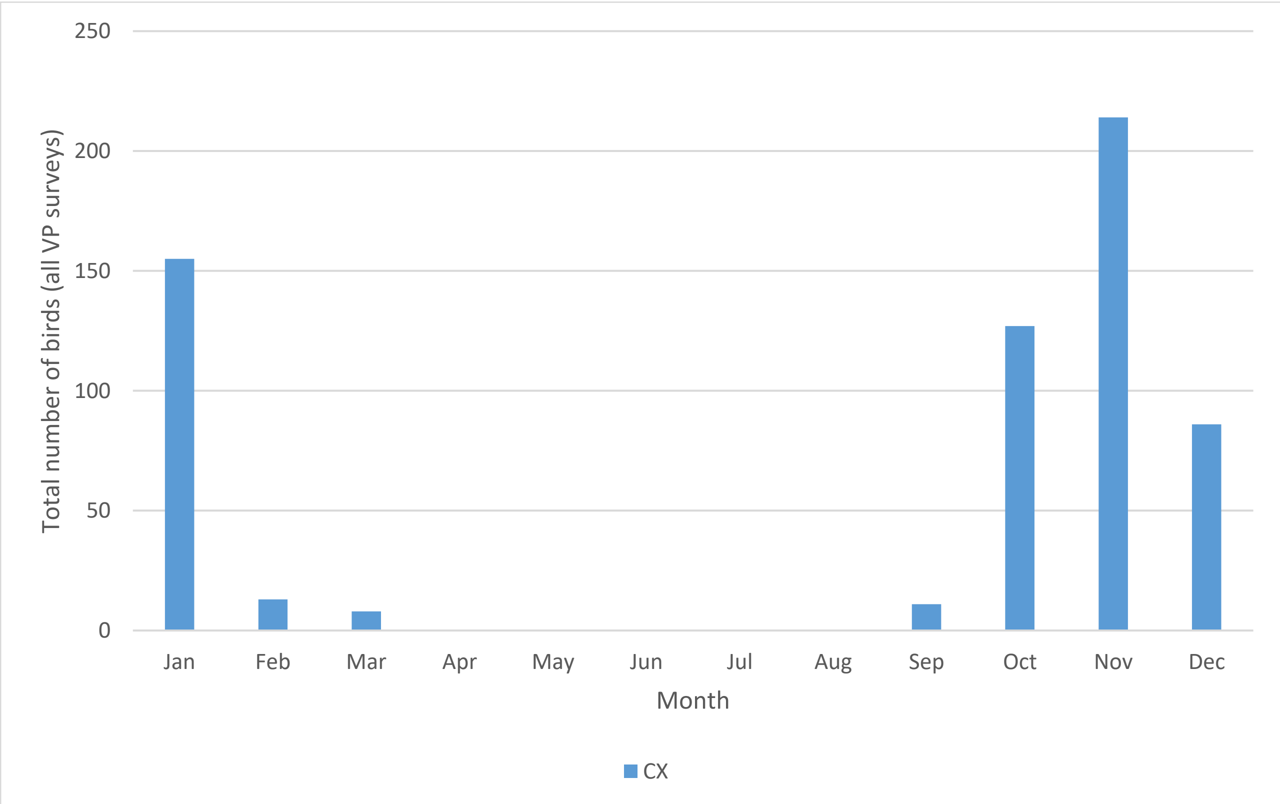

**Graph A10.11: Total number of redshanks (RK) and ringed plovers (RP) recorded by month during VP surveys during entire survey programme**



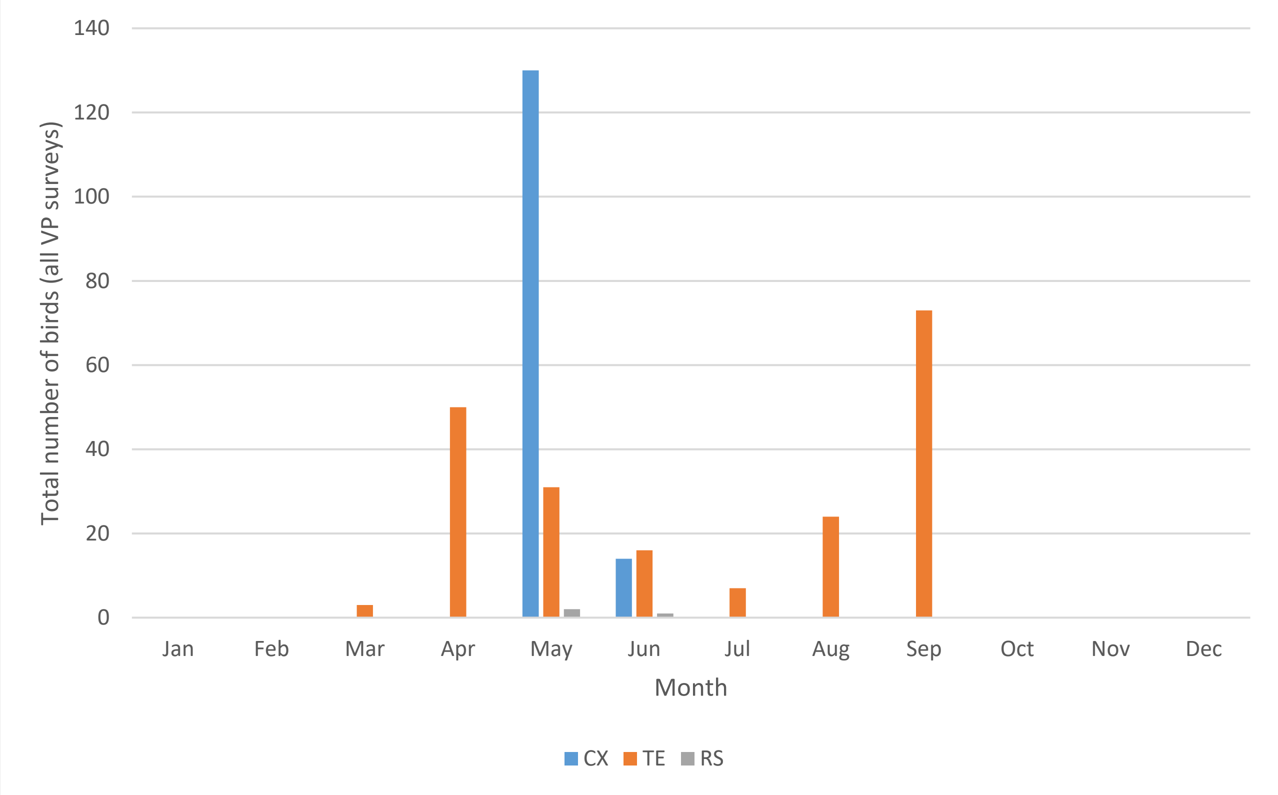

**Graph A10.12: Total number of black-headed gulls (BH), common gulls (CM) and lesser black-backed gulls (LB) recorded by month during VP surveys during entire survey programme**



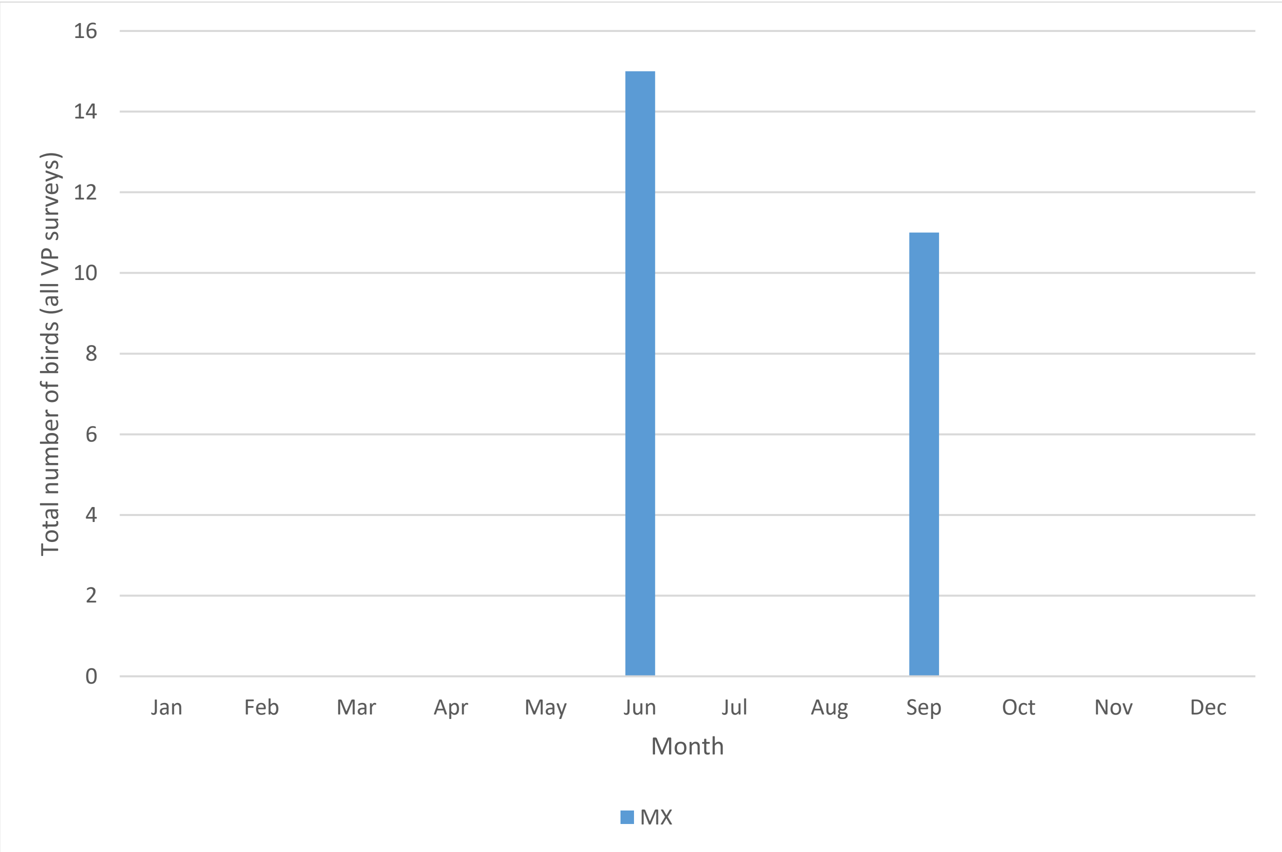

**Graph A10.13: Total number of red-breasted mergansers, red-throated divers (RH), black-throated divers (BV) and great northern divers (ND) recorded by month during VP surveys during entire survey programme**



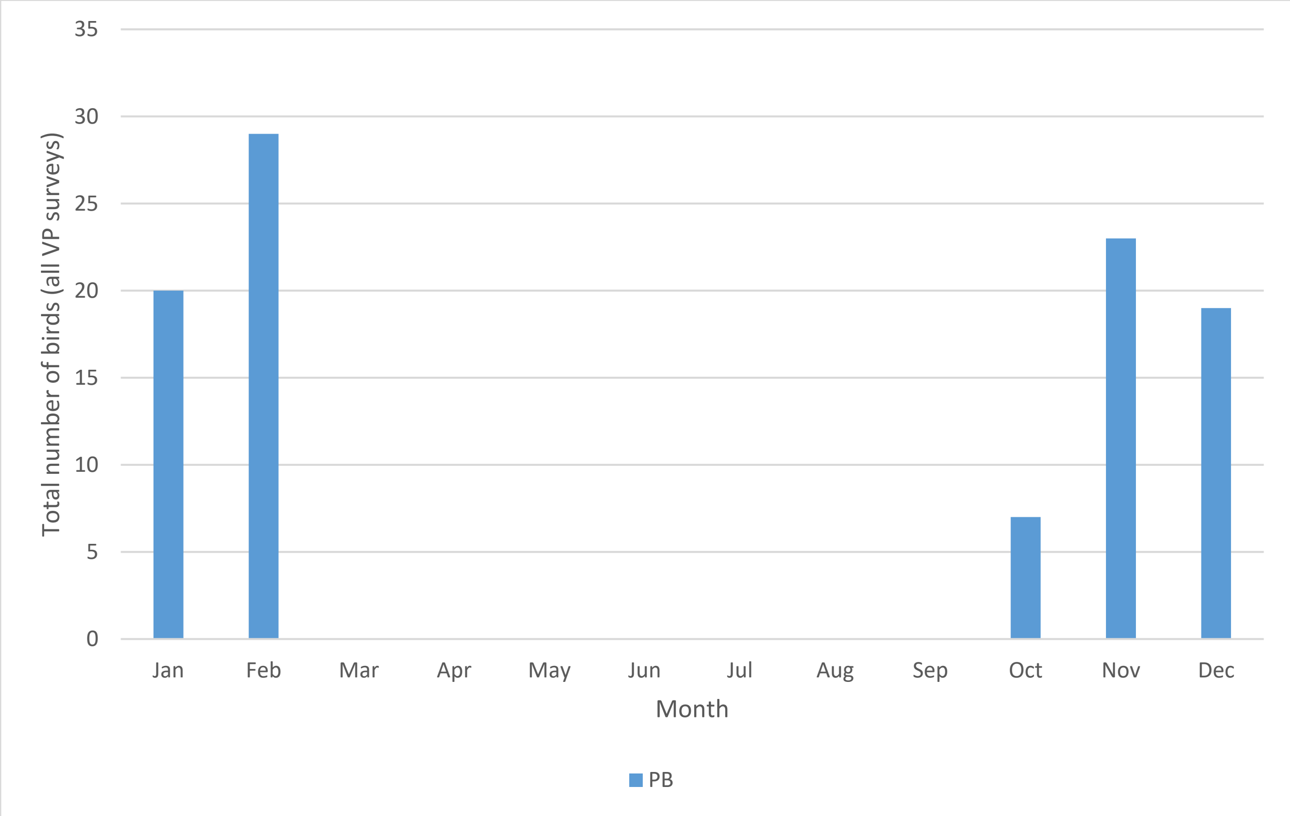

**Graph A10.14: Total number of common scoters (CX) recorded by month during VP surveys during entire survey programme**




**Graph A10.15: Total number of common terns (CN), Sandwich terns (TE) and Roseate terns (RS) recorded by month during VP surveys during entire survey programme**




**Graph A10.16: Total number of Manx shearwaters (MX) recorded by month during VP surveys during entire survey programme**




**Graph A10.17: Total number of Light-bellied Brent geese (PB) recorded by month during VP surveys during entire survey programme**

**Appendix B - Benthic Solutions Ltd - Reef Assessment Reports**

1. Phase II Ireland’s Eye Reef Survey 2015,
2. Marine Habitat Assessment Survey 2023
3. Irelands Eye Sublittoral Biotope Surbey 2023

# IRISH WATER

# GREATER DUBLIN DRAINAGE

# PHASE II IRELAND'S EYE REEF SURVEY

**Date of Survey:**
30/06/2015 - 02/07/2015

**Prepared By:**
Benthic Solutions Limited
Elanco Works
Marsh Road
Hoveton
Norfolk
NR12 8UH
United Kingdom

**Client:**
**RPS Group Ltd**
West Pier Business Campus
Dun Laoghaire, County Dublin
Ireland

**Disclaimer:**
This report has been produced in line with the requirements and objectives of the scope of work and contractual terms between Benthic Solutions Limited and the Client. The results are based upon expert interpretation. All interpretation and opinions contained herein are provided based upon the data collated as part of the survey, and other data provided by the Client and available within the public domain.

| Reference | Revision | Date | Issue Type | Author | QC | Approved |
|---|---|---|---|---|---|---|
| 1502 | 00 | 08/11/2015 | DRAFT | TM/KT/HL | HL | IW |
| 1502 | 01 | 09/11/2015 | FINAL | TM/KT/HL | HL | IW |
| | | | | | | |

# Contents

Contents ........ 1
1. Executive Summary ........ 4
2. Scope of Work ........ 6
3. Historical Data ........ 7
4. Site Selection ........ 8
5. Field Operations Summary observations ........ 10
6. Results and Discussion ........ 11
6.1. Biotope Classification ........ 11
6.1.1. Littoral Station 1 ........ 11
6.1.2. Littoral Station 2 ........ 13
6.1.3. Littoral Station 3 ........ 17
6.1.4. Sublittoral Station 1 ........ 20
6.1.5. Sublittoral Station 2 ........ 23
6.1.6. Sublittoral Station 3 ........ 28
6.1.7. Sublittoral Station 4 ........ 31
6.2. Univariate Analyses ........ 35
6.3. Multivariate Analyses ........ 37
6.3.1. Littoral Stations ........ 37
6.3.2. Sublittoral Stations ........ 38
7. Conclusion ........ 40
8. References ........ 41

## List of Figures

Figure 2.1 Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC....... 6

Figure 4.1 Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines) and Littoral Coastlines (Stars) ............................................................ 9

Figure 6.1 Littoral Zones and Biotopes for Station L1 ................................................................... 12

Figure 6.2 Littoral Zones and Biotopes for Station L2 ................................................................... 15

Figure 6.3 Littoral Zones and Biotopes for Station L3 ................................................................... 18

Figure 6.4 Sublittoral Zones and Biotopes for Station S1 ............................................................. 21

Figure 6.5 Sublittoral Zones and Biotopes for Station S2 ............................................................. 25

Figure 6.6 Sublittoral Zones and Biotopes for Station S3 ............................................................. 29

Figure 6.7 Sublittoral Zones and Biotopes for Station S4 ............................................................. 33

Figure 6.8 Distribution of Species per Phyla and Station ............................................................. 36

Figure 6.9 Dendrogram of Biotopes Recorded at the Littoral Stations ........................................... 37

Figure 6.10 MDS of Biotopes Recorded at the Littoral Stations ..................................................... 38

Figure 6.11 Dendrogram of Biotopes Recorded at the Sublittoral Stations ..................................... 39

Figure 6.12 MDS of Biotopes Recorded at the Sublittoral Stations ................................................ 39

## List of Tables

Table 2.1 Rockabill to Dalkey Island SAC Conservation Objectives.................................................... 6

Table 4.1 Proposed Littoral and Sublittoral Locations......................................................................... 8

Table 5.1 Chronological Sequence of Field Operations.................................................................. 10

Table 6.1 Species List for Station L1 with SACFOR Abundance Classifications for Each Biotope......... 13

Table 6.2 Species List for Station L2 with SACFOR Abundance Classifications for Each Biotope......... 16

Table 6.3 Species List for Station L3 with SACFOR Abundance Classifications for each Biotope......... 18

Table 6.4 Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope ........ 22

Table 6.5 Species List for Station S2 with SACFOR Abundance Classifications for each Biotope ........ 25

Table 6.6 Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope ........ 30

Table 6.7 Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope ........ 33

Table 6.8 Number of Species per Phyla and Station ........................................................................ 36

## Abbreviations

| Abbreviation | Meaning |
|---|---|
| ASML | Aquatic Survey and Monitoring Limited |
| BSL | Benthic Solutions Limited |
| CR.HCR.XFa.ByErSp.Sag | Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept ciraclittoral rock |
| CR.HCR.XFa.FluCoAs | *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock |
| GDD | Greater Dublin Drainage |
| CR.HCR.XFa.FluCoAs.Paur | *Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock |
| IR.HIR.KFaR.FoR | Foliose red seaweeds on exposed lower infralittoral rock |
| IR.HIR.KFaR.FoR.Dic | Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock |
| IR.MIR.KR.Ldig | *Laminaria digitata* on moderately exposed sublittoral fringe rock |
| IR.MIR.KR.Ldig.Ldig | *Laminaria digitata* on moderately exposed sublittoral fringe bedrock |
| LR.FLR.Lic.Pra | *Prasiola stipitata* on nitrate-enriched supralittoral or littoral fringe rock |
| LR.HLR.FR.Coff | *Corallina officinalis* on exposed to moderately exposed lower eulittoral rock |
| LR.HLR.FR.Mas | *Mastocarpus stellatus* and *Chondrus crispus* on very exposed to moderately exposed lower eulittoral rock |
| LR.HLR.MusB | Mussel and/or barnacle communities |
| LR.HLR.MusB.Cht | *Chthamalus* spp. on exposed eulittoral rock |
| LR.HLR.MusB.Sem | *Semibalanus balanoides* on exposed to moderately exposed or vertical sheltered eulittoral rock |
| LR.LLR.F.Asc.FS | *Ascophyllum nodosum* on full salinity mid eulittoral rock |
| LR.MLR.BF.Fser.R | *Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock |
| LR.MLR.BF.FspiB | *Fucus spiralis* on exposed to moderately exposed upper eulittoral rock |
| MDS | Multi-Dimensional Scaling |
| MERC | Marine and Environmental Resource Conservation Consultants |
| MNCR | Marine Nature Conservation Review |
| MDS | Multi-Dimensional Scaling |
| NPWS | National Parks & Wildlife Service |
| ODM | Ordnance Datum Malin |
| PRIMER | Plymouth Routines In Multivariate Ecological Research |
| RIB | Rigid-Inflatable Boat |
| SAC | Special Areas of Conservation |
| SACFOR | Superabundant, Abundant, Common, Frequent, Occasional and Rare |
| SD | Standard Deviation |

## 1. Executive Summary

The Irelands Eye is a small uninhabited islands located to the north of Howth head, located within the Rockabill to Dalkey Island Special Area of Conservations (site code 3000), and is designated for Annex 1 qualifying interest Reefs. As the site is within close proximity to the proposed GDD outfall, these interests may be subject to plume effects from suspended sediment during parts of the construction operation whilst dredging or be impacted by the outfall plume itself. Field operations to acquire a detailed assessment of these qualifying habitats was carried out and completed successfully at three littoral and four sublittoral stations between the 30$^{th}$ June and 2$^{nd}$ of July 2015. These were based on a generic assessment of biotopes using the standard (Marine Nature Conservation Review) MNCR-style format. Identification and abundance of conspicuous fauna and flora were scaled onsite using the SACFOR scheme (e.g. superabundant, abundant, common, frequent, occasional and rare).

In the littoral zone, the biotopes '*Corallina officinalis* on exposed to moderately exposed lower eulittoral rock/*Laminaria digitata* on moderately exposed sublittoral fringe rock (*LR.HLR.FR.Coff/IR.MIR.KR.Ldig)* usually emerged from the sublittoral, followed by a zone covered by seaweeds to a faunally dominated shore consisting of limpets, barnacles and littorinids.

The sublittoral stations were characterised by *Laminaria digitata* forests in the shallower part (*IR.MIR.KR.Ldig.Ldig*) and were usually replaced by the biotope 'Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock' (*IR.HIR.KFaR.FoR.Dic)*. The deeper extend was dominated by a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock' (*CR.HCR.XFa.ByErSp.Sag*) or in the case of Sublittoral Station 2 '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock' (*CR.HCR.XFa.FluCoAs*). The deeper biotope at Sublittoral Station 4 was categorised as a possible '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock' (*HCR.XFa.FluCoAs.Paur*), probably due to the increased sedimentation noted at this station.

Univariate analyses showed clear differences between the littoral and sublittoral stations in terms of species richness with twice as many species recorded from the sublittoral area (88.3±19.2SD as opposed to 44.7±11.6SD). Both littoral and sublittoral environments indicated moderately high species diversity. Multivariate analyses revealed statistical separation of biotopes with the vertical zonation of the fauna (by water depth or height on the foreshore) constituting the dominant community patterns observed.

No species of particular nature conservation interest were noted during the any of the surveys and no rare or particularly fragile biotopes were recorded. However natural siltation levels were high in the sublittoral environment, a fact that has not appeared to have a significant impact to the biological diversity in this area. Whilst, siltation levels are high in the sublittoral environment, a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. No species of particular conservational interest were noted during the surveys and no rare or fragile biotopes recorded.

## 2. Scope of Work

The proposed outfall route of the Greater Dublin Drainage (GDD) scheme, terminates at the diffuser location 1km north-east of Ireland's Eye, and falls within the Rockabill to Dalkey Island SAC. The conservation objectives of the Rockabill to Dalkey Island SAC include Annex I qualifying Reefs (Figure 2.1). To maintain the favourable conservation conditions of these Reefs within the SAC, the following criteria are proposed by NPWS (as outlined in Table 2.1).

Table 2.1 Rockabill to Dalkey Island SAC Conservation Objectives

| Attribute | Measure | Target | Notes |
|---|---|---|---|
| Habitat area | Hectares | The permanent area is stable or increasing, subject to natural processes. See Figure 2.1 | Habitat area estimated as 182ha using 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0) |
| Habitat distribution | Occurrence | Distribution is stable or increasing, subject to natural processes. See Figure 2.1 | Distribution derived from 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0). |
| Community structure | Biological composition | Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex. See Figure 2.1 | Reef community mapping based on 2010 and 2011 intertidal and subtidal reef survey data (MERC, 2010, 2012a, b). |


Figure 2.1 Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC

# 3. Historical Data

Within the Rockabill to Dalkey Island SAC, two community types were recorded within the Annex I habitat, namely the Intertidal reef community complex and the Subtidal reef community complex (Reefs 1170). Intertidal and subtidal surveys were undertaken in 2010 and 2011 (MERC, 2010, MERC 2012a and MERC 2012b). These data were used to determine the physical and biological nature of the Annex I habitat. Estimated areas of each community type within the Annex I habitat, are based on interpolation, and are shown in Figure 2.1.

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 Rockabill to Dalkey Island SAC 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.

INTERTIDAL REEF COMMUNITY COMPLEX

This reef community complex is recorded on the eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The exposure regime of the complex ranges from exposed to 'moderately exposed' reef for Ireland's Eye. The substrate here is that of flat and sloping bedrock, cobbles and boulders. Vertical cliff faces are found on the north and northeast shores of Ireland's Eye.

SUBTIDAL REEF COMMUNITY COMPLEX

This reef community complex is recorded off the northern, eastern and southern shores of Ireland's Eye immediately south of the proposed outfall route and diffuser location. The substrate ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland's Eye, whilst the northern reaches of the island both show sediment scouring and a thin veneer of silt on the reefs.

In general, previous surveys (MERC 2010, MERC 2012a and MERC 2012b) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals were found.

## 4. Site Selection

Following a review and combination of existing and surveyed bathymetric datasets, the locations for sublittoral and littoral survey locations was based on a combination of seabed topography, and site exposure. A total of four sublittoral locations and three littoral locations were established for survey operations (outlined in Table 4.1, and presented in Figure 4.1).

**Table 4.1 Proposed Littoral and Sublittoral Locations**

| Site | Transect | Easting | Northing | Description | Depth (ODM) |
|---|---|---|---|---|---|
| S1 | Start | 728470.3 | 741625.0 | Sublittoral: Northwest stack and discrete sublittoral reef feature | -12.1 |
| | End | 728369.1 | 741589.2 | | 0.34 |
| S2 | Start | 728745.5 | 741626.2 | Sublittoral: Standard slope with boulder field at base | -13.99 |
| | End | 728752.9 | 741526.2 | | 1.13 |
| S3 | Start | 729161.4 | 740937.5 | Sublittoral: Exposed southeast island pinnacles | -11.81 |
| | End | 729060.2 | 740969.6 | | 0.26 |
| S4 | Start | 729187.4 | 740556.2 | Sublittoral: Exposed southeast islet pinnacles | -10.50 |
| | End | 729102.2 | 740624.0 | | 0.01 |
| L1 | | 729033.1 | 741472.4 | Littoral: Exposed northeast channel between stack | 0.04 |
| L2 | | 728910.9 | 741053.5 | Littoral: Sheltered southeast inlet | 0.80 |
| L3 | | 729077.5 | 740648.7 | Littoral: Exposed southeast islet rocky coast | 0.98 |

*Geodesy based on Irish National Grid and vertical datum of Ordnance datum Malin Head (ODM)*

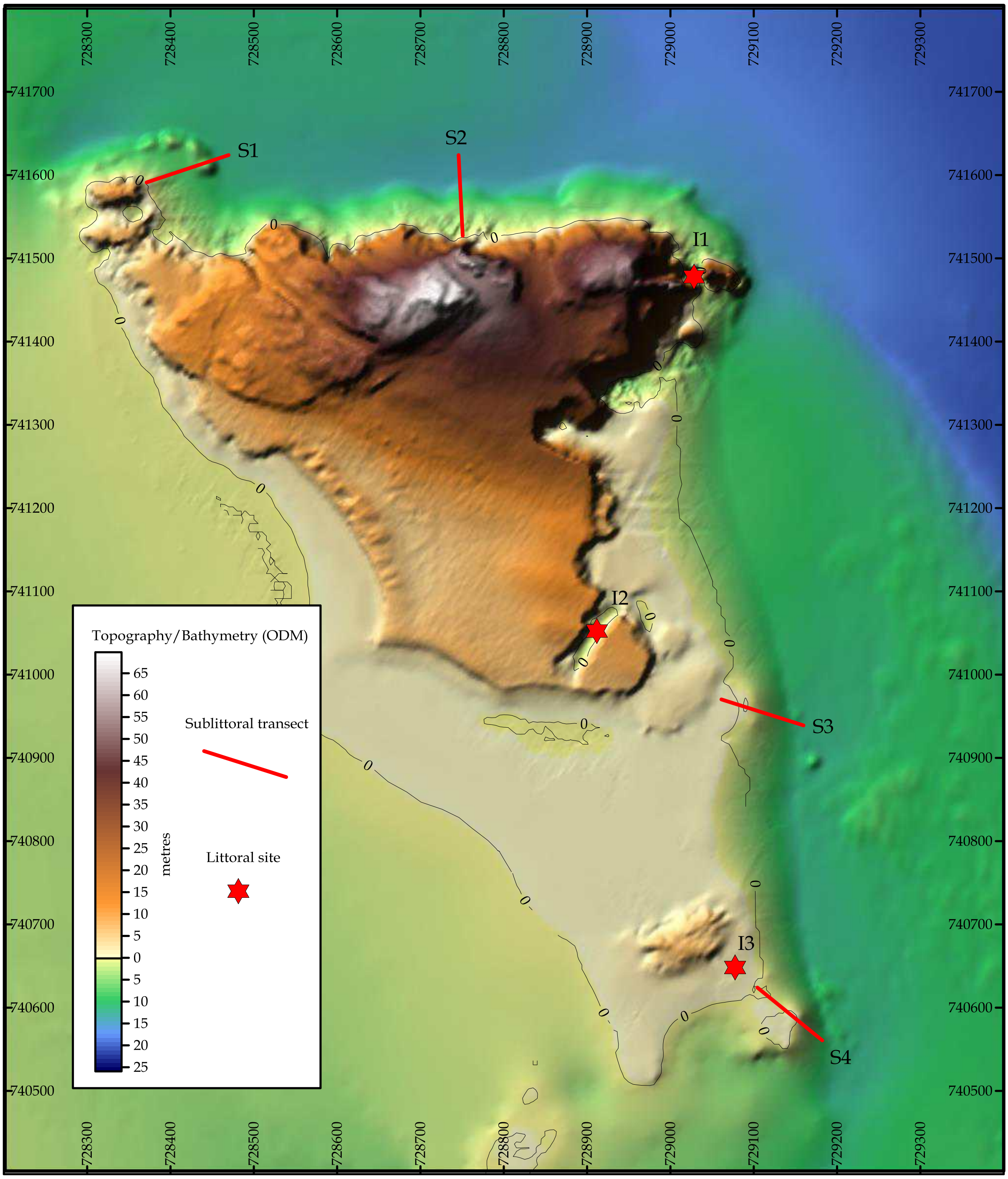



**Figure 4.1 Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines) and Littoral Coastlines (Stars)**

## 5. Field Operations Summary observations

Field survey operations were completed successfully at all proposed locations between the 30th June and 2nd of July 2015. A four man dive team, made up from representatives from both MERC and ASML, was mobilised to site on the 29th June, with operations carried out from an 8m RIB. Weather remained good throughout the survey period, with only localised periods of marginal winds occurring on a couple of days. Consequently operations were spread between the dive sites (four in total) and inter-tidal (three in total), to make the best use of the prevailing conditions.

A summary of the field operations is outlined in Table 5.1.

**Table 5.1 Chronological Sequence of Field Operations**

| Day | Date | Operations | Comment |
|---|---|---|---|
| 1 | 29/06/15 | Mobilisation to Howth | ASML mobilised. MERC launched the 8m RIB service vessel locally (Howth harbour). |
| 2 | 30/06/15 | Ops: Diving and intertidal | 2 diving sites and 1 intertidal completed. |
| 3 | 01/07/15 | Ops: Diving and intertidal | IW of BSL travels to site for oversight. 1 diving site and 1 intertidal site completed. |
| 4 | 02/07/15 | Ops: Diving and intertidal | 1 dive site completed in the morning and 1 intertidal site completed in the afternoon. Vessel recovered and survey personnel demobilised. IW onsite for oversight. |
| 5 | 03/07/15 | Demobilisation from Howth | ASML team demobilised back to the UK. |

Field operations were based on a generic assessment of biotopes using the standard MNCR-style (Marine Nature Conservation Review) format. Identification and abundance was scaled onsite using the SACFOR (e.g. superabundant, abundant, common, frequent, occasional and rare) scale on all the conspicuous flora and fauna within each biotope encountered. Taxa that could not be readily identified were removed and later identified under a microscope back at the field laboratory (i.e hotel).

During the intertidal survey, sites were selected from aerial photography to present different exposures and the vertical profiles completed along all of the lower, middle and upper shorelines at these locations. Each biological zone was photographed and surveyed. The floral and faunal taxa were identified and abundance scale values allocated also using the SACFOR protocol on all the conspicuous species in each biotope encountered.

## 6. Results and Discussion

This survey has collected semi-quantitative data from two moderately exposed littoral stations (L1 and L3) and a sheltered station (L2). L1 is slightly modified by shading, wave surge and nitrogenous enrichment and the L3 upper shore biotope was similarly enriched by roosting seabirds. In the sublittoral, four stations (S1 to S4) were investigated of which all were found to be heavily silted, but were moderately diverse. The photographs and data presented herein may act as a comparison, against which future gross changes could be qualitatively assessed.

In order to determine any significant differences between the stations surveyed, the SACFOR scale was additionally categorised from 1 (rare) to 6 (superabundant). Basic statistical analyses as well as multi-dimensional statistical techniques were applied to the dataset to present the data as a cluster diagram and MDS plot. While useful to present general trends within the datasets, due to the semi quantitative nature of the SACFOR classifications, not too much reliance should be placed on the statistical analyses.

### 6.1. Biotope Classification

#### 6.1.1. Littoral Station 1

Littoral Station 1 was located in the gully between the northeast stack and the main island, and was characterised by a typically exposed shore, with the exposure to wave action amplified by the effect of surge through the gully. There was also an effect of shading which was apparent in a reduced algal component. The order of the biotopes ran from an algae dominated *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (vi) through the lower middle shore *LR.HLR.FR.Mas* (v) to a faunally dominated *LR.HLR.MusB.Sem* (iv) in the upper middle shore. Then through the barnacles *LR.HLR.MusB.Cht* (iii), followed by a LR.HLR.MusB (ii) *Porphyra* sp. band to a nitrate enriched *LR.FLR.Lic.Pra* (i) zone in the supralittoral where the copious bird droppings from the nesting and roosting seabirds made their impact on the littoral ecology.

Photographs from each littoral zone/biotope are shown in Figure 6.1, while a full species list with the SACFOR classification is presented in Table 6.1.

vi: *LR.HLR.FR.Coff/IR.MIR.KR.Ldig*

v: *LR.HLR.FR.Mas*

iv: *LR.HLR.MusB.Sem*

iii: *LR.HLR.MusB.Cht*

ii: *LR.HLR.MusB*

i: *LR.FLR.Lic.Pra*

**Figure 6.1 Littoral Zones and Biotopes for Station L1**

Table 6.1 Species List for Station L1 with SACFOR Abundance Classifications for Each Biotope

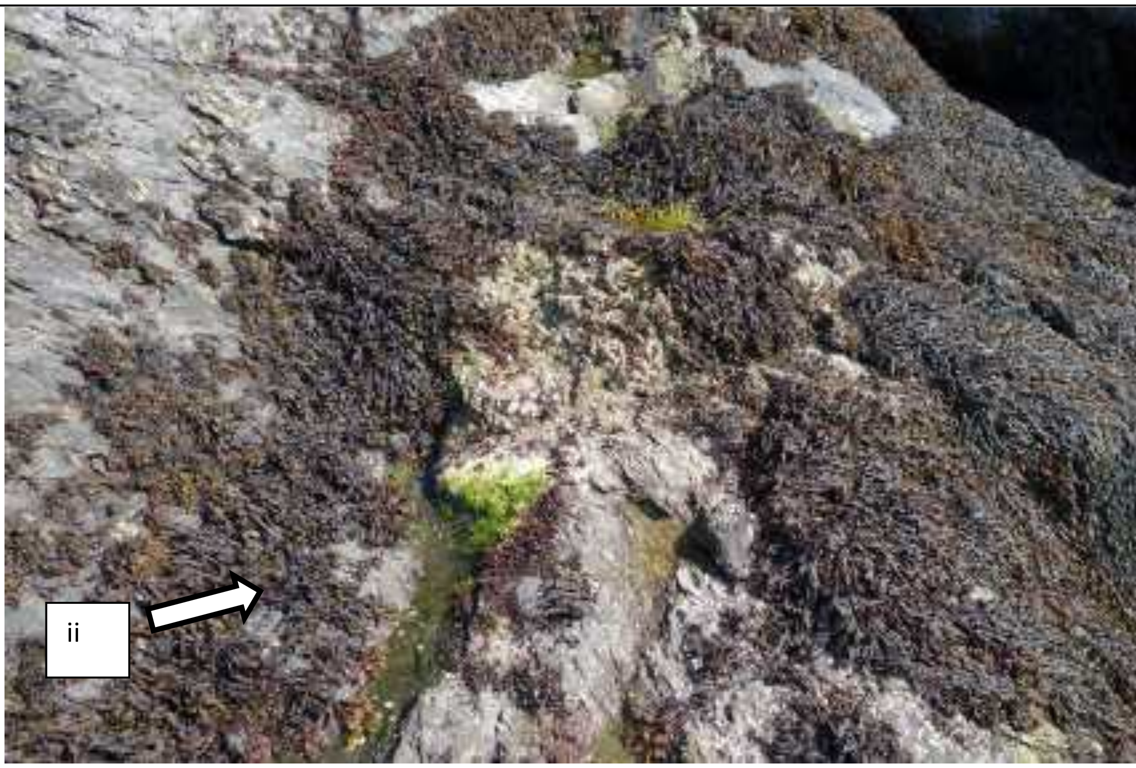
| MCS Code | Taxa | L1 | | | | | |
|---|---|---|---|---|---|---|---|
| | | vi | v | iv | iii | ii | i |
| | **Porifera** | | | | | | |
| C05230 | *Hymeniacidon perlevis* | R | | | | | |
| | **Cnidaria** | | | | | | |
| D11510 | *Actinia equina* | | | O | | | |
| | **Annelida** | | | | | | |
| P23040 | *Spirobranchus triqueter* | F | | | | | |
| P02770 | *Eulalia viridis* | F | | | | | |
| | **Arthropda** | | | | | | |
| R00720 | *Chthamalus montagui* | | | | F | R | |
| R01080 | *Semibalanus balanoides* | A | C | | S | R | |
| S26900 | *Carcinus maenas* | R | | | | | |
| | **Mollusca** | | | | | | |
| W00500 | Polyplacophora | O | | | | | |
| W01340 | *Patella vulgata* | C | A | F | C | | |
| W02390 | *Lacuna pallidula* | | O | | | | |
| W02500 | *Littorina littorea* | | C | | | | |
| W02520 | *Melarhaphe neritoides* | | | | R | R | |
| W02630 | *Littorina saxatilis* | | | | R | R | |
| W08170 | *Nucella lapillus* | | | R | | | |
| W16500 | *Mytilus edulis* | O | R | R | | | |
| | **Bryozoa** | | | | | | |
| Y06780 | *Electra pilosa* | O | | | | | |
| | **Rhodophyta** | | | | | | |
| ZM00900 | *Porphyra umbilicalis* | | | | | A | R |
| ZM02420 | *Palmaria palmata* | R | O | R | | | |
| ZM03790 | *Hildenbrandia rubra* | O | | | | | |
| ZM03840 | Corallinaceae (enc) | A | | | | | |
| ZM04010 | *Corallina caespitosa* | | R | | | | |
| ZM06050 | *Mastocarpus* | | | R | | | |
| ZM06050 | *Mastocarpus stellatus* | C | S | A | R | | |
| ZM07510 | *Lomentaria articulata* | R | R | | | | |
| ZM08240 | *Ceramium shuttleworthianum* | | R | R | R | R | |
| ZM09900 | *Membranoptera alata* | R | | | | | |
| ZM10800 | *Osmundea pinnatifida* | | R | | | | |
| ZM11170 | *Polysiphonia fucoides* | | R | | | | |
| | **Ochrophyta** | | | | | | |
| ZR06320 | *Laminaria digitata* | S | | | | | |
| | **Chlorophyta** | | | | | | |
| ZS02400 | *Ulva* sp. (flat) | R | R | | | R | |
| ZS02890 | *Prasiola stipitata* | | | | | | A |
| ZS03560 | *Cladophora rupestris* | | F | | | R | |
| | **Ascomycota** | | | | | | |
| | *Verrucaria maura* | | | | | C | F |

### 6.1.2. Littoral Station 2

The shore at Littoral Station 2 was a more sheltered inlet on the east coast of the island. The protection from wave action afforded by the sheltering intertidal reef has allowed a series of algal dominated biotopes to develop. Initially the *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (v) emerged from the sublittoral and passes through a typical *Fucus serratus* and red seaweeds *LR.MLR.BF.Fser.R* (iv) zone, to an *Ascophyllum nodosum* and *Fucus vesiculosus* *LR.LLR.F.Asc.FS* (iii) biotope. Above this the spiral wrack and channel wrack mixed together and form an *LR.MLR.BF.FspiB* (ii) biotope with limpets, barnacles and littorinids found amongst the algae. This shore finished with a typical lichen zone dominated by the nitrophilous yellow lichen *Xanthoria parietina* and the green algae *Pasiola stipitata* *LR.FLR.Lic.Pra* (i) previously seen at station L1.

Photographs from each littoral zone/biotope are shown in Figure 6.2, while a full species list with SACFOR classification is presented in Table 6.2.


v: *LR.HLR.FR.Coff/IR.MIR.KR.Ldig*, iv: *LR.MLR.BF.Fser.R* and iii: *LR.LLR.F.Asc.FS*




ii: *LR.MLR.BF.FspiB*


i: *LR.FLR.Lic.Pra*

**Figure 6.2 Littoral Zones and Biotopes for Station L2**

Table 6.2 Species List for Station L2 with SACFOR Abundance Classifications for Each Biotope

| MCS Code | Taxa | L2 | | | | |
|---|---|---|---|---|---|---|
| | | i | ii | iii | iv | v |
| | **Annelida** | | | | | |
| P23040 | *Spirobranchus triqueter* | | | | | R |
| | **Arthropoda** | | | | | |
| R01080 | *Semibalanus balanoides* | R | | O | O | |
| R01200 | *Austrominius modestus* | | R | | | |
| S01660 | Amphipoda | | R | R | | |
| | *Anurida maritima* | | R | R | | |
| | **Mollusca** | | | | | |
| W01340 | *Patella vulgata* | | R | O | O | |
| W02500 | *Littorina littorea* | | | R | | |
| W02630 | *Littorina saxatilis* | | | R | | |
| W08170 | *Nucella lapillus* | | | | R | |
| | **Bryozoa** | | | | | |
| Y01390 | *Alcyonidium hirsutum* | | | R | | |
| Y06780 | *Electra pilosa* | | | | | R |
| | **Rhodophyta** | | | | | |
| ZM00900 | *Porphyra umbilicalis* | | R | | | |
| ZM01160 | *Rhodothamniella floridula* | | | | R | |
| ZM02160 | *Gelidium spinosum* | | | | R | |
| ZM02420 | *Palmaria palmata* | | | R | O | F |
| ZM03840 | Corallinaceae (enc) | | | O | | |
| ZM06050 | *Mastocarpus stellatus* | | | O | C | |
| ZM07510 | *Lomentaria articulata* | | | | O | |
| ZM08240 | *Ceramium shuttleworthianum* | | | R | R | |
| ZM08830 | *Plumaria plumosa* | | | | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | | | | | R |
| ZM09900 | *Membranoptera alata* | | | | R | |
| ZM10780 | *Osmundea hybrida* | | | | R | |
| ZM11150 | *Vertebrata lanosa* | | | F | | |
| | **Ochrophyta** | | | | | |
| ZR02490 | *Elachista fucicola* | | | | O | |
| ZR06320 | *Laminaria digitata* | | | | | S |
| ZR06640 | *Ascophyllum nodosum* | | | S | R | |
| ZR06740 | *Fucus serratus* | | | R | S | |
| ZR06750 | *Fucus spiralis* | | C | | | |
| ZR06760 | *Fucus vesiculosus* | | | F | R | |
| ZR06810 | *Pelvetia canaliculata* | | C | | | |
| | **Chorophyta** | | | | | |
| ZS02400 | *Ulva* sp. (tubular) | | | O | | |
| ZS02400 | *Ulva* sp. (flat) | | R | | R | |
| ZS02890 | *Prasiola stipitata* | C | | | | |
| ZS03400 | *Cladophora albida* | | | R | | |
| ZS03560 | *Cladophora rupestris* | | | R | | |
| | **Ascomycota** | | | | | |
| | *Verrucaria maura* | F | O | | R | |
| | *Caloplaca thallincola* | A | | | | |
| | *Caloplaca marina* | O | | | | |
| | *Tephromela atra var. atra* | R | | | | |
| | *Xanthoria parietina* | R | | | | |
| | **Tracheophyta** | | | | | |
| | *Armeria maritima* | R | | | | |

### 6.1.3. Littoral Station 3

Littoral Station 3 was located at the southeast tip of the island partially separated from the main island by a connecting intertidal reef. Here the type and order of the biotopes up to the shore from the low tide level were somewhat similar to those of station L1, with the addition of several other common algae species, probably present due to the improved light regime on the open coast. The order of the biotopes again ran up from an algae dominated *LR.HLR.FR.Coff/IR.MIR.KR.Ldig* (vi), *Laminaria digitata* forest (with occasional *L. hyperborea*) with frequent patches of red algae dominated by coralline crusts. The lower middleshore was dominated by *Fucus serratus, Osmundea pinnatifida* and *Mastocarpus stellatus LR.HLR.FR.Mas* (v) and this continued into to a faunally dominated middle shore of *LR.HLR.MusB.Sem* (iv), limpets, and *Semibalanus balanoides* barnacles, with a patchy canopy of the bladderless 'Bladder wrack' *Fucus evesiculosus.* Above this mixed algae and barnacle biotope, a barnacle dominated zone of *LR.HLR.MusB.Cht* (iii) was found, with all three common native littoral barnacle species present (the two *Chthamalus* and one *Semibalanus* species). Above this biotope, as with station L1, there was a *LR.HLR.MusB* (ii) *Porphyra sp.* and *Verrucaria maura* band with sparse barnacles and littorinids sheltered in the crevices. Finally, at the top of the shore, there was another nitrate enriched *LR.FLR.Lic.Pra* (i) *Prasiola stipitata* zone found in the supralittoral.

Photographs from each littoral zone/biotope are shown in Figure 6.3, while a full species list with SACFOR classification is presented in Table 6.3.

vi: *LR.HLR.FR.Coff/ IR.MIR.KR.Ldig*

v: *LR.HLR.FR.Mas*

iv: *LR.HLR.MusB.Sem*

iii: *LR.HLR.MusB.Cht*

ii: *LR.HLR.MusB*

i: *LR.FLR.Lic.Pra*

**Figure 6.3 Littoral Zones and Biotopes for Station L3**

**Table 6.3 Species List for Station L3 with SACFOR Abundance Classifications for each Biotope**

| MCS Code | Taxa | L3 | | | | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | iv | v | vi |
| | **Porifera** | | | | | | |
| C04840 | *Halichondria panicea* | | | | | | R |
| C05230 | *Hymeniacidon perlevis* | | | | | | R |
| | **Cnidaria** | | | | | | |
| D06480 | *Dynamena pumila* | | | | | | R |
| | **Annelida** | | | | | | |
| P23020 | *Spirobranchus* sp. | | | | | | R |
| | **Arthropoda** | | | | | | |
| R00720 | *Chthamalus montagui* | | R | O | | | |
| R00730 | *Chthamalus stellatus* | | | R | | | |
| R01080 | *Semibalanus balanoides* | | | S | S | A | A |
| R01100 | *Balanus crenatus* | | | | | | O |
| R01200 | *Austrominius modestus* | | | | F | R | |
| R01940 | Copepoda (in small pools) | | P* | | | | |
| S26460 | *Cancer pagurus* | | | | | | O |
| S26900 | *Carcinus maenas* | | | | | | O |
| | **Mollusca** | | | | | | |
| W00740 | *Lepidochitona cinerea* | | | | | R | |
| W01320 | *Patella depressa* | | | | | F | |

| MCS Code | Taxa | L3 | | | | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | iv | v | vi |
| W01340 | *Patella vulgata* | | | C | C | C | F |
| W02520 | *Melarhaphe neritoides* | | R | C | | | |
| W02562 | *Littorina obtusata/ mariae* | | | | | O | |
| W02630 | *Littorina saxatilus* | R | R | C | | | |
| W07360 | *Trivia* sp. | | | | | | R |
| W08170 | *Nucella lapillus* | | | | F | | |
| W16500 | *Mytilus edulis* | | | R | R | | |
| | **Bryozoa** | | | | | | |
| Y06640 | *Membranipora* | | | | | | O |
| Y06780 | *Electra pilosa* | | | | | | F |
| Y08720 | *Bugulina flabellata* | | | | | | R |
| | **Chordata** | | | | | | |
| ZD00060 | *Clavelina lepadiformis* | | | | | | R |
| | **Rhodophyta** | | | | | | |
| ZM00020 | Rhodophyceae | | | | | | R |
| ZM00870 | *Porphyra linearis* | | | F | | | |
| ZM00900 | *Porphyra umbilicalis* | R | A | | | | |
| ZM02420 | *Palmaria palmata* | | | | O | R | F |
| ZM02660 | *Dumontia contorta* | | | | R | R | |
| ZM03790 | *Hildenbrandia rubra* | | O | | R | O | |
| ZM03840 | Corallinaceae (enc) | | | | R | O | C |
| ZM04010 | *Corallina caespitosa* | | | | | R | |
| ZM04040 | *Corallina officinalis* | | | | | R | |
| ZM06050 | *Mastocarpus* | | | | | R | |
| ZM06050 | *Mastocarpus stellatus* | | R | R | O | C | O |
| ZM07510 | *Lomentaria articulata* | | | | | R | R |
| ZM08239 | *Ceramium secundatum* | | | | | R | |
| ZM08240 | *Ceramium shuttleworthianum* | | | | R | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | | | | | | R |
| ZM09900 | *Membranoptera alata* | | | | | | O |
| ZM10120 | *Phycodrys rubens* | | | | | | R |
| ZM10800 | *Osmundea pinnatifida* | | | | O | C | |
| | **Ochrophyta** | | | | | | |
| ZR02810 | *Leathesia marina* | | | | | R | |
| ZR06320 | *Laminaria digitata* | | | | | | A |
| ZR06330 | *Laminaria hyperborea* | | | | | | F |
| ZR06740 | *Fucus serratus* | | | | | A | |
| ZR06760 | *Fucus vesiculosus* | | | | | O | |
| ZR06760 | *Fucus evesiculosus* | | | R | A | | |
| | **Chlorophyta** | | | | | | |
| ZS02400 | *Ulva* sp. (tubular) | | | | C | | |
| ZS02400 | *Ulva* sp. (flat) | | O | F | | O | R |
| ZS02890 | *Prasiola stipitata* | A | | | | | |
| ZS03400 | *Cladophora albida* | | | | | R | |
| ZS03560 | *Cladophora rupestris* | | | | R | O | O |
| | **Ascomycota** | | | | | | |
| | *Verrucaria mucosa* | | | | | O | |
| | *Verrucaria maura* | F | A | O | | | |
| | *Lichina pygmaea* | | R | | | | |

### 6.1.4. Sublittoral Station 1

This station was situated off the north-west corner of the island and here the reef ran on to the muddy gravel at approximately 10.5m ODM. The rock surface in this vicinity was found to be considerably silted. Just above the sediment interface this biotope was found to be dominated by the feather-star *Antedon bifida*, the plumose anemone *Metridium dianthus*, the common starfish and the barnacle *Balanus crenatus.* Other anemones such as *Sagartia elegans* and *Urticina felina*, the soft coral *Alcyonium digitatum* were also frequently encountered along with several sponge species (*Haliclona simulans*, *Suberites ficus, Halichondria panicea* and *Amphilectus fucorum).* The hydroids (*Obelia dichotoma*) and bryozoans (*Flustra foliacea* and *Scrupocellaria* spp.) were also common and the overall biotope make-up was similar to the *CR.HCR.XFa.ByErSp.Sag* biotope – a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

Above this community, the next biotope (ii) lay between 6-6.5m ODM and here the foliose algae began to colonise the rock surface. This biotope was also heavily silted. This biotope was characterised by the foliose brown algae *Dictyota dichotoma* and the foliose red algae *Delesseria sanguinea* with numerous other small foliose species encountered as well, along with the occasional large sugar kelp plant, *Saccharina latissima*. The faunal component of this biotope was characterised by the anemones *Urticina felina* and *Sagartia elegans,* with the brittle-star *Ophiothrix fragilis,* the hydroids *Obelia* spp., mussels, *Balanus crenatus* and *Pomatoceros* spp. all of which were found within the silty sward. The biotope was situated close to a *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

The final biotope encountered at S1 above the foliose algal zone, was a zone of stunted *Laminaria digitata* kelp plants, with several other foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea.* Beneath these algae, crusts of mussels and barnacles were found, often being predated by the common starfish *Asterias rubens*. A probable biotope for this assemblage is *IR.MIR.KR.Ldig.Ldig*.

Photographs from each littoral zone/biotope are shown in Figure 6.4, while a full species list with SACFOR classification is presented in Table 6.4.

| | |
|---|---|
|  |  |
| iii: *CR.HCR.XFa.ByErSp.Sag* | iii: *CR.HCR.XFa.ByErSp.Sag* |
|  |  |
| iii: *CR.HCR.XFa.ByErSp.Sag* | ii: *IR.HIR.KFaR.FoR.Dic* |
|  |  |
| ii: *IR.HIR.KFaR.FoR.Dic* | i: *IR.MIR.KR.Ldig.Ldig* |

**Figure 6.4 Sublittoral Zones and Biotopes for Station S1**

**Table 6.4 Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope**

| MCS Code | Taxa | S1 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| | **Porifera** | | | |
| C00350 | *Sycon ciliatum* | F | R | |
| C02210 | *Suberites ficus* | | | R |
| C04840 | *Halichondria panicea* | R | O | O |
| C05960 | *Amphilectus fucorum* | | O | O |
| C08630 | *Haliclona simulans* | | F | O |
| | Red sponge crust | | R | |
| | **Cnidaria** | | | |
| D01440 | *Tubularia indivisa* | | | O |
| D06760 | *Sertularia argentea* | | | O |
| D07300 | *Obelia dichotoma* | | O | O |
| D07310 | *Obelia geniculata* | F | O | R |
| D10240 | *Alcyonium digitatum* | | C | C |
| D11580 | *Anemonia viridis* | | F | |
| D11680 | *Urticina felina* | O | C | A |
| D12250 | *Metridium dianthus* | | C | C |
| D12310 | *Sagartia elegans* | O | C | C |
| D13700 | *Caryophyllia smithii* | | | R |
| | **Annelida** | | | |
| P23040 | *Spirobranchus triqueter* | F | O | |
| | **Arthropda** | | | |
| R01100 | *Balanus crenatus* | | C | S |
| S25020 | *Pisidia longicornis* | | R | R |
| S26460 | *Cancer pagurus* | | F | |
| S26720 | *Necora puber* | F | A | C |
| | **Mollusca** | | | |
| W12740 | *Doto coronata* | | O | O |
| W14030 | *Doris pseudoargus* | R | | |
| W16500 | *Mytilus edulis* | S | R | |
| | **Bryozoa** | | | |
| Y06640 | *Membranipora membranaceae* | F | | |
| Y06780 | *Electra pilosa* | F | | |
| Y06940 | *Flustra foliacea* | | | O |
| Y08360 | *Scrupocellaria* sp. | | | F |
| Y08720 | *Bugulina flabellata* | | | R |
| | **Echinodermata** | | | |
| ZB00110 | *Antedon bifida* | | C | S |
| ZB01900 | *Asterias rubens* | C | A | C |
| ZB02350 | *Ophiothrix fragilis* | | | O |
| ZB02680 | *Ophiactis balli* | | | R |
| ZB03000 | *Amphipholis squamata* | | R | |
| | **Chordata** | | | |
| ZD00060 | *Clavelina lepadiformis* | O | R | C |
| ZD00460 | *Morchellium argus* | O | R | R |
| ZD00640 | *Aplidium punctum* | O | R | R |
| ZD02090 | *Botryllus schlosseri* | | R | |
| ZG01500 | Gadidae | P | R | |
| ZG04380 | *Taurulus bubalis* | R | R | |
| ZG07050 | Gobiidae | R | | |

| MCS Code | Taxa | S1 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| | **Rhodophyta** | | | |
| ZM02080 | *Bonnemaisonia asparagoides* | O | O | |
| ZM03230 | *Callophyllis laciniata* | O | | |
| ZM04040 | *Corallina officinalis* | R | | |
| ZM06310 | *Plocamium cartilagineum* | O | O | |
| ZM06820 | *Calliblepharis ciliata* | R | R | |
| ZM06880 | *Cystoclonium purpureum* | O | F | |
| ZM06930 | *Rhodophyllis divaricata* | O | F | |
| ZM08070 | *Ceramium* sp. | O | O | |
| ZM08460 | *Halurus flosculosus* | | R | |
| ZM09500 | *Cryptopleura ramosa* | F | R | |
| ZM09550 | *Delesseria sanguinea* | F | F | |
| ZM09850 | *Hypoglossum hypoglossoides* | O | O | |
| ZM09900 | *Membranoptera alata* | R | | |
| | *Brogniartella byssoides* | O | | |
| ZM10120 | *Phycodrys rubens* | R | F | |
| ZM10180 | *Erythroglossum laciniatum* | | R | |
| ZM11050 | *Polysiphonia elongata* | | R | |
| | **Ochrophyta** | | | |
| ZR04570 | *Dictyota dichotoma* | R | C | |
| ZR04780 | *Taonia atomaria* | | R | |
| ZR04970 | *Desmarestia aculeata* | O | O | |
| ZR04990 | *Desmarestia ligulata* | R | | |
| ZR05000 | *Desmarestia viridis* | R | | |
| ZR06320 | *Laminaria digitata* | S | | |
| ZR06360 | *Saccharina latissima* | O | R | |
| | **Chlorophyta** | | | |
| ZS02400 | *Ulva* sp. (flat) | R | | |
| ZS03920 | *Bryopsis plumosa* | R | | |

### 6.1.5. Sublittoral Station 2

This station was situated in the middle of the north coast of the island and again, there was evidence of a heavy silt burden. Here, the deeper sediment plains gave way to a steeply inclined reef at a depth of circa 15.5m ODM. The reef is initially broken, with deposits of muddy gravel lying between boulders and outcrops of sloping bedrock. The biotope on these outcrops was dominated by the bryozoans *Flustra foliacea, Scupocellaria* sp. and *Bugulina flabellata.* Other sub-dominant taxa of note were the hydroid *Nemertesia antennina* and the soft coral *Alcyonium digitatum,* frequent erect sponges *Hymeniacidon perlevis*, *Amphilectus fucorum* and *Haliclona simulans*, the hydroids *Nemertesia antennina* and *Obelia dichotoma* as well as the tunicate *Clavelina lepadiformis.* A possible biotope tag for this assemblage was *CR.HCR.XFa.FluCoAs*, or *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock.

Above this biotope, at 8.5m ODM, the *Dictyota* and foliose red algae biotope was again found, as recorded at station L1. However, several new algal species were noted such as

*Rhodymenia holmesii, Sphondylothamnion multifidum* and *Apoglossum ruscifolium* amongst the sward. Several new species of fish were also noted in this biotope, such as the ling (*Molva molva*), the black goby (*Gobius niger*) as well as the Greater pipefish (*Syngnathus acus*). Hence, the biotope was found to be close to *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

As with station L1, above the foliose algal zone, there was again a zone of stunted *Laminaria digitata* kelp plants, with numerous foliose red algae, mussels and starfish. The biotope being *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

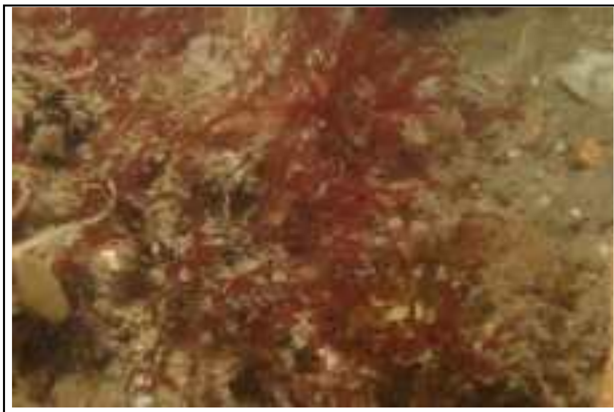
Photographs from each littoral zone/biotope are shown in Figure 6.5, while a full species list with SACFOR classification is presented in Table 6.5.

iii: *CR.HCR.XFa.FluCoAs*

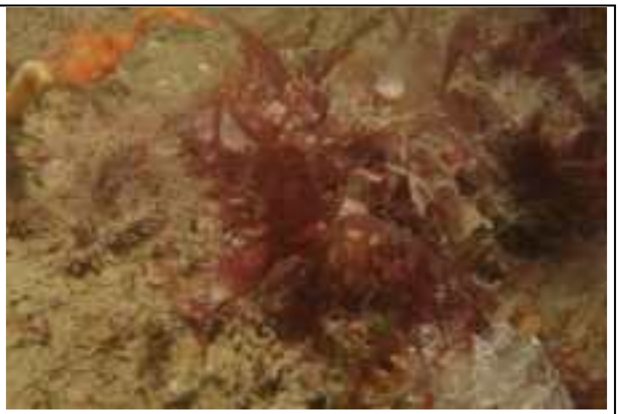
iii: *CR.HCR.XFa.FluCoAs*

iii: *CR.HCR.XFa.FluCoAs*

iii: *CR.HCR.XFa.FluCoAs*



ii: *IR.HIR.KFaR.FoR.Dic*



ii: *IR.HIR.KFaR.FoR.Dic*

i: *IR.MIR.KR.Ldig.Ldig*

i: *IR.MIR.KR.Ldig.Ldig*

**Figure 6.5 Sublittoral Zones and Biotopes for Station S2**

**Table 6.5 Species List for Station S2 with SACFOR Abundance Classifications for each Biotope**

| MCS Code | Taxa | S2 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| | **Porifera** | | | |
| C00350 | *Sycon ciliatum* | F | | F |
| C02210 | *Suberites ficus* | | R | R |
| C04810 | *Halichondria bowerbanki* | | | O |
| C04840 | *Halichondria panicea* | F | | |
| C05230 | *Hymeniacidon perlevis* | O | F | F |
| C05960 | *Amphilectus fucorum* | O | F | F |
| C06420 | *Myxilla* sp. | R | | R |
| C06840 | *Iophon hyndmani* | | O | |
| C08630 | *Haliclona simulans* | | F | F |
| | **Cnidaria** | | | |
| D01440 | *Tubularia indivisa* | | | R |
| D05260 | *Halecium halecinum* | | O | O |
| D05500 | *Aglaophenia* sp. | | R | R |
| D05780 | *Halopteris catharina* | | | F |
| D05970 | *Nemertesia antennina* | | F | F |
| D05990 | *Nemertesia ramosa* | | O | R |
| D06690 | *Sertularella polyzonias* | | | O |
| D06760 | *Sertularia argentea* | R | | |
| D07300 | *Obelia dichotoma* | O | F | F |
| D07310 | *Obelia geniculata* | F | | |
| D07320 | *Obelia longissima* | | | O |

| MCS Code | Taxa | S2 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| D10240 | *Alcyonium digitatum* | F | C | F |
| D11680 | *Urticina felina* | | | R |
| D12310 | *Sagartia elegans* | | R | R |
| | **Annelida** | | | |
| P23020 | *Spirobranchus* sp. | | | F |
| P23040 | *Spirobranchus triqueter* | F | R | |
| | **Arthropoda** | | | |
| R01090 | *Balanus balanus* | | R | O |
| R01100 | *Balanus crenatus* | C | F | O |
| S01660 | Amphipoda | C | C | F |
| S10700 | Caprellidae | C | C | |
| S22100 | *Palaemon serratus* | O | F | F |
| S23220 | *Pandalus montagui* | F | | |
| S23600 | *Homarus gammarus* | | | R |
| S24650 | *Pagurus bernhardus* | | | R |
| S25850 | *Macropodia rostrata* | O | O | |
| S26460 | *Cancer pagurus* | R | O | O |
| S26720 | *Necora puber* | O | O | O |
| S26900 | *Carcinus maenas* | O | | |
| | **Mollusca** | | | |
| W12720 | *Doto* sp. | | R | R |
| | *Diapharodoris luteocincta* | | | R |
| W16500 | *Mytilus edulis* | C | | |
| | **Bryozoa** | | | |
| Y00030 | Crisiidae | F | O | O |
| Y01370 | *Alcyonidium diaphanum* | | F | F |
| Y06640 | *Membranipora* sp. | C | | |
| Y06780 | *Electra pilosa* | A | F | |
| Y06940 | *Flustra foliacea* | | F | C |
| Y07050 | *Chartella papyracea* | | R | O |
| Y07100 | *Securiflustra securifrons* | | R | |
| Y08360 | *Scrupocellaria* sp. | F | C | |
| Y08410 | *Scrupocellaria scruposa* | | | A |
| Y08530 | *Bicellariella ciliata* | | | O |
| Y08720 | *Bugulina flabellata* | R | O | C |
| Y08750 | *Bugulina plumosa* | | | R |
| | **Echinodermata** | | | |
| ZB00110 | *Antedon bifida* | R | O | O |
| ZB01900 | *Asterias rubens* | C | C | C |
| ZB02350 | *Ophiothrix fragilis* | C | | O |
| ZB03620 | *Echinus esculentus* | R | R | O |
| ZB04950 | *Thyone fusus* | | O | |
| | **Chordata** | | | |
| ZD00060 | *Clavelina lepadiformis* | R | F | F |
| ZD00640 | *Aplidium punctum* | R | O | O |
| ZD01880 | *Polycarpa scuba* | | | O |
| ZD01940 | *Dendrodoa grossularia* | | R | R |
| ZD02090 | *Botryllus schlosseri* | R | R | |
| ZG01500 | Gadidae | | R | R |
| ZG01960 | *Molva molva* | | R | |

| MCS Code | Taxa | S2 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| ZG03760 | *Syngnathus acus* | | R | |
| ZG04340 | *Myoxocephalus scorpius* | | | R |
| ZG06050 | *Ctenolabrus rupestris* | | R | |
| ZG07000 | *Callionymus lyra* | | R | O |
| ZG07050 | Gobiidae | | | R |
| ZG07230 | *Gobius niger* | | R | R |
| ZG07440 | *Pomatoschistus pictus* | | | R |
| | **Rhodophyta** | | | |
| ZM02080 | *Bonnemaisonia asparagoides* | O | R | |
| ZM02420 | *Palmaria palmata* | O | | |
| ZM02560 | *Dilsea carnosa* | O | R | |
| ZM03230 | *Callophyllis laciniata* | O | R | |
| ZM03840 | Corallinaceae (enc) | F | O | |
| ZM05840 | *Phyllophora crispa* | F | O | |
| ZM05860 | *Phyllophora pseudoceranoides* | C | | |
| ZM06110 | *Chondrus crispus* | C | | |
| ZM06310 | *Plocamium cartilagineum* | F | O | |
| ZM06820 | *Calliblepharis ciliata* | F | A | |
| ZM06880 | *Cystoclonium purpureum* | | O | |
| ZM06930 | *Rhodophyllis divaricata* | | F | |
| ZM07230 | *Rhodymenia holmesii* | | C | |
| ZM07530 | *Lomentaria orcadensis* | R | R | |
| ZM07860 | *Aglaothamnion tenuissimum* | | R | |
| ZM08239 | *Ceramium secundatum* | | R | |
| ZM08460 | *Halurus flosculosus* | R | | |
| ZM09230 | *Sphondylothamnion multifidum* | | R | |
| ZM09400 | *Apoglossum ruscifolium* | | R | |
| ZM09500 | *Cryptopleura ramosa* | F | C | |
| ZM09550 | *Delesseria sanguinea* | F | F | |
| ZM09850 | *Hypoglossum hypoglossoides* | | C | |
| ZM09900 | *Membranoptera alata* | O | | |
| ZM10120 | *Phycodrys rubens* | F | F | |
| ZM10180 | *Erythroglossum laciniatum* | | F | |
| ZM10390 | *Heterosiphonia plumosa* | R | R | |
| | *Brogniartella byssoides* | O | O | |
| ZM11050 | *Polysiphonia elongata* | | R | |
| ZM11170 | *Polysiphonia fucoides* | | R | |
| ZM11370 | *Pterosiphonia parasitica* | | R | |
| | **Ochrophyta** | | | |
| ZR04570 | *Dictyota dichotoma* | F | C | |
| ZR04780 | *Taonia atomaria* | | R | |
| ZR04970 | *Desmarestia aculeata* | O | | |
| ZR04990 | *Desmarestia ligulata* | F | | |
| ZR06310 | *Laminaria sporelings* | | R | |
| ZR06320 | *Laminaria digitata* | S | | |
| ZR06330 | *Laminaria hyperborea* | A | | |
| ZR06360 | *Saccharina latissima* | C | | |

### 6.1.6. Sublittoral Station 3

This station was located off the east coast of the island, slightly south of station L2. It was exposed to the easterly winds and therefore moderately exposed to wave action. The reef appeared out of the sediment at approximately 13.5m ODM and slopes gently up towards the island. Again, the reef was heavily silted and the initial biotope was dominated by erect sponges and hydroids, with species of note being *Haliclona simulans, Halichondria panicea* and *Nemertesia antennina.* Also dominant were the hydrozoan *Halecium halecinum*, *Alcyonium digitatum,* the anemones *Sagartia elegans* and *Urticina felina*, whilst the decapods, *Palaemon serratus, Cancer pagurus, Macropodia rostrata* and *Necora puber* were frequent constituent in this zone. The overall biotope make-up of this biotope was similar to the *CR.HCR.XFa.ByErSp.Sag* biotope – a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

Above this biotope at 8.5m ODM was the *Dictyota dichotoma* and foliose red algal assemblage previously found at S1 and S2. Here the silt still formed a thick covering and the *Dictyota* was possibly less abundant and hence several more delicate red algae were more prominent, such as *Rhodymenia ardissonei*, *Phycodrys rubens* and *Apoglossum ruscifolium*. As a result the community was possibly more similar to the *IR.HIR.KFaR.FoR* biotope or Foliose red seaweeds on exposed lower infralittoral rock.

Finally at station S3 from 6.5m ODM upwards was a kelp zone with a dense understory of foliose red algae and barnacles. Dominant red algae included *Ploccamium cartilagineum*, *Delesseria sanguinea* and *Cryptopleura ramosa*, whilst the foliose brown algae were dominated by *Desmarestia spp*. and *Ectocarpaceae* indet. Although the dominant kelp was *Laminaria digitata, L. hyperborea* was present in the kelp forest. Hence the biotope was consistent with S1 and S2, being *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each littoral zone/biotope are shown in Figure 6.6, while a full species list with SACFOR classification is presented in Table 6.6.

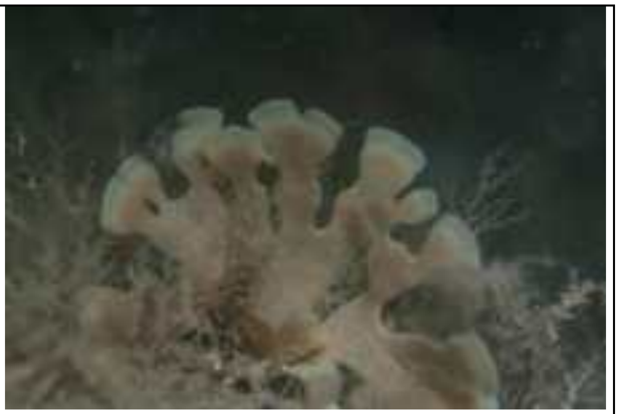
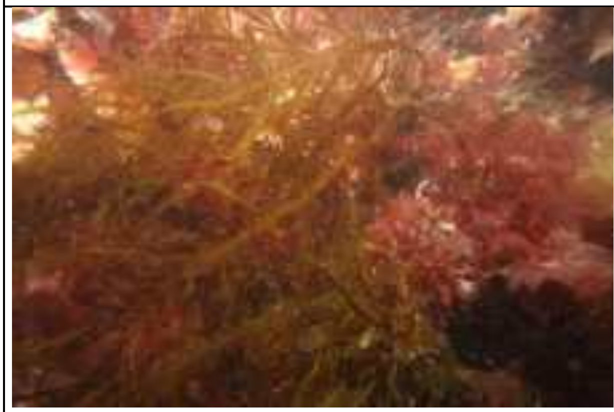
| | |
|---|---|
| <br>iii: *CR.HCR.XFa.ByErSp.Sag* | <br>iii: *CR.HCR.XFa.ByErSp.Sag* |
| <br>ii: *IR.HIR.KFaR.FoR* | <br>ii: *IR.HIR.KFaR.FoR* |
| <br>i: *IR.MIR.KR.Ldig.Ldig* | |

**Figure 6.6 Sublittoral Zones and Biotopes for Station S3**

**Table 6.6 Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope**

| MCS Code | Taxa | S3 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| | **Porifera** | | | |
| C00350 | *Sycon ciliatum* | | | R |
| C02210 | *Suberites ficus* | | R | R |
| C04810 | *Halichondria bowerbanki* | | | R |
| C04840 | *Halichondria panicea* | O | R | O |
| C05230 | *Hymeniacidon perlevis* | O | | |
| C05960 | *Amphilectus fucorum* | | R | R |
| C06450 | *Myxilla incrustans* | | R | |
| C06780 | *Iophon nigricans* | | R | R |
| C08630 | *Haliclona simulans* | | R | A |
| | **Cnidaria** | | | |
| D01440 | *Tubularia indivisa* | R | R | |
| D05260 | *Halecium halecinum* | | R | O |
| D05970 | *Nemertesia antennina* | R | R | C |
| D05990 | *Nemertesia ramosa* | | R | R |
| D06760 | *Sertularia argentea* | | R | |
| D07300 | *Obelia dichotoma* | | R | |
| D07310 | *Obelia geniculata* | F | | O |
| D07430 | *Rhizocaullus verticillatus* | | R | R |
| D10240 | *Alcyonium digitatum* | | F | C |
| D11580 | *Anemonia viridis* | O | | |
| D11680 | *Urticina felina* | | R | F |
| D12310 | *Sagartia elegans* | O | F | C |
| | **Nemertea** | | | |
| G00780 | *Lineus longissimus* | | | R |
| | **Annelida** | | | |
| P23040 | *Spirobranchus triqueter* | O | F | O |
| | **Arthropoda** | | | |
| R01090 | *Balanus balanus* | R | R | R |
| R01100 | *Balanus crenatus* | C | C | R |
| S01660 | Amphipoda | | | O |
| S22100 | *Palaemon serratus* | O | C | C |
| S23220 | *Pandalus montagui* | R | | |
| S23600 | *Homarus gammarus* | R | | R |
| S25020 | *Pisidia longicornis* | | O | |
| S25850 | *Macropodia rostrata* | O | C | A |
| S26460 | *Cancer pagurus* | C | F | R |
| S26720 | *Necora puber* | A | C | A |
| S26900 | *Carcinus maenas* | C | | |
| | **Mollusca** | | | |
| W16500 | *Mytilus edulis* | R | O | |
| | **Bryozoa** | | | |
| Y00001 | Bryozoa | | O | O |
| Y01370 | *Alcyonidium diaphanum* | | C | C |
| Y06640 | *Membranipora* sp. | O | | |
| Y06780 | *Electra pilosa* | O | | |
| Y06940 | *Flustra foliacea* | | O | R |
| Y07050 | *Chartella papyracea* | | O | |

| MCS Code | Taxa | S3 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| Y08790 | *Bugulina turbinata* | | | O |
| | **Echinodermata** | | | |
| ZB00110 | *Antedon bifida* | R | O | C |
| ZB01900 | *Asterias rubens* | C | C | C |
| ZB02350 | *Ophiothrix fragilis* | R | | |
| | **Chordata** | | | |
| ZD00060 | *Clavelina lepadiformis* | | F | F |
| ZD00460 | *Morchellium argus* | | | R |
| ZD00640 | *Aplidium punctum* | R | R | O |
| ZD01940 | *Dendrodoa grossularia* | R | F | C |
| ZG02080 | *Pollachius pollachius* | R | R | R |
| ZG04380 | *Taurulus bubalis* | R | R | R |
| ZG07050 | Gobiidae | R | O | R |
| ZG07400 | *Pomatoschistus* | | R | R |
| | **Rhodophyta** | | | |
| ZM02420 | *Palmaria palmata* | O | | |
| ZM03840 | Corallinaceae (enc) | F | O | |
| ZM04040 | *Corallina officinalis* | R | | |
| ZM06310 | *Plocamium cartilagineum* | C | | |
| ZM06820 | *Calliblepharis ciliata* | R | | |
| ZM06880 | *Cystoclonium purpureum* | R | | |
| ZM07230 | *Rhodymenia holmesii* | | R | |
| ZM07260 | *Rhodymenia ardissonei* | | R | |
| ZM07510 | *Lomentaria articulata* | R | | |
| ZM08239 | *Ceramium secundatum* | | R | |
| ZM09400 | *Apoglossum ruscifolium* | | R | |
| ZM09500 | *Cryptopleura ramosa* | A | R | |
| ZM09550 | *Delesseria sanguinea* | A | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | R | R | |
| ZM09900 | *Membranoptera alata* | R | | |
| ZM10120 | *Phycodrys rubens* | | R | |
| ZM10180 | *Erythroglossum laciniatum* | F | | |
| ZM11050 | *Polysiphonia elongata* | R | R | |
| | **Ochrophyta** | | | |
| | Chrysophyceae | A | | |
| ZR00030 | Ectocarpaceae indet. | C | | |
| ZR04570 | *Dictyota dichotoma* | O | F | |
| ZR04970 | *Desmarestia aculeata* | R | | |
| ZR04990 | *Desmarestia ligulata* | O | | |
| ZR06320 | *Laminaria digitata* | A | | |
| ZR06330 | *Laminaria hyperborea* | R | | |

### 6.1.7. Sublittoral Station 4

This station was located off the south east corner of the island, adjacent to station L3. The reef emerged out of the sediment at approximately 14.9m ODM and rose at a shallow angle towards the shore. Initially the reef sloped shore-wards relatively smoothly and latterly in a series of steep ridges and gullies. Again the silt covering was significant but where rock surfaces were less impacted by siltation, the community was again relatively rich, comprising of encrusting assemblages of hydroids and bryozoans with frequent erect sponges and anemones. The deepest reef biotope (iii) were dominated by the anemones *Urticina felina* and *Metridium dianthus* and the bryozoans *Flustra foliacea*, *Bugulina flabellata* and *Scrupocellaria* spp., whilst the sponges *Halichondria bowerbanki, Amphilectus fucorum* and *Haliclona simulans* were also present. Several ascidian species also occurred in the biotope, *Polycarpa scuba* and *Dendrodoa grossularia* being the most common along with *Polyclinum aurantium* and *Aplidium punctum* which were also present. The biotope therefore could be *HCR.XFa.FluCoAs.Paur* – '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock'. This difference from the other stations was probably brought about by the increased sedimentation regime noted at this station.

Above this biotope, at 9m ODM, was the *Dictyota dichotoma* and foliose red algal assemblage previously found at S1 and S2. Here again the silt still formed a thick covering but the *Dictyota* was accompanied by numerous small foliose red algal species, such as *Hypoglossum hypoglossoides, Erythroglossum laciniatum* and *Rhodomenia holmesii.* On the vertical faces, *Schottera nicaensis* was noted and the delicate brown algae *Taonia atomaria* was also recorded. Beneath the silt, a crust of the solitary ascidian *Dendrodoa grossularia* and the barnacle *Balanus crenatus* was found along with the frequent clumps of sponges, hydroids and bryozoans. The less common sponge *Hemimycale columella* was evident for the first time in this biotope, as shown in the photo below. However, the biotope was still found to be close to *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock.

Above the foliose algal zone, the *Laminaria digitata* forest was again present, with understorey dominants of *Phyllophora crispa* and *Chondrus crispus*, amongst a crust of mussels and the barnacle *Balanus crenatus*. The bryozoans *Electra pilosa* and *Membranipora membranaceae* were frequently recorded on the algal thalli and *Asterias rubens* was also present, feeding on the mussels. Occasional sugar kelp plants of *Saccarhina lattissima* were also noted within the kelp forest, however the biotope would still be recorded as *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each littoral zone/biotope are shown in Figure 6.7, while a full species list with SACFOR classification is presented in Table 6.7.

iii: *HCR.XFa.FluCoAs.Paur*

iii: *HCR.XFa.FluCoAs.Paur*

ii: *IR.HIR.KFaR.FoR.Dic*

ii: *IR.HIR.KFaR.FoR.Dic*

**Figure 6.7 Sublittoral Zones and Biotopes for Station S4**

**Table 6.7 Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope**

| MCS Code | Taxa | S4 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| | **Porifera** | | | |
| C00350 | *Sycon ciliatum* | O | O | |
| C02210 | *Suberites ficus* | | R | R |
| C04810 | *Halichondria bowerbanki* | | O | O |
| C04840 | *Halichondria panicea* | F | O | |
| C05230 | *Hymeniacidon perlevis* | F | | |
| C05960 | *Amphilectus fucorum* | | O | O |
| C06450 | *Myxilla incrustans* | R | | |
| C06780 | *Iophon nigricans* | | O | O |
| C07750 | *Hemimycale columella* | | R | |
| C08630 | *Haliclona simulans* | | F | F |
| C08900 | *Dysidea fragilis* | | | R |
| | Red sponge crust | | O | |
| | **Cnidaria** | | | |
| D05260 | *Halecium halecinum* | | | O |
| D05780 | *Halopteris catharina* | | O | O |
| D05970 | *Nemertesia antennina* | | O | F |
| D05990 | *Nemertesia ramosa* | | O | O |
| D06690 | *Sertularella polyzonias* | | | O |
| D06760 | *Sertularia argentea* | | | R |
| D07300 | *Obelia dichotoma* | O | F | F |
| D07310 | *Obelia geniculata* | O | | |

| MCS Code | Taxa | S4 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| D07430 | *Rhizocaullus verticillatus* | | | O |
| D10240 | *Alcyonium digitatum* | O | C | F |
| D11680 | *Urticina felina* | R | F | C |
| D12250 | *Metridium dianthus* | | O | C |
| D12310 | *Sagartia elegans* | R | F | F |
| D12480 | *Sagartiogeton undatus* | | | R |
| | **Annelida** | | | |
| P23040 | *Spirobranchus triqueter* | R | | |
| P20310 | *Lanice conchilega* | | O | O |
| P23090 | *Serpula vermicularis* | | O | |
| | **Arthropoda** | | | |
| R01090 | *Balanus balanus* | | R | C |
| R01100 | *Balanus crenatus* | C | F | C |
| S01660 | Amphipoda | | F | F |
| S23600 | *Homarus gammarus* | | | R |
| S24650 | *Pagurus bernhardus* | | | O |
| S25850 | *Macropodia rostrata* | | | F |
| S26460 | *Cancer pagurus* | O | F | F |
| S26690 | *Liocarcinus depurator* | | | O |
| S26720 | *Necora puber* | F | C | C |
| | **Mollusca** | | | |
| W14030 | *Doris pseudoargus* | | R | |
| W16500 | *Mytilus edulis* | F | | O |
| | **Bryozoa** | | | |
| Y00030 | Crisiidae | F | F | F |
| Y01370 | *Alcyonidium diaphanum* | F | F | F |
| Y06640 | *Membranipora* sp. | F | | |
| Y06780 | *Electra pilosa* | C | O | |
| Y06940 | *Flustra foliacea* | | O | O |
| Y08360 | *Scrupocellaria* | | F | F |
| Y08530 | *Bicellariella ciliata* | | | O |
| Y08720 | *Bugulina flabellata* | | O | F |
| | **Porifera** | | | |
| ZB00110 | *Antedon bifida* | O | F | R |
| ZB01900 | *Asterias rubens* | C | C | C |
| ZB02350 | *Ophiothrix fragilis* | | | O |
| ZB02680 | *Ophiactis balli* | | O | O |
| ZB02780 | *Ophiopholis aculeata* | | O | O |
| ZB03000 | *Amphipholis squamata* | | O | R |
| | **Chordata** | | | |
| ZD00060 | *Clavelina lepadiformis* | O | O | O |
| ZD00340 | *Polyclinum aurantium* | | | O |
| ZD00640 | *Aplidium punctum* | F | O | O |
| ZD00680 | Didemnidae indet. | | | R |
| ZD01880 | *Polycarpa scuba* | | R | R |
| ZD01940 | *Dendrodoa grossularia* | | F | O |
| ZD02090 | *Botryllus schlosseri* | O | R | |
| ZD02140 | *Botrylloides leachii* | R | | |
| | **Rhodophyta** | | | |
| ZM02080 | *Bonnemaisonia asparagoides* | | O | |

| MCS Code | Taxa | S4 | | |
|---|---|---|---|---|
| | | i | ii | iii |
| ZM02420 | *Palmaria palmata* | F | | |
| ZM02560 | *Dilsea carnosa* | | O | |
| ZM03230 | *Callophyllis laciniata* | O | O | |
| ZM03840 | Corallinaceae (enc) | F | | |
| ZM04040 | *Corallina officinalis* | O | | |
| ZM05840 | *Phyllophora crispa* | F | F | |
| ZM05860 | *Phyllophora pseudoceranoides* | F | | |
| ZM05940 | *Schottera nicaeensis* | | O | |
| ZM06110 | *Chondrus crispus* | F | | |
| ZM06310 | *Plocamium cartilagineum* | F | O | |
| ZM06820 | *Calliblepharis ciliata* | | R | |
| ZM06880 | *Cystoclonium purpureum* | F | F | |
| ZM06930 | *Rhodophyllis divaricata* | | F | |
| ZM07230 | *Rhodomenia holmesii* | | F | R |
| ZM07530 | *Lomentaria orcadensis* | | R | |
| ZM08070 | *Ceramium* sp. | O | O | |
| ZM08460 | *Halurus flosculosus* | | R | |
| ZM09500 | *Cryptopleura ramosa* | O | F | |
| ZM09550 | *Delesseria sanguinea* | F | F | |
| ZM09850 | *Hypoglossum hypoglossoides* | | F | |
| ZM10120 | *Phycodrys rubens* | F | | |
| ZM10180 | *Erythroglossum laciniatum* | | F | |
| | *Brogniartella byssoides* | O | F | |
| ZM11160 | *Polysiphonia nigra* | | R | |
| | **Ochrophyta** | | | |
| | Chrysophyceae | A | | |
| ZR00030 | Ectocarpaceae indet. | C | | |
| ZR04570 | *Dictyota dichotoma* | C | C | |
| ZR04780 | *Taonia atomaria* | | R | |
| ZR04970 | *Desmarestia aculeata* | O | R | |
| ZR04990 | *Desmarestia ligulata* | R | | |
| ZR05000 | *Desmarestia viridis* | R | R | |
| ZR06310 | *Laminaria sporelings* | | O | R |
| ZR06320 | *Laminaria digitata* | S | | |
| ZR06330 | *Laminaria hyperborea* | O | | |
| ZR06360 | *Saccharina latissima* | F | | |
| ZS03920 | *Bryopsis plumosa* | | R | |

## 6.2. Univariate Analyses

Univariate analyses revealed clear differences between the number of species from the littoral and sublittoral stations. As expected, species richness was on average higher (twice as high) in the sublittoral stations (88.3±19.2SD) compared to the numbers found in the littoral stations (44.7±11.6SD; Table 6.8 & Figure 6.8). Nemerteans and echinoderms were restricted to the sublittoral stations whereas Ascomycota and Tracheophyta were only recorded in the littoral zones. The highest species richness was encountered at Sublittoral

Station S2 (109 species) with the lowest number of species being counted at Littoral Station L1 (34 species).

Table 6.8 Number of Species per Phyla and Station

| Phylum | Littoral Station | | | Sublittoral Station | | | |
|---|---|---|---|---|---|---|---|
| | L1 | L2 | L3 | S1 | S2 | S3 | S4 |
| Porifera | 1 | 0 | 2 | 6 | 9 | 9 | 12 |
| Cnidaria | 1 | 0 | 1 | 10 | 14 | 12 | 14 |
| Nemertea | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Annelida | 2 | 1 | 1 | 1 | 2 | 1 | 3 |
| Arthropoda | 3 | 4 | 8 | 4 | 12 | 11 | 9 |
| Mollusca | 9 | 5 | 9 | 3 | 3 | 1 | 2 |
| Bryozoa | 1 | 2 | 3 | 5 | 12 | 7 | 8 |
| Echinodermata | 0 | 0 | 0 | 5 | 5 | 3 | 6 |
| Chordata | 0 | 0 | 1 | 7 | 14 | 8 | 8 |
| Rhodophyta | 12 | 13 | 18 | 17 | 30 | 18 | 25 |
| Ochrophyta | 1 | 7 | 6 | 7 | 8 | 7 | 11 |
| Chlorophyta | 3 | 5 | 5 | 2 | 0 | 0 | 1 |
| Ascomycota | 1 | 5 | 3 | 0 | 0 | 0 | 0 |
| Tracheophyta | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **34** | **43** | **57** | **67** | **109** | **78** | **99** |
| **Average** | **44.7** | | | **88.3** | | | |
| **Standard Deviation** | **11.6** | | | **19.2** | | | |

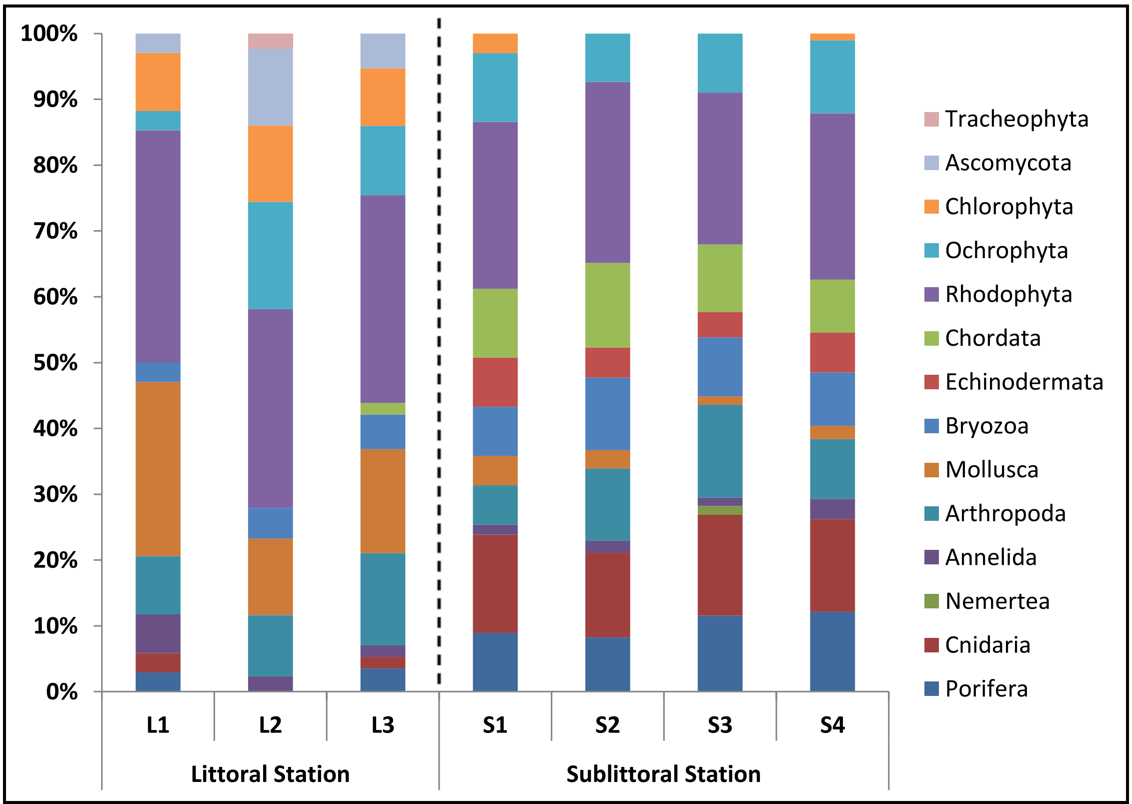



Figure 6.8 Distribution of Species per Phyla and Station

## 6.3. Multivariate Analyses

### 6.3.1. Littoral Stations

Multivariate analyses (PRIMER; Clarke and Warwick, 1994) of the littoral stations indicated some statistical separation of biotopes such as *LR.FLR.Lic.Pra* and *LR.HLR.FR.Coff/IR.MIR.KR.Ldig.* While the biotopes *LR.HLR.MusB.Sem, LR.HLR.FR.Mas, LR.LLR.F.Asc.FS* and *LR.MLR.BF.Fser.R* could not be statistically distinguished (Figure 6.9).

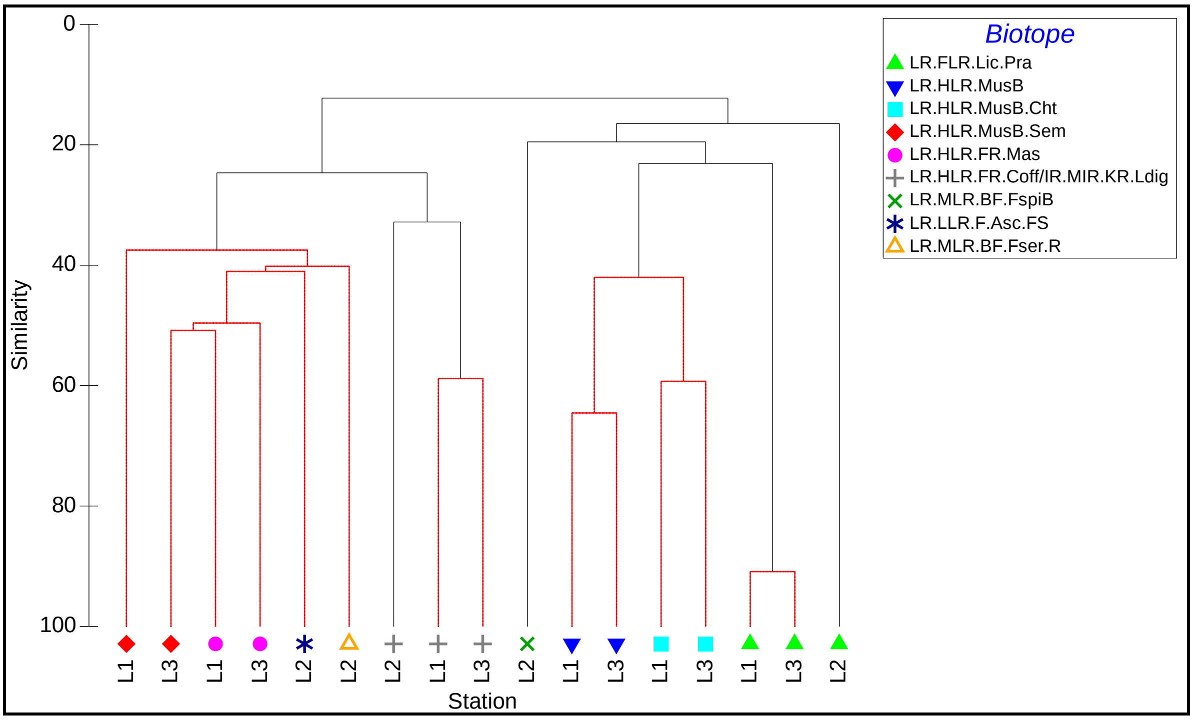



Figure 6.9 Dendrogram of Biotopes Recorded at the Littoral Stations

The MDS plot indicated that throughout the Littoral stations, greater similarities existed between the exposed stations L1 and L3, than compared with the more sheltered station L2, although vertical zonation indicated similar biotopes throughout all three stations (Figure 6.10). Station L2 was located within a gully where water movement/wave exposure was limited to the northeast direction only area and probably responsible for the absence of sponge and cnidarian species.

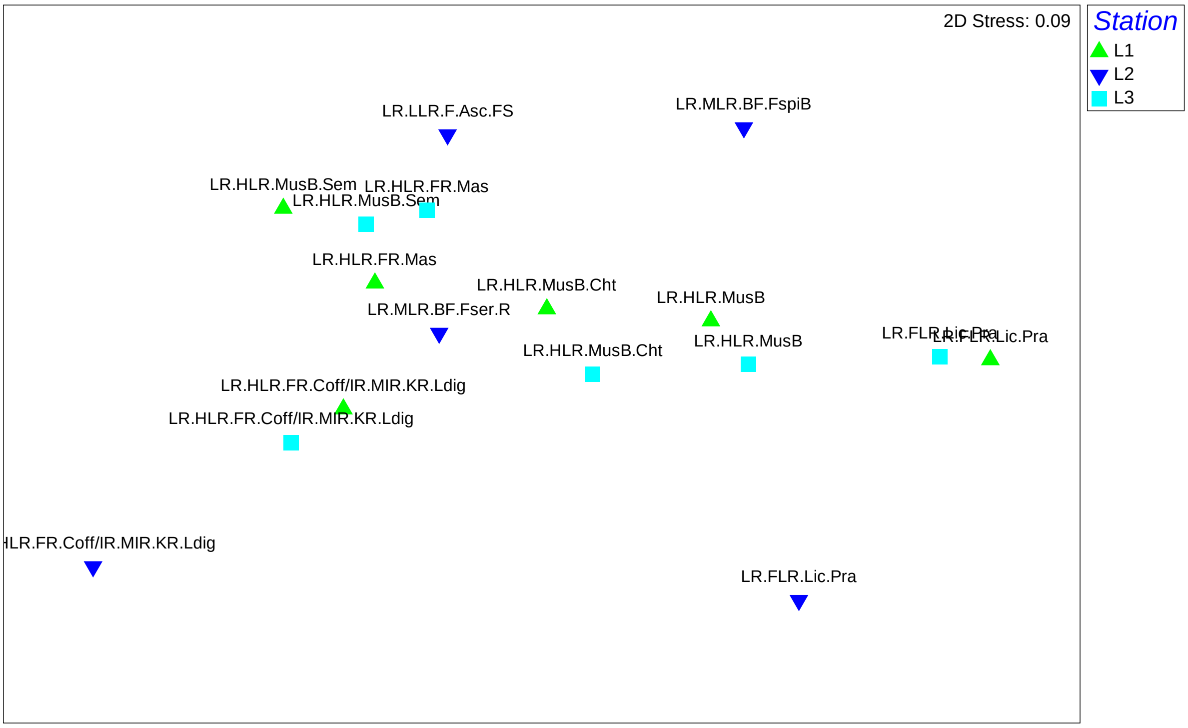



**Figure 6.10 MDS of Biotopes Recorded at the Littoral Stations**

### 6.3.2. Sublittoral Stations

All four stations in the sublittoral areas were characterised by *Laminaria digitata* forest in the shallows (*IR.MIR.KR.Ldig.Ldig*), below this zone, three of the four stations recorded the biotope *IR.HIR.KFaR.FoR.Dic.* The deepest extent of the reef was the most variable, with three different biotopes recorded at the four stations, with only Sublittoral Stations S1 and S3 characterised by the same biotope of 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'.

The cluster and MDS plot for the sublittoral stations indicated some statistical separation of biotopes, most notably that of *IR.MIR.KR.Ldig.Ldig*, with all four occurrences being statistically indistinguishable (Figure 6.11). Stations S2 and S4 showed statistical separation of biotopes from the other stations, whilst these two stations were also statistically indeterminate within each depth zone (Figure 6.12). The subtle variations in biotope composition geographically is probably due to differences within the seabed profiles and morphology.

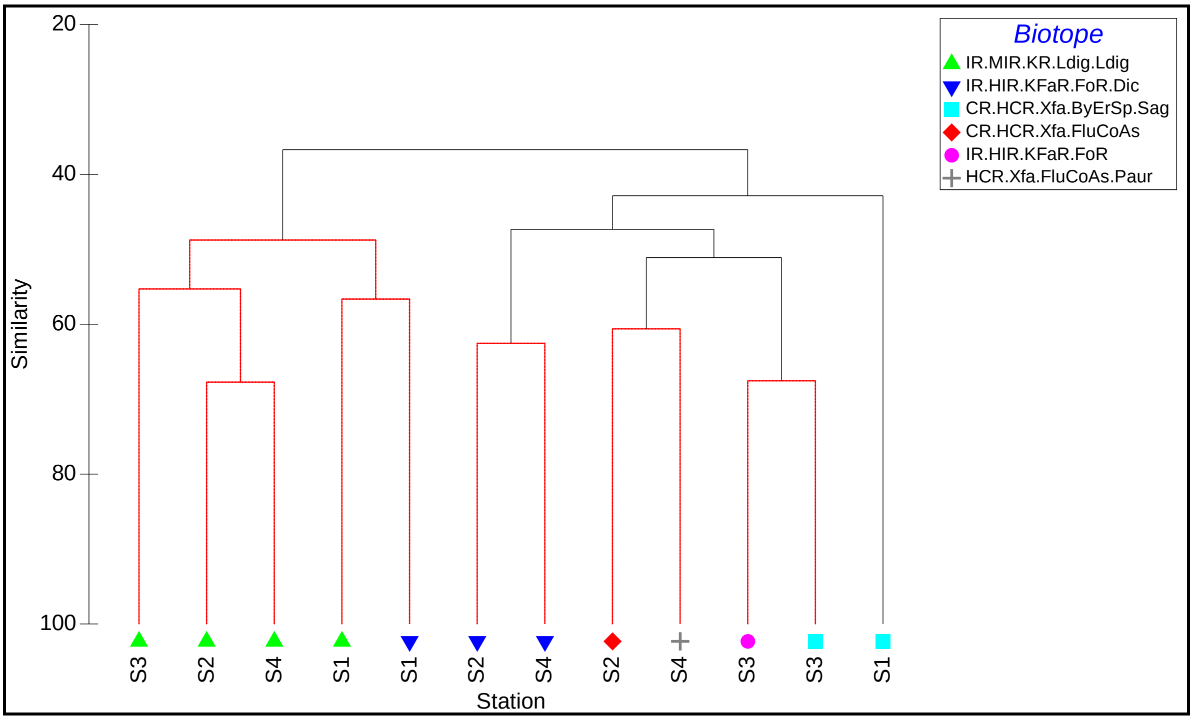



Figure 6.11 Dendrogram of Biotopes Recorded at the Sublittoral Stations

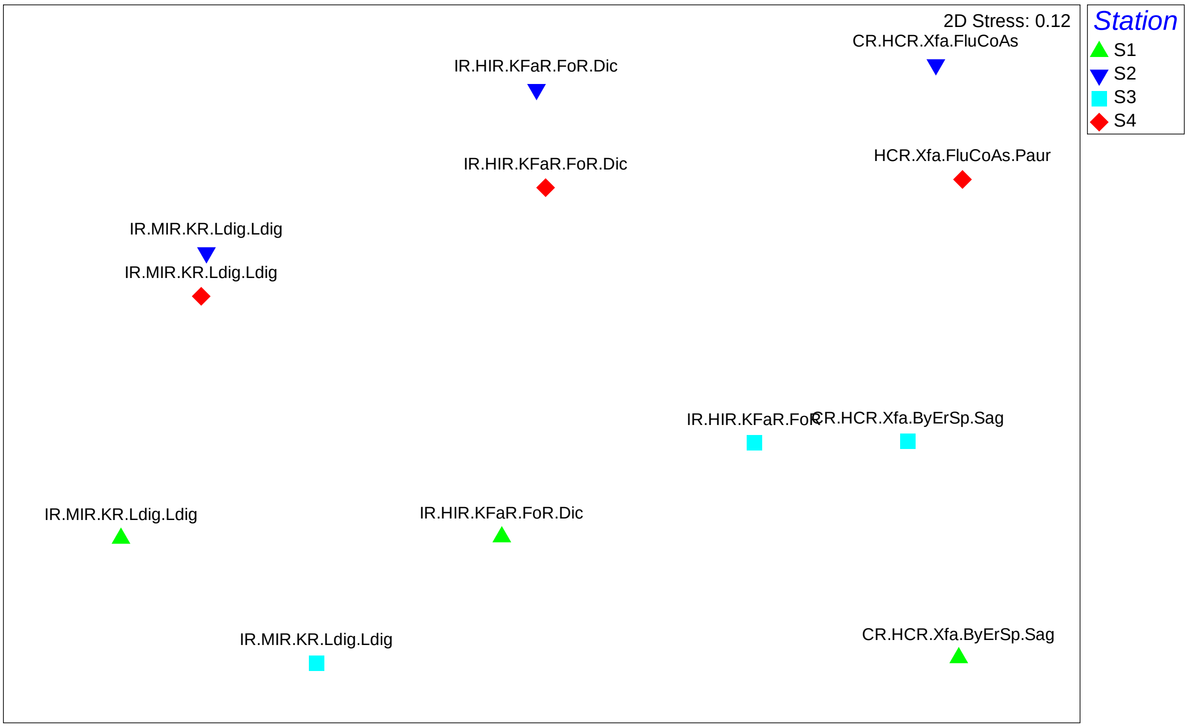



Figure 6.12 MDS of Biotopes Recorded at the Sublittoral Stations

## 7. Conclusion

The results showed clear separation between the littoral and sublittoral stations in terms of species composition and biotopes with on average of twice as many species found in the sublittoral environment. This survey has collected semi-quantitative data from two moderately exposed littoral sites (L1 and L3) and a sheltered site (L2). L1 was slightly modified by shading, wave surge and nitrogenous enrichment and the L3 uppershore biotope was similarly enriched by roosting seabirds. The photographs and data collected may act as a comparison, against which future gross changes could be qualitatively assessed.

In the sublittoral zone, four sites were surveyed and similar semi-quantitative data collected along with photographs. Overall, all sublittoral environments indicated the presence of significant siltation in the deeper zones. However, the faunal populations of both littoral and sublittoral zones showed well represented and moderately diverse habitats containing many of the common species found along the Irish Sea coastline. Stations S2 and S3 indicated greater habitats similarity recorded within their vertical zonation.

The result of a moderately high diversity is similar to that recorded in the macro-invertebrate population previously recorded within the soft sediments north of this island as part of the outfall route baseline surveys (BSL, 2013), and is probably indicative for the survey area as a whole. The presence of significant siltation at all locations within the survey would indicate that this phenomenon is ubiquitous in the waters surrounding this island and has subsequently created a habitat with limited sensitivity to suspended sediments in this area. Whilst, siltation levels are high in the sublittoral environment a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. No species of particular conservational interest were noted during the surveys and no rare or fragile biotopes recorded.

# 8. References


Benthic Solutions Limited, 2013. Baseline benthic environmental survey along the proposed Greater Dublin Drainage scheme outfall locations. Survey data reported within Environmental Impact Statement.

Clarke, K. R. and Warwick, R. M. (1994). Similarity-based testing for community pattern: the 2-way layout with no replication. Mar. Biol. 118: 167-176.

MERC (2010). Irish Sea Reef Survey Project Report. Carried out by MERC on behalf of National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

MERC (2012a). Intertidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

MERC (2012b). Subtidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

# Greater Dublin Drainage Project:

# Appendix B – Habitat Assessment Survey

**Date of Survey:**
05/01/2023 – 10/01/2023

**Prepared By:**
**Benthic Solutions Limited**

**Disclaimer:**
This report has been produced in line with the requirements and objectives of the scope of work and contractual terms between Benthic Solutions Limited and the Client. The results are based upon expert interpretation. All interpretation and opinions contained herein are provided based upon the data collated as part of the survey, and other data provided by the Client and available within the public domain.

Page left intentionally blank

# 1 Contents

2 Introduction ........ 3
2.1 Project Information ........ 4
2.2 Background ........ 4
2.3 Scope of Work ........ 6
3 Field Survey Programme and Analytical Methods ........ 7
3.1 Geodetic Parameters ........ 7
3.2 Logistics ........ 7
3.3 Estuarine Habitats Survey ........ 8
3.4 Benthic Habitat Surveys ........ 8
3.5 Seabed Photography and Video ........ 9
4 Habitat Investigation Methods ........ 12
4.1 Environmental Habitat Assessment ........ 12
4.2 Legislative Species Protection Assessment ........ 12
5 Results and Discussion ........ 13
5.1 Estuarine Habitats ........ 13
5.1.1 North of the Proposed Outfall Pipeline Route (Marine Section) – Eastern Side ........ 13
5.1.2 South of the Proposed Outfall Pipeline Route (Marine Section) – Eastern Side ........ 13
5.1.3 North of the Proposed Outfall Pipeline Route (Marine Section) – Western Side ........ 13
5.1.4 South of the Proposed Outfall Pipeline Route (Marine Section) – Western Side ........ 17
5.2 Offshore Environmental Habitats ........ 17
5.2.1 Proposed Outfall Pipeline Route (Marine Section) ........ 17
5.2.2 Ireland's Eye and ENV_27 ........ 20
5.2.3 Potential Sensitive Habitats and Species ........ 23
6 Conclusion ........ 24
6.1 Proposed Outfall Pipeline Route (Marine Section) ........ 24
6.2 Sublittoral Reef (Rockabill to Dalkey Island SAC) ........ 26
6.3 Investigation of Biogenic Sands (Maerl) South of Ireland's Eye ........ 27
7 Key Material Changes in Baseline ........ 28
7.1 Estuarine Habitats ........ 28
7.2 Marine Habitats ........ 28
8 References ........ 29
Appendix I – Field Operations and Survey Methods ........ 30
Appendix II – Service Warranty ........ 32

## Tables

Table 3.1: Geodetic Parameters .......... 7
Table 3.2: Summarised Operational Timings .......... 8
Table 3.3: Summary of Camera Transect Data Acquired .......... 9
Table 5.1: Seabed Substrate Categories Identified .......... 18

## Figures

Figure 2.1: Survey Area Overview .......... 5
Figure 3.1: Environmental Sampling Strategy Overview .......... 11
Figure 5.1: Habitat Map of the Fossitt Habitats of Baldoyle Estuary (Based on 2022 Update Survey) 14
Figure 5.2 Habitat Map of Annex I habitats of Baldoyle Estuary (Based on 2022 Update Survey) .......... 15
Figure 5.3: Habitat Map of Annex I Habitats of Baldoyle Estuary (Prepared by McCorry and Ryle (2009) (2013 Survey- Appendix A9.1 of the 2018 EIAR submission ) .......... 16
Figure 5.4: Examples of Conspicuous Fauna .......... 20
Figure 5.5: Summary of Environmental Habitats at each Seabed Location .......... 21
Figure 5.6: Summary of Conspicuous Fauna Present at each Seabed Image Location .......... 22
Figure 6.1: Summary of Conspicuous Fauna Present at each Seabed Image Location .......... 25
Figure 6.2: Seabed Sediments at the Proposed Marine Diffuser Location Showing Changes in Sands in 2012, 2017 and 2023 .......... 26
Figure 6.3: Seabed Camera Observations Show Example Images Taken in High Water Turbidity Showing Heavily Silted Boulders (S2), Soft Corals on Bedrock (S4) and Heavily Silted Foliose Red Algaes (S3), January 2023 .......... 27
Figure 6.4: Seabed Camera Observations From Reference Site Station 27, Showing Silty Sands and Gravels (Left), Boulders with Occasional Soft Corals (Middle) and Boulders Punctuated by Biogenic Sands (Right), January 2023 .......... 27

## Glossary

| Abbreviation | Meaning |
|---|---|
| BSL | Benthic Solutions Limited |
| DDV | Drop Down Video |
| EIA | Environmental Impact Assessment |
| EIAR | Environmental Impact Assessment Report |
| EOL | End of Line |
| GDD | Greater Dublin Drainage Project |
| GPS | Global Positioning System |
| HAS | Habitat Assessment Survey |
| HSE | Health and Safety Executive |
| LED | Light Emitting Diode |
| MOD4.0 | BSL MOD4.0 Camera System |
| RPS | RPS Group Plc |
| SAC | Special Area of Conservation |
| SD | Standard Definition |
| SOL | Start of Line |
| WGS84 | World Geodetic System 1984 |

## 2 Introduction

Benthic Solutions Limited (BSL) was commissioned to complete updated marine habitat assessment surveys to inform the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project) Environmental Impact Assessment Report (EIAR) Addendum Report.

An Environmental Impact Assessment Report (EIAR) was prepared for the Proposed Project and submitted for planning in 2018. Chapter 9 (Biodiversity (Marine)) of the EIAR in the 2018 planning application considered marine biodiversity.

As detailed in Chapter 1A (Introduction) in Volume 2A of the Environmental Impact Assessment Report (EIAR) Addendum Report, we have reviewed the Chapter 9 (Biodiversity (Marine)) and the associated appendices of the EIAR submitted with the original 2018 planning application, in the light of:

- Changes to the baseline environment;
- The requirement for updated surveys; and
- Any changes to the law, policy, or industry standards and guidance in the intervening period.

In updating the baseline ecology information for the Proposed Project this was completed cognisant of the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater, Coastal and Marine (hereafter referred to as the CIEEM Guideline) (CIEEM 2018), with respect to the validity of baseline data.

This Appendix is a factual account of the update surveys which have been completed for the Proposed Project. The update surveys that have been completed are:

- Wetland Estuary Walkover,
- Offshore Habitat Assessment; and
- Benthic Video Survey.

These surveys were undertaken using an estuary walkover survey and using seabed photography and videography data spanning the length of the proposed outfall pipeline route (marine section), in addition to five transects surrounding and immediately to the south of Ireland's Eye (Figure 2.1).

In addition, the data has been compared with the relevant baseline in Chapter 9 (Biodiversity (Marine)) in Volume 3 Part A of the EIAR in the 2018 planning application to identify any material changes to the baseline conditions in the intervening period. Any identified material changes have then been used to inform Chapter 9A (Biodiversity (Marine)) in Volume 3A Part A of the EIAR addendum.

## 2.1 Project Information

| | |
|---|---|
| **Client:** | Uisce Éireann |
| **Project:** | Greater Dublin Drainage Project |
| **Contractor:** | RPS and Benthic Solutions Limited (BSL) |
| **BSL Contractor Reference:** | 2241 |
| **Survey Areas:** | Irish Sea |
| **Survey Type:** | Wetland Estuary Walkover, Offshore Habitat Assessment and Benthic Video Survey |
| **Survey Period:** | 14/11/22 (Walkover Survey) and 05/01/23 to 10/01/23 (Offshore habitat and video survey) |
| **Survey Vessel:** | *Ros Aine* |
| **Survey Equipment:** | BSL MOD4.0 camera with freshwater lens, Kongsberg 14-408 camera with freshwater lens |

## 2.2 Background

Detailed marine environmental surveys were previously carried out along the proposed outfall pipeline route (marine section) and surrounding environments by BSL to inform the EIAR in the 2018 planning application, as follows:

Broad survey assessment of benthic conditions between Dublin Bay and Skerries in August 2012 (29 sampling stations). As a regional assessment, this survey covered other possible outfall locations not selected for the final route. The eight sites pertinent to the Proposed Project were targeted for further assessments in 2013 and 2017 (see bullet points below):

- The water quality component of the August 2012 survey was repeated in December 2012 (three sampling stations);
- Estuarine / wetland walkover habitat survey of Baldoyle Bay was completed in summer 2013;
- Assessment of eight sampling stations focused along the proposed outfall pipeline route (marine section) was completed in July 2013;
- Ireland's Eye sublittoral reef drop down video survey was completed in 2014;
- Ireland's Eye littoral and sublittoral reef survey carried out using intertidal walkover and sub-tidal diving assessment was completed in 2015; and
- Repeat assessment of eight sampling stations focused along the proposed outfall pipeline route (marine section) was completed in August 2017.

The full reports relating to these surveys can be found within the supporting appendices of the EIAR in the 2018 planning application.

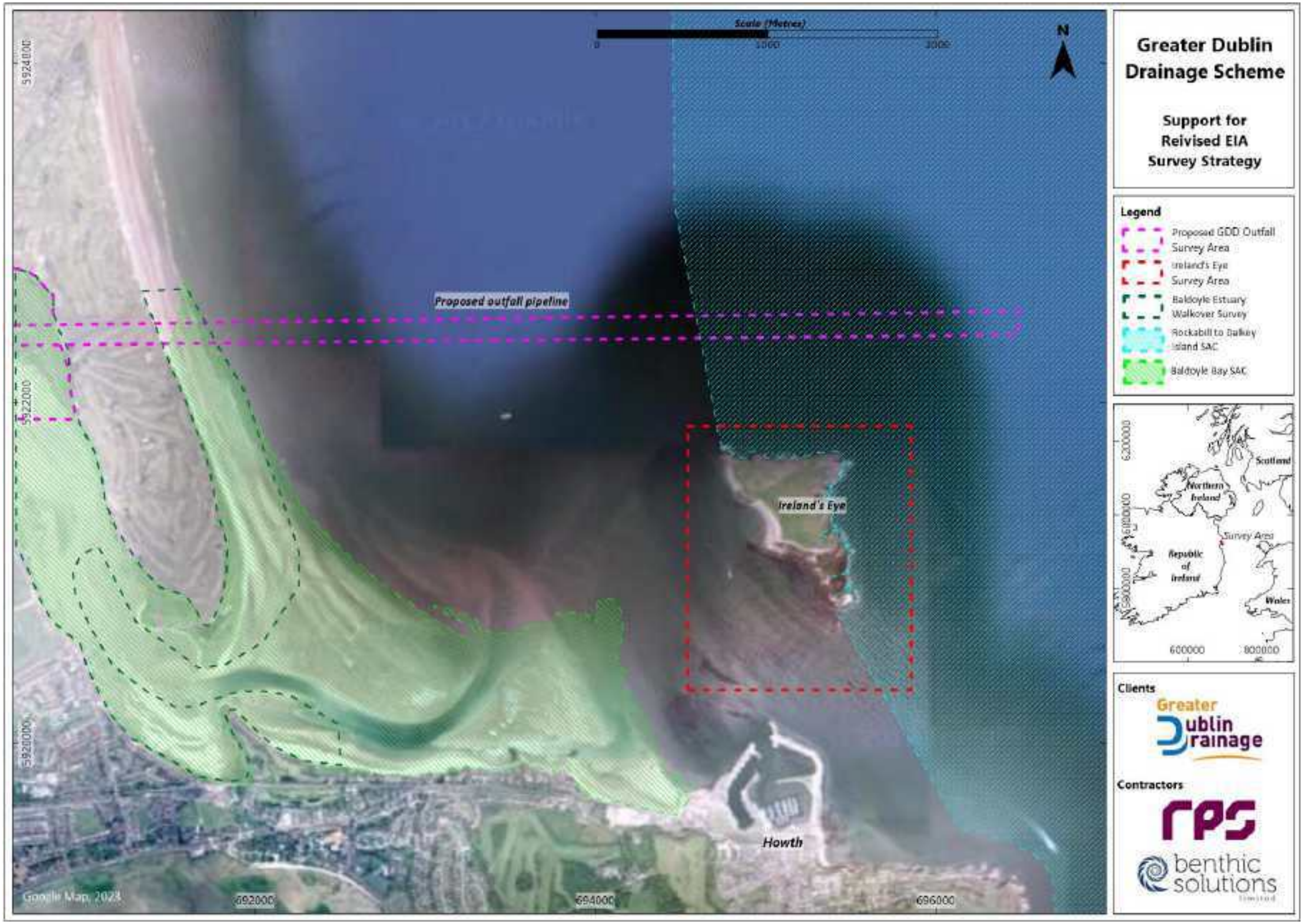



*Figure 2.1: Survey Area Overview*

## 2.3 Scope of Work

In November 2022, RPS completed a walkover survey of Baldoyle Estuary and in January 2023. BSL completed a video inspection survey of the Proposed Outfall Pipeline Route (Marine Section) and surrounding areas to assess the distribution of seabed habitats to support the preparation of the EIAR Addendum for the Proposed Project.

The main objectives of these updated habitat assessment surveys are as follows:

- Baldoyle walkover survey - to identify any material changes since the last survey completed in 2013;
- Video inspection survey - to provide video / photographic footage along the proposed outfall pipeline route (marine section) to assess the identity and distribution of seabed habitats and identify any material changes to the seabed since the original surveys completed in 2012 and 2017;
- Video inspection survey - to provide video / photographic footage of the sublittoral reefs surrounding and immediately to the south of Ireland’s Eye to identify any material changes to the condition of sublittoral reefs since last survey completed in 2015.

# 3 Field Survey Programme and Analytical Methods

## 3.1 Geodetic Parameters

The horizontal datum was referenced to the WGS84 Datum, UTM 29N projection. The geodetic parameters used are provided below in Table 3.1.

*Table 3.1: Geodetic Parameters*

| GPS Satellite System – WGS84 | |
|---|---|
| Datum | WGS84 |
| Spheroid | WGS 1984 |
| Semi-Major Axis | a = 6378137.000m |
| Semi-Minor Axis | b = 6356752.314m |
| First Eccentricity Squared | E I= 0.006694379990 |
| Inverse Flattening | 1/f = 298.257223563 |
| **Project Projection Parameters for Site Surveys** | |
| EPSG Map Projection Code | 32629 |
| Projection | UTM Zone 29N |
| Central Meridian | 0° |
| Longitude of Origin | 3° East |
| Latitude of Origin | 0° North |
| False Easting | 500000.00m |
| Scale Factor at Central Meridian | 0.9996 |
| Units | Metres |

## 3.2 Logistics

An estuarine survey was conducted on 14 November 2022 at Baldoyle Estuary by an experienced RPS ecologist. The survey comprised a walkover survey undertaken during daylight hours, commencing during low tide at approximately 09.00hrs and finishing at approximately 17.00hrs. The weather conditions during the survey were sunny and dry, with temperatures ranging from 10-12°C (degrees Celsius).

Between 4 January and 10 January 2023, video transects were conducted along the proposed outfall pipeline route (marine section) and around Ireland's Eye aboard the *Ros Aine* working on a 12 hour basis. Throughout the survey there were no health, safety and environmental (HSE) incidents reported. Environmental survey equipment was deployed using the onboard crane and positioned using a Garmin Global Positioning System (GPS). An overview of the survey operations and dates is outlined in Table 3.2 below.

*Table 3.2: Summarised Operational Timings*

| Date | Activity | Details of Activity |
|---|---|---|
| 14/11/2022 | Operations | Baldoyle wetland walkover survey (RPS) |
| 04/01/2023 | Personnel travel | Personnel and equipment travel to Howth, Ireland. |
| 05/01/2023 | Mobilisation<br>Operations<br>Weather Standby | Mobilisation of equipment onto the *Ros Aine*.<br>Camera transects attempted but poor data acquired due to marginal weather conditions encountered along the proposed route.<br>Standby for weather |
| 06/01/2023 | Operations<br>Demobilisation<br>Travel | Camera transects completed at the Proposed Outfall Pipeline Route (Marine Section) and around Ireland's Eye.<br>Demobilisation of equipment from *Ros Aine*.<br>One personnel travelled back to Norfolk. |
| 07/01/2023 | Standby | Standby due to customs delays in Dublin. |
| 08/01/2023 | Standby | Standby due to customs delays in Dublin. |
| 09/01/2023 | Standby<br>Travel | Standby due to customs delays in Dublin.<br>Remaining personnel travelled to Liverpool on the overnight ferry. |
| 10/01/2023 | Travel | Remaining personnel travelled back to Norfolk. |

## 3.3 Estuarine Habitats Survey

The main estuarine habitats were mapped according to A Guide to Habitats in Ireland (Fossitt 2000). Habitat types were also considered with reference to Annex 1 habitat types, in order to be consistent with the habitat mapping prepared for a Saltmarsh Monitoring Survey conducted in Baldoyle Estuary between 2006 and 2008 (McCorry and Ryle 2009), as documented in the EIAR in the 2018 planning application. Field notes included information on species composition, habitat structure and features. The most abundant and characteristic species were recorded and used to distinguish the main habitat types.

The results of the survey were mapped using the Geographic Information System (GIS) and used to compare key changes in habitat extent since the previous walkover survey in 2013, as documented in the EIAR in the 2018 planning application.

Such surveys can be completed at any time of year, however optimally during the spring and summer. The completion of the update surveys during the autumn of 2022, however, is not considered a significant limitation given that the area had been previously mapped, and it was the aim to identify any material changes.

## 3.4 Benthic Habitat Surveys

Camera transects were carried out at predetermined locations in line with previous operations and Proposed Project requirements targeting the proposed outfall pipeline route (marine section), sublittoral reef transects surrounding Ireland's Eye and a historic environmental sampling station between Ireland's Eye and Howth Harbour, in which maerl was previously found to be present. Actual sampling locations are presented in Figure 3.1.

The aim of these surveys was to update the understanding of these dynamic environments and identify any material changes to the distribution or description of the habitats within close proximity to the proposed outfall pipeline route (marine section) or the proposed marine diffuser location. The survey was consistent with previous surveys carried out at the site using drop-down camera equipment. However, an additional 'freshwater lens' adaptation was required to allow for the high turbidity in the waters in the region and during the winter months. The weather conditions during the survey were marginal with slight to moderate seas of around 1m (metre) wave height.

Such visual survey assessments can be completed at any time of the year, however, optimally during the spring and summer for more detailed biodiversity assessments. The completion of these update surveys during the winter of 2023 is not considered a significant limitation given that the primary requirement for these surveys was to assess possible habitat changes and that the area had been significantly mapped and described previously.

## 3.5 Seabed Photography and Video

Seabed video footage and stills were acquired along predetermined transects in line with survey requirements. A total of six camera transects were carried out using both the BSL MOD4.0 and Kongsberg 408 camera systems. One transect was positioned along the length of the proposed outfall pipeline route (marine section), with a further four transects positioned around Ireland's Eye and one between Ireland's Eye and Howth Harbour (~400m north-northeast of Howth harbour).

Video footage and stills were acquired along the proposed outfall pipeline route (marine section) using a MOD4.0 camera system mounted within a BSL 'freshwater lens' drop-down frame, equipped with separate strobes and LED (light-emitting diode) lamps. Footage and stills from the transects surrounding and immediately south of Ireland's Eye were acquired using a Kongsberg 14-408 underwater camera system also mounted within a 'freshwater lens' drop-down frame equipped with separate LED lamps. Once at the seabed, the camera was moved along the length of the transect at an approximate speed of 0.8 knots. Still photographs were captured remotely using a surface control unit via a towed umbilical cable. The stills were uploaded in real-time and saved to the camera and a laptop via specialist software. Live video footage, overlaid with the date, time, position and site details were viewed in real-time. The live video stream was used to assist with targeting of the stills camera and to facilitate a habitat assessment. Footage was saved internally by the video camera and data was downloaded after approximately six hours of camera operations and backed-up onto a hard drive.

A total of six camera transects were conducted over the survey area (one along the proposed outfall pipeline route (marine section), four surrounding Ireland's Eye and one between Ireland's Eye and Howth Harbour). Due to the presence of fishing gear over the proposed outfall pipeline route (marine section) transect approximately 1km (kilometre) to the west of the proposed marine diffuser location, a continuous transect was not achievable. Consequently, the transect was therefore split into two sections running from the shore up to the fishing gear (west to east, Section 1) and from the proposed marine diffuser location to the fishing gear (east to west, Section 2) with two further drop-down video (DVV) deployments undertaken within the area between the fishing gear to achieve as much coverage as possible (Figure 3.1). A summary of the surveyed transects and acquired video and photography data is provided below in Table 3.3.

*Table 3.3: Summary of Camera Transect Data Acquired*

| Geodesy Universal Transfer Mercator (UTM) zone 29N, WGS84 Datum | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Transect** | **Date and Time** | **Rationale** | **Length (m)** | Start or End of Line | **Easting (m)** | **Northing (m)** | **Video/Photos (hh:mm:ss/ images)** |
| Proposed Outfall Pipeline Route (Marine Section) Section 1 | 06/01/23 | Proposed outfall pipeline route | 3,500 | SOL | 691 734 | 5 922 406 | 02:20:06/519 |
| | | | | EOL | 695 146 | 5 922 447 | |
| Proposed Outfall Pipeline Route (Marine Section) Section 2 | 06/01/23 | Proposed outfall pipeline route | 722 | SOL | 696 459 | 5 922 480 | 00:34:21/38 |
| | | | | EOL | 695 812 | 5 922 466 | |
| | 06/01/23 | | 175 | SOL | 695 230 | 5 922 464 | 00:07:22/21 |

| Geodesy Universal Transfer Mercator (UTM) zone 29N, WGS84 Datum | | | | | | | |
|---|---|---|---|---|---|---|---|
| Proposed Outfall Pipeline Route (Marine Section) DDV 1 | | Proposed outfall pipeline route | | EOL | 695 133 | 5 922 431 | |
| Proposed Outfall Pipeline Route (Marine Section) DDV 2 | 06/01/23 | Proposed outfall pipeline route | 269 | SOL | 695 601 | 5 922 466 | 00:13:42/120 |
| | | | | EOL | 695 388 | 5 922 441 | |
| S1 | 06/01/23 | Sublittoral transect positioned around northern extent of Ireland’s Eye | 1,085 | SOL | 694 914 | 5 921 799 | 00:09:53/33 |
| | | | | EOL | 694 867 | 5 921 824 | |
| S2 | 06/01/23 | Sublittoral transect positioned around northern extent of Ireland’s Eye | 442 | SOL | 695 167 | 5 921 803 | 00:03:39/14 |
| | | | | EOL | 695 147 | 5 921 691 | |
| S3 | 06/01/23 | Sublittoral transect positioned around northern extent of Ireland’s Eye | 158 | SOL | 695 579 | 5 921 128 | 00:03:14/7 |
| | | | | EOL | 695 565 | 5 921 158 | |
| S4 | 06/01/23 | Sublittoral transect positioned around northern extent of Ireland’s Eye | 96 | SOL | 695 599 | 5 920 731 | 00:04:57/23 |
| | | | | EOL | 695 573 | 5 920 802 | |
| ENV_27 | 06/01/23 | Transect targeting historic maerl between Ireland’s Eye and Howth harbour. | 1,206 | SOL | 695 301 | 5 920 347 | 00:19:14/101 |
| | | | | EOL | 695 048 | 5 920 638 | |

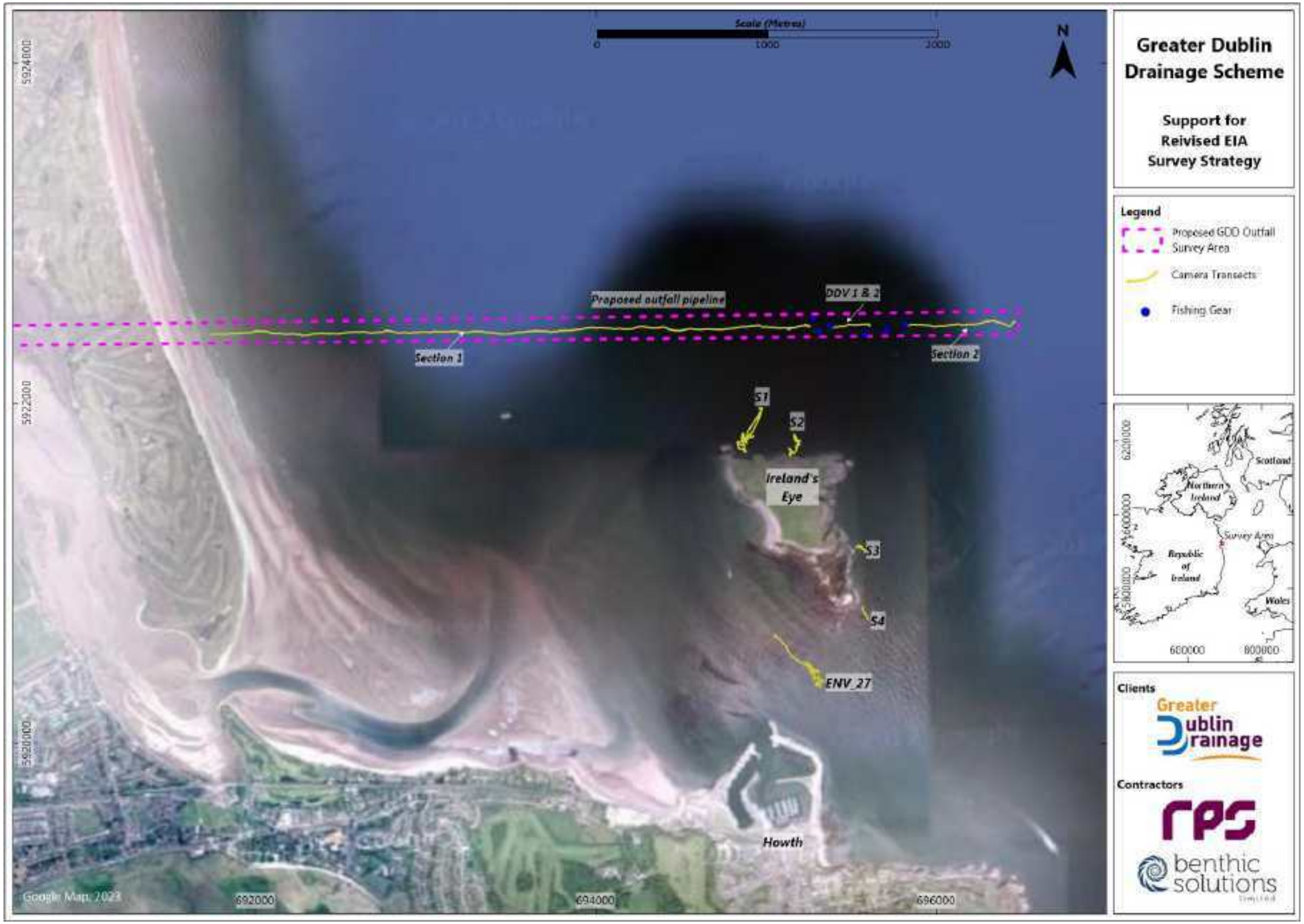



*Figure 3.1: Environmental Sampling Strategy Overview*

# 4 Habitat Investigation Methods

## 4.1 Environmental Habitat Assessment

The habitat assessment was based on a review of high resolution still images and the recorded standard definition (SD) video footage with consideration of historical data acquired over the same area. The sediment type and conspicuous fauna observed within each still image was recorded and used in conjunction with the SD video footage as a basis for habitat determination.

## 4.2 Legislative Species Protection Assessment

The conspicuous fauna recorded from review of the underwater video footage and stills were inputted into a database developed by BSL staff which identifies any species that are afforded protection under several legislative conventions / directives implemented in the United Kingdom (UK) and Ireland.

# 5 Results and Discussion

## 5.1 Estuarine Habitats

This Section should be read with reference to Figure 5.1 Habitat Map of the Fossitt Habitats of Baldoyle Estuary, Figure 5.2 Habitat Map of Annex I habitats of Baldoyle Estuary, and Figure 5.3 Habitat Map of Annex I Habitats of Baldoyle Estuary prepared by McCorry and Ryle (McCorry and Ryle 2009), and review notes from 2013 revisit survey (Appendix A9.1 of the 2018 EIAR submission).

### *5.1.1 North of the Proposed Outfall Pipeline Route (Marine Section) – Eastern Side*

The previous 2013 survey (Appendix A9.1 of the 2018 EIAR submission) described a similar habitat to that surveyed in the 2022 survey; with the upper vegetation dominated by Spartina swards, creeping bent grass (*Agrostis stolonifera*), sea beet (*Beta vulgaris*), rushes (Juncus sp.), sea aster (*Aster tripolium*) and sea purslane (*Halimione portulacoides).*

The previous study reported a wider extent of Atlantic salt meadow directly above the proposed outfall pipeline route (marine section), which in the 2022 survey was dominated by Spartina swards and only extended into Atlantic salt meadow at the uppermost section of the marsh. Overall, the extent of Mediterranean salt meadow remained broadly unchanged since the previous survey. Some of the species recorded in the previous survey, such as common scurvy grass (*Cochlearia officinalis*) and sea pink (*Armeria maritima*) were not encountered in the 2022 survey.

It should be noted that the 2022 study was recorded in the field using primarily the Fossitt Habitat classification code (Fossitt 2000), whereas the previous survey used Annex I Habitat classification code, therefore explaining slight differences in mapping classifications.

### *5.1.2 South of the Proposed Outfall Pipeline Route (Marine Section) – Eastern Side*

The previous 2013 survey (Appendix A9.1 of the 2018 EIAR submission) reported a similar extent of Spartina swards along the western side of the Portmarnock golf course to that recorded in the 2022 survey. However, there were patches of Mediterranean and Atlantic salt meadows Annex I habitat south of Portmarnock golf course which were not noted in the 2022 survey. In the 2022 survey, this area was identified as a broadly Marram grass dune habitat. A distinct cluster of sea buckthorn (*Hippophae rhamnoidesi*), associated with Dune Scrub and Woodland habitat (CD4) was observed to the south of Portmarnock golf course in 2022, which was not previously recorded in the 2013 survey (Appendix A9.1 of the 2018 EIAR submission).

### *5.1.3 North of the Proposed Outfall Pipeline Route (Marine Section) – Western Side*

Overall, in 2022, the western section of the proposed outfall pipeline route (marine section) was similar to the previous survey. The scrub vegetation, and mosaic of Mediterranean and Atlantic salt meadow marsh was also documented, although this represented a smaller area in the 2022 survey.

The previous survey in 2013 recorded species such as bush vetch (*Vicia sepium*), common comfrey (*Symphytum officinale*), tall fescue (*Festuca aruninacea*), common scurvy grass (*Cochlearia officinalis*) and glasswort (*Salicornia sp*.), which were not encountered in the 2022 survey.


*Figure 5.1: Habitat Map of the Fossitt Habitats of Baldoyle Estuary (Based on 2022 Update Survey)*


***Figure* 5.2 *Habitat Map of Annex I habitats of Baldoyle Estuary (Based on 2022 Update Survey)***

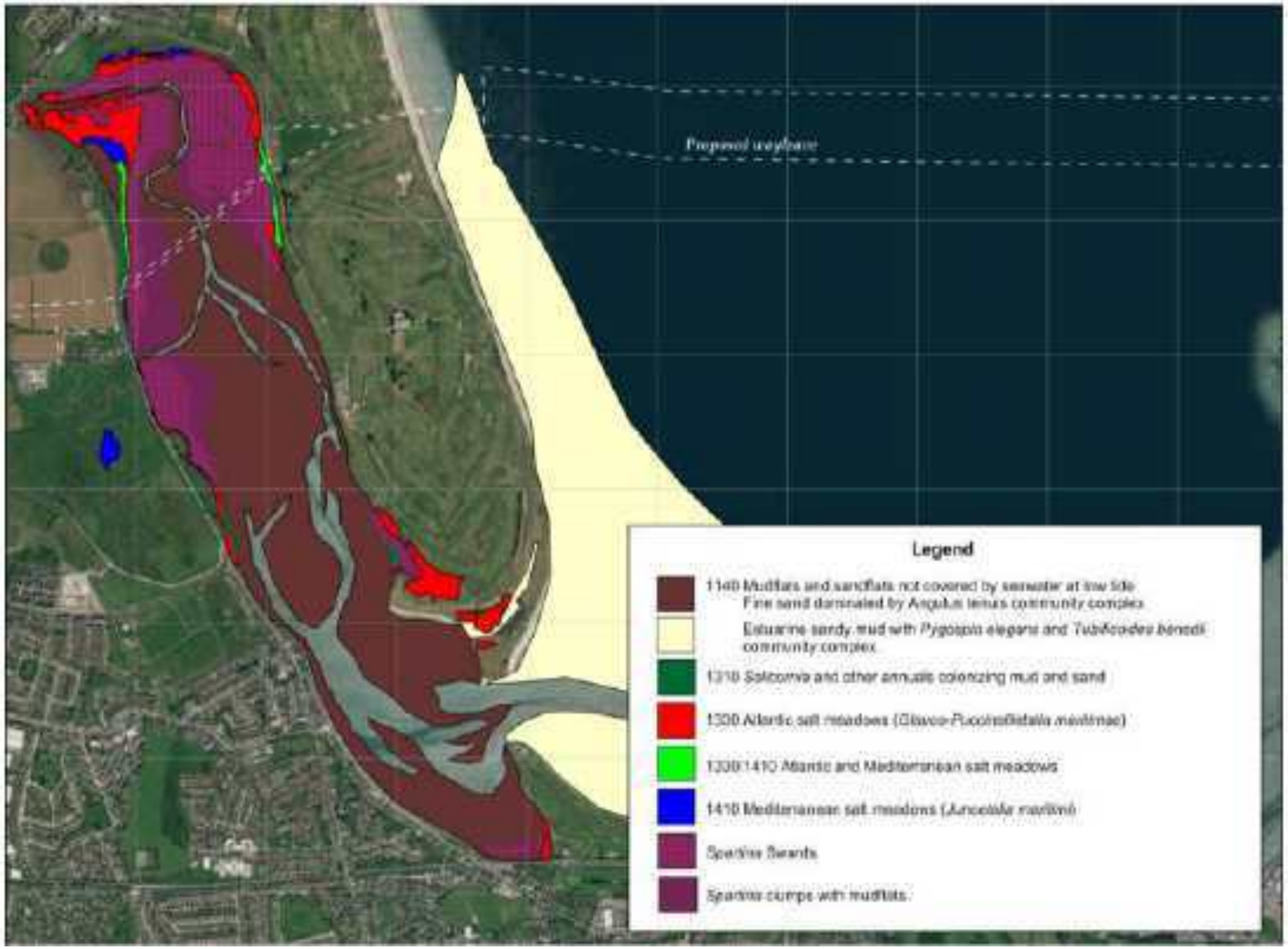



*Figure 5.3: Habitat Map of Annex I Habitats of Baldoyle Estuary (Prepared by McCorry and Ryle (2009) (2013 Survey-  Appendix A9.1 of the 2018 EIAR submission* )

#### *5.1.4 South of the Proposed Outfall Pipeline Route (Marine Section) – Western Side*

The previous study in 2013 (Appendix A9.1 of the 2018 EIAR submission ) documented Spartina swards at the lowermost sections of estuary. However, the extent of this habitat was greater in the 2022 survey. The previous study reported an Annex I Atlantic salt meadow habitat, which was not identified in the 2022 study. There was no mention of Marram grass dune habitat in the previous study.

In 2022, the Sand shore (LS2) and Mud shore (LS4) habitats occupied a similar extent to that described in the previous survey. The previous survey habitat map (Figure 5.3) excluded sections of the mudflats within the centre of the estuary which were likely covered by channels of seawater at the time of the survey. In the 2022 survey, due to tidal conditions and health and safety constraints, this area in the centre of the estuary was not surveyed. However, based on previous survey results and desk-based review using aerial photography, it was mapped as LS4 Mud shore.

### 5.2 Offshore Environmental Habitats

A detailed review of the seabed photography data revealed the presence of five main sediment types along the proposed outfall pipeline route (marine section) with substrates ranging from fine rippled sands to cobbles with minor variations in-between. Four main sediment types surrounding and immediately south of Ireland’s Eye were observed, ranging from bedrock to a mixed mosaic of fine sands, fragmented rock and shell fragments. All substrate categories for both the proposed outfall pipeline route (marine section) and Ireland’s Eye survey areas are described in Table 5.1 below, whilst the sediment assignments and conspicuous fauna of each of the assessed still images can be found in Appendix II.

Using the seabed substrate categories outlined in Table 5.1, it was possible to delineate sections of camera transects characterised by different substrates, with an overview for both survey areas displayed in Figure 5.5.

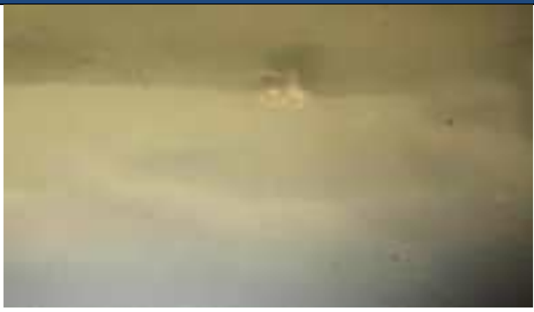
#### *5.2.1 Proposed Outfall Pipeline Route (Marine Section)*

Analysis of the photographic stills revealed the presence of a fine rippled sand spanning the initial approximately 1km of the proposed outfall pipeline route (marine section). Conspicuous fauna observed over this substrate type was sparse and was primarily comprised of mobile crustaceans (*Pagurus* sp. and Pleocyemata sp.), likely due to the high mobility of the surface sediments this close to the shore. This fine sand was replaced by sand with a minor gravel component spanning out to approximately 3km from the shore, with razor clams (*Ensis* sp.) and Ophiuroidea sp. (*Ophiura ophiura* and *Ophiura albida*) being the most dominant fauna observed (Figure 5.6). A coarser and more variable substrate to the north of Ireland’s Eye spanned a distance of approximately 1km and ranged from sandy gravel to cobbles with minor variation in-between. Fishing gear was observed along this section of the proposed outfall pipeline route (marine section) with Pectinidae sp. frequently observed in addition to a notable sessile epifaunal community that included *Alcyonium digitatum*, Porifera sp., encrusting bryozoans and calcareous tube dwelling worms (Serpulidae sp.). The easternmost extent of the proposed outfall pipeline route (marine section), spanning a distance of approximately 0.5km from the proposed marine diffuser location, was also classified as gravelly sand; albeit with a higher gravel component reflected by the presence of sporadic sessile epifauna including Actinaria sp., Porifera sp. and *Alcyonium digitatum*. Example images of conspicuous fauna observed along the proposed outfall pipeline route (marine section) are provided in Figure 5.4.

*Table 5.1: Seabed Substrate Categories Identified*

| Substrate Category | Description |
|---|---|
| **Proposed Outfall Pipeline Route (Marine Section)** | |
| Sand | Fine rippled sand covering the westerly extent of the proposed outfall pipeline route (shore to diffuser) with relatively sparse conspicuous fauna observed consisting primarily of mobile crustaceans (*Pagurus* sp. and Pleocyemata sp.). |
| Gravelly Sand | Fine sand with a minor gravel component covering the largest extent of the proposed pipeline route including the proposed diffuser location. Ophiuroidea sp. and *Ensis* sp. were the most dominant conspicuous fauna observed across this substrate type. A slightly coarser variation of this substrate was found at the easternmost extent of the proposed pipeline. |
| Sandy Gravel | This substrate type was encountered within the central portion of the proposed Proposed Outfall Pipeline Route (Marine Section) in proximity to the location of fishing gear encountered during the survey. Conspicuous fauna included Pectinidae sp. and the presence of sessile epifauna including Porifera sp., Serpulidae sp. and *Alcyonium digitatum*. This area is expected to coincide with a bathymetric slope. |
| Gravel | This substrate type was also encountered within the central portion of the Proposed Outfall Pipeline Route (Marine Section) and overlapped in extent with that of sandy gravel. Conspicuous fauna was similar to that observed over sandy gravel substrate types and included a notable sessile epifaunal component. |
| Cobbles | Cobbles often encrusted with calcareous tube dwelling worms (Serpulidae sp.); this substrate type was also present within the central portions of Proposed Outfall Pipeline Route (Marine Section) area and overlapped in extent with that of sandy gravel and gravel. |
| **Ireland's Eye and ENV_27 Survey Area** | |
| Bedrock | Sloping and flat bedrock encountered at all transects excluding transect S2, often heavily encrusted with sessile epifauna with some areas displaying high levels of siltation. |
| Boulders | Boulders of varying size typically found in proximity to areas of bedrock, displaying heavy encrustation of sessile epifauna and high levels of siltation in some areas. |
| Shelly Sand | This sediment type consisted of fine sand with varying levels of shell fragments and was present within the northern transects surrounding Ireland's Eye (S1 and S2). Conspicuous fauna included encrusting sessile epifauna (Serpulidae sp. and encrusting bryozoans) and occasionally *Asterias rubens*. |
| Mixed Sediment | This sediment comprised of a highly variable mosaic of fine sand, shell fragments and rock fragments, and was observed at transect ENV_27. Exposed areas of rock were often heavily encrusted with sessile epifauna including Cirripedia sp., Actinaria sp., encrusting bryozoans and Porifera sp. Mobile fauna observed included *Necora puber* and *Asterias rubens*. |

Comparison of the sediment types observed during the course of the current survey are comparable with the broadscale findings of the historical marine surveys outlined within the EIAR in the 2018 planning application, namely the presence of a fine sand spanning the western extent of the proposed outfall pipeline route (marine section) that transitions to a coarser sediment, that in turn sub-crops a thin fine sand veneer toward the easternmost extent of the proposed outfall pipeline route (marine section).

| **Examples of Conspicuous Fauna** | |
|---|---|
| ***Proposed Outfall Pipeline Route (Marine Section)*** | |
|  *Pagurus* sp. |  Actinaria sp. & Brachyura sp. |
|  Ophiuroidea sp. |  Crinoidea sp. and Pectinidae sp. |
| ***Ireland's Eye and ENV_27*** | |
|  Rhodophyta sp. |  Mussel bed and *Laminaria* sp. on bedrock |
|  *Alcyonium digitatum* |  *Porifera* sp. & *Asterias rubens* |
|  Crinoidea sp. |  Actinaria sp. |


Serpulidae sp. & Cirripedia sp.


*Necora puber*

***Figure** 5.4: **Examples of Conspicuous Fauna***

### *5.2.2 Ireland's Eye and ENV_27*

Areas of flat and sloping bedrock were observed to the north (S1) and south-east of Ireland's Eye (S3 and S4) as well as immediately to the south (ENV_27), with boulders typically in close proximity. Exposed rock was often heavily encrusted with sessile epifauna including barnacles (Cirripedia sp.), encrusting bryozoans, anemones (Actinaria sp.), encrusting and erect sponges (Porifera sp.), dead man's fingers coral (*Alcyonium digitatum*), red seaweeds (Rhodophyta sp.) and kelp (*Laminaria* sp.). However, in some areas, notably transect S3, high levels of siltation were apparent which led to an obvious reduction in the quantity and range of sessile epifauna. Mobile epifauna observed across the areas of bedrock and boulders consisted predominantly of the velvet crab (*Necora puber*) and the common starfish (*Asterias rubens*), with aggregations of feather stars (Crinoidea sp.) observed in some instances. Areas of fine sand featuring varying levels of shell fragments were found to the north of Ireland's Eye and were characterised by sparse conspicuous fauna with the occasional common starfish (*Asterias rubens)* and encrusting sessile epifauna such as calcareous tube dwelling worms (Serpulidae sp.) and encrusting bryozoans in areas featuring higher concentrations of shell fragments. Finally, a mixed mosaic of fine sands, shell fragments and rock fragments interspersed between areas of boulders and bedrock was apparent across transect ENV_27. Exposed rock fragments were often heavily encrusted with barnacles (Cirripedia sp.) and calcareous tube dwelling worms (Serpulidae sp.) as well as encrusting bryozoans, whilst areas of coarse shell fragments were typically associated with the presence of anemones (Actinaria sp.). Example images of conspicuous fauna observed across the Ireland's Eye survey area can be found in Figure 5.4 and Figure 5.6.


*Figure 5.5: Summary of Environmental Habitats at each Seabed Location*

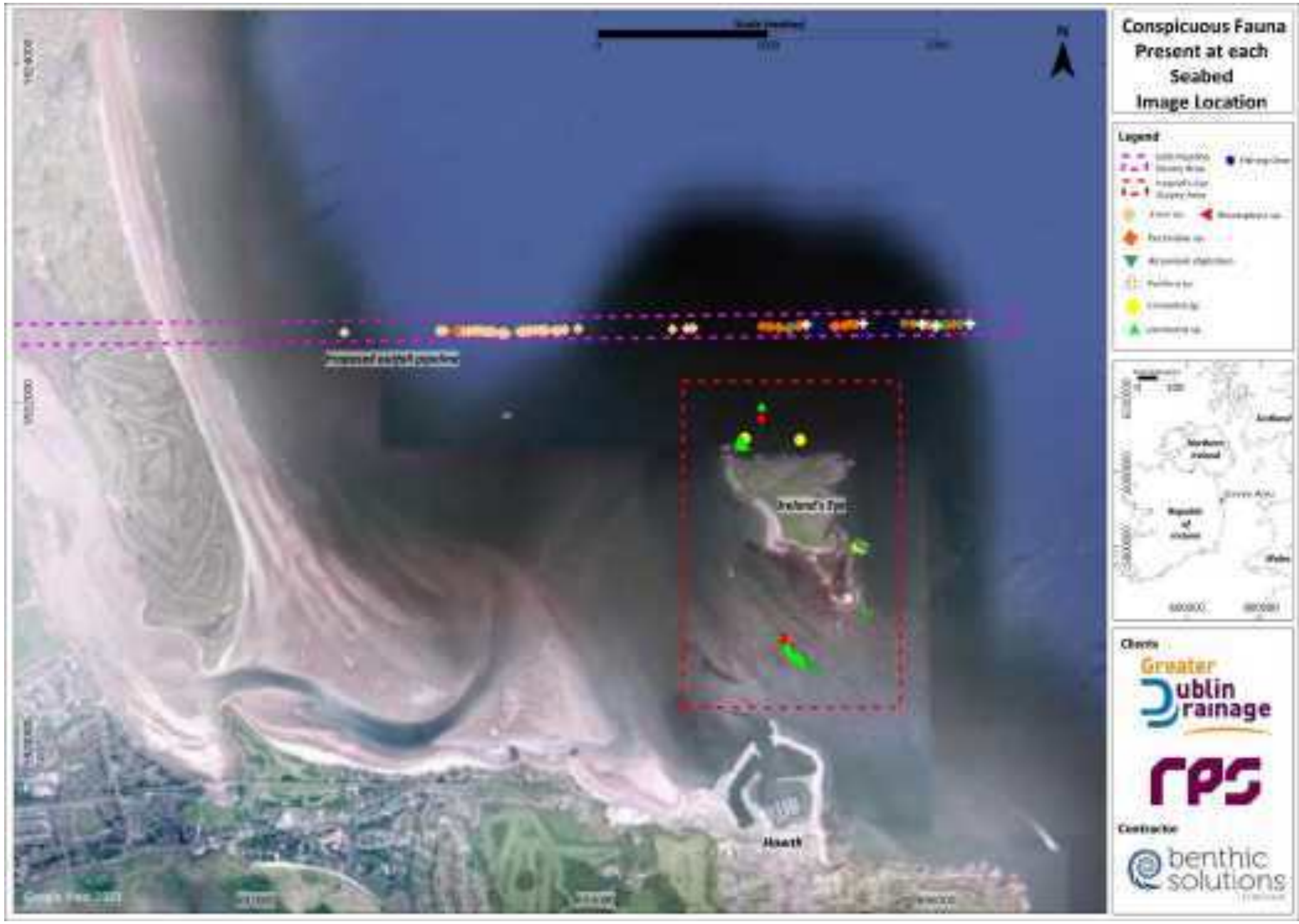



*Figure 5.6: Summary of Conspicuous Fauna Present at each Seabed Image Location*

### 5.2.3 Potential Sensitive Habitats and Species

#### 5.2.3.1 Legislative Species Protection

In order to assess if any species which are afforded legislative protection were present within the survey area, the identified conspicuous fauna were run through a listed species database developed by BSL staff. However, none of the species / taxa identified were designated with legislative protection.

#### 5.2.3.2 Annex I Stony Reef

Whilst the extent and elevation of the bedrock formations surrounding and immediately to the south of Ireland's Eye meet the classification criteria for Joint Nature Conservation Committee (JNCC) Annex I reefs, which are described as: "*Rocky reefs occur where bedrock or stable boulders and cobbles arise from the surrounding seabed creating a habitat that is colonised by many different marine animals and plants. Rocky reefs can be very variable in terms of both their structure and the communities they support. They provide a home to many species such as corals, sponges and sea squirts as well as giving shelter to fish and crustaceans such as lobsters and crabs*" (JNCC, 2016); these features have already been designated as reefs as a qualifying feature within the Rockabill to Dalkey Island Special Area of Conservation (SAC) displayed in Figure 2.1.

# 6 Conclusion

## 6.1 Proposed Outfall Pipeline Route (Marine Section)

Previous investigations along the proposed outfall pipeline route (marine section) outlined in Section 9.3.2 (Geomorphology and Seabed Sediments) of Chapter 9 (Biodiversity (Marine) in Volume 3 Part A of the EIAR in the 2018 planning application), gave a broad description of the proposed outfall pipeline route (marine section) based on a number of surveys using both acoustic mapping and biological habitat techniques. The proposed outfall pipeline route (marine section) was originally separated into three sections east of the landfall beneath Velvet Sands beach break. Here, the proposed outfall pipeline route (marine section) will run along a consistent shallow shelving fine sand (gradient <0.5°) out to a distance of 3.3km from the beach with no bedforms observed. After this, the slope notably steepens to approximately 3° for around 150m, before returning to the shallow slope, but also becomes rougher and harder, indicative of mixed gravelly sand with some large sediment clasts (such as cobbles). At 4.8km from the beach, the seabed returns to a smoother morphology but remains at a high reflectivity until arrival at the proposed marine diffuser location. This is indicative of a thin veneer of fine sands overlying a mixed gravelly sand and shell. Detailed sediment analysis from sampling and camera operations near the proposed outfall route (marine section) between 2012 and 2017, similarly, interpreted these sites into three sediment habitat types. These were fine sands along the first 3.3km of the proposed outfall pipeline route (marine section), but with the presence of a coarser outcropping of sandy gravels in the central section of the shelf break. Evidence from photography and samples indicated patchy exposures of coarser sediments, including some cobbles. This sediment type then sub-crops beneath a fine sand veneer at the eastern end of the proposed outfall pipeline route (marine section) near the proposed marine diffuser location.

The marine sediments are expected to remain in a consistent state of flux with finer sediment components, such as the fine and medium sands, migrating in and out of the shorelines during storm events, and up and down the coastline through tidal currents and long-shore drift. The video survey provided evidence that the status of the habitat along the entire length of the proposed outfall pipeline route (marine section) has remained largely unaltered since the previous assessment in 2017 (Figure 6.2), despite some storm events within the intervening years. The sandy habitat remained consistent from close to the shoreline, through to the shelf break, where the rippled sands are replaced by the exposure of a gravelly underlying fraction. This harder, more heterogenic seabed remained in place until the very end of the proposed outfall pipeline route (marine section) and the proposed marine diffuser location, where evidence of a thin veneer of fine sands was noted. Previous surveys have demonstrated changes in the thickness of these sands immediately surrounding the proposed marine diffuser location (Figure 6.2) with erosion and accretion expected to occur periodically.

Observations of epifaunal species recorded using seabed photography have also confirmed earlier observations, which identified a significant epifaunal community, particularly towards the east end of the proposed outfall pipeline route (marine section) relating to the coarser gravels. Taxonomic records previously showed that both solitary and colonial species of epifauna were recorded during the benthic surveys in 2012 and 2017, with large number of bryozoans, cnidaria (in particular hydroids), and sponges found. Whilst previous operations had indicated occasional settlement from juvenile *Mytilus* and *Modiolus* mussels, the recent 2022 survey showed no evidence of biogenic reef species or sensitive habitats along the proposed outfall pipeline route (marine section).

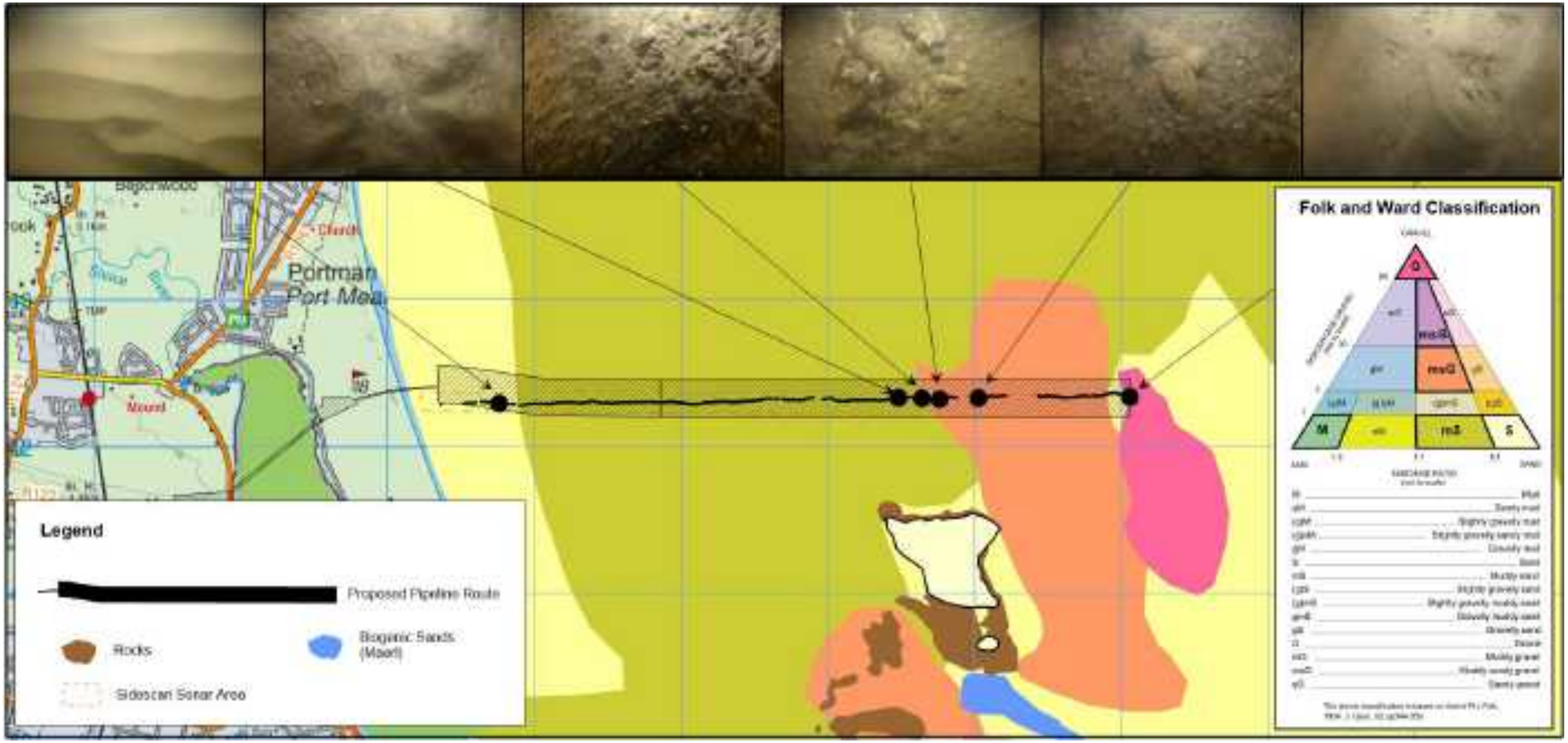



*Figure 6.1: Summary of Conspicuous Fauna Present at each Seabed Image Location*

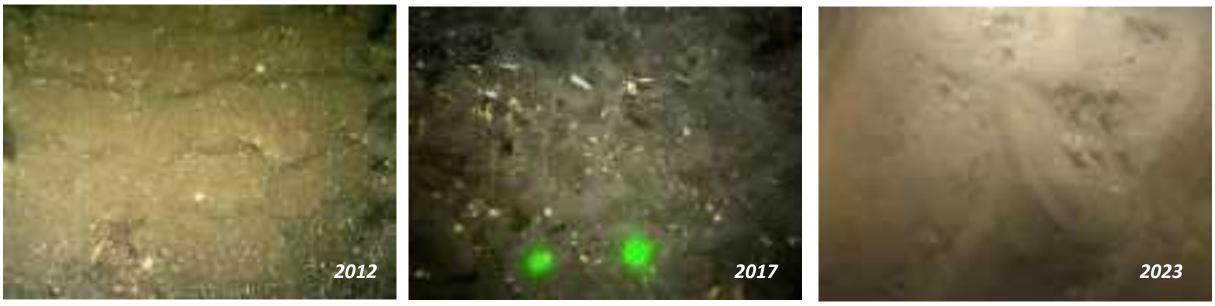



*Figure 6.2: Seabed Sediments at the Proposed Marine Diffuser Location Showing Changes in Sands in 2012, 2017 and 2023*

## 6.2 Sublittoral Reef (Rockabill to Dalkey Island SAC)

The conservation objectives for the sublittoral reefs located within Rockabill to Dalkey Island SAC were outlined by the National Parks and Wildlife Service (NPWS) so as to remain a stable or increasing habitat subject to natural processes. Furthermore, the community structure of the intertidal and subtidal reef community complex was to be maintained. The SAC was initially based on drop-down video surveys (MERC 2010; 2012a; 2012b). A reef community complex is recorded off the northern, eastern and southern shores of Ireland's Eye, immediately south of the proposed outfall pipeline route (marine section) and the proposed marine diffuser location. The substrate, as recorded by the earlier MERC studies and subsequent assessments carried out during the surveys for the Proposed Project (in 2014 and 2015), ranges from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occur on the north and east of Ireland's Eye, whilst the northern reaches of the island show both sediment scouring and a thin veneer of silt covering the reef. In general, the surveys undertaken for NPWS to determine the physical and biological nature of the Annex I habitat within the SAC (MERC 2010; 2012a; 2012b) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals occurred, although these observations were based on extremely limited site investigation works with only a couple of drop-down video sites acquired. A detailed assessment of the subtidal reefs was carried out in 2015 during two separate surveys based on a specialist drop-down camera system (BSL 2015a) and a more detailed assessment was carried out using a scientific dive team at four locations on the northern and eastern sides of the island in June / July 2015 (BSL 2015b). Sites were selected using the earlier video system looking for representative examples based on transects at the base of the reef structure up to the eulittoral zone. As recorded by the earlier MERC surveys, the sublittoral reefs were all found to be heavily silted, but were moderately diverse.

The recent survey visit carried out at each of the sublittoral reef sites has allowed for observations at the deeper parts of each sublittoral transect but only obtained intermittent results close to the shoreline and cliffs due to limited vessel access or steep seabed gradients. As with the previous surveys, two sites were located beneath the steep cliff face of the northern coast of Ireland's Eye (S1 and S2), and two located adjacent to the rocky shorelines in the south-east of the island (S3 and S4). Habitats and biotopes at the sublittoral stations were characterised by *Laminaria digitata* forests in the shallower part and replaced by the biotope 'Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock'. The deeper extent was dominated by a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock' or in the case of Sublittoral S2, '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock'. The deeper biotope at Sublittoral S4 was categorised as possible '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock'. The 2023 survey confirmed a high level of suspended sediment within the water column and areas on the rocky reef substrate and confirmed high levels of sedimentation and silt burden both on open rocky surfaces as well as within the faunal swards (Figure 6.3).


*Figure 6.3: Seabed Camera Observations Show Example Images Taken in High Water Turbidity Showing Heavily Silted Boulders (S2), Soft Corals on Bedrock (S4) and Heavily Silted Foliose Red Algaes (S3), January 2023*

## 6.3 Investigation of Biogenic Sands (Maerl) South of Ireland's Eye

An important substrate found during the initial benthic surveys in 2012 was that of biogenic maerl sands in isolated patches at Station 27, south of Ireland's Eye. This is coralline red algae which can create a diverse biological community at the seabed through sediment modification and habitat creation, although only isolated pockets of dead debris were recorded during the 2012 survey. The presence of maerl has also been previously recorded by the geological Survey of Ireland (GSI) as part of the INFOMAR project in this area of Dublin Bay (data available through www.INFOMAR.ie). This site was not investigated during the later surveys (2012 and 2017) as this location was on the opposite side of Ireland's Eye to the study area and no impacts were expected from the proposed outfall pipeline route (marine section). This interpretation of biogenic sands has therefore only been covered as part of this re-investigation of the site using a drop-down and stills camera operations during the 2023 study.

*Figure 6.4: Seabed Camera Observations From Reference Site Station 27, Showing Silty Sands and Gravels (Left), Boulders with Occasional Soft Corals (Middle) and Boulders Punctuated by Biogenic Sands (Right), January 2023*

As with the 2012 survey, the site was only investigated using photography in 2023. Images confirmed the presence of a heterogeneous seabed made up of mixed sandy gravels and areas of weathered bedrock and boulders punctuated by areas of biogenic sands and gravels. Close inspection of these granular pockets indicated a biogenic sand composed predominantly of dead shell fragments rather than that of dead maerl algae, although the presence of this substrate cannot be ruled out. Whilst the 2023 survey covered a significantly longer transect (i.e. 1.2km) than that previously surveyed by the drop-down video in 2012 (approximately 50m), no additional habitats of conservation importance were recorded, other than the existence of geogenic sublittoral reefs. The evidence of the 2023 survey shows that this rock habitat can be considered as a dominant component of the seabed between Irelands Eye and Howth Harbour. An example of the range of observed habitats recorded during the current survey are summarised in Figure 5.5 and Figure 5.6.

# 7 Key Material Changes in Baseline

## 7.1 Estuarine Habitats

The previous study reported a wider extent of Atlantic salt meadow directly above the proposed outfall pipeline route (marine section), which in the 2022 survey was dominated by *Spartina* swards and only extended into Atlantic salt meadow at the uppermost section of the marsh. There was also a distinct cluster of sea buckthorn (*Hippophae rhamnoidesi),* associated with Dune Scrub and Woodland habitat (CD4), to the south of Portmarnock golf course which was not previously recorded in in 2013. While the same study documented *Spartina* swards at the lowermost sections of estuary, the extent of this habitat was greater in the 2022 survey.

## 7.2 Marine Habitats

The habitat mapping based visual investigation surveys carried out in 2023 confirmed that the habitat distribution, whilst in constant flux, has largely remained unaltered since the previous surveys in 2012 and 2017. The majority of the proposed outfall route (marine section) remains a rippled sand, becoming gravelly at the shelf break and out to the proposed marine diffuser location. A veneer of surface sands was shown to accumulate above the gravels at the diffuser, reversing the trend of sand erosion previously recorded during the intervening surveys in 2017. Observations at the sublittoral reefs at Ireland's Eye, within the Rockabill to Dalkey Island SAC, reconfirm earlier observations in 2015 that the reefs display a high diversity with a high settled silt burden recorded over most of the substrate. The presence of geogenic reef complex south of Ireland's Eye was also shown to be more extensive and likely to cover a much larger area than previously thought at Station 27, south of Ireland's Eye. This area was previously designated as 'maerl'-based biogenic sands, although the recent survey has shown that this is predominantly shell-sands.

# 8 References

**Fossitt, 2000**. A Guide to Habitats in Ireland. The Heritage Council. ISSN 1393-6808

**JNCC, 2016.** Annex I Reefs. [Online] Available at http://jncc.defra.gov.uk/page-1448 [Accessed 25 January . 2023].

**MERC, 2010**. Irish Sea Reef Survey Project Report. Carried out by MERC on behalf of National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

**MERC, 2012a.** Intertidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

**MERC, 2012b**. Subtidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

# Appendix I – Field Operations and Survey Methods

**Seabed Photography and Video**

Seabed video and still image acquisition along the proposed outfall pipeline route (marine section) was performed using the BSL MOD 4.0 camera system mounted within a BSL freshwater lens drop down frame equipped with separate strobes and LED lamps. A Kongsberg 408 underwater camera system mounted within a freshwater lens drop down frame equipped with separate LED lamps was used for video and still image acquisition at the transects surrounding and immediately south of Ireland's Eye. Live video streaming was available during operations with SD footage recorded continuously throughout each transect. Still images were captured remotely using a surface control unit via an umbilical to the camera system. The key acquisition parameters of the MOD 4.0 camera system used during the course of this survey are outlined in the brochure manual below.

## BSL MOD4 Camera System

benthic solutions limited

### UNDERWATER CAMERA – MOD4
### Seabed Monitoring & Underwater Real-time Footage

- General Specifications
  - Flexible deployment scenarios
  - Depth rated to 3500m
  - Superior stills and streaming video quality
  - Near zero-delay shutter release
  - Unattended time lapse photography
  - Solutions for very low visibility environments

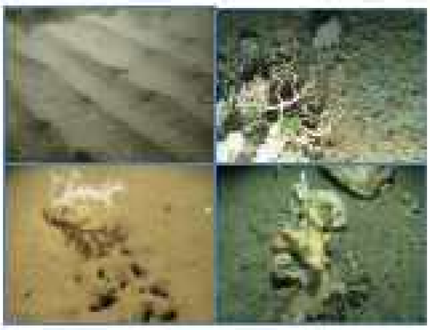
- 4 Camera Configurations
  1. Deepwater real time
  2. Shallow water real time
  3. Ultra deepwater timelapse
  4. Remote timelapse

- 4 Deployment Configurations
  1. Towed system (deep to shallow)
  2. Bed-hop ultra deep water
  3. Remote mooring timelapse
  4. Poor visibility freshwater lens

- Services

Benthic Solutions Ltd have an array of underwater cameras for various deployment scenarious. Our latest development (MOD4) is the most flexible camera to date. For water depths of less than 400m it is capable of communicating with the surface via a multicore umbilical cable, which provides a very high quality live view of the seabed. Zero-delay still images of 24 megapixels can be captured and transmitted to the surface for instant review.

For deeper waters the camera can be controlled via an armoured coax cable, of the type commonly used for towing sidescan sonar. A theoretical maximum cable length of 12km can be used. In this setup, the live feed quality is slightly reduced. To compensate for this an additional 1080p 30fps camera can be added if very high quality seabed video footage is desired.



High output lighting has been developed using the latest LED technology. 2x 2200 lumen lamps provide flood lighting ahead of the camera for video streaming, whilst a multi-head strobe system (up to three heads) can be utilised in TTL configuration to give perfectly exposed under water still images.

Benthic solutions can also provide different camera frames suitable for seabed towing or 'drop down' use. These can be small and lightweight, or larger with increased ballast for deep water scenarios.

| | |
|---|---|
| Shipping weight | 200kg * |
| Shipping dimension | 2 x 1 x 0.2m * |
| Specifications | 2 x 1 x 1m * |

*as multiple configurations are available, values shown indicate the maximum

www.benthicsolutions.com

## Appendix II – Service Warranty

This Appendix, with its associated works and services, has been designed solely to meet the requirements of the contract agreed with Uisce Éireann. If used in other circumstances, some or all of the results may not be valid and we can accept no liability for such use. Such circumstances include different or changed objectives, use by third parties, or changes to, for example, site conditions or legislation occurring after completion of the work. In case of doubt, please consult BSL.

# GREATER DUBLIN DRAINAGE PROJECT

# Appendix B IRELAND’S EYE SUBLITTORAL BIOTOPE SURVEY

**Date of Survey:**
30/03/2023 - 31/03/2023

**Prepared By:**
Benthic Solutions Limited

**Disclaimer:**
This report has been produced in line with the requirements and objectives of the scope of work and contractual terms between Benthic Solutions Limited and the Client. The results are based upon expert interpretation. All interpretation and opinions contained herein are provided based upon the data collated as part of the survey, and other data provided by the Client and available within the public domain.

Page left intentionally blank

# Contents

Contents ... 1
Executive Summary ... 4
1. Introduction ... 6
2. Conservation Objectives ... 6
3. Historical Data ... 8
4. Site Selection ... 9
5. Field Operations Summary Observations 2023 ... 11
6. Results and Discussion ... 13
6.1. Biotope Classification ... 13
6.1.1. Sublittoral Station S1 (2015 and 2023 Comparison) ... 13
6.1.2. Sublittoral Station S2 (2015 and 2023 Comparison) ... 17
6.1.3. Sublittoral Station S3 (2015 and 2023 Comparison) ... 21
6.1.4. Sublittoral Station S4 (2015 and 2023 Comparison) ... 25
6.2. Univariate Analyses ... 29
6.3. Multivariate Analyses ... 30
6.3.1. Sublittoral Stations (2015 and 2023 Comparison) ... 30
7. Conclusion ... 32
8. References ... 33

## List of Figures

Figure 2-1: Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC (NPWS, 2013) ... 7
Figure 4-1: Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines) ... 10
Figure 5-1: Operational Images of 2023 Diving Survey ... 12
Figure 6-1 Sublittoral Zones and Biotopes for Station S1 (2015 and 2023) ... 15
Figure 6-2:Sublittoral Zones and Biotopes for Station S2 (2015 and 2023) ... 19
Figure 6-3: Sublittoral Zones and Biotopes for Station S3 (2015 and 2023) ... 23
Figure 6-4: Sublittoral Zones and Biotopes for Station S4 (2015 and 2023) ... 27
Figure 6-5: Dendrogram of Biotopes Recorded at the Sublittoral Stations (2015 and 2023) ... 31
Figure 6-6: MDS of Biotopes Recorded at the Sublittoral Stations (2015 and 2023) ... 31

## List of Tables

Table 2-1: Rockabill to Dalkey Island SAC Conservation Objectives ... 7

Table 4-1: Proposed Sublittoral Locations in 2015 and 2023 Assessments .......................................... 9

Table 5-1: Chronological Sequence of Field Operations ..................................................................... 11

Table 6-1: Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope (2015 and 2023) ........................................................................................................................... 16

Table 6-2: Species List for Station S2 with SACFOR Abundance Classifications for each Biotope (2015 and 2023) ........................................................................................................................... 19

Table 6-3: Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope (2015 and 2013) ........................................................................................................................... 23

Table 6-4: Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope (2015 and 2023) ........................................................................................................................... 27

## Abbreviations

| Abbreviation | Meaning |
|---|---|
| ASML | Aquatic Survey and Monitoring Limited |
| BSL | Benthic Solutions Limited |
| CR.HCR.XFa.ByErSp.Cyl | 'Mixed turf of bryozoans and erect sponges with *Cylista elegans* on tide-swept circalittoral rock' (in 2023) |
| CR.HCR.XFa.ByErSp.Sag | Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept ciraclittoral rock (in 2015) |
| CR.HCR.XFa.FluCoAs | *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock |
| GDD | Greater Dublin Drainage |
| CR.HCR.XFa.FluCoAs.Paur | *Polyclinum aurantium* and *Flustra foliacea* on sand-scoured tide-swept moderately wave-exposed circalittoral rock |
| IR.HIR.KFaR.FoR | Foliose red seaweeds on exposed lower infralittoral rock |
| IR.HIR.KFaR.FoR.Dic | Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock |
| IR.MIR.KR.Ldig | *Laminaria digitata* on moderately exposed sublittoral fringe rock |
| IR.MIR.KR.Ldig.Ldig | *Laminaria digitata* on moderately exposed sublittoral fringe bedrock |
| MDS | Multi-Dimensional Scaling |
| MERC | Marine and Environmental Resource Conservation Consultants |
| MNCR | Marine Nature Conservation Review |
| MDS | Multi-Dimensional Scaling |
| NPWS | National Parks & Wildlife Service |
| ODM | Ordnance Datum Malin |
| PRIMER | Plymouth Routines In Multivariate Ecological Research |
| RIB | Rigid-Inflatable Boat |
| SAC | Special Areas of Conservation |
| SACFOR | Superabundant, Abundant, Common, Frequent, Occasional and Rare |
| SD | Standard Deviation |

# Executive Summary

Ireland's Eye is a small uninhabited island located to the north of Howth Head, within the Rockabill to Dalkey Island Special Area of Conservation (SAC) (site code 3000), and is designated for Annex 1 qualifying interest, Reefs. As the site is within close proximity to the proposed outfall pipeline route (marine section), these interests may be subject to plume effects from suspended sediment during parts of the construction phase that involve dredging or by the proposed outfall plume itself.

An Environmental Impact Assessment Report (EIAR) was prepared for the Proposed Project and submitted for planning in 2018. Chapter 9 (Biodiversity (Marine)) of the EIAR in the 2018 planning application considered marine biodiversity. As detailed in Chapter 1A (Introduction) in Volume 2A of the Environmental Impact Assessment Report (EIAR) Addendum Report, we have reviewed the Chapter 9 (Biodiversity (Marine)) and the associated appendices of the EIAR submitted with the original 2018 planning application, in the light of:

- Changes to the baseline environment;
- The requirement for updated surveys; and
- Any changes to the law, policy, or industry standards and guidance in the intervening period.

The data has been compared with the relevant baseline in Chapter 9 (Biodiversity (Marine)) in Volume 3 Part A of the EIAR in the 2018 planning application to identify any material changes to the baseline conditions in the intervening period.

The survey undertaken in March 2023 is a re-evaluation of the sublittoral environment along four repeated transects. These were based on a generic assessment of biotopes using the standard Marine Nature Conservation Review (MNCR) style format. Identification and abundance of conspicuous fauna and flora were scaled on-site using the SACFOR scheme (e.g. superabundant, abundant, common, frequent, occasional and rare) ); (Hiscock 1996).

The sublittoral stations were characterised by *Laminaria digitata* forests in the shallower part (*IR.MIR.KR.Ldig.Ldig*) and were usually replaced by the biotope 'Foliose red seaweeds with dense *Dictyota dichotoma* and/or *Dictyopteris membranacea* on exposed lower infralittoral rock' (*IR.HIR.KFaR.FoR.Dic)*. The deeper extent was dominated by a 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock' (*CR.HCR.XFa.ByErSp.Sag, in 2015*) updated to 'Mixed turf of bryozoans and erect sponges with *Cylista elegans* on tide-swept circalittoral rock' (*CR.HCR.XFa.ByErSp.Cyl* in 2023), or in the case of Sublittoral Station 2, '*Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock' (*CR.HCR.XFa.FluCoAs*). The deeper biotope at Sublittoral Station 4 was categorised as a possible '*Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock' (*HCR.XFa.FluCoAs.Paur*), probably due to the increased sedimentation noted at this station.

Univariate analyses showed clear differences between the littoral and sublittoral stations in terms of species richness with twice as many species recorded from the sublittoral area (88.3±19.2SD in 2015 and 62.8±6.82SD in 2023) as opposed to 44.7±11.6SD). Both littoral and sublittoral environments indicated moderately high species diversity. Multivariate analyses revealed statistical separation of biotopes with the vertical zonation of the fauna (by water depth or height on the foreshore) constituting the dominant community patterns observed. of the sublittoral surveys indicated a notable reduction in diversity between survey years, predominantly due to the reduction in over-wintering algal species recorded during the winter survey in 2023.

No species of particular nature conservation interest were noted during any of the surveys and no rare or particularly fragile biotopes were recorded. However natural siltation levels were high in the sublittoral environment (for both survey years and seasons), a fact that has not appeared to have had

a significant impact to the biological diversity in this area. Whilst siltation levels are high in the sublittoral environment, a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities..

# 1. Introduction

Benthic Solutions Limited (BSL) was commissioned to complete updated surveys to inform the Greater Dublin Drainage Project (hereafter referred to as the Proposed Project) Environmental Impact Assessment Report (EIAR) Addendum Report.

An Environmental Impact Assessment Report (EIAR) was prepared for the Proposed Project and submitted for planning in 2018. Chapter 9 (Biodiversity (Marine)) of the EIAR in the 2018 planning application considered marine biodiversity.

As detailed in Chapter 1A (Introduction) in Volume 2A of the Environmental Impact Assessment Report (EIAR) Addendum Report, we have reviewed the Chapter 9 (Biodiversity (Marine)) and the associated appendices of the EIAR submitted with the original 2018 planning application, in the light of:

- Changes to the baseline environment;
- The requirement for updated surveys; and
- Any changes to the law, policy, or industry standards and guidance in the intervening period.

In updating the baseline ecology information for the Proposed Project this was completed cognisant of the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater, Coastal and Marine (hereafter referred to as the CIEEM Guideline) (CIEEM 2018), with respect to the validity of baseline data.

This Appendix is a factual account of the update surveys which have been completed for the Proposed Project; documenting the methodology and findings of these surveys.

Field operations were completed via a dedicated dive survey, undertaken in March 2023 to acquire a detailed assessment of the qualifying habitats at sublittoral stations.

In addition, the data has been compared with the relevant baseline in Chapter 9 (Biodiversity (Marine)) in Volume 3 Part A of the EIAR in the 2018 planning application to identify any material changes to the baseline conditions in the intervening period. Any identified material changes have then been used to inform Chapter 9A (Biodiversity (Marine)) in Volume 3A Part A of the EIAR addendum.

# 2. Conservation Objectives

The proposed outfall pipeline route (marine section) will terminate at the proposed marine diffuser location, approximately 1km (kilometre) north-east of Ireland's Eye, and will fall within the Rockabill to Dalkey Island Special Area of Conservation (SAC). The conservation objectives of the Rockabill to Dalkey Island SAC include Annex I qualifying Reefs (Figure 2-1). To maintain the favourable conservation conditions of these Reefs within the SAC, the following criteria are proposed by the National Parks and Wildlife Service (NPWS) .

Table 2-1: Rockabill to Dalkey Island SAC Conservation Objectives

| Attribute | Measure | Target | Notes |
|---|---|---|---|
| Habitat area | Hectares | The permanent area is stable or increasing, subject to natural processes. See Figure 2-1 | Habitat area estimated as 182ha (hectares) using 2010 and 2011 intertidal and subtidal reef survey data (MERC 2010; 2012a; 2012b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0) |
| Habitat distribution | Occurrence | Distribution is stable or increasing, subject to natural processes. See Figure 2-1 | Distribution derived from 2010 and 2011 intertidal and subtidal reef survey data (MERC 2010; 2012a; 2012b), InfoMar bathymetry and the Arklow to Skerries Islands Admiralty Chart (1468_0). |
| Community structure | Biological composition | Conserve the following community types in a natural condition: Intertidal reef community complex; and Subtidal reef community complex. See Figure 2-1 | Reef community mapping based on 2010 and 2011 intertidal and subtidal reef survey data (MERC 2010; 2012a; 2012b). |

Figure 2-1: Ireland's Eye Marine Community Types Designated by Rockabill to Dalkey Island SAC (NPWS, 2013)

# 3. Historical Data

Within the Rockabill to Dalkey Island SAC, two community types were recorded within the Annex I habitat, namely the Intertidal reef community complex and the Subtidal reef community complex (Reefs 1170). Intertidal and subtidal surveys were undertaken in 2010 and 2011 (MERC 2010; MERC 2012a and MERC 2012b). These data were used to determine the physical and biological nature of the Annex I habitat. Estimated areas of each community type within the Annex I habitat, are based on interpolation, and are shown in Figure 2-1. Both complexes were surveyed via a dedicated dive survey team undertaken in 2015, whilst the sublittoral complex was repeated as part of the current survey.

**SUBTIDAL REEF COMMUNITY COMPLEX**

This reef community complex was initially recorded off the northern, eastern and southern shores of Ireland’s Eye immediately south of the proposed outfall pipeline route (marine section) and proposed marine diffuser location. The substrate ranged from that of flat and sloping bedrock, to bedrock with boulders and also a mosaic of cobbles and boulders. Vertical rock walls occurred on the north and east of Ireland’s Eye, whilst the northern reaches of the island both show sediment scouring and a thin veneer of silt on the reefs.

In general, previous surveys (MERC 2010; MERC 2012a; MERC 2012b and BSL 2015a) noted that where the reef was subjected to the effects of sediment, either through scouring or settlement of silt, low numbers of species and individuals were found. The later dive survey (BSL 2015b and the current survey) confirmed that natural siltation levels were high in the sublittoral environment, although this fact had not appeared to have had a significant impact on biological diversity in this area.

# 4. Site Selection

A total of four sublittoral locations were established for survey operations in 2015 and repeated in the current study (outlined in Table 4-1, and presented in Figure 4-1).

**Table 4-1: Proposed Sublittoral Locations in 2015 and 2023 Assessments**

| Site | Transect | Easting | Northing | Description | Depth (ODM) |
|---|---|---|---|---|---|
| Sublittoral sites (2015 and 2023) | | | | | |
| S1 | Start | 728470.3 | 741625.0 | Sublittoral: Northwest stack and discrete sublittoral reef feature | -9.5m |
| | End | 728369.1 | 741589.2 | | |
| S2 | Start | 728745.5 | 741626.2 | Sublittoral: Standard slope with boulder field at base | -17.2m |
| | End | 728752.9 | 741526.2 | | |
| S3 | Start | 729161.4 | 740937.5 | Sublittoral: Exposed southeast island pinnacles | -13.8m |
| | End | 729060.2 | 740969.6 | | |
| S4 | Start | 729187.4 | 740556.2 | Sublittoral: Exposed southeast islet pinnacles | -14.9m |
| | End | 729102.2 | 740624.0 | | |

*Geodesy based on Irish National Grid and vertical datum of Ordnance datum Malin Head (ODM)*

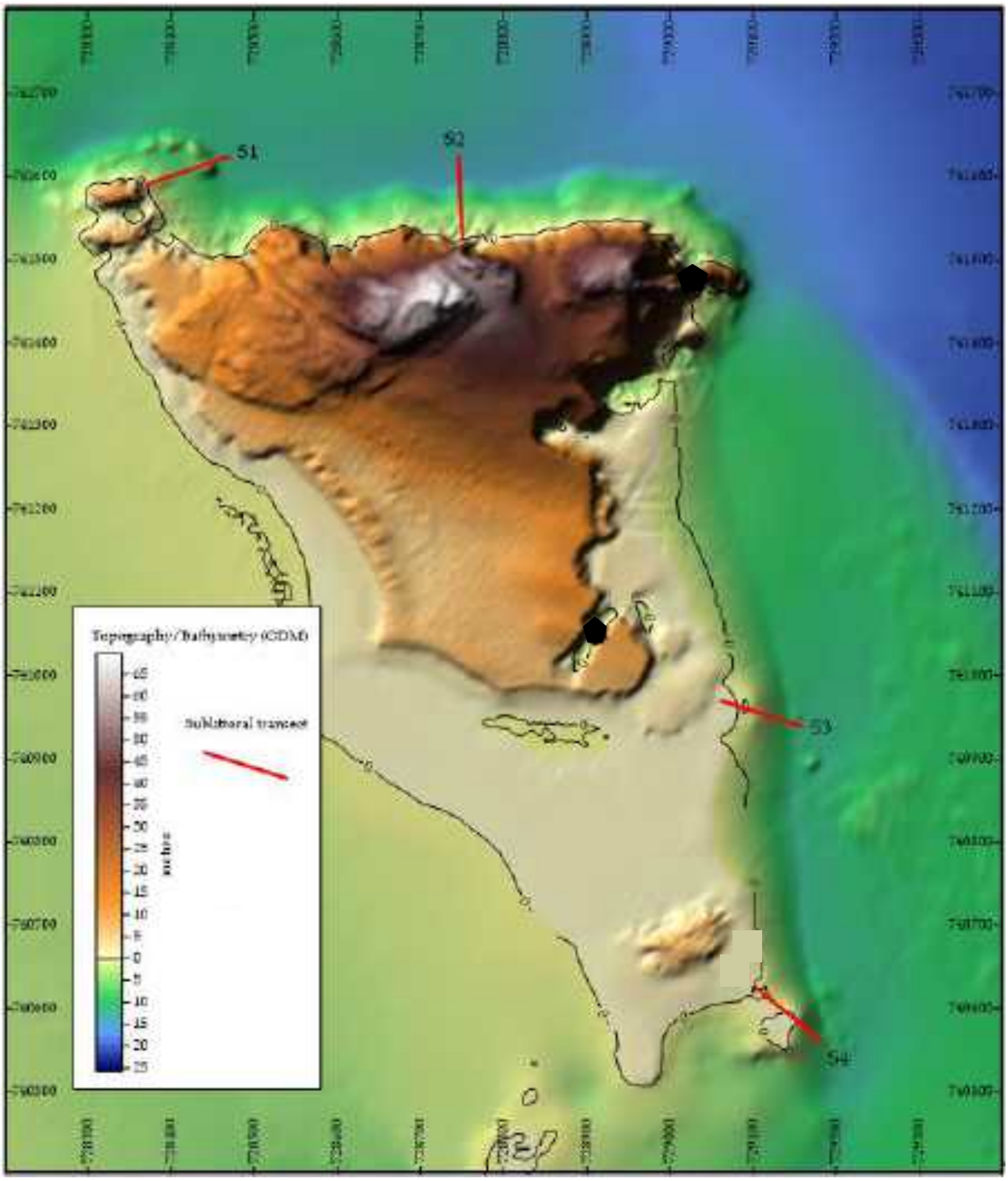



**Figure 4-1: Composite Topography/Bathymetry of Irelands Eye with Proposed Survey Locations for Sublittoral Transects (lines)**

# 5. Field Operations Summary Observations 2023

Field survey operations were completed successfully at all sublittoral locations between 30 and 31 March 2023. A four man dive team, made up from representatives from both MERC and ASML, was mobilised to site on 29 March 2023, with operations carried out from a 10m Offshore 105 work vessel mobilised from the West Pier in Howth. Weather was marginal on the first day but became good for the remainder of the survey period. Transects S1 and S2 were completed on the first day, with transects S3 and S4 concluded on the second. Operational visibility was poor at less than one metre throughout.

A summary of the field operations is outlined in Table 5-1.

**Table 5-1: Chronological Sequence of Field Operations**

| Day | Date | Operations | Comment |
|---|---|---|---|
| 1 | 29/03/23 | Mobilisation to Howth | ASML and MERC mobilised. Vessel supplied by Commercial Charters awaiting arrival on Wet Pier Howth.. |
| 2 | 30/03/23 | Ops: Diving survey | 2 diving sites completed (S1 and S2) |
| 3 | 31/03/23 | Ops: Diving survey | 2 diving sites completed (S3 and S4) |
| 4 | 01/04/23 | Demobilisation from Howth | ASML team demobilised back to the UK. |

Operations were carried out using a pair of divers. The survey involved the divers descending to the seabed, locating the sediment reef interface and then proceeding along the pre-determined bearing, ascending the reef towards the shore (Figure 5-1). The diver pairs consisted of a recorder and a photographer. As with the 2015 survey, the recorder surveyed the seabed for both fauna and flora along the transect with a width of approximately 5m. All taxa observed were recorded in terms of their abundance values as assessed on the Marine Nature Conservation Review (MNCR) Abundance Scale (SACFOR); (Hiscock 1996). If the identification was in doubt, then taxa were either photographed for later identification, or a specimen was collected for identification with the aid of keys and microscopes back at the survey base. The photographer endeavoured to create a digital photographic record of the faunal and floral component along each transect and within each biotope. Due to the winter timing of the survey, some of the floral and faunal component of the biotopes that are annual species were missing as they had not had time to grow large enough to be observed. However, perennial taxa and many small individuals of annual species were recorded and so gross biotopes were still identifiable.


North shore of Ireland Eye

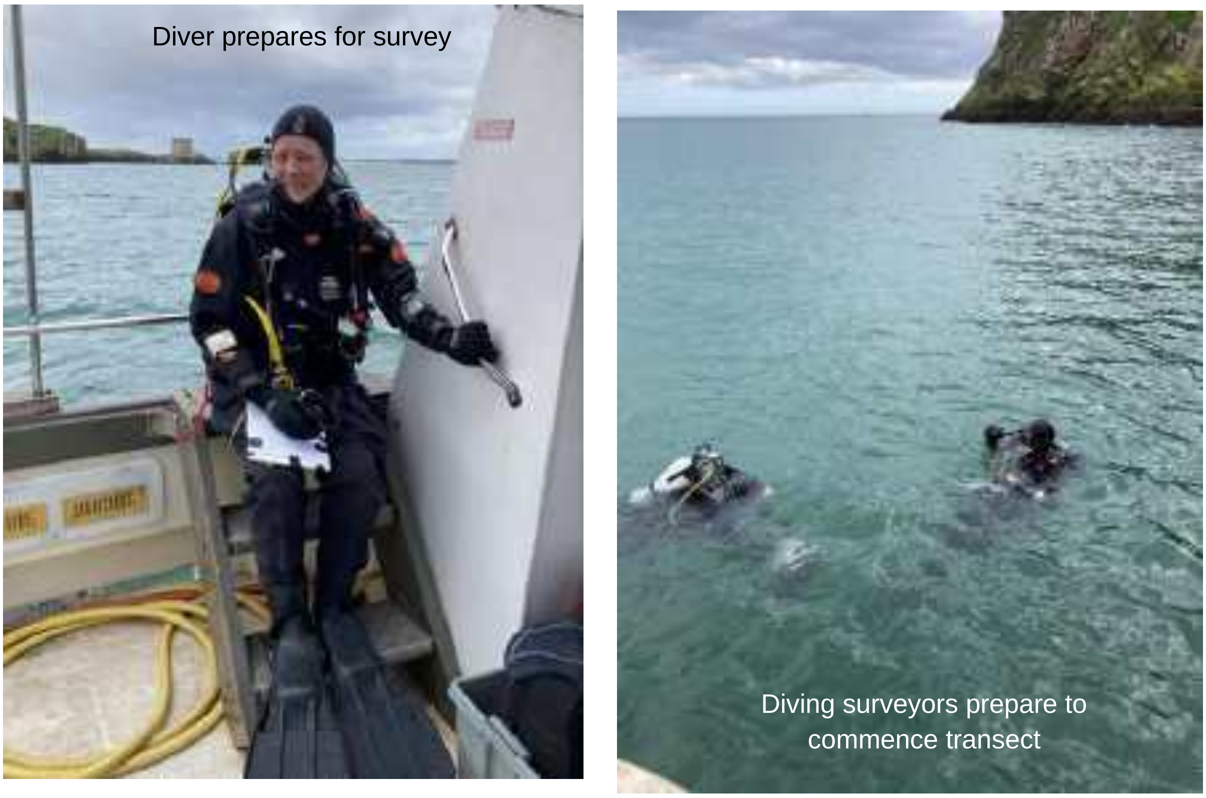



**Figure 5-1: Operational Images of 2023 Diving Survey**

# 6. Results and Discussion

This survey has collected semi-quantitative data from the sublittoral zone, four stations (S1 to S4) of which all were found to be heavily silted, but were moderately diverse. The photographs and data presented herein may act as a comparison, against which future gross changes could be qualitatively assessed. Some comparisons have been drawn with dive data acquired in 2015.

In order to determine any significant differences between the stations surveyed, the SACFOR scale was additionally categorised from 1 (rare) to 6 (superabundant). Basic statistical analyses as well as multi-dimensional statistical techniques were applied to the dataset to present the data as a cluster diagram and MDS plot. While useful to present general trends within the datasets, due to the semi quantitative nature of the SACFOR classifications, not too much reliance should be placed on the statistical analyses.

## 6.1. Biotope Classification

### 6.1.1. Sublittoral Station S1 (2015 and 2023 Comparison)

This site lies off the north-west corner of Ireland's Eye and the reef here runs on to the muddy gravel at approximately 10.7m ODM. The rock surface in this vicinity was found to be considerably silted as in 2015. Just above the sediment interface (9.5 to 6.7m ODM – biotope iii), the biotope was found to be dominated by the feather-star *Antedon bifida*, the plumose anemone *Metridium senile*, common starfish and the barnacle *Balanus crenatus*. Other anemones such as *Cylista elegans*, *Alcyonium digitatum* and *Urticina felina* were also frequently encountered along with several sponge species (Hali*clona oculata, Hymeniacidon perleve, Suberites ficus, Halichondria panicea* and *Amphilectus fucorum*). The hydroids (*Obelia dichotoma*) and bryozoans (*Flustra foliacea, Chartella papyracea* and *Scrupocellaria* spp) were also common and the overall biotope make-up was still similar to the *CR.HCR.XFa.ByErSp.Cyl* which is a biotope of a 'Mixed turf of bryozoans and erect sponges with *Cylista elegans* on tide-swept circalittoral rock' (this was *CR.HCR.XFa.ByErSp.Sag* in 2015).

Above this community, the next biotope (ii) lay between 6.7 to 4.9 Ordnance Datum Malin (ODM) approximately. Here the foliose algae began to colonise the rock surface. This biotope was also heavily silted.

Biotope ii was previously characterised in the summer by the foliose brown algae *Dictyota dichotoma* and *Dictyopteris polypodioides*, but at this time of year these were only visible as minute brown sporelings. Some of the foliose red algae had over-wintered, in particular *Delesseria sanguinea, Phyllophora crispa* and *Hypoglossum hypoglossoides* were seen. Numerous other small foliose red algal species were also noted. Occasional sugar kelp, *Saccharina latissima* was present on the more sheltered rock.

The faunal component of this biotope was characterised by the anemones *Urticina felina*, *Cylista elegans* and *Anemonia viridis* with abundant feather-stars *Antedon bifida*. Obe*lia* spp., *Balanus crenatus, Aplidium punctum*, and *Spirobranchus* spp. were all found within the silty turf, along with large patches of *Cliona celata* which is the yellow boring sponge. The biotope was still found to be close to *IR.HIR.KFaR.FoR.Dic*, as recorded in 2015 (i.e. Foliose red seaweeds with dense *Dictyota dichotoma* on exposed lower infralittoral rock).

The final sublittoral biotope encountered at S1 from 4.9 to 2.7 above the foliose algal zone, was a zone of stunted *Laminaria digitata* and *L. hyperborea* kelp plants, with several other foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea*. Beneath these algae were crusts of barnacles and sparse mussels, with frequent common starfish (*Asterias rubens*). Abundant kelp sporelings were seen in the sward with U*rticina felina, Halichondria panicea* and *Alcyonium digitatum*. A probable pair of biotopes for this assemblage is *IR.MIR.KR.Ldig.Ldig* above a band of *IR.HIR.-KFaR.LhypR.Ft Laminaria hyperborea* forest with dense foliose red seaweeds on exposed upper infralittoral rock i.e. similar to 2015.

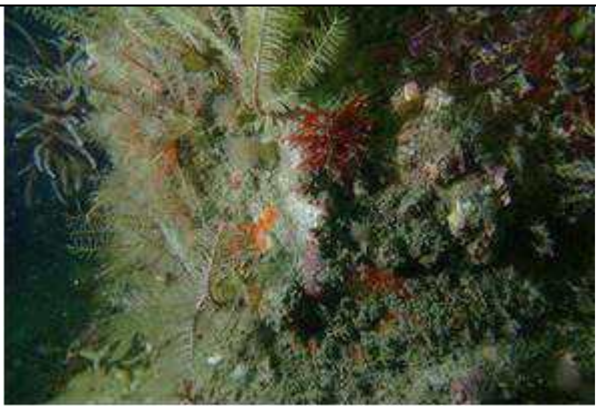
The final biotope encountered at S1 above the foliose algal zone, was a zone of stunted *Laminaria digitata* kelp plants, with several other foliose red algae, such as *Palmaria palmata* and *Delesseria sanguinea.* Beneath these algae, crusts of mussels and barnacles were found, often being predated by the common starfish, *Asterias rubens*. A probable biotope for this assemblage is *IR.MIR.KR.Ldig.Ldig*.

Photographs from each sublittoral zone / biotope are shown in Figure 6-1, while a full species list with SACFOR classification is presented in Table 6-1.


*iii: CR.HCR.XFa.ByErSp.Cyl (2023)*


iii: *CR.HCR.XFa.ByErSp.Sag (2015)*


iii: *CR.HCR.XFa.ByErSp.Sag (2015)*


*ii: IR.HIR.KFaR.FoR.Dic (2023)*


ii: *IR.HIR.KFaR.FoR.Dic (2015)*

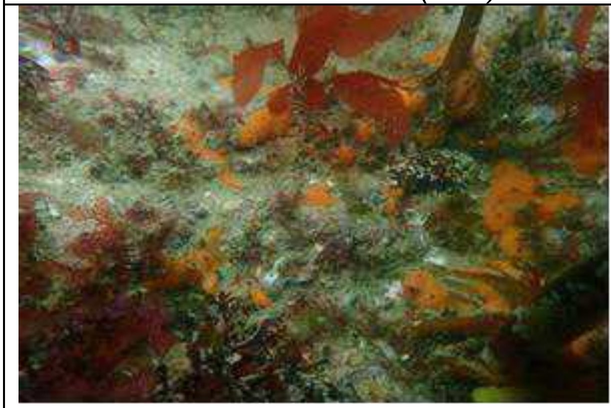
| | |
|---|---|
| <br>*ii: IR.HIR.KFaR.FoR.Dic (2023)* | <br>ii: *IR.HIR.KFaR.FoR.Dic (2015)* |
| <br>*i: IR.MIR.KR.Ldig.Ldig (2023)* | <br>i: *IR.MIR.KR.Ldig.Ldig* |

**Figure 6-1 Sublittoral Zones and Biotopes for Station S1 (2015 and 2023)**

**Table 6-1: Species List for Station S1 with SACFOR Abundance Classifications for Each Biotope (2015 and 2023)**

| MCS Code | Taxa | 2015 S1 | | | 2023 S1 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| C00350 | *Scypha ciliata* | F | R | | R | | |
| C02210 | *Suberites ficus* | | | R | | R | O |
| C04840 | *Halichondria panicea* | R | O | O | F | O | O |
| C05230 | *Hymeniacidon perleve* | | | | | | R |
| C05960 | *Esperiopsis fucorum* | | O | O | | | |
| C07750 | *Hemimycale columella* | | | | R | R | R |
| C08600 | *Haliclona oculata* | | | | | R | O |
| C08630 | *Haliclona simulans* | | F | O | | | |
| D01440 | *Tubularia indivisa* | | | O | | R | O |
| D06690 | *Sertularella polyzonias* | | | | R | | R |
| D06760 | *Sertularia argentea* | | | O | | | R |
| D07300 | *Obelia dichotoma* | | O | O | | R | R |
| D07310 | *Obelia geniculata* | F | O | R | O | R | R |
| D10240 | *Alcyonium digitatum* | | C | C | R | C | C |
| D11580 | *Anemonia viridis* | | F | | | F | R |
| D11680 | *Urticina felina* | O | C | A | C | C | A |
| D12250 | *Metridium senile* | | C | C | | O | F |
| D12310 | *Cylista elegans* | O | C | C | R | F | R |
| D13700 | *Caryophyllia smithii* | | | R | | | R |
| P23020 | *Spirobranchus* | | | | F | O | O |
| P23040 | *Spirobranchus triqueter* | F | O | | | | |
| R01090 | *Balanus balanus* | | | | | R | O |
| R01100 | *Balanus crenatus* | | C | S | | C | S |
| S25020 | *Pisidia longicornis* | | R | R | | R | R |
| S25750 | *Inachus sp.* | | | | | R | R |
| S26460 | *Cancer pagurus* | | F | | | F | O |
| S26720 | *Necora puber* | F | A | C | F | A | A |
| W12740 | *Doto coronata* | | O | O | | | |
| W14030 | *Archidoris pseudoargus* | R | | | R | R | |
| W16500 | *Mytilus edulis* | S | R | | O | R | |
| W18130 | Anomiidae | | | | R | A | C |
| Y00030 | Crisiidae | | | | F | F | C |
| Y06640 | *Membranipora membranaceae* | F | | | R | | |
| Y06780 | *Electra pilosa* | F | | | O | | |
| Y06940 | *Flustra foliacea* | | | O | | | O |
| Y07050 | *Chartella papyracea* | | | | | R | O |
| Y08360 | *Scrupocellaria sp.* | | | F | R | F | F |
| Y08720 | *Bugula flabellata* | | | R | | R | R |
| ZB00110 | *Antedon bifida* | | C | S | | C | A |
| ZB01900 | *Asterias rubens* | C | A | C | C | C | C |
| ZB02350 | *Ophiothrix fragilis* | | | O | R | | O |
| ZB02680 | *Ophiactis balli* | | | R | | | |
| ZB03000 | *Amphipholis squamata* | | R | | | | |
| ZD00060 | *Clavelina lepadiformis* | O | R | C | | R | R |
| ZD00340 | *Polyclinum aurantium* | | | | | O | O |
| ZD00460 | *Morchellium argus* | O | R | R | R | R | R |
| ZD00640 | *Aplidium punctum* | O | R | R | F | F | O |
| ZD01940 | *Dendrodoa grossularia* | O | O | | | | |
| ZD02090 | *Botryllus schlosseri* | | R | | | | |
| ZG01500 | Gadidae | R | R | | R | | R |
| ZG04380 | *Taurulus bubalis* | R | R | | | | |
| ZG07050 | *Gobiidae* | R | | | | | |
| ZM02080 | *Bonnemaisonia asparagoides* | O | O | | | | |
| ZM03230 | *Callophyllis laciniata* | O | | | | | |
| ZM04040 | *Corallina officinalis* | R | | | R | | |
| ZM06310 | *Plocamium cartilagineum* | O | O | | R | | |
| ZM06820 | *Calliblepharis ciliata* | R | R | | | | |
| ZM06880 | *Cystoclonium purpureum* | O | F | | R | | |
| ZM06930 | *Rhodophyllis divaricata* | O | F | | | | |
| ZM08070 | *Ceramium sp.* | O | O | | | | |

| MCS Code | Taxa | 2015 S1 | | | 2023 S1 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| ZM08460 | *Halurus flosculosus* | | R | | | | |
| ZM09500 | *Cryptopleura ramosa* | F | R | | R | R | |
| ZM09550 | *Delesseria sanguinea* | F | F | | R | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | O | O | | R | R | |
| ZM09900 | *Membranoptera alata* | R | | | | | |
| ZM10120 | *Phycodrys rubens* | R | F | | | | |
| ZM10180 | *Erythroglossum laciniatum* | | R | | | | |
| ZM11050 | *Polysiphonia elongata* | | R | | | | |
| - | *Brogniartella byssoides* | O | | | | | |
| - | Red sponge crust | | R | | | | |
| ZR04570 | *Dictyota dichotoma* | R | C | | R | R | |
| ZR04780 | *Taonia atomaria* | | R | | | | |
| ZR04970 | *Desmarestia aculeata* | R | | | | | |
| ZR04990 | *Desmarestia ligulata* | R | | | | | |
| ZR06320 | *Laminaria digitata* | S | | | F | | |
| ZR06330 | *Laminaria hyperborea* | | | | O | | |
| ZR06360 | *Saccharina latissima* | O | R | | | R | |
| ZS02400 | *Ulva* (flat) | R | | | | | |
| ZS03920 | *Bryopsis plumosa* | R | | | | | |

### 6.1.2. Sublittoral Station S2 (2015 and 2023 Comparison)

This site is situated in the middle of the north coast of Ireland's Eye and begins where the steep boulder slope meets the muddy gravel plain at approximately 15.7m ODM. The broken reef is pockmarked with deposits of muddy gravel which are frequently inhabited by the holothurian *Thyone fusus*. The biotope on the reef of boulders and bedrock outcrops is dominated by the erect hydroids and bryozoans *Flustra foliacea, Nemertesia* sp. and *Obelia geniculata* and the rock surface is colonised by crustose bryozoans, young hydroids, the polychaete worm *Sabellaria spinulosa* and occasional sponge crusts and tunicates.

Other dominant taxa of note were the barnacles *Balanus crenatus* and the anemone *Alcyonium digitatum*, and frequent sponges, *Hymeniacidon perleve*, *Haliclona oculata* and *Hemimycale columella* were seen. Both the hydroids *Nemertesia antennina* and *Nemertesia ramosa* were present as was the cup coral *Caryophyllia smithii*. Whilst the tunicate *Clavelina lepadiformis* was seen but was still very small. The colonial tunicate *Aplidium punctum* was prominent in the community. The biotope tag for this assemblage is therefore still consistent with the findings of the 2015 survey (i.e. *CR.HCR.XFa.FluCoAs*, or *Flustra foliacea* and colonial ascidians on tide-swept moderately wave-exposed circalittoral rock).

Above biotope iii, at 8.7m ODM, biotope ii was found to still be the *Dictyota* and foliose red algal biotope, as in 2015. However, the algal sward was fairly thin due to the lack of seasonal growth found in March. The dominant visible algae seen were *Delesseria sanguinea* and *Hypoglossum hypoglossoides* and possibly very small *Rhodymenia holmesii. Dictyota dichotoma* and / or *Dictyopteris membranacea* can be seen in the plates below to be no more than minute brown sporelings. The tiny tunicate, *Pycnoclavella aurilucens*, can also be seen in the surface of the silt, and where the urchin *Echinus esculentus* was present, coralline crusts were visible on the rock in the grazed track.

Hence, the biotope was found to be close to *IR.HIR.KFaR.FoR.Dic* or Foliose red seaweeds with dense *Dictyota dichotoma* and / or *Dictyopteris membranacea* on exposed lower infralittoral rock, as in 2015.

As with Sublittoral Station 1, above the foliose algal zone, there was again a zone of stunted *Laminaria digitata* kelp plants, with numerous small foliose red algae. Many of the kelp plants had been lost to winter weather and foliose algae were also sparse. However the biotope *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock was seen to be still valid. Photographs from each littoral zone/biotope are shown in Figure 6-2, while a full species list with SACFOR classification is presented in Table 6-2.

| | |
|---|---|
| <br>iii: *CR.HCR.XFa.FluCoAs (2023)* | <br>iii: *CR.HCR.XFa.FluCoAs (2015)* |
| <br>iii: *CR.HCR.XFa.FluCoAs (2023)* | <br>iii: *CR.HCR.XFa.FluCoAs (2015)* |
| <br>ii: *IR.HIR.KFaR.FoR.Dic (2023)* | <br>ii: *IR.HIR.KFaR.FoR.Dic (2015)* |


i: *IR.MIR.KR.Ldig.Ldig(2023)*


i: *IR.MIR.KR.Ldig.Ldig (2015)*

**Figure 6-2:Sublittoral Zones and Biotopes for Station S2 (2015 and 2023)**

**Table 6-2: Species List for Station S2 with SACFOR Abundance Classifications for each Biotope (2015 and 2023)**

| MCS Code | Taxa | 2015 S2 | | | 2023 S2 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| C00350 | *Sycon ciliatum* | | | | O | | |
| C00350 | *Scypha ciliata* | F | | F | | | |
| C02210 | *Suberites ficus* | | R | R | | R | R |
| C04810 | *Halichondria bowerbanki* | | | O | | | |
| C04840 | *Halichondria panicea* | F | | | F | R | |
| C05230 | *Hymeniacidon perleve* | O | F | F | O | O | |
| C05960 | *Esperiopsis fucorum* | O | F | F | | O | O |
| C06420 | *Myxilla sp.* | R | | R | | | R |
| C06840 | *Iophon hyndmani* | | O | | | | |
| C08630 | *Haliclona simulans* | | F | F | | R | R |
| D01440 | *Tubularia indivisa* | | | R | | | R |
| D05260 | *Halecium halecinum* | | O | O | | R | R |
| D05500 | Aglaophenia | | R | R | R | R | |
| D05780 | *Halopteris catharina* | | | F | | | |
| D05970 | *Nemertesia antennina* | | F | F | | O | F |
| D05990 | *Nemertesia ramosa* | | O | R | | F | R |
| D06690 | *Sertularella polyzonias* | | | O | | | |
| D06760 | *Sertularia argentea* | R | | | R | R | |
| D07300 | *Obelia dichotoma* | O | F | F | | | |
| D07310 | *Obelia geniculata* | F | | | F | O | R |
| D07320 | *Obelia longissima* | | | O | | | |
| D10240 | *Alcyonium digitatum* | F | C | F | O | C | O |
| D11680 | *Urticina felina* | | | R | R | R | R |
| D12310 | *Cylista elegans* | | R | R | | R | R |
| D13700 | *Caryophyllia smithii* | | | | | | R |
| P23020 | *Spirobranchus* | | | F | O | O | F |
| P23040 | *Spirobranchus triqueter* | F | R | | | | |
| R01090 | *Balanus balanus* | | R | O | | R | O |
| R01100 | *Balanus crenatus* | C | F | O | C | F | O |
| S01660 | Amphipoda | C | C | F | O | O | R |
| S10700 | Caprellidae | C | C | | | | |
| S22100 | *Palaemon serratus* | O | F | F | O | F | F |
| S23220 | *Pandalus montagui* | F | | | | | |
| S23600 | *Homarus gammarus* | | | R | | | R |
| S24650 | *Pagurus bernhardus* | | | R | R | R | R |
| S25850 | *Macropodia rostrata* | O | O | | | | |
| S26460 | *Cancer pagurus* | R | O | O | | O | O |
| S26720 | *Necora puber* | O | O | O | F | F | O |
| S26900 | *Carcinus maenas* | O | | | | | |
| W12720 | *Doto sp* | | R | R | | | |
| W16500 | *Mytilus edulis* | C | | | O | | |
| Y00030 | Crisiidae | F | O | O | F | O | O |

| MCS Code | Taxa | 2015 S2 | | | 2023 S2 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| Y01370 | *Alcyonidium diaphanum* | | F | F | | O | O |
| Y06640 | *Membranipora* | C | | | O | | |
| Y06780 | *Electra pilosa* | A | F | | F | F | |
| Y06940 | *Flustra foliacea* | | F | C | | F | C |
| Y07050 | *Chartella papyracea* | | R | O | R | O | O |
| Y07100 | *Securiflustra securifrons* | | R | | | | |
| Y08360 | *Scrupocellaria sp.* | F | C | | | | |
| Y08410 | *Scrupocellaria scruposa* | | | A | | | |
| Y08530 | *Bicellariella ciliata* | | | O | | | O |
| Y08720 | *Bugula flabellata* | R | O | C | R | R | O |
| Y08750 | *Bugula plumosa* | | | R | | | |
| ZB00110 | *Antedon bifida* | R | O | O | R | F | F |
| ZB01900 | *Asterias rubens* | C | C | C | O | O | F |
| ZB02350 | *Ophiothrix fragilis* | C | | O | R | R | O |
| ZB03620 | *Echinus esculentus* | R | R | O | | O | O |
| ZB04740 | *Pawsonia saxicola* | | | | | O | |
| ZB04950 | *Thyone fusus* | | O | | | O | O |
| ZD00060 | *Clavelina lepadiformis* | R | F | F | R | R | O |
| ZD00640 | *Aplidium punctum* | R | O | O | O | F | F |
| ZD01880 | *Polycarpa scuba* | | | O | R | O | O |
| ZD01940 | *Dendrodoa grossularia* | | R | R | | R | R |
| ZD02090 | *Botryllus schlosseri* | R | R | | R | R | |
| ZG01500 | Gadidae | | R | R | | | |
| ZG01960 | *Molva molva* | | R | | | | |
| ZG03760 | *Syngnathus acus* | | R | | | | |
| ZG04340 | *Myoxocephalus scorpius* | | | R | | | |
| ZG04380 | *Taurulus bubalis* | | | | | | R |
| ZG06050 | *Ctenolabrus rupestris* | | R | | | | |
| ZG07000 | *Callionymus lyra* | | R | O | | | |
| ZG07050 | Gobiidae | | | R | | | |
| ZG07230 | *Gobius niger* | | R | R | | | |
| ZG07440 | *Pomatoschistus pictus* | | | R | | | |
| ZM02080 | *Bonnemaisonia asparagoides* | O | R | | | | |
| ZM02420 | *Palmaria palmata* | O | | | | | |
| ZM02560 | *Dilsea carnosa* | O | R | | R | R | |
| ZM03230 | *Callophyllis laciniata* | O | R | | | | |
| ZM03840 | Corallinaceae (enc) | F | O | | F | O | |
| ZM05840 | *Phyllophora crispa* | F | O | | R | R | |
| ZM05860 | *Phyllophora pseudoceranoides* | C | | | | | |
| ZM06110 | *Chondrus crispus* | C | | | | | |
| ZM06310 | *Plocamium cartilagineum* | F | O | | | | |
| ZM06820 | *Calliblepharis ciliata* | F | A | | | | |
| ZM06880 | *Cystoclonium purpureum* | | O | | R | R | |
| ZM06930 | *Rhodophyllis divaricata* | | F | | | R | |
| ZM07230 | *Rhodymenia holmesii* | | C | | | | |
| ZM07530 | *Lomentaria orcadensis* | R | R | | | | |
| ZM07860 | *Aglaothamnion byssoides* | | R | | | | |
| ZM08239 | *Ceramium secundatum* | | R | | | | |
| ZM08460 | *Halurus flosculosus* | R | | | | | |
| ZM09230 | *Sphondylothamnion multifidum* | | R | | | | |
| ZM09400 | *Apoglossum ruscifolium* | | R | | | | |
| ZM09500 | *Cryptopleura ramosa* | F | C | | R | R | |
| ZM09550 | *Delesseria sanguinea* | F | F | | R | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | | C | | | R | |
| ZM09900 | *Membranoptera alata* | O | | | | | |
| ZM10120 | *Phycodrys rubens* | F | F | | | | |
| ZM10180 | *Erythroglossum laciniatum* | | F | | | | |
| ZM10390 | *Heterosiphonia plumosa* | R | R | | | | |
| ZM11050 | *Polysiphonia elongata* | | R | | | | |
| ZM11170 | *Polysiphonia fucoides* | | R | | | | |
| ZM11370 | *Pterosiphonia parasitica* | | R | | | | |

| MCS Code | Taxa | 2015 S2 | | | 2023 S2 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| - | *Diapharodoris luteocincta* | | | R | | | |
| - | *Brogniartella byssoides* | O | O | | | | |
| ZR04570 | *Dictyota dichotoma* | F | C | | | | |
| ZR04780 | *Taonia atomaria* | | R | | | | |
| ZR04970 | *Desmarestia aculeata* | O | | | | | |
| ZR04990 | *Desmarestia ligulata* | F | | | | | |
| ZR06310 | *Laminaria sporelings* | | R | | | R | |
| ZR06320 | *Laminaria digitata* | S | | | F | | |
| ZR06330 | *Laminaria hyperborea* | A | | | O | | |
| ZR06360 | *Saccharina latissima* | C | | | O | | |

### 6.1.3. Sublittoral Station S3 (2015 and 2023 Comparison)

This site lies off the south-east corner of Ireland's Eye. It is exposed to the easterly winds and onshore swell and is therefore moderately exposed to wave action. The reef appears out of the sediment at approximately 13.7m ODM and initially slopes gently up towards the island then a gulley dissects this first reef, before it rises steeply up to the intertidal. The reef was heavily silted and the initial biotope (iii) was found to be similar to the findings of the 2015 survey, being dominated by erect sponges, tunicates, bryozoans and hydroids, with species of note being *Aplidium punctum, Haliclona oculata, Cliona celata, Halichondria panicea* and *Nemertesia antennina*. Also abundant were the hydroid *Halecium halecinum* and the anemones *Alcyonium digitatum, Cylista elegans* and *Urticina felina,* whilst the decapods, *Palaemon serratus, Cancer pagurus* and *Necora puber* were also a common constituent.

The silty turf was home to several other tunicate taxa, namely, Po*lyclinum aurantium/ Synoicum incrustatum, Lissoclinum perforatum, Ascidia mentula* and *Clavelina lepadiformis* and several sponges such as *Pachymatisma johnstonia, Dysidea fragilis, Raspalia hispida*. In March 2023, the taxonomic make-up of this biotope was similar to *CR.HCR.XFa.ByErSp.Cyl* (or *CR.HCR.XFa.ByErSp.Sag*; an earlier version of this classification) recorded in June 2015. This is a 'Mixed turf of bryozoans and erect sponges with *Cylista elegans* on tide-swept circalittoral rock'. This suggests that there had been no significant change in the reef community at depth on the east coast of Ireland's Eye.

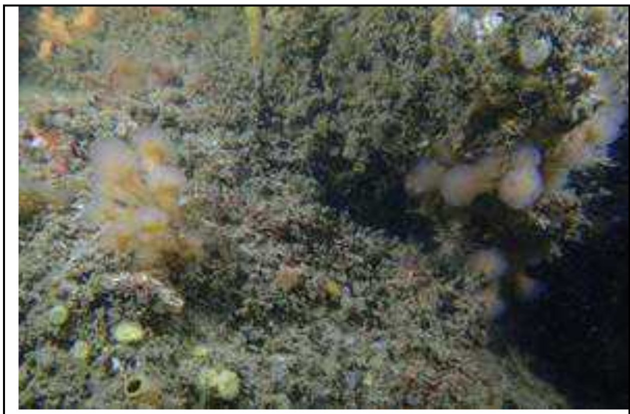
Above this biotope at approximately 8.7m to 6.7m ODM was Biotope (ii) the foliose red algal assemblage found in 2015, *IR.HIR.KFaR.FoR* - Foliose red seaweeds on exposed lower infralittoral rock. Here the silt still formed a thick covering and the algae were possibly even more sparse than at S1 and S2. The brown alga *Dictyota dichotoma* was barely showing as a sporeling through the silt cover, though the green alga, *Ulva* species, were obvious amongst the barnacles and the faunal turf. These specimens had probably over-wintered. Other algae that were visible were *Hypoglossum hypoglossoides* and *Cystoclonium purpureum*, as well as occasional patches of better developed *Delesseria sanguinea* and *Rhodophyllis divaricata*. Small *Schottera nicaeensis* sporelings were also noted in the turf.

Prominent faunal species in the biotope were the sponges *Hymeniacidon perleve* and *Dysidea fragilis,* as well as the tunicates *Clavelina lepadiformis* and *Aplidium punctum.* Also the decapod crabs *Necora puber* and *Cancer pagurus* were also well represented. The foliose bryozoan *Bicellariella ciliata* was common amongst the *Balanus crenatus* barnacle crusts.

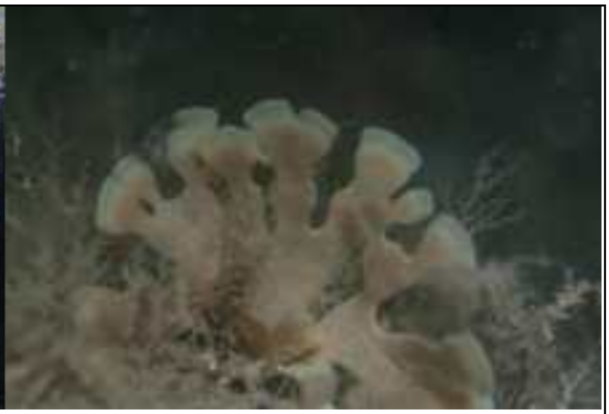
Finally at site S3, from 6.7m ODM upwards, there was a kelp zone with the beginnings of a seasonal understory growth of foliose red algae and barnacles. Prominent red algae in March 2023 included, *Delesseria sanguinea* and *Rhodophyllis divaricata*, whilst the dominant brown alga was *Laminaria digitata* and sparse *L. hyperborea. Dictyota dichotoma* sporelings were again visible species amongst the silt and fauna turf. The biotope was therefore still consistent with S1 and S2, being *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Dominant faunal taxa were the tunicates *Synoicum incrustatum / Polyclinum aurantium Dendrodoa grossularia* and *Polycarpa scuba,* the sponge *Halichondria panicea* and the barnacle *Balanus crenatus*.

Photographs from each sublittoral zone / biotope are shown in Figure 6-3, while a full species list with SACFOR classification is presented in Table 6-3.



*iii: CR.HCR.XFa.ByErSp.Cyl (2023)*



iii: *CR.HCR.XFa.ByErSp.Sag (2015)*

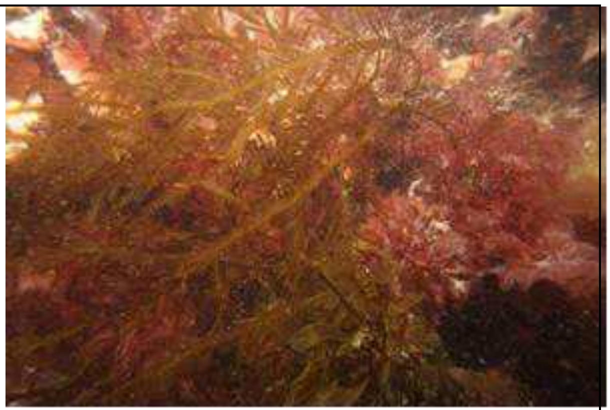
iii: CR.HCR.XFa.ByErSp.Cyl (2023)

iii: *CR.HCR.XFa.ByErSp.Sag (2015)*

ii: *IR.HIR.KFaR.FoR (2023)*

ii: *IR.HIR.KFaR.FoR (2015)*

*i: IR.MIR.KR.Ldig.Ldig (2023)*



i: *IR.MIR.KR.Ldig.Ldig (2015)*

**Figure 6-3: Sublittoral Zones and Biotopes for Station S3 (2015 and 2023)**

**Table 6-3: Species List for Station S3 with SACFOR Abundance Classifications for Each Biotope (2015 and 2013)**

| MCS Code | Taxa | 2015 S3 | | | 2023 S3 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| C00350 | *Sycon ciliatum* | | | | | | R |
| C00350 | *Scypha ciliata* | | | R | | | |
| C01670 | *Pachymatisma johnstonia* | | | | | | O |
| C02210 | *Suberites ficus* | | R | R | | R | R |
| C04250 | *Raspailia hispida* | | | | | | O |
| C04810 | *Halichondria bowerbanki* | | | R | | | |
| C04840 | *Halichondria panicea* | O | R | O | O | R | O |
| C05230 | *Hymeniacidon perleve* | O | | | O | | |
| C05960 | *Esperiopsis fucorum* | | R | R | | | |
| C06450 | *Myxilla incrustans* | | R | | R | R | |
| C06780 | *Iophonopsis nigricans* | | R | R | R | R | |
| C08630 | *Haliclona simulans* | | R | A | | | |
| C08900 | *Dysidea fragilis* | | | | | O | O |
| D01440 | *Tubularia indivisa* | R | R | | R | R | |
| D05260 | *Halecium halecinum* | | R | O | | R | O |
| D05970 | *Nemertesia antennina* | R | R | C | R | O | C |
| D05990 | *Nemertesia ramosa* | | R | R | | R | O |
| D06760 | *Sertularia argentea* | | R | | | | |
| D07300 | *Obelia dichotoma* | | R | | | R | |
| D07310 | *Obelia geniculata* | F | | O | R | R | R |
| D07430 | *Rhizocaullus verticillatus* | | R | R | R | R | |
| D10240 | *Alcyonium digitatum* | | F | C | R | O | O |
| D11580 | *Anemonia viridis* | O | | | R | | |
| D11680 | *Urticina felina* | | R | F | R | R | O |
| D12310 | *Cylista elegans* | O | F | C | O | R | O |
| D13700 | *Caryophyllia smithii* | | | | | | R |
| G00780 | *Lineus longissimus* | | | R | | | |
| P23020 | *Spirobranchus* | | | | R | O | O |
| P23040 | *Spirobranchus triqueter* | O | F | O | | | |
| R01090 | *Balanus balanus* | R | R | R | | R | R |
| R01100 | *Balanus crenatus* | C | C | R | C | F | O |
| S01660 | Amphipoda | | | O | F | F | O |
| S22100 | *Palaemon serratus* | O | C | C | | O | C |
| S23220 | *Pandalus montagui* | R | | | | | |
| S23600 | *Homarus gammarus* | R | | R | | | |
| S25020 | *Pisidia longicornis* | | O | | | | |

| MCS Code | Taxa | 2015 S3 | | | 2023 S3 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| S25850 | *Macropodia rostrata* | O | C | A | | | |
| S26460 | *Cancer pagurus* | C | F | R | | F | F |
| S26720 | *Necora puber* | A | C | A | F | F | F |
| S26900 | *Carcinus maenas* | C | | | | | |
| W16500 | *Mytilus edulis* | R | O | | O | R | |
| Y00001 | Bryozoa | | O | O | O | O | O |
| Y01370 | *Alcyonidium diaphanum* | | C | C | | C | C |
| Y06640 | *Membranipora* | O | | | O | | |
| Y06780 | *Electra pilosa* | O | | | O | | |
| Y06940 | *Flustra foliacea* | | O | R | | O | R |
| Y07050 | *Chartella papyracea* | | O | | R | O | R |
| Y08530 | *Bicellariella ciliata* | | | | R | O | R |
| Y08720 | *Bugula flabellata* | | | | | R | O |
| Y08790 | *Bugula turbinata* | | | O | | | |
| ZB00110 | *Antedon bifida* | R | O | C | R | F | F |
| ZB01900 | *Asterias rubens* | C | C | C | C | F | C |
| ZB02350 | *Ophiothrix fragilis* | R | | | | | |
| ZD00060 | *Clavelina lepadiformis* | | F | F | R | F | F |
| ZD00460 | *Morchellium argus* | | | R | R | | R |
| ZD00640 | *Aplidium punctum* | R | R | O | R | F | F |
| ZD01500 | *Ascidia mentula* | | | | | | R |
| ZD01880 | *Polycarpa scuba* | | | | F | | |
| ZD01940 | *Dendrodoa grossularia* | R | F | C | F | F | R |
| ZG02080 | *Pollachius pollachius* | R | R | R | R | R | R |
| ZG04380 | *Taurulus bubalis* | R | R | R | R | R | R |
| ZG07050 | Gobiidae | R | O | R | | | |
| ZG07400 | *Pomatoschistus* | | R | R | | | |
| ZM02420 | *Palmaria palmata* | O | | | R | | |
| ZM03840 | Corallinaceae (enc) | F | O | | F | O | |
| ZM04040 | *Corallina officinalis* | R | | | R | | |
| ZM05940 | *Schottera nicaeensis* | | | | R | R | |
| ZM06310 | *Plocamium cartilagineum* | C | | | | | |
| ZM06820 | *Calliblepharis ciliata* | R | | | R | | |
| ZM06880 | *Cystoclonium purpureum* | R | | | R | R | |
| ZM06930 | *Rhodophyllis divaricata* | | | | R | R | |
| ZM07230 | *Rhodymenia holmesii* | | R | | | | |
| ZM07260 | *Rhodymenia ardissonei* | | R | | | | |
| ZM07510 | *Lomentaria articulata* | R | | | | | |
| ZM08239 | *Ceramium secundatum* | | R | | | | |
| ZM09400 | *Apoglossum ruscifolium* | | R | | | | |
| ZM09500 | *Cryptopleura ramosa* | A | R | | R | R | |
| ZM09550 | *Delesseria sanguinea* | A | R | | R | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | R | R | | R | R | |
| ZM09900 | *Membranoptera alata* | R | | | | | |
| ZM10120 | *Phycodrys rubens* | | R | | | | |
| ZM10180 | *Erythroglossum laciniatum* | F | | | | | |
| ZM11050 | *Polysiphonia elongata* | R | R | | | | |
| - | Chrysophyceae | A | | | | | |
| ZR00030 | Ectocarpaceae indet. | C | | | | | |
| ZR04570 | *Dictyota dichotoma* | O | F | | R | R | |
| ZR04970 | *Desmarestia aculeata* | R | | | | | |
| ZR04990 | *Desmarestia ligulata* | O | | | | | |
| ZR06320 | *Laminaria digitata* | A | | | F | | |
| ZR06330 | *Laminaria hyperborea* | R | | | O | | |

| MCS Code | Taxa | 2015 S3 | | | 2023 S3 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| ZS02400 | *Ulva* (flat) | | | | R | | |

### 6.1.4. Sublittoral Station S4 (2015 and 2023 Comparison)

This site is located off the south-east corner of Ireland's Eye, refer Figure 4-1. This site was much more current swept and subject to swell during the March 2023 survey than the other three sites, and consequently the visibility was poorer. The reef emerges out of the sediment at approximately 14.7m ODM and rises at a shallow angle towards the shore. Initially the reef slopes shore-wards relatively smoothly and latterly in a series of steep ridges and gullies. The silt covering was significant and responsible for the poor visibility. Where the rock was exposed to the current, the community was a relatively rich encrusting assemblage of hydroids and bryozoans with frequent erect sponges and anemones. The community on this deepest reef (biotope (iii)) was dominated by a faunal turf of *Flustra foliacea, Securiflustra securifrons, Scrupocellaria* spp., whilst the sponges *Amphilectus fucorum, Haliclona oculata* and *Haliclona simulans* were also present. The anemones *Alcyonium digitatum, Urticina felina* and *Cylista elegans* were frequently encountered along with the erect hydroid *Nemertesia antennina*.

Ascidians form a major constituent of the biotope and as at the other sites, the colonial ascidians *Aplidium punctum, Synoicum incrustatum / Polyclinum aurantium* were noted in the turf on the rock surface along with the solitary ascidians *Polycarpa scuba* and *Dendrodoa grossularia*.

The biotope can still, therefore, be designated as similar to the 2015 survey label of *HCR.XFa.FluCoAs.Paur* - *Polyclinum aurantium* and *Flustra foliacea* on sand scoured tide-swept moderately wave-exposed circalittoral rock.

Above this biotope, at 9.2m ODM, was the *Dictyota dichotoma* and foliose red algal assemblage which were also found at S1 and S2, as in 2015. Generally here the silt still formed a really thick covering on any surfaces out of the direct current, but the *Dictyota* sporelings were still just visible in the sward. Again, the accompanying small foliose red algal species visible were, *Hypoglossum hypoglossoides, Schottera nicaeensis, Cryptopleura 25ivari*, *Rhodophyllis 25ivaricate* and *Delesseria sanguinea*, but they were very sparse. Occasional ragged specimens of over-wintered *Phyllophora crispa* were seen in the turf, heavily colonised by epiphytes. Beneath the silt, the solitary ascidian *Dendrodoa grossularia* and the ever-present barnacles *Balanus crenatus* formed a faunal crust with frequent clumps of crustose, massive and erect sponges, as well as colonial ascidians, hydroids and bryozoans.

The sponges seen in the surge were both *Haliclona oculata* and *H. simulans*, as well as *Halichondria panicea, Hymeniacidon perleve* and *Hemimycale columella.* Hydroids included *Obelia* species, and Nemertesia antennina and *Aplidium punctum* was the ever present dominant colonial ascidian.

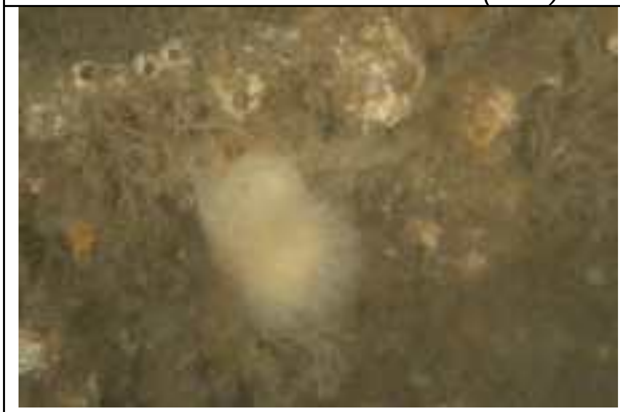
As with the 2015 survey, the water movement in the shallower depths at S4 made photography more difficult during the March 2023 survey and no useable photos were obtained in the kelp zone.

This sublittoral fringe biotope encountered at S4, from 5.2m ODM above the foliose algal zone, was another zone of stunted *Laminaria digitata and L. hyperborea* kelp plants, with several other sparse foliose red algae, such as *Phyllophora crispa* and *Delesseria sanguinea*. Beneath these algae were crusts of barnacles and sparse mussels, with frequent common starfish (*Asterias rubens*) feeding on the mussels. *Urticina felina*, *Halichondria panicea* and *Alcyonium digitatum* were all noted in the surge. The bryozoans *Electra pilosa* and *Membranipora membranacea* were seen on the kelp fronds, whilst *Asterias rubens* was also present, feeding on the mussels. The biotope would still be designated as *IR.MIR.KR.Ldig.Ldig* or *Laminaria digitata* on moderately exposed sublittoral fringe rock.

Photographs from each sublittoral zone / biotope are shown in Figure 6-4, while a full species list with SACFOR classification is presented in Table 6-4.

*iii: HCR.XFa.FluCoAs.Paur (2023)*

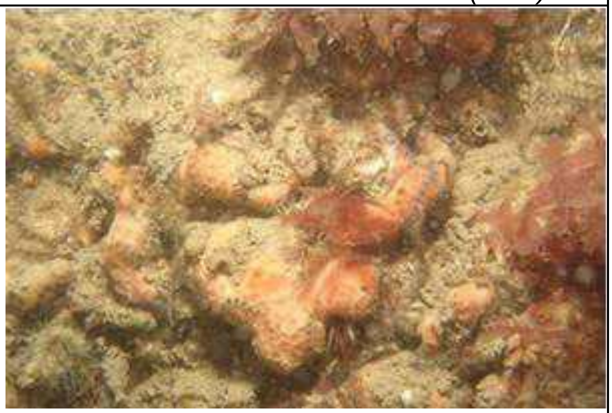
iii: *HCR.XFa.FluCoAs.Paur (2015)*



*iii: HCR.XFa.FluCoAs.Paur (2023)*

iii: *HCR.XFa.FluCoAs.Paur (2015)*

ii: *IR.HIR.KFaR.FoR.Dic (2023)*



ii: *IR.HIR.KFaR.FoR.Dic (2015)*

ii: *IR.HIR.KFaR.FoR.Dic (2023)*

ii: *IR.HIR.KFaR.FoR.Dic (2015)*

**Figure 6-4: Subtlittoral Zones and Biotopes for Station S4 (2015 and 2023)**

**Table 6-4: Species List for Station S4 with SACFOR Abundance Classifications for Each Biotope (2015 and 2023)**

| MCS Code | Taxa | 2015 S4 | | | 2023 S4 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| C00350 | *Sycon ciliatum* | | | | R | O | |
| C00350 | *Scypha ciliata* | O | O | | | | |
| C02210 | *Suberites ficus* | | R | R | | | |
| C04810 | *Halichondria bowerbanki* | | O | O | | | |
| C04840 | *Halichondria panicea* | F | O | | O | O | |
| C05230 | *Hymeniacidon perleve* | F | | | O | R | |
| C05960 | *Amphilectus fucorum* | | | | | | O |
| C05960 | *Esperiopsis fucorum* | | O | O | | | |
| C06450 | *Myxilla incrustans* | R | | | | | |
| C06780 | *Iophonopsis nigricans* | | O | O | R | O | R |
| C07750 | *Hemimycale columella* | | R | | O | O | |
| C08600 | *Haliclona oculata* | | | | | | O |
| C08630 | *Haliclona simulans* | | F | F | | O | O |
| C08900 | *Dysidea fragilis* | | | R | | R | R |
| C09100 | *Halisarca dujardini* | | | | R | R | |
| D05260 | *Halecium halecinum* | | | O | | R | O |
| D05780 | *Halopteris catharina* | | O | O | | | |
| D05970 | *Nemertesia antennina* | | O | F | | O | F |
| D05990 | *Nemertesia ramosa* | | O | O | | | R |
| D06690 | *Sertularella polyzonias* | | | O | | | |
| D06760 | *Sertularia argentea* | | | R | | | |
| D07300 | *Obelia dichotoma* | O | F | F | R | R | |
| D07310 | *Obelia geniculata* | O | | | O | O | R |
| D07430 | *Rhizocaullus verticillatus* | | | O | | R | O |
| D10240 | *Alcyonium digitatum* | O | C | F | O | F | O |
| D11070 | *Epizoanthus couchii* | | | | | R | R |
| D11680 | *Urticina felina* | R | F | C | R | O | C |
| D12250 | *Metridium senile* | | O | C | | R | |
| D12310 | *Cylista elegans* | R | F | F | R | O | O |
| D12480 | *Sagartiogeton undatus* | | | R | | | |
| P20310 | *Lanice conchilega* | | O | O | | | |
| P23020 | *Spirobranchus* | | | | R | O | O |
| P23040 | *Spirobranchus triqueter* | R | | | | | |
| P23090 | *Serpula vermicularis* | | O | | | | |
| R01090 | *Balanus balanus* | | R | C | | R | C |
| R01100 | *Balanus crenatus* | C | F | C | F | F | F |
| S01660 | Amphipoda | | F | F | R | O | O |
| S23600 | *Homarus gammarus* | | | R | | R | R |
| S24650 | *Pagurus bernhardus* | | | O | | | |
| S25750 | *Inachus sp.* | | | | | R | F |
| S25850 | *Macropodia rostrata* | | | F | | | |
| S26460 | *Cancer pagurus* | O | F | F | R | O | F |
| S26690 | *Liocarcinus depurator* | | | O | | R | O |

| MCS Code | Taxa | 2015 S4 | | | 2023 S4 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| S26720 | *Necora puber* | F | C | C | O | O | O |
| W07380 | *Trivia monacha* | | | | | R | R |
| W14030 | *Archidoris pseudoargus* | | R | | | R | R |
| W16500 | *Mytilus edulis* | F | | O | F | | |
| Y00030 | Crisiidae | F | F | F | R | O | O |
| Y01370 | *Alcyonidium diaphanum* | F | F | F | O | O | O |
| Y06640 | *Membranipora membranaceae* | | | | O | | |
| Y06640 | *Membranipora* | F | | | | | |
| Y06780 | *Electra pilosa* | C | O | | F | R | |
| Y06940 | *Flustra foliacea* | | O | O | | O | O |
| Y07100 | *Securiflustra securifrons* | | | | | F | O |
| Y08360 | *Scrupocellaria sp.* | | F | F | O | O | O |
| Y08530 | *Bicellariella ciliata* | | | O | R | O | O |
| Y08720 | *Bugula flabellata* | | O | F | | O | F |
| ZB00110 | *Antedon bifida* | O | F | R | | O | O |
| ZB01900 | *Asterias rubens* | C | C | C | F | F | O |
| ZB02350 | *Ophiothrix fragilis* | | | O | | R | O |
| ZB02680 | *Ophiactis balli* | | O | O | | | |
| ZB02780 | *Ophiopholis aculeata* | | O | O | | | |
| ZB03000 | *Amphipholis squamata* | | O | R | O | O | R |
| ZB04950 | *Thyone fusus* | | | | | R | O |
| ZD00060 | *Clavelina lepadiformis* | O | O | O | O | R | R |
| ZD00340 | *Polyclinum aurantium* | | | O | | | |
| ZD00640 | *Aplidium punctum* | F | O | O | O | F | F |
| ZD00680 | Didemnidae indet. | | | R | | | |
| ZD01090 | *Lissoclinum perforatum* | | | | | R | R |
| ZD01880 | *Polycarpa scuba* | | R | R | | O | R |
| ZD01940 | *Dendrodoa grossularia* | | F | O | O | F | O |
| ZD02090 | *Botryllus schlosseri* | O | R | | O | R | |
| ZD02140 | *Botrylloides leachi* | R | | | R | R | |
| ZM02080 | *Bonnemaisonia asparagoides* | | O | | | | |
| ZM02420 | *Palmaria palmata* | F | | | | | |
| ZM02560 | *Dilsea carnosa* | | O | | R | R | |
| ZM03230 | *Callophyllis laciniata* | O | O | | | | |
| ZM03840 | Corallinaceae (enc) | F | | | O | O | |
| ZM04040 | *Corallina officinalis* | O | | | R | | |
| ZM05840 | *Phyllophora crispa* | F | F | | R | R | |
| ZM05860 | *Phyllophora pseudoceranoides* | F | | | | | |
| ZM05940 | *Schottera nicaeensis* | | O | | R | R | |
| ZM06110 | *Chondrus crispus* | F | | | R | | |
| ZM06310 | *Plocamium cartilagineum* | F | O | | | | |
| ZM06820 | *Calliblephapharis ciliata* | | R | | | | |
| ZM06880 | *Cystoclonium purpureum* | F | F | | R | R | |
| ZM06930 | *Rhodophyllis divaricata* | | F | | | R | |
| ZM07230 | *Rhodymenia holmesii* | | F | R | | | |
| ZM07530 | *Lomentaria orcadensis* | | R | | | | |
| ZM08070 | *Ceramium sp.* | O | O | | | | |
| ZM08460 | *Halurus flosculosus* | | R | | | | |
| ZM09500 | *Cryptopleura ramosa* | O | F | | R | R | |
| ZM09550 | *Delesseria sanguinea* | F | F | | R | R | |
| ZM09850 | *Hypoglossum hypoglossoides* | | F | | R | R | |
| ZM10120 | *Phycodrys rubens* | F | | | | | |
| ZM10180 | *Erythroglossum laciniatum* | | F | | | | |
| ZM11160 | *Polysiphonia nigra* | | R | | | | |
| - | Chrysophyceae | A | | | | | |
| - | Red sponge crust | | O | | | O | |
| - | *Brogniartella byssoides* | O | F | | | | |
| ZR00030 | *Ectocarpaceae indet.* | C | | | | | |
| ZR04570 | *Dictyota dichotoma* | C | C | | R | R | |
| ZR04780 | *Taonia atomaria* | | R | | | | |
| ZR04970 | *Desmarestia aculeata* | O | R | | | | |

| MCS Code | Taxa | 2015 S4 | | | 2023 S4 | | |
|---|---|---|---|---|---|---|---|
| | | i | ii | iii | i | ii | iii |
| ZR04990 | *Desmarestia ligulata* | R | | | | | |
| ZR05000 | *Desmarestia viridis* | R | R | | | | |
| ZR06310 | *Laminaria* sporelings | | O | R | | R | R |
| ZR06320 | *Laminaria digitata* | S | | | O | | |
| ZR06330 | *Laminaria hyperborea* | O | | | R | | |
| ZR06360 | *Saccharina latissima* | F | | | R | | |
| ZS03920 | *Bryopsis plumosa* | | R | | | | |

## 6.2. Univariate Analyses

The addition of the 2023 winter study provides an additional seasonal dimension to the sublittoral transects, with notably fewer species recorded at all sites, although the majority of these were due to reduced algae, in particular Rhodophya and Ochrophyta. A net loss of approximately 26 taxa was recorded during the winter study.

**Table 6.5: Number of Species per Phyla and Station**

| Phylum | Sublittoral Station (2015) | | | | Sublittoral Station (2023) | | | |
|---|---|---|---|---|---|---|---|---|
| | S1 | S2 | S3 | S4 | S1 | S2 | S3 | S4 |
| Porifera | 6 | 9 | 9 | 12 | 6 | 7 | 9 | 11 |
| Cnidaria | 10 | 14 | 12 | 14 | 11 | 11 | 12 | 11 |
| Nemertea | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| Annelida | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 1 |
| Arthropoda | 4 | 12 | 11 | 9 | 6 | 8 | 6 | 8 |
| Mollusca | 3 | 3 | 1 | 2 | 3 | 1 | 1 | 3 |
| Bryozoa | 5 | 12 | 7 | 8 | 11 | 8 | 8 | 9 |
| Echinodermata | 5 | 5 | 3 | 6 | 3 | 6 | 3 | 5 |
| Chordata | 7 | 14 | 8 | 8 | 5 | 6 | 9 | 8 |
| Rhodophyta | 17 | 30 | 18 | 25 | 6 | 8 | 9 | 11 |
| Ochrophyta | 7 | 8 | 7 | 11 | 4 | 4 | 4 | 5 |
| Chlorophyta | 2 | 0 | 0 | 1 | 0 | 0 | 1 | 0 |
| Ascomycota | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Tracheophyta | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **TOTAL** | **67** | **109** | **78** | **99** | **56** | **60** | **63** | **72** |
| **Average** | **88.3** | | | | **62.8** | | | |
| **Standard Deviation** | **19.2** | | | | **6.8** | | | |

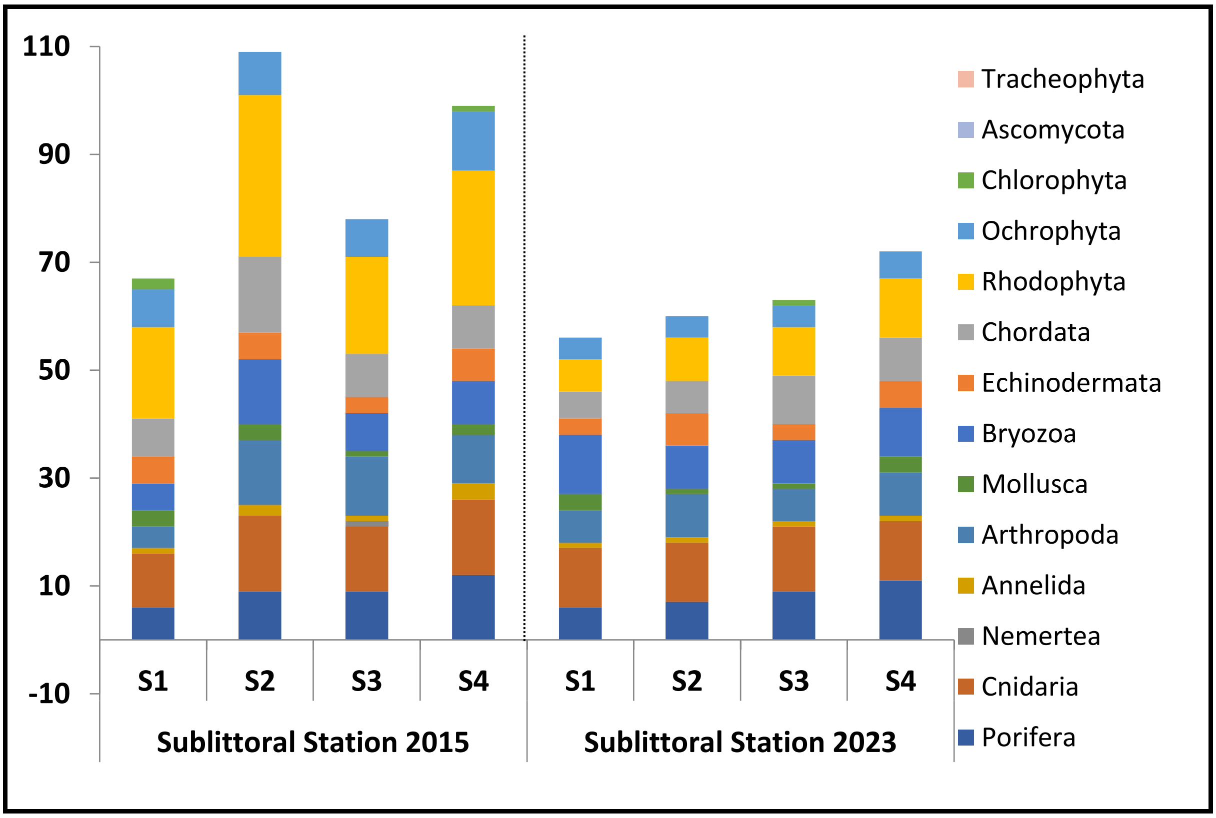



**Figure 6.5: Distribution of Species per Phyla and Station by Survey**

## 6.3. Multivariate Analyses

### 6.3.1. Sublittoral Stations (2015 and 2023 Comparison)

All four stations (S1, S2, S3 and S4) in the sublittoral areas were characterised by *Laminaria digitata* forest in the shallows (*IR.MIR.KR.Ldig.Ldig*). Below this zone, three of the four stations recorded the biotope *IR.HIR.KFaR.FoR.Dic* (S1, S2 and S4). The deepest extent of the reef was the most variable, with three different biotopes recorded at the four stations, with only Sublittoral S1 and S3 characterised by the same biotope of 'Mixed turf of bryozoans and erect sponges with *Sagartia elegans* on tide-swept circalittoral rock'. The repeated survey in 2023, undertaken during the winter, indicated no significant changes in the biotopes recorded, despite the slightly reduced number of over-wintering species identified. It should also be noted that the biotiope *CR.HCR.XFa.ByErSp.Cyl* of a 'Mixed turf of bryozoans and erect sponges with *Cylista elegans* on tide-swept circalittoral rock' recorded at depth at S1 has been renamed from *CR.HCR.XFa.ByErSp.Sag*, as was used in the 2015 survey report.

The cluster and MDS plot for the sublittoral stations indicated some statistical separation of biotopes, most notably that of *IR.MIR.KR.Ldig.Ldig*, with all four occurrences being statistically indistinguishable from both years (Figure 6.6). S2 and S4 showed statistical similarities to each other and also between years, although the winter survey remained closely associated with the summer populations. Both sites separated from S3 which indicated a similarity between the survey years. A presentation of the MDS plot indicates similar patterns of distribution between transects but with a separation by survey year (or season), with the 2023 dataset generally separating from the 2015 cluster due to the reduced over-wintering algal populations. The only variable to this was recorded in 2015 at S1_biotope iii, observed from the deepest layer, which clustered within the 2023 transects Figure 6-6As with all of the deeper layers, the variation between seasons was less due to the increased depth and reduced influence from the algal population. The deepest part of transect S1 was also slightly degraded due to the high silt content at this site and depth.

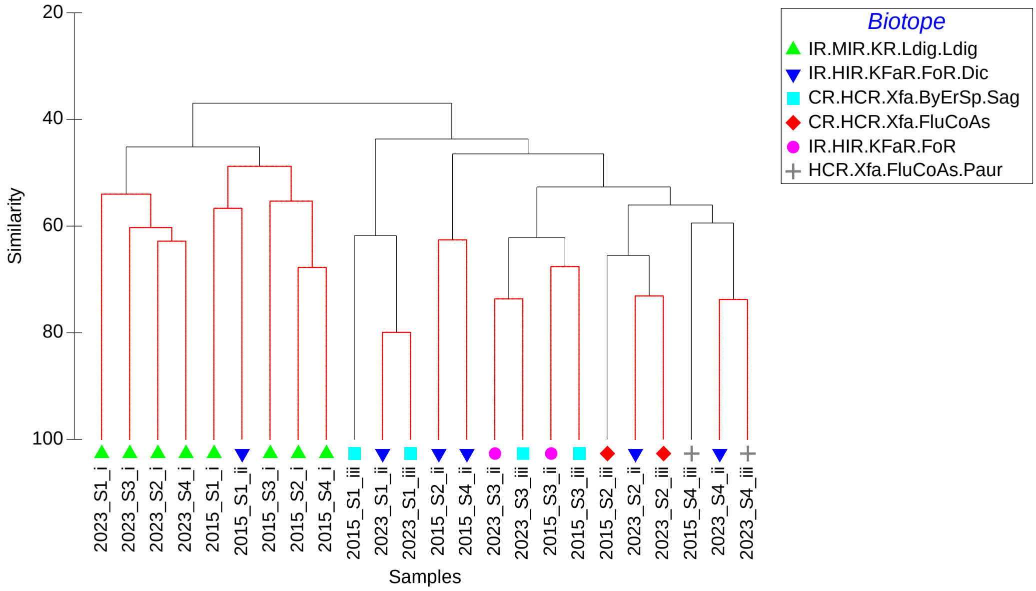



**Figure 6-5: Dendrogram of Biotopes Recorded at the Sublittoral Stations (2015 and 2023)**

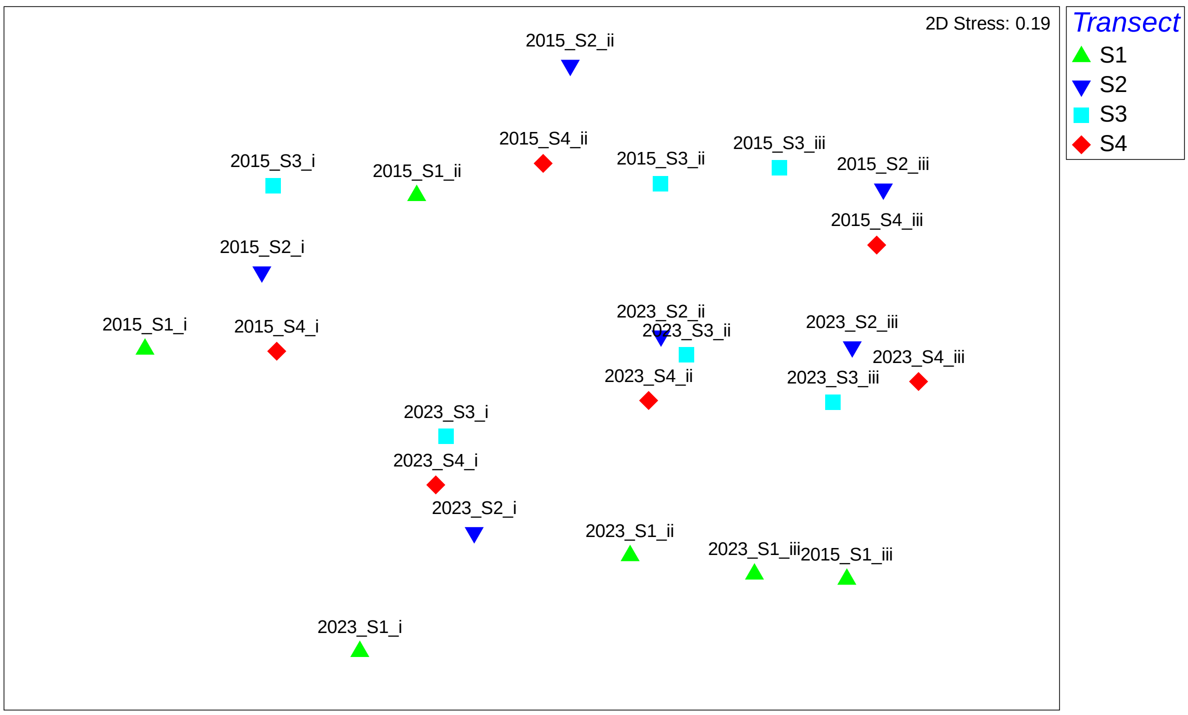



**Figure 6-6: MDS of Biotopes Recorded at the Sublittoral Stations (2015 and 2023)**

# 7. Conclusion

Four sites were surveyed in the sublittoral zone and similar semi-quantitative data collected along with photographs in both summer 2015 and winter 2023 surveys. Overall, all sublittoral environments indicated the presence of significant siltation in the deeper zones. However, the faunal populations in each of the station transects showed well represented and moderately diverse habitats containing many of the common species found along the Irish Sea coastline. In the summer (2015), stations S2 and S4 indicated greater habitats similarity recorded within their vertical zonation, which continue during the winter(2023), although the winter population varied at all sites due to reduced numbers of over-wintering algal populations.

The result of a moderately high diversity is similar to that recorded in the macro-invertebrate population previously recorded within the soft sediments north of Ireland's Eye as part of the proposed outfall pipeline route (marine section) baseline surveys (BSL 2013; 2017), and is probably indicative for the survey area as a whole. The presence of significant siltation at all locations within the surveys would indicate that this phenomenon is ubiquitous in the waters surrounding this island and has subsequently created a habitat with limited sensitivity to suspended sediments in this area. Whilst siltation levels are high in the sublittoral environment, a significant increase in suspended sediment, particularly during the summer months during peak algal growth, might cause some damage to the algal biotopes present through reduced light penetration and availability. However, the moderately strong tidal currents experienced in this area are sufficient to prevent the deposition of significant silt material which might degrade the sublittoral benthic biotopes through smothering and burial of the infralittoral and circalittoral communities. No species of particular conservational interest were noted during the surveys and no rare or fragile biotopes recorded.

# 8. References

**Benthic Solutions Limited, 2013**. Baseline benthic environmental survey along the proposed Greater Dublin Drainage scheme outfall locations. Survey data reported within Environmental Impact Statement.

**Benthic Solutions Limited, 2015**. Irish Water Greater Dublin Drainage Phase II Ireland's Eye Reef Survey. Project number 1502

**Benthic Solutions Limited, 2017**. Baseline benthic environmental survey along the proposed Greater Dublin Drainage scheme outfall locations. Survey data reported within Environmental Impact Statement.

**Clarke, K. R. and Warwick, R. M. (1994).** Similarity-based testing for community pattern: the 2-way layout with no replication. Mar. Biol. 118: 167-176.

**Hiscock, K (ed.) (1996)** Marine Nature Conservation Review: Rationale and methods. Coasts and seas of the United Kingdom. MNCR series. Joint Nature Conservation Committee, Peterborough.

**MERC (2010).** Irish Sea Reef Survey Project Report. Carried out by MERC on behalf of National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

**MERC (2012a).** Intertidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

**MERC (2012b).** Subtidal Reef Survey of Lambay Island SAC and SPA, Rockabill Island SPA, Ireland's Eye SAC, Dalkey Islands SPA and Muglins. Carried out by MERC on behalf of the Marine Institute in partnership with National Parks and Wildlife Service, Department of Environment, Heritage and Local Government.

**NPWS (2013).** Conservation Objectives: Rockabill to Dalkey Island SAC 003000. Version 1.0. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.

**Appendix C - IWDG Report on Marine Mammals**

# Greater Dublin Drainage Project, Co. Dublin

# Report on Marine Mammal Surveys

---

# Final Report

**Rossa Meade, Joanne O'Brien and Simon Berrow**

Merchants Quay
Kilrush, Co Clare

http://consulting.iwdg.ie

**April 2017**

# Table of Contents

**EXECUTIVE SUMMARY** ..... **1**

**INTRODUCTION** ..... **5**

**METHODS** ..... **6**

2.1 Study Area ..... 6

2.2 Land-based Surveys ..... 7

2.3 Boat-based Surveys ..... 8

2.4 Static Acoustic Monitoring ..... 10

2.5 Data Analysis ..... 15

**RESULTS** ..... **17**

3.1 Land-based observations ..... 17

3.2 Boat-based surveys ..... 23

3.3 Static Acoustic Monitoring ..... 36

**DISCUSSION** ..... **52**

4.1 Visual surveys ..... 52

4.2 Static Acoustic Monitoring ..... 54

4.3 Recommendations ..... 57

**ACKNOWLEDGEMENTS** ..... **58**

**REFERENCES** ..... **58**

**APPENDIX – Results from the Loughshinny Marine Mammal Surveys** ..... **62**

5.1 Land-based Observations ..... 62

5.2 Boat-based Surveys ..... 66

5.3 Static Acoustic Monitoring ..... 72

5.4 Discussion ..... 78

5.5 Appendix References ..... 83

# EXECUTIVE SUMMARY

A marine mammal survey using visual and static acoustic monitoring methodology was conducted between March 2015 and September 2015 off Loughshinny and March 2015 and March 2017 off Portmarnock, North Co. Dublin as part of the Greater Dublin Drainage (GDD) project. The study aimed to assess the distribution, habitat use, seasonal occurrence and behaviour of marine mammals in the study area and if possible derive density and abundance estimates for harbour porpoise.

Three integrated methods were used in line with best practice, these were land-based vantage point surveys, boat-based transects and Static Acoustic Monitoring. Visual surveys were only carried out in favourable weather conditions (Beaufort sea-state <2 and visibility >6km). Monthly land-based surveys were conducted from sites at Loughshinny and Howth Head. Single platform line-transect boat surveys were conducted bi-monthly following a pre-determined route and standardised design. Static acoustic monitoring using C-PODs was conducted for six months at a single site off Loughshinny and for 24 months at three locations off Portmarnock.

The software programme DISTANCE was used for calculating detection functions, which is the probability of detecting an object a certain distance from the track-line and used to calculate the density of animals on the track-line of the vessel. A detection function was calculated from each boat survey, providing sufficient number of sightings were made to provide a robust estimate.

All C-POD data were analysed using only high probability clicks, which reduced the possibility of false positives (i.e. recorded as present when there were in fact no dolphins or porpoise present). Harbour porpoise detections were extracted as detection positive minutes per day and were analysed statistically for temporal and geographical trends. Porpoise detections were analysed with respect to season (spring, summer, autumn and winter), diel cycle (day and night-time), tidal state (ebb, flood, slack high, slack low) and tidal phase (spring, neap) at a resolution of one hour. A Generalised Linear Mixed Model (GLMM) was fitted to the binomial data using the glmer function in the *lme4 package* developed for the statistical program *R*. Details of individual harbour porpoise click trains were extracted and analysed.

Six monthly land-based surveys were conducted from the Martello Tower at Loughshinny. Twenty hours of land-based monitoring was conducted over six survey days. The weather was favourable throughout all surveys with no swell, sea state ≤2 and visibility of 6-20km. Precipitation was recorded on two days in July and September. Marine mammals were sighted on 86% of land-based survey days with harbour porpoise present on 67% and seal species present on 67% of days. Eleven (11) sightings of harbour porpoise (23 individuals) and 12 seal sightings (12 individuals) were recorded. Ten (10) of the seal sightings were identified as grey seals while two could not be identified to species level. Harbour porpoise numbers peaked in September, however there was no peak in seal numbers.

Land-based survey effort conducted from Howth Head amounted to around 144 hours (23 surveys) between 18 March 2015 and 11 March 2017. Environmental conditions were favourable with no swell, sea-state <2 for 99% and visibility >6km for 97% of survey effort. Marine mammals were sighted on 100% of survey days with grey seals present on 100% and harbour porpoise present on 83% of days. Two-hundred and sixty (260) sightings of grey seals totalling 325 individual animals, comprising 323 adults and two juveniles, were recorded with an average group size of one individual. Sighting rate for grey seals was greatest in April 2015 although high numbers were also recorded in September 2015, January 2016 and October 2016. One-hundred and sixty-seven (167) sightings of harbour porpoise totalling 293 individual animals were recorded comprising 237 adults, 41 juveniles and 15 calves. Mean group size for harbour porpoise from land-based watches was two individuals. Calves were present between September and November 2015 and in August 2016. Harbour porpoise sighting rate was greatest between August and January 2015 and August and October 2016 with mean group size also increasing during this period.

A total of 897km of track-line was surveyed during eleven independent surveys, carried out from April 2015 to January 2017. Environmental conditions were favourable with visibility of >6km for 91% and swell of <1m for 100% of survey effort. Sea-state <2 was recorded for all of eight of the eleven surveys however sea-state of >2 was recorded for 8% of the survey carried out in April 2015, 36% in June 2015 and 46% during the December 2016. Marine mammals were sighted on all survey days with a total of 192 sightings of 251 individual animals. Four marine mammal species were recorded; harbour porpoise, grey seal, harbour seal and minke whale. Seals were recorded on 91% of survey days with the highest numbers of individuals recorded in November 2015. Grey seal sightings were distributed evenly across the study area and all sightings recorded were of single adults. Two harbour seals were sighted, one each in April and August 2015, both of which were of single adults. Single minke whales were recorded in June 2015 and August 2016. Harbour porpoise were recorded on 100% of survey days with the greatest number of sightings recorded in November 2015 and August 2016. Group size also increased between August and November 2015 and in August 2016 with calves recorded during these three surveys. The lowest number of sightings were in June 2015, June 2016 and December 2016.

Density estimates for harbour porpoises were calculated for seven of the eleven boat survey days but not for surveys in June 2015, March 2016, June 2016 and December 2016 as the total number of sightings during each survey were less than 10, which is considered too few to derive a reliable density estimate. Mean group size was greater in August 2015 and August 2016 compared to other surveys, suggesting a peak occurred in late summer, which was consistent with land-based observations. Within the area surveyed, the density of harbour porpoise varied from 0.61 to 2.29 per $km^2$ per survey with a mean density of 1.32 harbour porpoise per $km^2$, which is high for coastal sites in Ireland and similar to previous surveys in the area. Density estimates increased during summer and early winter (August-November) in 2015 and in August 2016, with lowest densities recorded in April 2015 and February 2016.

A total of 189 days of Static Acoustic Monitoring data was collected off Loughshinny. Harbour porpoise detections were recorded on 100% of days. The number of Porpoise Positive Minutes (PPM) ranged from 8 to 475 per day with a mean of 139 PPM. Results showed that season had a significant effect on the presence of porpoises at the site with a peak in autumn. Most porpoise detections were recorded during early morning suggesting they were more active at the site during night-time and in the early morning. Tidal cycle was not found to be a significant factor but tidal phase was, with highest detections during spring cycles. A total of 100,421 porpoise click trains were recorded at Loughshinny over the six month deployment, with 95% (95,509 trains) consistent with foraging, highlighting Loughshinny as a very important feeding site.

Static Acoustic Monitoring was carried out at three sites simultaneously off Portmarnock for a total duration of 750 days, between March 2015 and March 2017. All three sites were along the proposed route of the discharge pipe ranging from 2.5km (GDD1) to 5km (GDD3) offshore. Detections were recorded on average between 96-99% of days at each site. The number of PPM ranged from 3690 to 25089 per year between sites, with the mean ranging between 41.3 to 94.3 per day. The highest detection rate was recorded across the autumn and winter months, during the hours of darkness (incl. at dawn and dusk), during high tide and at the furthest offshore station (GDD3) during the neap cycle of the tidal phase. The site in the middle of the SAM array (GDD2) had the highest overall detection rate.

This survey, carried out over two years, using a range of survey techniques, has clearly demonstrated that North County Dublin is a very important area for marine mammals. The waters off Loughshinny are an important feeding area for harbour porpoise, especially during the autumn months, and at night and during early morning and spring tides. The area off Portmarnock is important for both grey seals and harbour porpoise, both of which were recorded throughout the year. Grey seals were regularly present in small numbers and distributed throughout the survey area. Peaks in sightings from Howth Head occurred during spring and autumn, coinciding with pupping and post-moult periods at the local well-known breeding and haul out sites at Lambay Island, Skerries and Irelands Eye. Harbour porpoise were also distributed throughout the site, with numbers increasing during late summer and autumn in both 2015 and 2016, which may be due to seasonally abundant food sources such as sprat, herring, *Trisopterus spp.* and gadoid species. Lower numbers were recorded during late spring/early summer (March-June) which may be linked to an offshore movement of this species before calving. Density estimates of harbour porpoise were high compared to coastal sites elsewhere in Ireland, and emphasizes the importance of this site for this species as these were some of the highest densities for this species recorded in Ireland to date. Static Acoustic Monitoring provided a high resolution (hourly) insight into the use of this habitat across time and throughout the day and night. Harbour porpoise were present almost daily at Portmarnock but were strongly influenced by seasonal, diel and tidal factors.

Harbour porpoises and grey seals are both listed on Annex II of the Habitats Directive and are thus entitled to strict protection, including their habitats. Extreme care must be taken to ensure the proposed development does not degrade this habitat or cause undue disturbance to marine mammals.

# INTRODUCTION

The Irish Whale and Dolphin Group (IWDG) were sub-contracted by Techworks Marine to establish the extent and nature of marine mammals in north County Dublin in connection with the Greater Dublin Drainage (GDD) project. The GDD project proposes a new marine outfall pipe discharging 1km north-east of Ireland's Eye in north Dublin and 6km out to sea. The discharge is within the recently designated Rockabill to Dalkey Island Special Area of Conservation which lists harbour porpoise as a qualifying interest. The study aimed to assess the distribution, habitat use, seasonal occurrence and behaviour of marine mammals in the study area and derive density and abundance estimates for harbour porpoise. The results of this survey will be used to inform the most appropriate construction methodology for the marine outfall pipe while minimising any impacts on marine mammals. The survey commenced in March 2015 for two years within two defined study areas; i) Portmarnock and ii) Loughshinny. The Portmarnock site was monitored for two years while Loughshinny for six months from March 2015.

The survey used three independent methods: land-based, boat-based and Static Acoustic Monitoring (SAM) to ensure a robust assessment was carried out. This is in line with best practice which recommends a combination of visual and acoustic techniques especially if harbour porpoise (*Phocoena phocoena*) are known to occur in the area, as they can be very difficult to observe in even moderate sea conditions. Land-based observations were conducted from vantage points with a good field of view over the core study area, which avoided the possibility of disturbance and potential displacement during boat-based surveys (David, 2002). Boat-based line transect surveys were conducted to describe the broader -scale distribution and to derive density and abundance estimates. Boat-based surveys can cover a large area including sites which are difficult to observe from land even with good optics. However, all visual monitoring techniques can be influenced by variables such as sea-state (Evans and Hammond, 2004; Teilmann, 2003; Palka, 1996; Clarke, 1982), observer variability (Young and Peace, 1999), optics and height above sea level. Evans and Hammond (2004) recommended that visual surveys should generally not be carried out in sea-states above Beaufort 2, as the probability of detecting animals is markedly reduced above this. Static Acoustic Monitoring (SAM) is a very useful tool for monitoring small cetaceans since it can be carried out without these visual constraints, and does not influence their behaviour. SAM involves the detection and recording of odontocete vocalisations or echolocation clicks and is especially useful for defining fine-scale habitat use. Additionally, SAM can be used to study behaviour, such as foraging, approach behaviour and communication. SAM however is spatially constrained as the detection distance for harbour porpoise can be as little as 200-300m and it cannot provide information on density or abundance but can provide robust information on spatial and temporal trends. This report provides a detailed exploration of marine mammal activity off Loughshinny Co. Dublin over a 6-month period and Portmarnock Co. Dublin over a 24-month period.

# METHODS

## 2.1 Study Area

The study area in north County Dublin, where the proposed outfall pipe will be constructed and operated is adjacent to a number of high nature conservation sites for marine mammals, protected under EU legislation. One of the three Special Areas of Conservation (SACs) which include harbour porpoise as a qualifying interest; occurs within the study area.  Rockabill to Dalkey Island SAC (Site Code: 003000) was designated in 2012 while Lambay Island SAC (Site Code: 000204) with both grey and harbour seal as qualifying interests also lies within the study area (Figure 1). The boundaries of the current survey included both these protected sites and adjacent waters including the route of the proposed outfall pipe.

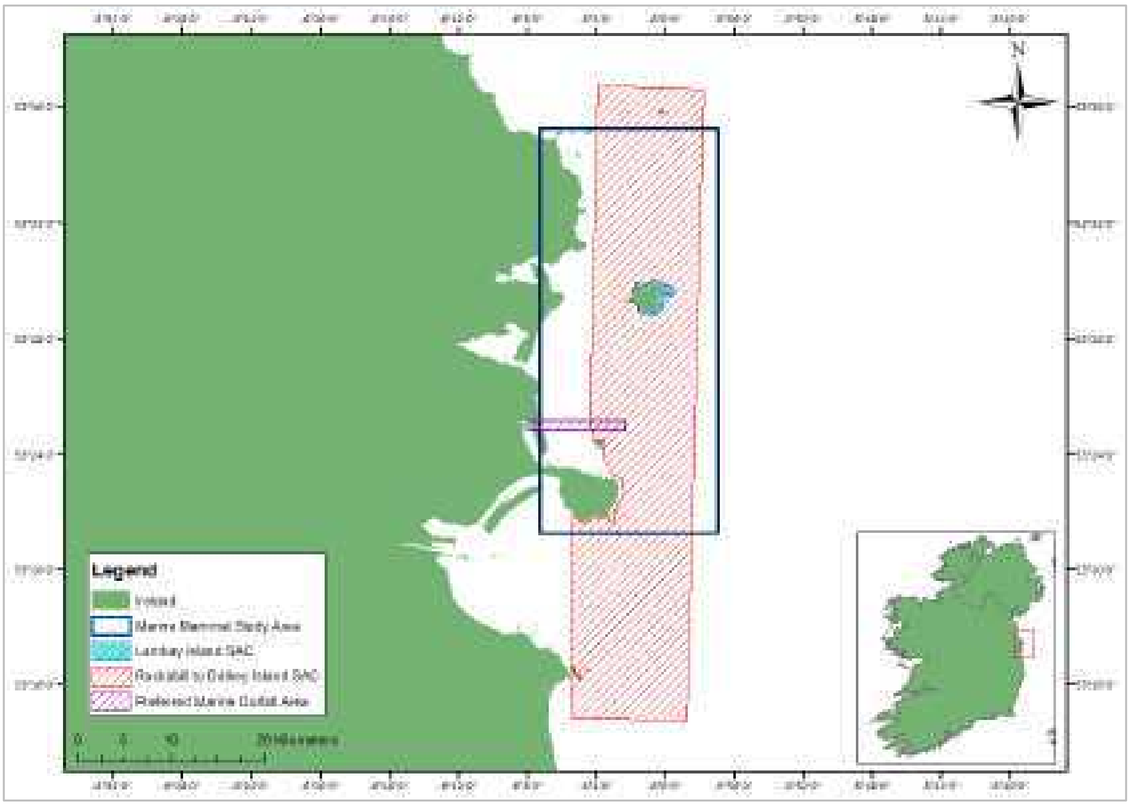



**Figure 1. Study area for GDD Marine Mammal Surveys showing the GDD Preferred Marine Outfall Area and SACs within the Study Area ©National Parks and Wildlife Services SAC**

## 2.2 Land-based Surveys

### 2.2.1 Land-based Observation Site

Land based observations were carried out from the Martello Tower at Loughshinny and from the north-eastern cliffs of Howth Head. Both sites were selected as a suitable vantage points for land-based observations based on their height above sea level and the field of view over the survey area (Figure 2).

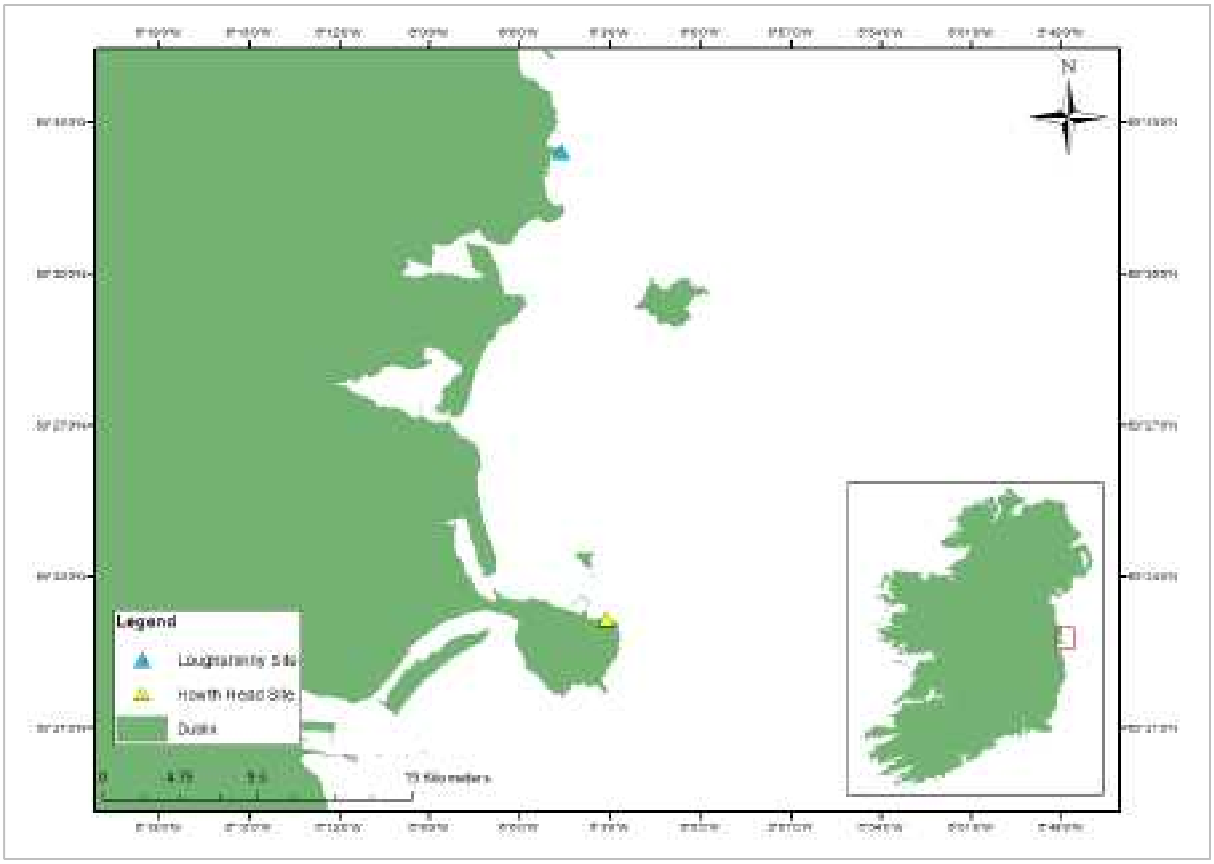



Figure 2. Location of Loughshinny and Howth Head land-based survey sites

### 2.2.2 Land-based Methodology

Land based observations were carried out for a duration of six months from Loughshinny and 24 months from Howth Head. Quantified effort watches, where time spent watching and weather conditions are recorded, were carried out once a month during suitable weather conditions defined as Beaufort sea-state <2 and in visibility of >6km. Each watch lasted for 420-560 minutes (7-8 hours) and were carried out in 100 minute samples in accordance with IWDG standardised methodology for their Inshore Cetacean Monitoring Programme (Berrow et al. 2010). Two observers were present at the observation site to maximise search effort and assist in tracking as well as compliance with health and safety.

Visual observations were made using a tripod-mounted scope (Opticron) equipped with a 20-60x wide-angle eyepiece and handheld binoculars (7 x 50; Opticron). Environmental conditions (sea-state, wind and weather variables) were recorded at the start of each observation and every 30 minutes throughout the watch or when weather conditions changed. During watches, two types of visual observations were conducted: scan sampling and focal follow observations (Mann, 1999).

#### 2.2.2.1 Scan Sampling

During scan sampling, the study area (up to 5km from the observation site) was systematically scanned using the telescope (observer 1) and binoculars (observer 2). For each sighting species, group size, group composition, location, direction of travel and behaviour were recorded. The geographical location of each sightings was recorded using a T107 Leica theodolite or, when the use of the theodolite was restricted, by estimating distance (km) and bearing (degrees) from the observation site using reticule binoculars.

#### 2.2.2.2 Focal Follow Observations

Harbour porpoise were tracked using a T107 Leica theodolite to determine their habitat use. During each surfacing the group size, composition, location and direction of travel were recorded along with the behaviours described by Mann (1999). Focal follow observations or tracks began at the first sighting of harbour porpoise and continued for as long as possible. Tracks ended when individuals either moved out of sight, weather conditions deteriorated or when darkness fell. If the use of the theodolite was restricted, location was determined by estimating distance (km) and bearing (degrees) from the observation site using reticule binoculars.

## 2.3 Boat-based Surveys

Conventional single line-transect marine mammal surveys were carried out aboard MV *Beluga* along a predetermined route. Four different routes were used; surveys 1-4 included coverage of the waters off Loughshinny while surveys 5-11 targeted the Portmarnock area after surveys had been completed off Loughshinny (Figure 3).

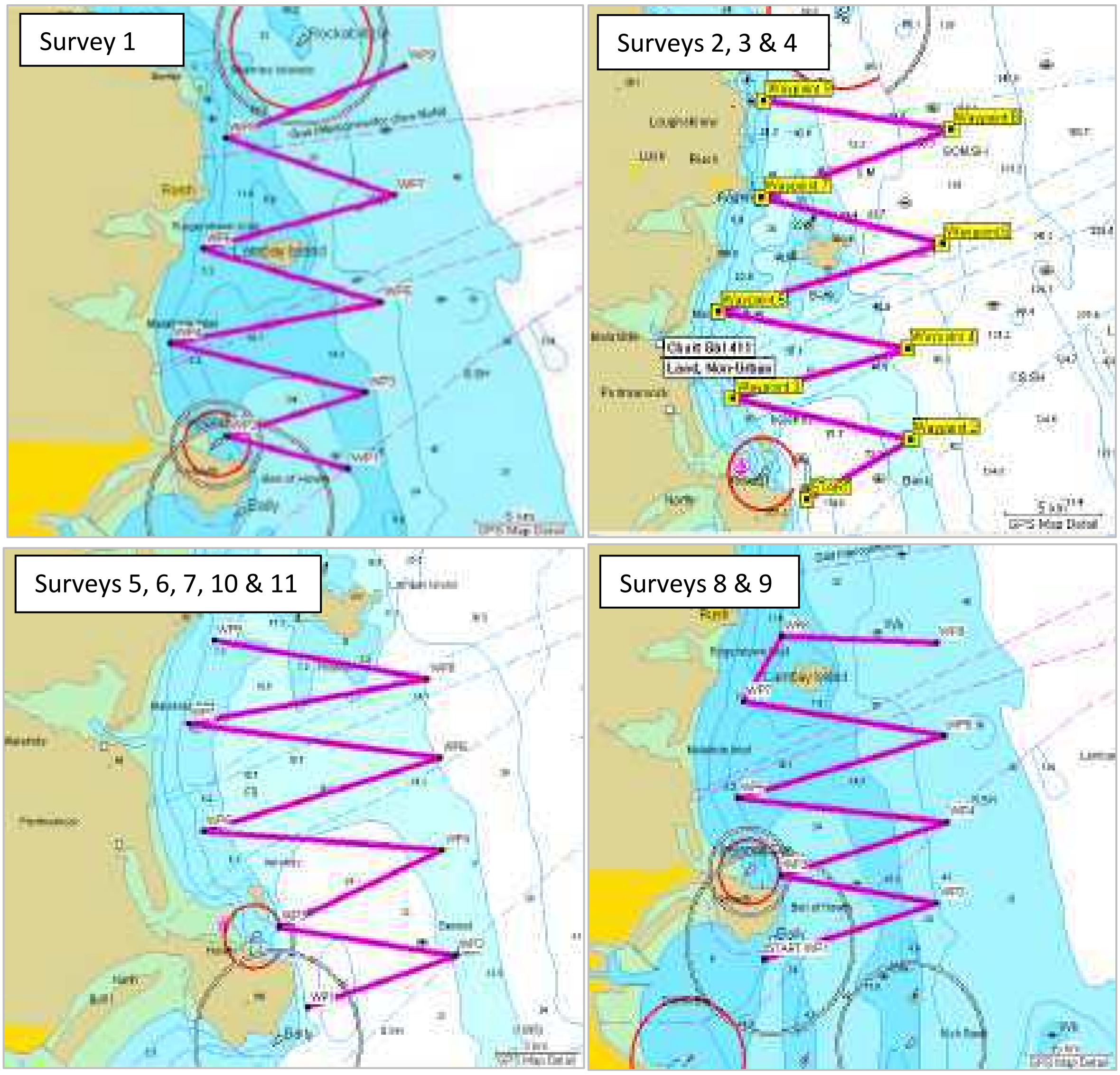



Figure 3. Line Transect Route for boat-based marine mammal surveys

### 2.3.1 Line Transect Methodology

Single platform line transect surveys were conducted every two months onboard a 13m cruiser with flying bridge, MV *Beluga* which has a platform height of 3.1m. Surveys were carried out in sea-state ≤2 and in visibility ≥6km. The vessel travelled at a speed of 9-10 knots, which was 2-3 times the typical average speed of the target species as recommended by Dawson et al. (2008). This helped minimise any potential missed sightings due to avoidance behaviour.

Three people were required on each survey; two primary observers and one operating the software programme LOGGER (©IFAW). The primary observers were positioned on the flying bridge, which provided an eye-height above sea-level of between 4-5m depending on the height of the observer. Primary observers scanned with the naked eye from dead ahead to 90º to port or starboard depending on which side of the vessel they were positioned. During all transects, the position of the survey vessel was tracked continuously through a GPS receiver fed directly into LOGGER software via a laptop. Survey effort, including environmental conditions (sea-state, wind strength and direction, glare etc.) were recorded directly onto LOGGER every 15 minutes.

When a sighting of a marine mammal was made, the position of the vessel and the angle and distance of the sighting from the track of the vessel were recorded. The angle to the sighting from the vessels course was recorded via an angle board attached to the vessel immediately in front of each observer. Binoculars (Opticron 10x50 Marine, with graduated reticle) or a range-finder stick (JNCC approved) were used to estimate distance to sighting, while the binoculars were used to confirm species identification, group numbers, composition and behaviour. This data was communicated to the LOGGER operator in the wheelhouse via a VHF radio. The team of three observers rotated positions between each side of the vessel and LOGGER every hour to avoid bias on one side of the track line or a decline in sighting detections due to fatigue.

## 2.4 Static Acoustic Monitoring

### 2.4.1 Study Area

Two CPODs were moored in one site (one as a control) around 3km east of Loughshinny, Co. Dublin and approximately 6km north of Lambay Island (Figure 4). Additional deployments took place off Portmarnock, Co. Dublin just north of Ireland's Eye. Three locations, (GDD1, GDD2 and GDD3) were monitored here with GDD1 closest to land at 2.5km offshore, GDD2 was 1km to the east of GDD2, while GDD3 was a further 1.5 km from GDD2 and thus 5km offshore (Figure 4).

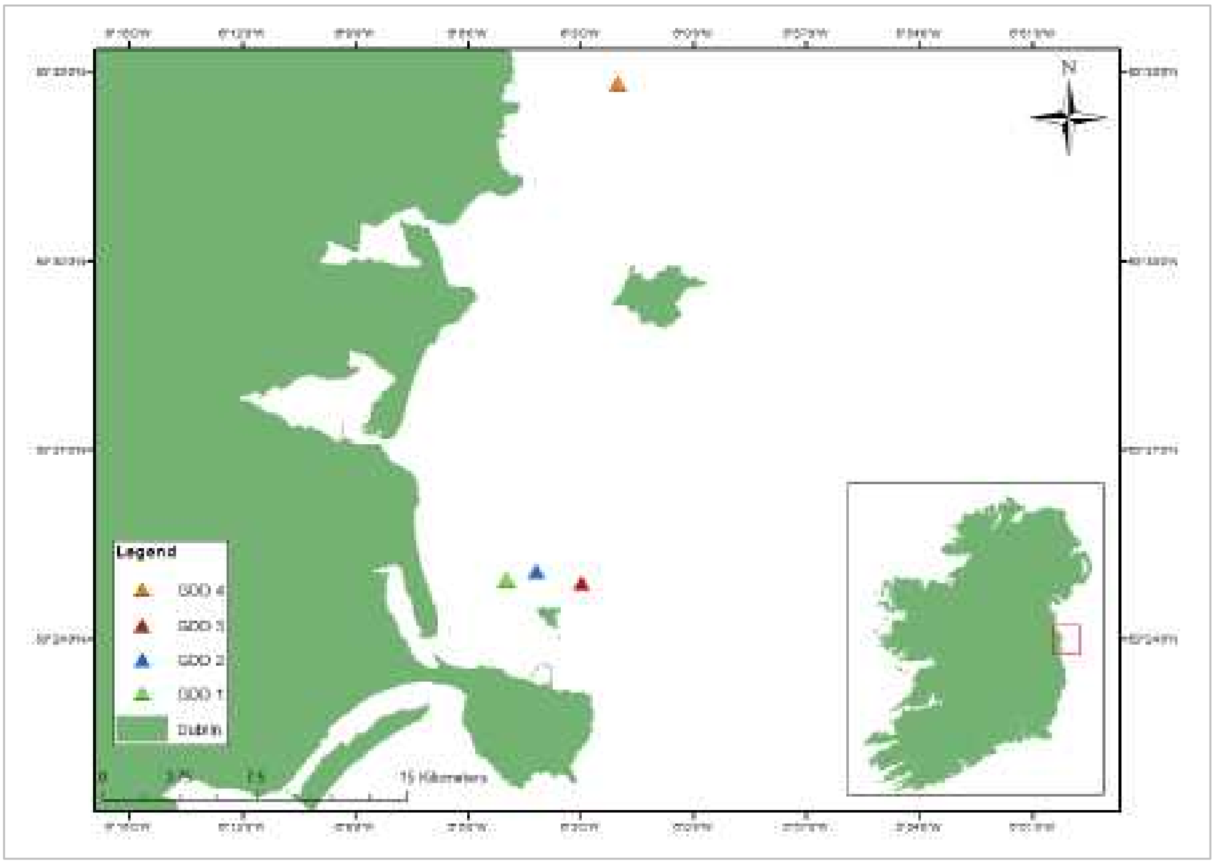



Figure 4. Map of deployment locations of C-PODs off Portmarnock (GDD1, GDD2 and GDD3) and Loughshinny (GDD4)

## 2.4.2 Static Acoustic Monitoring (SAM) Equipment

### *2.4.2.1 C-PODs*

Once deployed at sea, the C-POD operates in a passive mode and is constantly listening for tonal clicks within a frequency range of 20 to 160 kHz (Figure 5). When a tonal click is detected, the C-POD records the time of occurrence, centre frequency, intensity, duration, bandwidth and frequency of the click (Chelonia Ltd). Internally, the C-POD is equipped with a Secure Digital (SD) flash card, and all data are stored on this card. Dedicated software, CPOD.exe, provided by the manufacturer, is used to process the data from the SD card when connected to a PC via a card-reader. This allows for extraction of data files under pre-determined parameters, as set by the user. C-PODs also record temperature at its deployment depth. It should be noted that the C-POD does not record actual sound files, only information about the tonal clicks it detects. The C-POD is a sound pressure level detector with a threshold of 1Pa peak to peak at 130 kHz, with the frequency response shown below (Figure 6, www.chelonian.co.uk). An estimated detection distance of 797.6m ±61m (75% of groups recorded<400m) for C-PODs and bottlenose dolphins was generated in the Shannon Estuary, while distances estimates of 441m ±42m (92% <400m) were calculated for harbour porpoise in Galway Bay (O'Brien et al., 2013).


**Figure 5. C-POD unit by Chelonia Ltd**

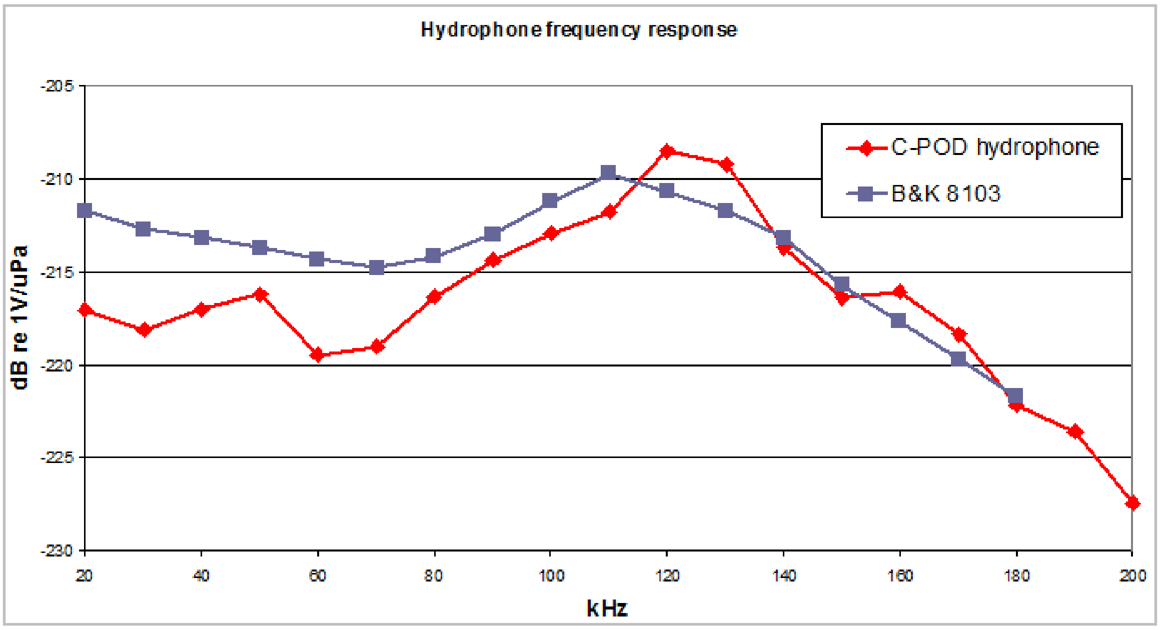



**Figure 6. Threshold for detection across various frequency bands between 20 and 200 kHz for the C-POD (note 1Pa p-p is the SI unit for pressure and correctly represents the threshold) © Chelonia Ltd.**

Through the C-POD.exe software, data can be viewed, analysed and exported. Additionally, the software can be used to change settings of individual SD cards. The C-POD.exe software includes automatic click train detection, which is continually evolving as Chelonia Ltd receives more feedback from their clients. C-POD.exe can be run on any version of Windows and requires an external USB card reader, which reads the SD card into the directory. Version 2.044 (October, 2014) was used for all analyses. C-POD.exe software allows the user to extract click trains under five classification parameters but only the porpoise like category was used for this analyses of the long-term dataset (Figure 7).

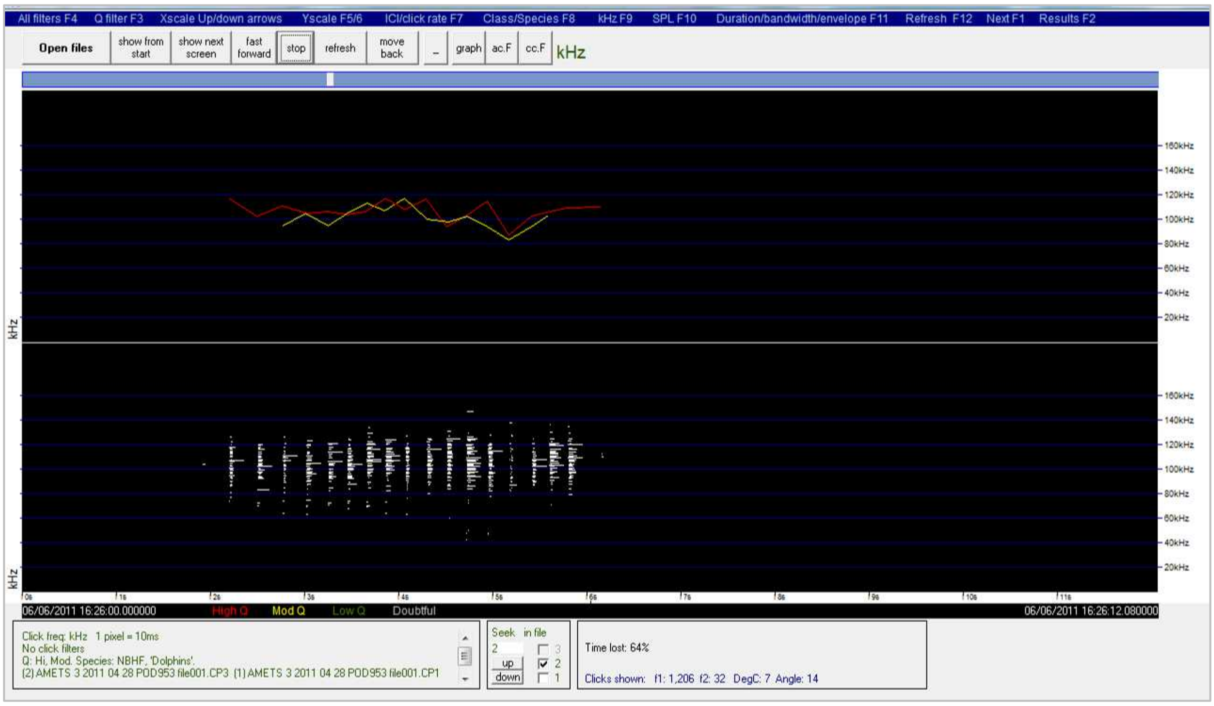



Figure 7. Screen grab of C-POD.exe, showing a harbour porpoise click train

### 2.4.3 C-POD Calibration

Calibration of C-PODs is important in order to facilitate a comparison of acoustic detection results collected by different units across various locations. Chelonia Ltd calibrates all units to a standard prior to dispatch. These calibrations are carried out in the lab under controlled conditions and thus Chelonia highly recommends that further calibrations are carried out in the field prior to their employment in monitoring programmes instead of further tank tests (Nick Tregenza, Chelonia Ltd., *pers. comm.*). Field calibrations are especially important where projects use several units aimed at comparing detections across a number of sites. If units of differing sensitivities are used, then these data do not truly reflect the activity at a site. For example, a low detection rate may be attributed to a less sensitive C-POD, with a lower detection threshold, which in turn leads to a lower detection range, while the opposite holds for a very sensitive unit. It is fundamental that differences between units are determined prior to their deployment as part of any project, to allow for the generation of correction factors which can be applied to the resulting data. Field trials should be carried out in high density areas in order to determine the detection function (O'Brien et al. 2013). The field calibration of new units should be carried out in conjunction with a reference C-POD, where a single unit is used solely for calibrations and is deemed a reference. This allows for the incidence where new units are acquired over the course of a project to be calibrated with the reference.

All units used to carry out SAM during the present project were deployed together in the Shannon Estuary prior to monitoring. C-PODs 549, 795, 796,950 and 1524 were deployed for a total of 13 days (Figure 33), and a second deployment consisting of C-PODs 169, 172, 173, 487 and 1147 for a total of 23 days (Figure 34). This allowed enough time to establish if sensitivity would be a confounding factor between units before been deployed as part of the present study.

Upon recovery of the units during monitoring, data were extracted under two categories, 1) NBHF (porpoise band) and 2) Other (dolphin band) using the C-POD.exe software (Version 2.044, October, 2014). These data were in the form of Excel.xlsx files using C.POD.exe software and analysed as Detection Positive Minutes (DPM) across hourly segments. Statistical analyses were carried out using the program *R* (R Development Core Team, 2011). All combinations of C-POD pairs were modelled using an orthogonal regression of DPM across hourly segments. This was compared to a null model, assuming no variation in C-POD detections, a = 0 and b = 1, and used to assess C-POD performance. An error margin of ±20% DPM per hour was plotted along the null model to distinguish between an acceptable level of variation in C-POD performance and problematic variation due to faulty or highly sensitive units (Tregenza *pers comm.).* From these graphs it is possible to determine successful or unsuccessful C-POD combinations. The mean intercept and gradient values of the orthogonal model for each C-POD pair were extracted and used to create centipede plots where, deviation from 0 on the horizontal axis, of mean intercept values and deviation from 1 on the horizontal axis, of mean gradient values indicated deviations from the null model. This was also used to identify if only one or two POD combinations were unsuccessful and also the extent of variability within the intercept and gradient values. Results were then used to highlight poor performing units or very sensitive units, if they existed and a correction factor can be generated and applied to the data.

### 2.4.4 Moorings

C-PODs were deployed as part of Techworks Marine's heavy weight mooring systems deployed to monitor current and turbidity over the same duration (Figure 8).

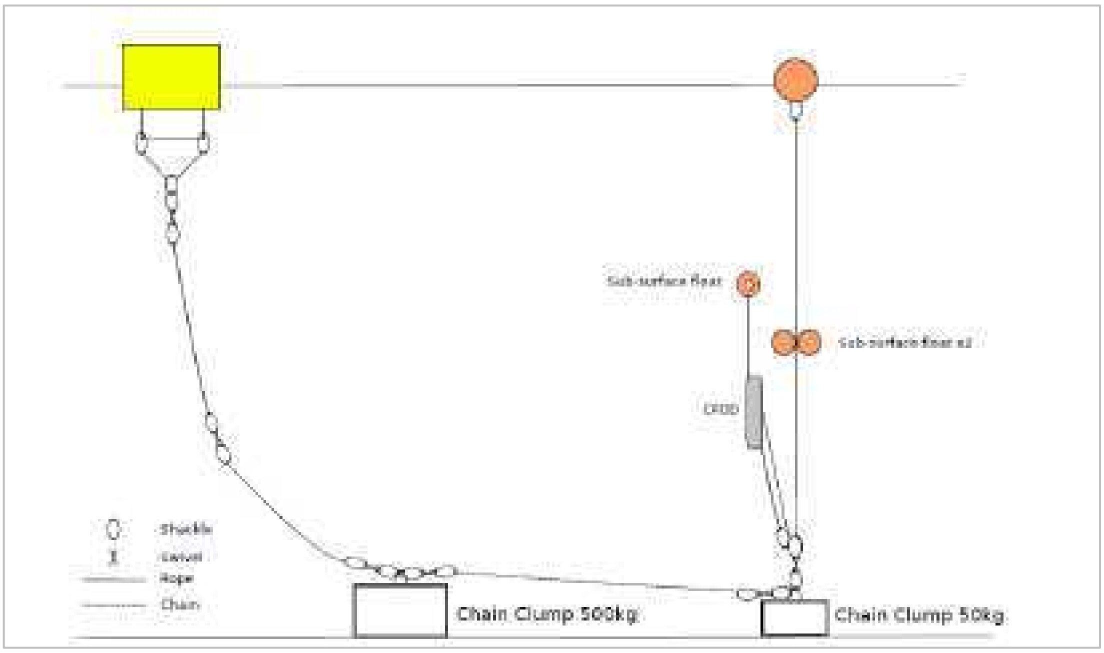



**Figure 8. Heavy weight mooring deployed with C-POD attached (image updated from TechWorks Marine mooring diagram)**

## 2.5 Data Analysis

### 2.5.1 Visual Observations

Visual survey data for land and boat-based surveys (i.e. sighting, effort and weather information) was compiled into a *Microsoft Access* database and *Microsoft Excel*. Maps of study areas and marine mammal sightings were created with ArcMap 10.2.

#### *2.5.1.1 Density and abundance estimation*

Distance sampling was used to derive a density estimate and to calculate a corresponding abundance estimate for the study area where possible. The software programme DISTANCE (Version 5, University of St Andrews, Scotland) was used for calculating the detection function, which is the probability of detecting an object a certain distance from the track-line. The detection function was used to calculate the density of animals on the track-line of the vessel. During this survey, we assume that all animals on the track-line were observed, i.e., that g(0) = 1, which is not correct but testing this would require a double platform survey which is not practical at small coastal sites. This assumption is consistent with previous small scale coastal sites in Ireland (see Berrow et al. 2014), to enable comparisons across sites. The DISTANCE software allows the user to select a number of models in order to identify the most appropriate for the data.  It also allows truncation of sighting outliers when estimating variance in group size and testing for evasive movement prior to detection.

To calculate density, “day” was used as the sample regime with sightings used as sampling observations. Estimates of abundance and density obtained via the DISTANCE modelling process are presented for each survey day. The overall pooled abundance/density estimate was derived from data from both survey days combined. This was necessary in order to obtain sufficient sightings for a robust estimate using the DISTANCE model (the minimum required is 40—60; Buckland *et al.* 2001). In conducting this pooled analysis, we assumed that there were no significant changes in distribution within each site between sample days or any immigration into or emigration out of the site.

The data were fitted to a number of models available in the DISTANCE software. The Half-Normal model with cosine adjustments was found to best fit according to the Akaike Information Criterion delivered by the model. The recorded data were grouped into equal distance intervals of 0-25m, 25-50m up to 200m for the first survey and 0-30m, 30-60m up to 300m for the second survey and both surveys combined. The DISTANCE model determines the influence of cluster size on variability by using a size-bias regression method with the log(n) of cluster size plotted against the corresponding estimated detection function g(x).

A Chi-squared test associated with the estimation of each detection function is delivered by the DISTANCE model. If found to be statistically significant it indicated that the detection function was a good fit and that the corresponding estimates were robust. The proportions of the variability accounted for by the encounter rates, detection probability and group size (cluster size) are presented with each detection function. Variability associated with the encounter rate reflects the number of sightings on each track-line. The detection probability reflects how far the sightings were from the track-line and cluster size reflects the range of estimated group sizes recorded on each survey.

### 2.5.2 Static Acoustic Monitoring

All C-POD data were analysed using only high probability clicks. Both dolphin and porpoise detections were extracted as detection positive minutes per day (DPM), but only porpoise detections were analysed statistically. Dolphin detections were present but upon visual validation were found to be false positives. False positives are very short click trains, similar to a dolphin echolocation click train and can occur due to background sounds in the marine environment. As recommended by the manufacturers, a validation overview was carried out on the data, where 10% of all detected trains were visually inspected on cpod.exe to verify they were rightly assigned to harbour porpoise. Of this 10%, 1% of trains were classified as false positives, and therefore analysis of the porpoise detections proceeded with the classification of hourly variables into the following categories; season (spring, summer, autumn and winter), diel cycle (day and night-time), tidal state (ebb, flood, slack high, slack low) and tidal phase (spring, neap). The term PPM represents the number of minutes in a day or an hour that harbour porpoises were acoustically detected. Seasonal categorisations were assigned according to the seasons spring (February, March, April), summer (May, June, July), autumn (August, September, October) and winter (November, December, January). Data files in the format porpoise minutes per hour (PPM/h) were classified into day and night-time categories using local times of sunrise and sunset times, obtained from the U.S. Naval Observatory, who provide the sun rise and sunset data in a readily available format (www.aa.usno.navy.mil/data/docs/RS). Hourly data segments were further categorised into each of the four tidal states, where three hours were assigned to each state (one hour either side of the hour).  Files were further split to correspond with tidal phase (spring and neap cycles) using admiralty data (WXTide 32) where two days either side of the highest tidal height was deemed spring, and two days either side of the least difference in tidal height between high and low tide was deemed neap, all other days were classified as transitional.

All data were analysed using the program *R*. *R* is a language and environment for statistical computing and graphics. It is free software, available at http://www.r-project.org/index.html. The software compiles and runs on a wide range of UNIX platforms, Windows and MacOS. *R* provides a wide variety of linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering and graphical techniques (*R* Development Core Team, 2011). *R* is designed around a true computer language, similar to the S language. The effective programming language includes conditionals, loops, user-defined recursive functions and input and output facilities. A Generalized Linear Mixed-effect Model (GLMM) was fitted to the binomial data using the glmer function in the lme4 package developed for *R*. C-POD ID number was included as a random factor to further take into account variability between units. Akaike's information criterion (AIC) and a histogram of fitted residuals were used as diagnostic tools for model selection. Wald chi-squared tests were computed for each variable and predicted proportions of Porpoise Positive Hours (PPH) were extracted across all levels and displayed as box plots using the HH package developed for *R*.

# RESULTS

## 3.1 Land-based observations

Land-based monitoring was carried out monthly from 18 March 2015 until 11 March 2017. Just under 144 hours of monitoring was conducted over 23 independent surveys. Half day surveys were carried out from March to 07 September 2015 when Loughshinny was also surveyed in the same day. Full days surveys off Howth Head commenced on 19 September 2015.

### 3.1.1 Environmental Conditions

Environmental conditions were favourable during nearly all of the land-based surveys. Swell of less than 1m was recorded on 100% of survey days. Sea-state 0 was recorded for 23% of total survey effort, sea-state 1 for 54%, sea-state 2 for 21% and sea-state 3 for 1% (Figure 9). Visibility of 1-5km was recorded for 3% of total survey effort, 6-10km for 21%, 11-15km for 7%, 16-20km for 36% and greater than 20km for 32% (Figure 10).


**Figure 9. Beaufort Sea-state (%) recorded during land-based surveys from Howth Head**

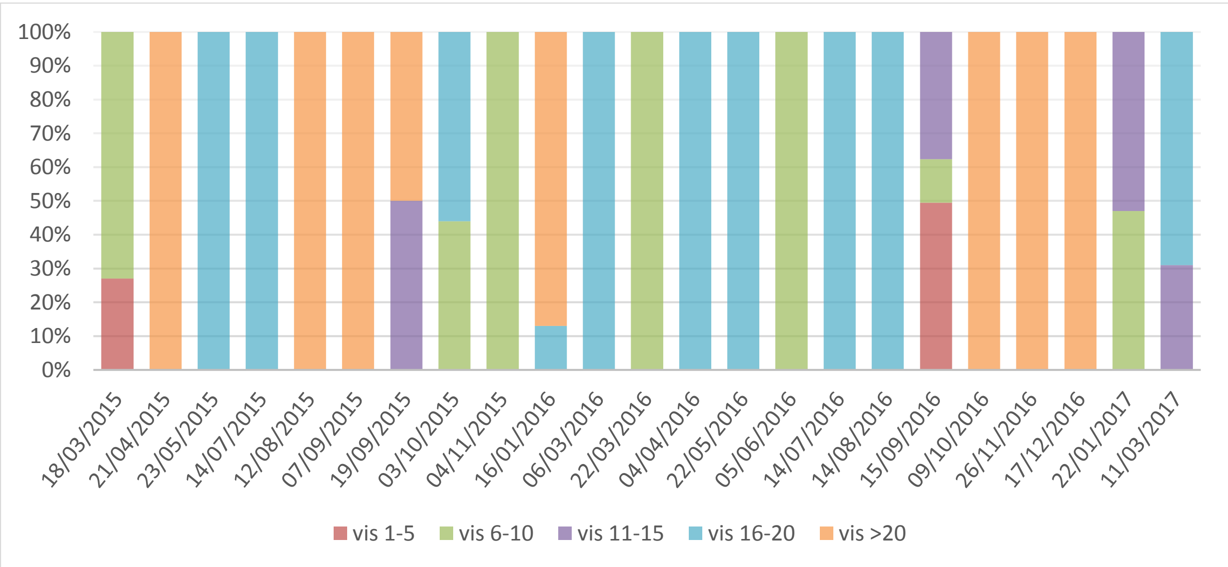



**Figure 10. Percentage visibility (km) recorded during land-based surveys from Howth Head**

### 3.1.2 Scan sampling marine mammal sightings

Marine mammals were sighted on 100% of survey days with harbour porpoise present on 83% and seals present on 100% of days. A total of two marine mammal species were recorded during the survey period; harbour porpoise and grey seal.

#### *3.1.2.1 Harbour Porpoise*

One hundred and sixty-seven (167) sightings of harbour porpoise were recorded totalling 293 animals (Table 1). A total of 237 adults, 41 juveniles and 15 calves were recorded and sightings had an average group size of two animals. Calves were only recorded between September and November 2015 and in August 2016.

**Table 1. Summary of harbour porpoise sightings recorded during Howth Head land-based observations. Grey shaded rows show half-day surveys.**

| Date | No. sightings | No. animals | Adults | Juveniles | Calves | Range of group size |
|---|---|---|---|---|---|---|
| 18/03/2015 | 0 | 0 | - | - | - | - |
| 21/04/2015 | 2 | 3 | 3 | - | - | 1-2 |
| 23/05/2015 | 0 | 0 | - | - | - | - |
| 14/07/2015 | 0 | 0 | - | - | - | - |
| 12/08/2015 | 1 | 4 | 3 | 1 | - | - |
| 07/09/2015 | 6 | 18 | 11 | 2 | 5 | 2-4 |
| 19/09/2015 | 15 | 28 | 22 | 1 | 5 | 1-5 |
| 03/10/2015 | 3 | 6 | 4 | 1 | 1 | 1-3 |
| 04/11/2015 | 11 | 19 | 14 | 3 | 2 | 1-5 |
| 16/01/2016 | 11 | 29 | 23 | 6 | - | 1-12 |
| 06/03/2016 | 2 | 2 | 2 | - | - | 1 |
| 22/03/2016 | 6 | 7 | 6 | 1 | - | 1-2 |
| 04/04/2016 | 0 | 0 | - | - | - | - |
| 22/05/2016 | 4 | 5 | 5 | - | - | 1-2 |
| 05/06/2016 | 1 | 2 | 2 | - | - | - |
| 14/07/2016 | 7 | 13 | 13 | - | - | 1-3 |
| 14/08/2016 | 43 | 66 | 59 | 5 | 2 | 1-3 |
| 15/09/2016 | 8 | 14 | 12 | 2 | - | 1-3 |
| 09/10/2016 | 31 | 60 | 43 | 17 | - | 1-4 |
| 26/11/2016 | 1 | 1 | 1 | - | - | - |
| 17/12/2016 | 5 | 5 | 5 | - | - | 1 |
| 22/01/2017 | 4 | 5 | 3 | 2 | - | 1-2 |
| 11/03/2017 | 6 | 6 | 6 | - | - | 1 |
| **TOTAL** | **167** | **293** | **237** | **41** | **15** | |

Sighting rate was calculated as the number of sightings and number of animals per hour of effort in order to compare the half day and full day surveys. Harbour porpoise sighting rate was consistently higher during late summer and autumn, between August and January 2015 and August and October 2016 (Figure 11). Group size also increased during this period (Table 1).

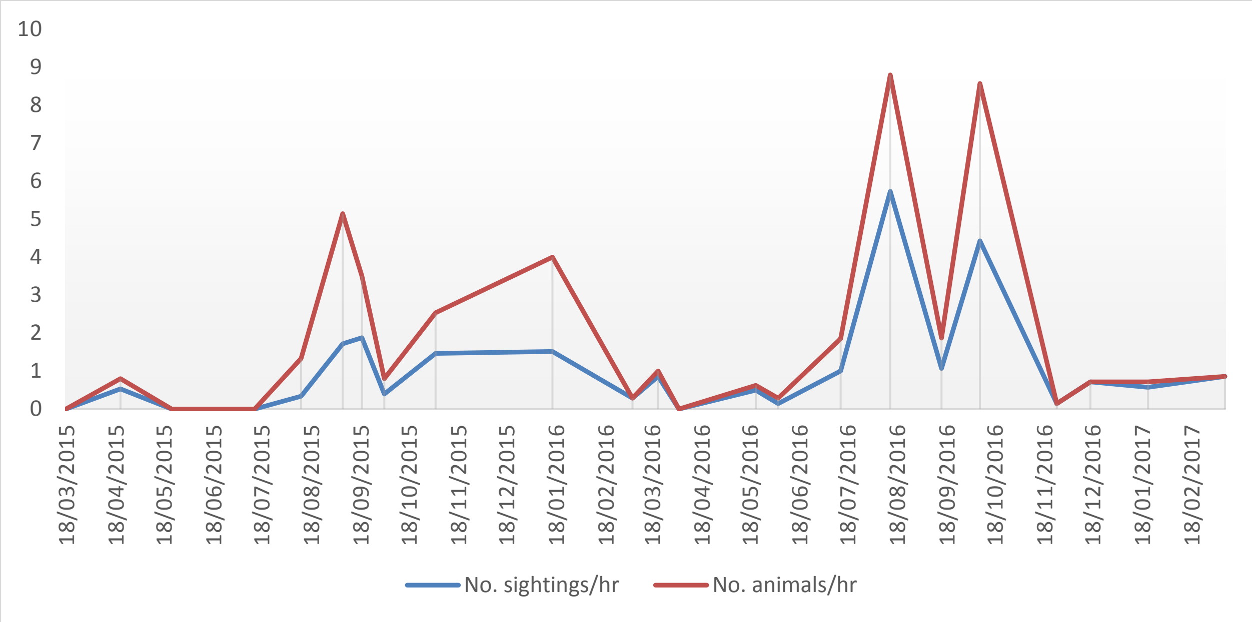



**Figure 11. Harbour porpoise sighting rate for Howth Head land-based surveys**

The greatest number of the harbour porpoise sightings were recorded to the northeast of the observation site, where animals were often recorded swimming in a tidal current close to the cliffs (Figure 12).

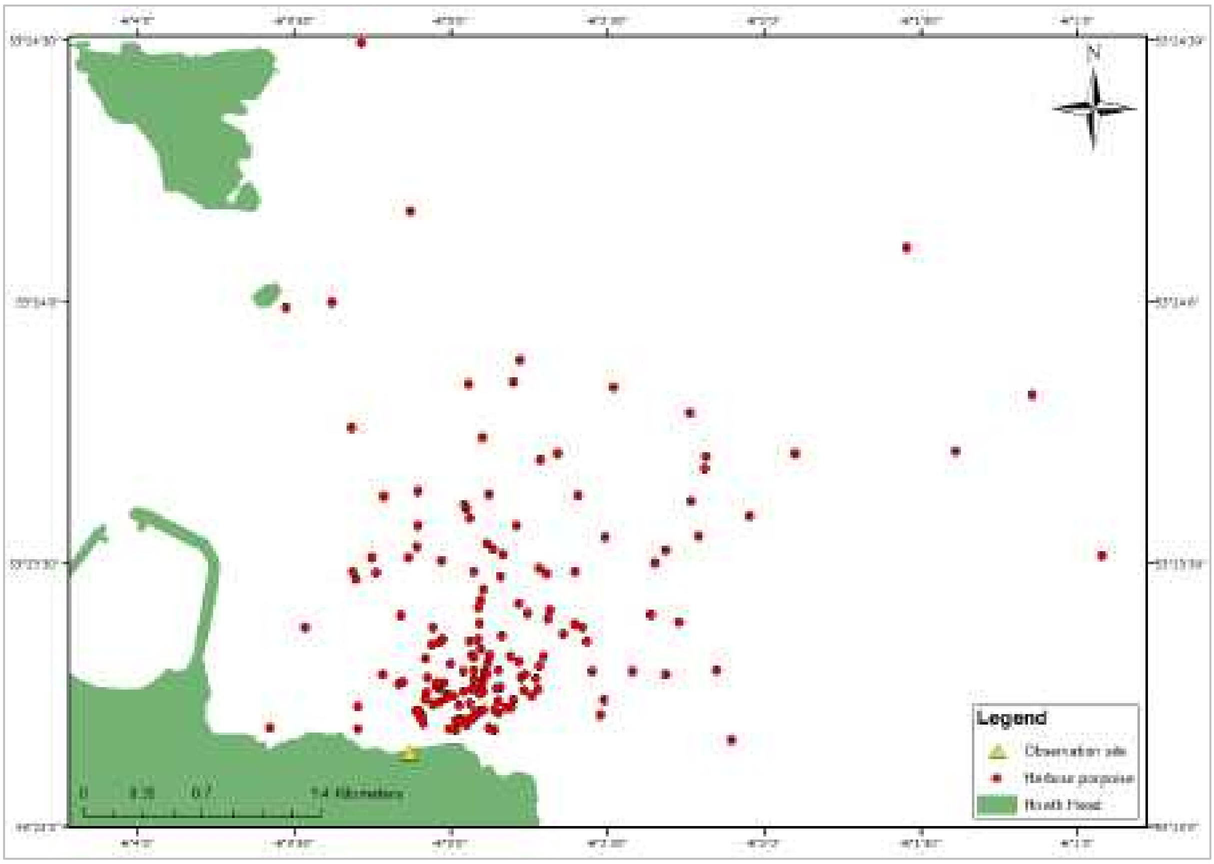



**Figure 12. Distribution of harbour porpoise sightings off Howth Head**

#### 3.1.2.2 *Grey seals*

Two hundred and sixty (260) sightings of grey seals were recorded totalling 325 animals. A total of 323 adults and two juveniles were recorded and sightings had an average group size of one animal.

Sighting rate for grey seals was more consistent over the survey period with less consistent peaks. Rate was greatest in April 2015 although high numbers were also recorded in September 2015, January 2016 and October 2016. Group size also increased during this time (Figure 13).

Grey seal distribution was more westerly than harbour porpoise and individuals were often recorded feeding within close proximity to the northern cliffs of Howth Head (Figure 14).

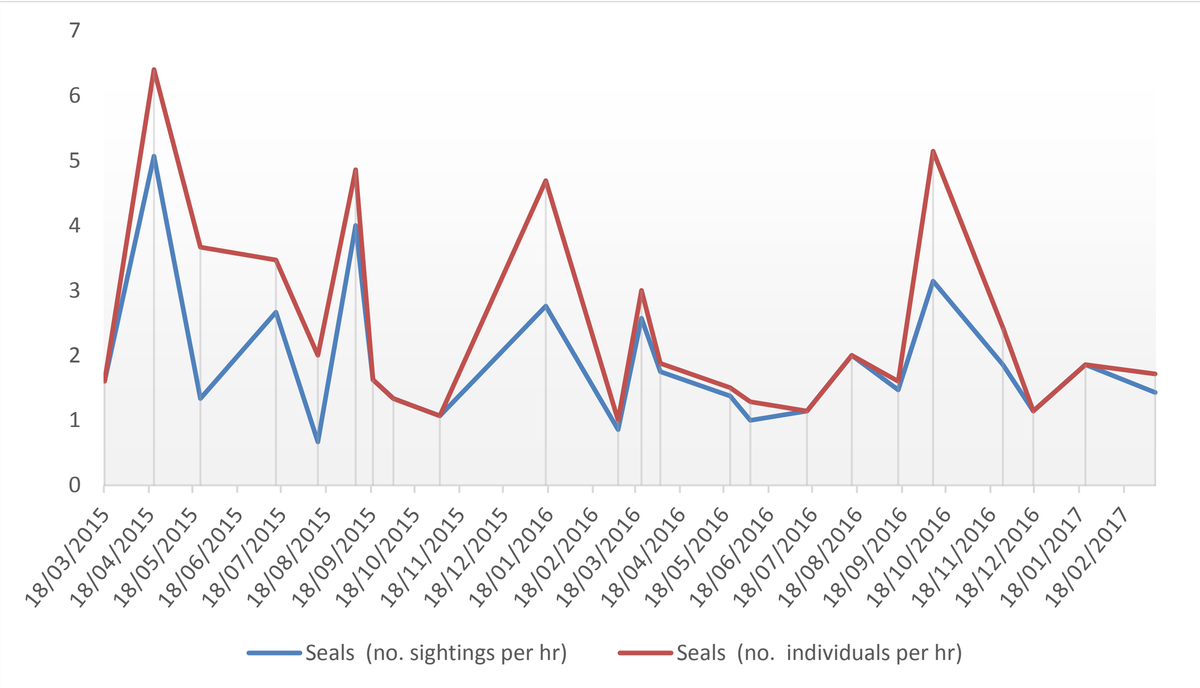



**Figure 13. Grey seal sighting rate for Howth Head land-based surveys**

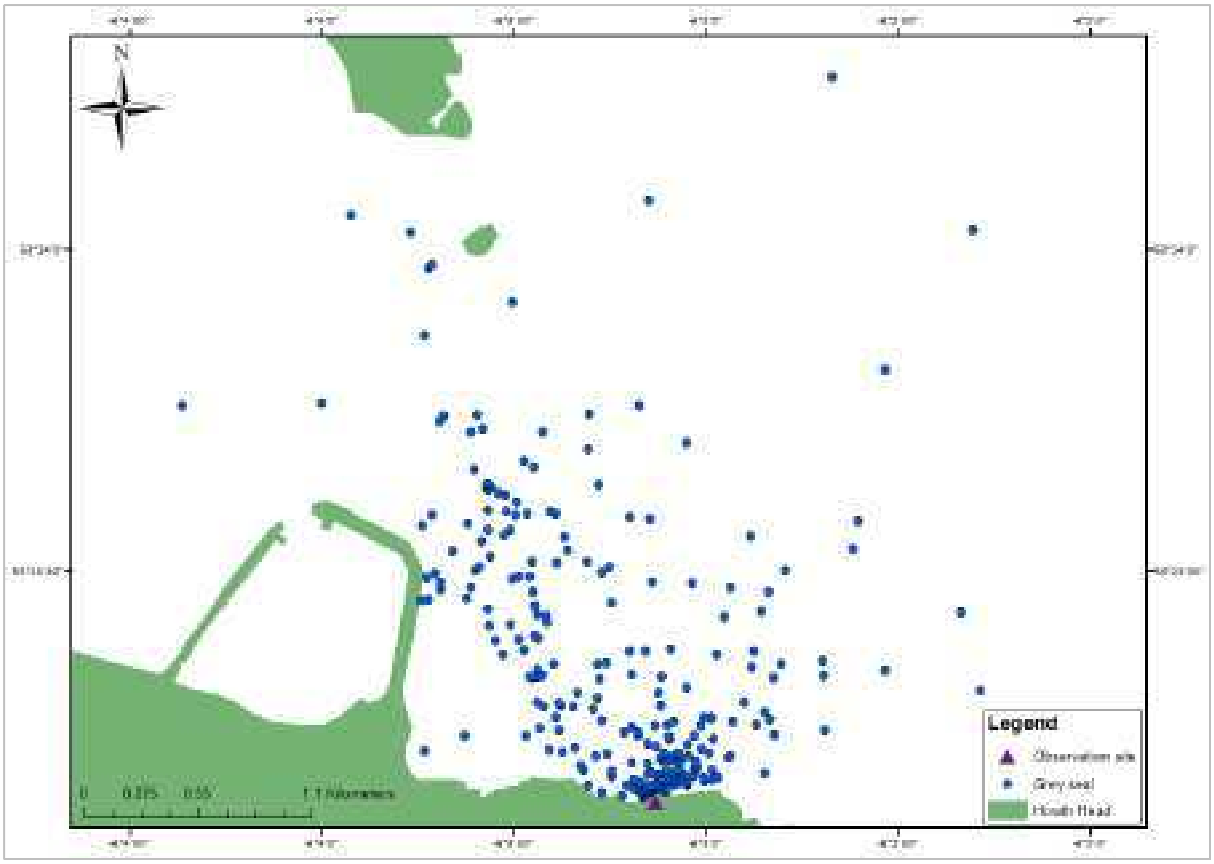



Figure 14. Distribution of grey seal sightings off Howth Head

#### 3.1.2.3 *Focal Follow Observations*

When possible, harbour porpoise were tracked during each surfacing event to gain an understanding of their behaviour. Four focal follows were obtained over four days in September 2015, March 2016 and January and March 2017. In September 2015, a group of harbour porpoise comprising of two adults and one calf was tracked for 20 minutes. Single adult harbour porpoise were tracked for 59 minutes in March 2016, 24 minutes in January 2017 and 53 minutes in March 2017. With the exception of March 2016, all focal follows tracked harbour porpoise in a visible tidal current on the northwest coast of Howth Head (Figure 15).

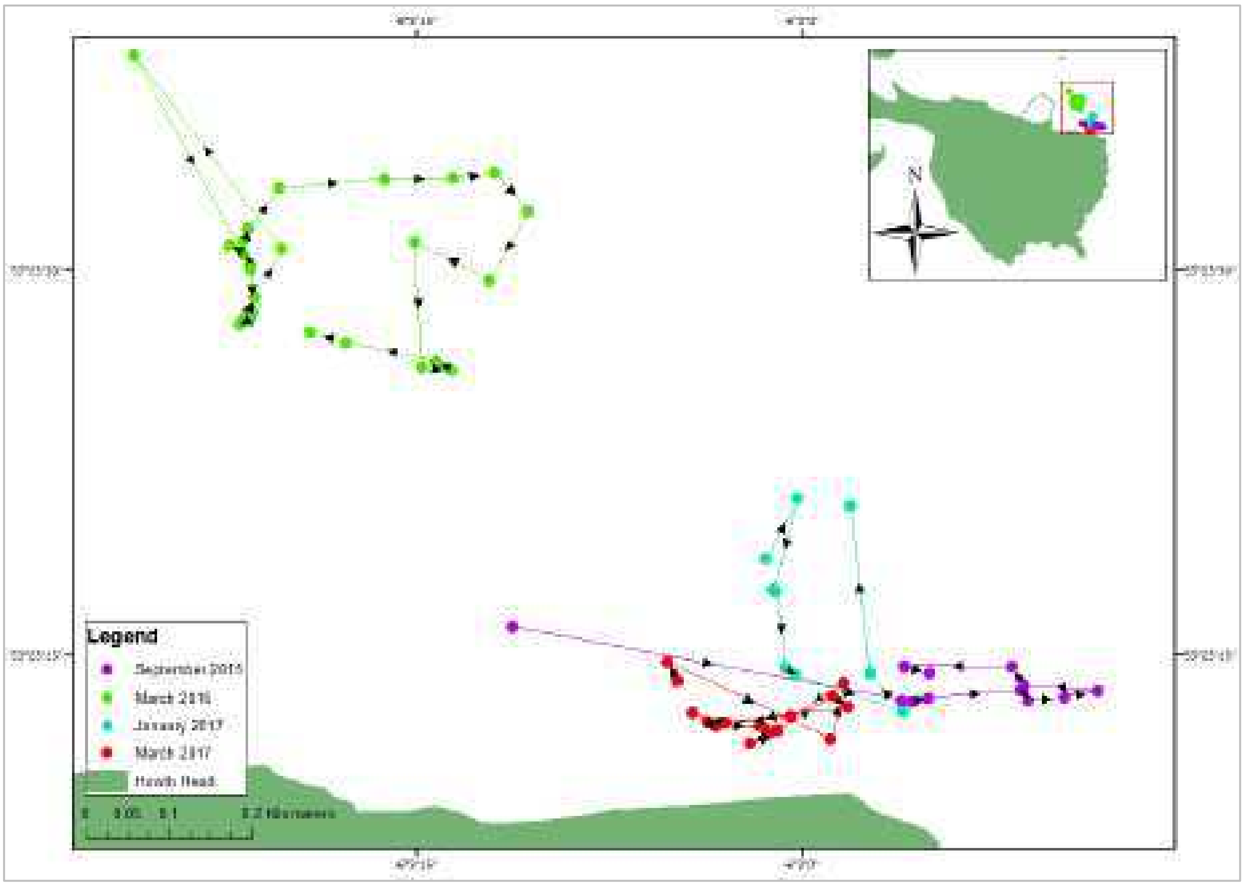



Figure 15. Focal follow tracking of harbour porpoise from the Howth Head site during 2015, 2016 and 2017

## 3.2 Boat-based surveys

Eleven boat-based marine mammal surveys were conducted onboard MV *Beluga* from April 2015 to January 2017 (Table 2). Track-lines were staggered to provide good coverage of the site and to ensure all habitats were surveyed (see Figure 3).

### 3.2.1 Environment

Environmental conditions were generally favourable throughout the boat-based surveys. Swell of less than 1m was recorded for 100% of survey effort. Visibility was greater >6km with the exception of the November 2015 where visibility was reduced to >3km due to sea fog. Sea-state of >2 was recorded for 8% during April 2015, 36% during the June 2015 survey and 46% during the December 2016 where sea-state was greater than forecast (Figure 16).

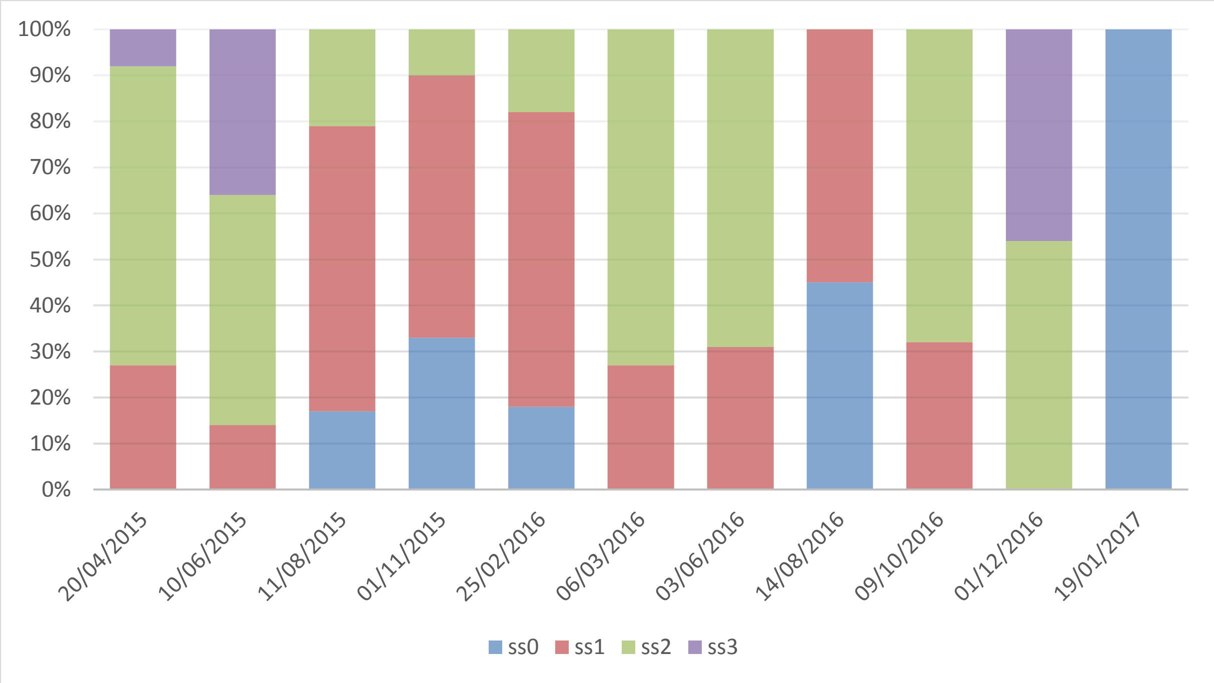



Figure 16. Beaufort Sea-state (%) recorded during boat-based surveys

### 3.2.2 Boat-based Marine Mammal Sightings

Marine mammals were recorded on 100% of boat-based surveys (Table 2, Figures 17-27). Species recorded comprised of harbour porpoise, grey seal, harbour seal and minke whale.

Table 2. Summary of marine mammal sightings and predominant sea-state from boat-based surveys

| Date | No. harbour porpoise sightings | No. seal sightings | No. harbour porpoise individuals | No. seal individuals | No. other marine mammals | Predominant sea-state (0-2) |
|---|---|---|---|---|---|---|
| **20/04/2015** | 11 | 2 | 15 | 2 | 0 | 2 |
| **10/06/2015** | 3 | 1 | 3 | 1 | 1 Minke whale | 2-3 |
| **11/08/2015** | 20 | 2 | 37 | 2 | 0 | 1 |
| **01/11/2015** | 30 | 8 | 35 | 8 | 0 | 1 |
| **25/02/2016** | 16 | 4 | 17 | 4 | 0 | 1 |
| **06/03/2016** | 8 | 2 | 9 | 2 | 0 | 2 |
| **03/06/2016** | 2 | 1 | 2 | 1 | 0 | 2 |
| **14/08/2016** | 39 | 0 | 58 | 0 | 1 Minke whale | 1 |
| **09/10/2016** | 12 | 2 | 16 | 2 | 0 | 2 |
| **01/12/2016** | 3 | 1 | 3 | 1 | 0 | 2 |
| **19/01/2017** | 23 | 2 | 31 | 2 | 0 | 0 |
| **Total** | **167** | **25** | **226** | **25** | **2** | |

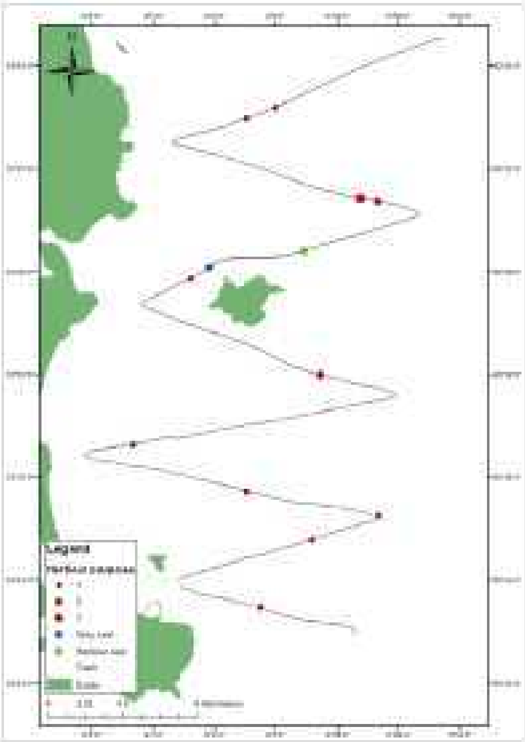


Figure 17. Trackline and sightings recorded during boat survey 1 (April 2015)

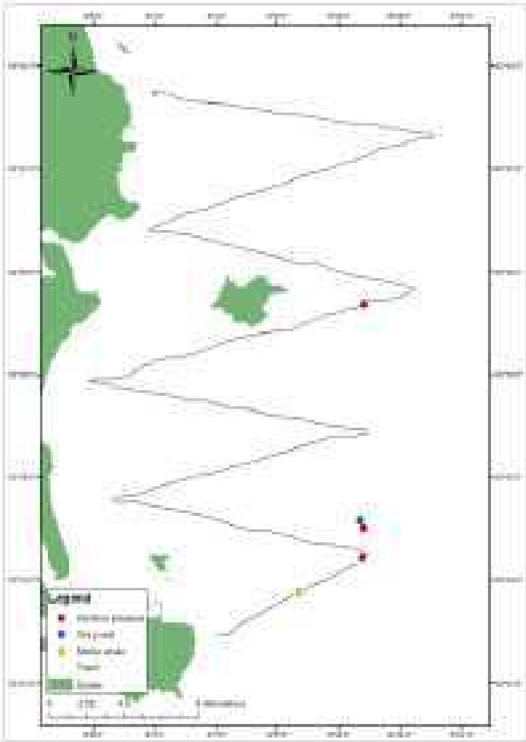


Figure 18. Trackline and sightings recorded during boat survey 2 (June 2015)

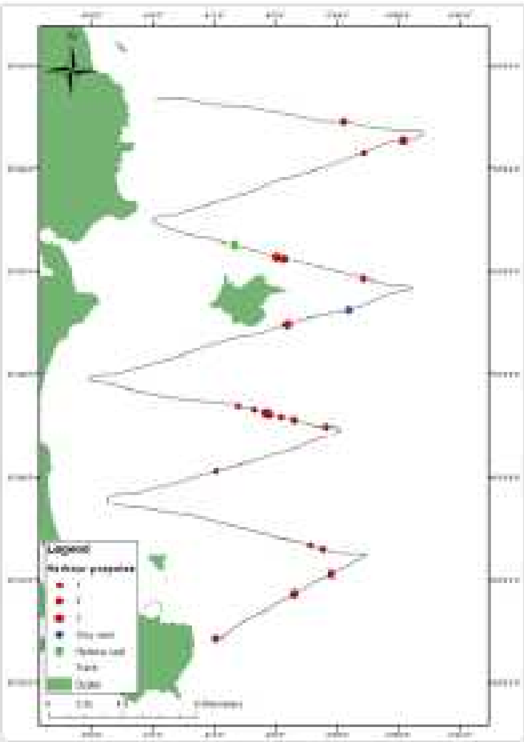


Figure 19. Trackline and sightings recorded during boat survey 3 (August 2015)

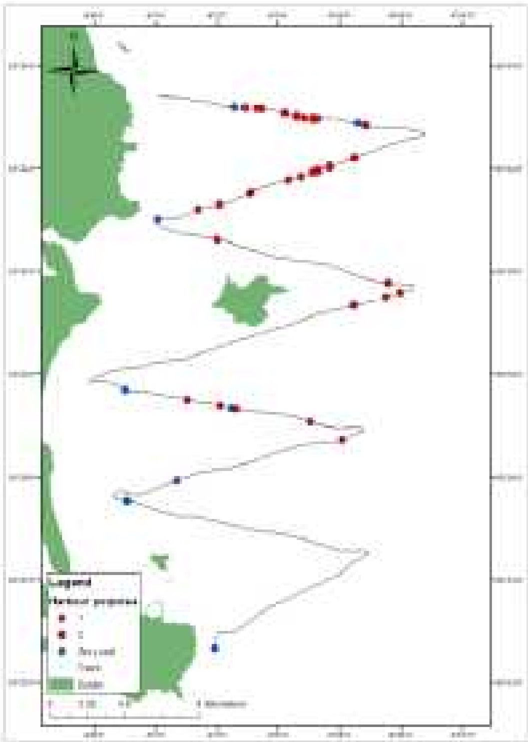


Figure 20. Trackline and sightings recorded during boat survey 4 (November 2015)

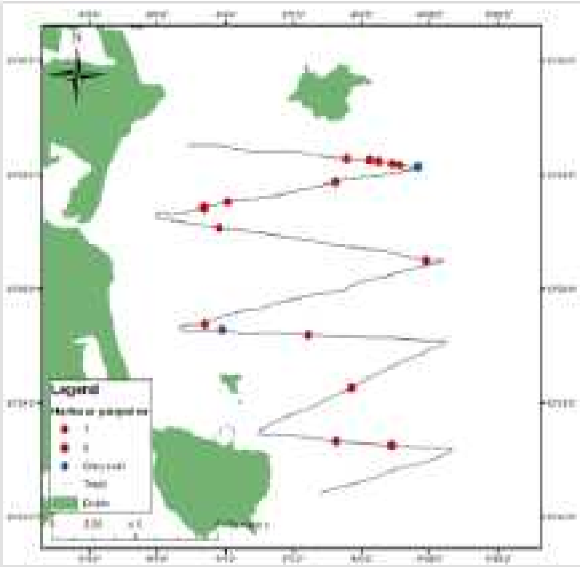



Figure 21. Trackline and sightings recorded during boat survey 5 (February 2016)

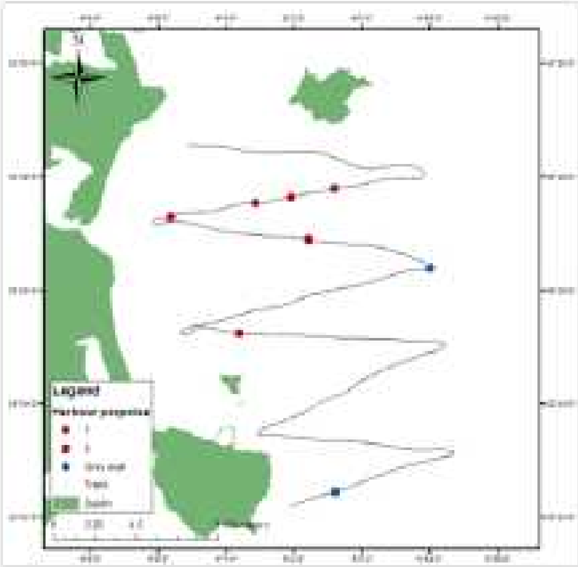



Figure 22. Trackline and sightings recorded during boat survey 6 (March 2016)

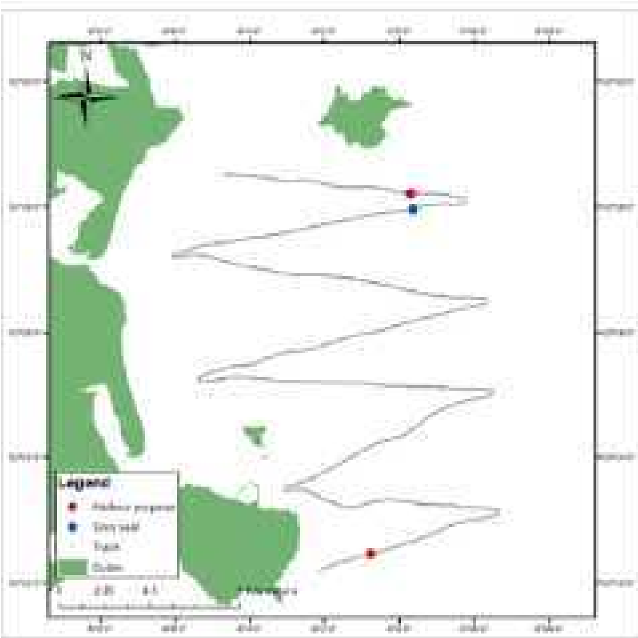



Figure 23. Trackline and sightings recorded during boat survey 7 (June 2016)

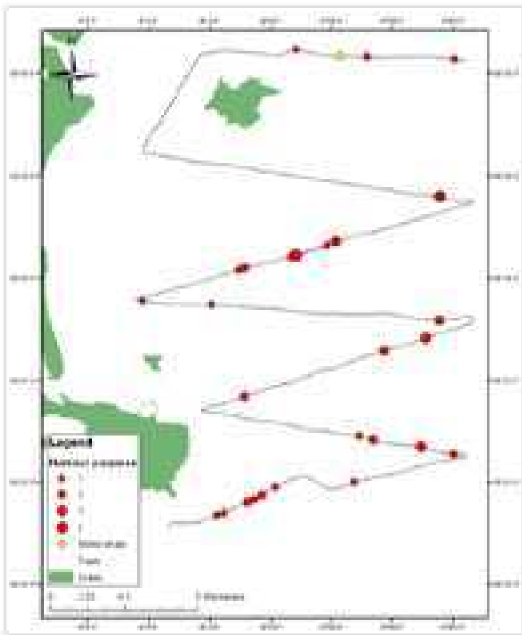
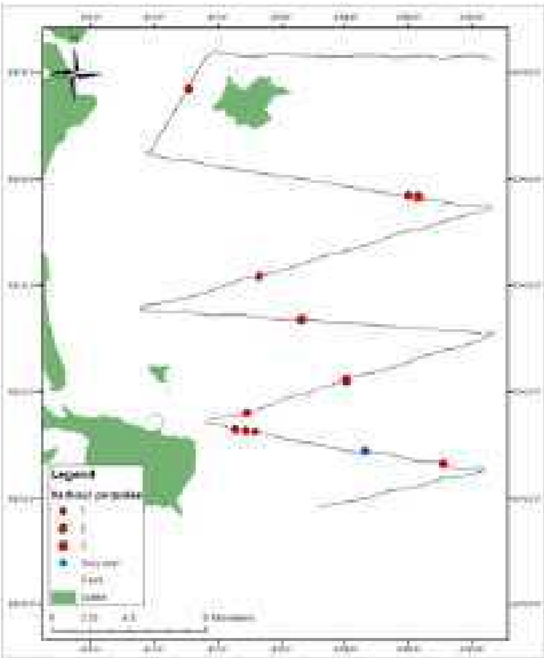



Figure 24. Trackline and sightings recorded during boat survey 8 (August 2016)



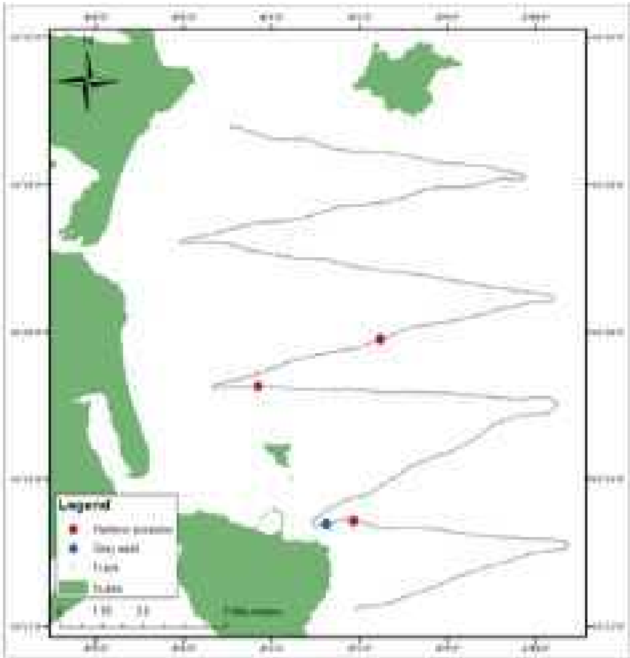




Figure 25. Trackline and sightings recorded during boat survey 9 (October 2016)

Figure 26. Trackline and sightings recorded during boat survey 10 (December 2016)

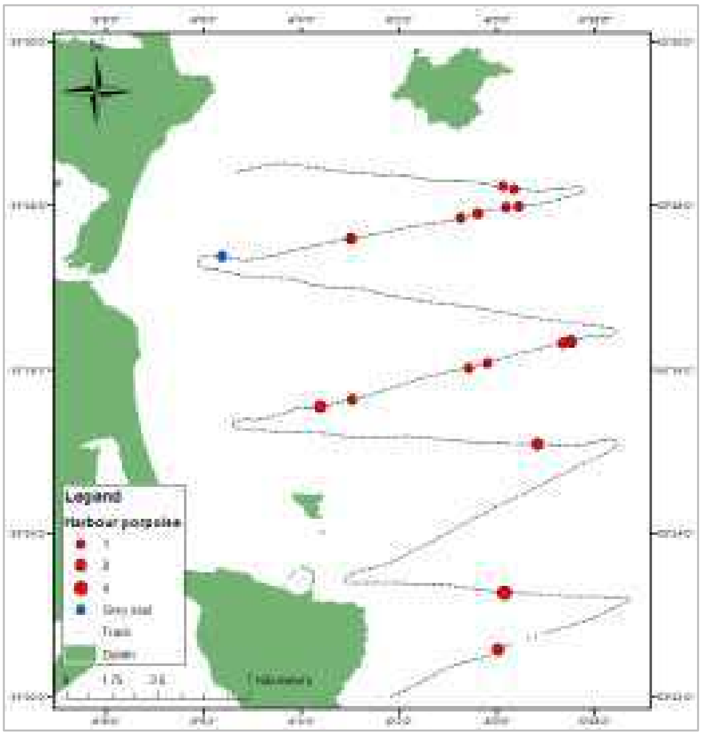



Figure 27. Trackline and sightings recorded during boat survey11 (January 2017)

#### 3.2.2.1 *Seal species and minke whale*

Seals were recorded on 91% of survey days with the highest numbers of individuals recorded during November 2015 (Table 3, Figure 28 ). Grey seal sightings were distributed evenly across the study area and all sightings were of single adult individuals. Only two harbour seals were sighted, one during the April and one in August 2015 surveys, both of which were single adults. Single minke whales were recorded during two surveys, one in June 2015 and one in August 2016 (Table 3, Figure 29).

**Table 3. Summary of seal sightings recorded during boat-based surveys**

| Date | No. seal sightings | No. seal individuals | Other marine mammals |
|---|---|---|---|
| 20/04/2015 | 2 | 2 | 0 |
| 10/06/2015 | 1 | 1 | 1 Minke whale |
| 11/08/2015 | 2 | 2 | 0 |
| 01/11/2015 | 8 | 8 | 0 |
| 25/02/2016 | 4 | 4 | 0 |
| 06/03/2016 | 2 | 2 | 0 |
| 03/06/2016 | 1 | 1 | 0 |
| 14/08/2016 | 0 | 0 | 1 Minke whale |
| 09/10/2016 | 2 | 2 | 0 |
| 01/12/2016 | 1 | 1 | 0 |
| 19/01/2017 | 2 | 2 | 0 |

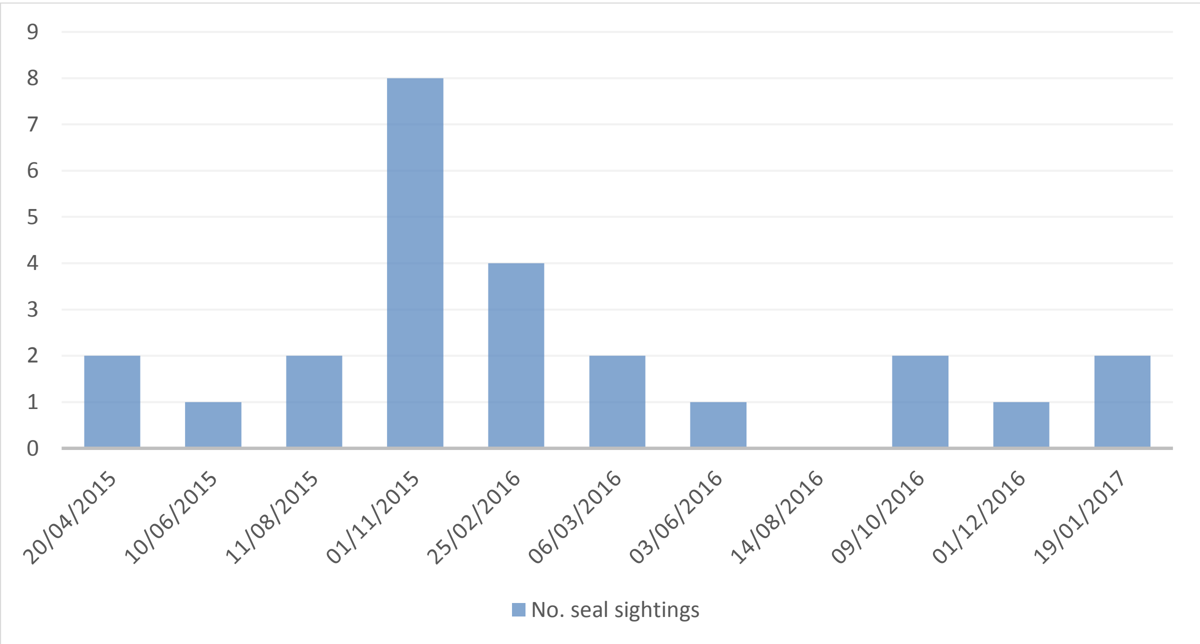



**Figure 28. Number of seal sightings recorded during boat-based surveys**

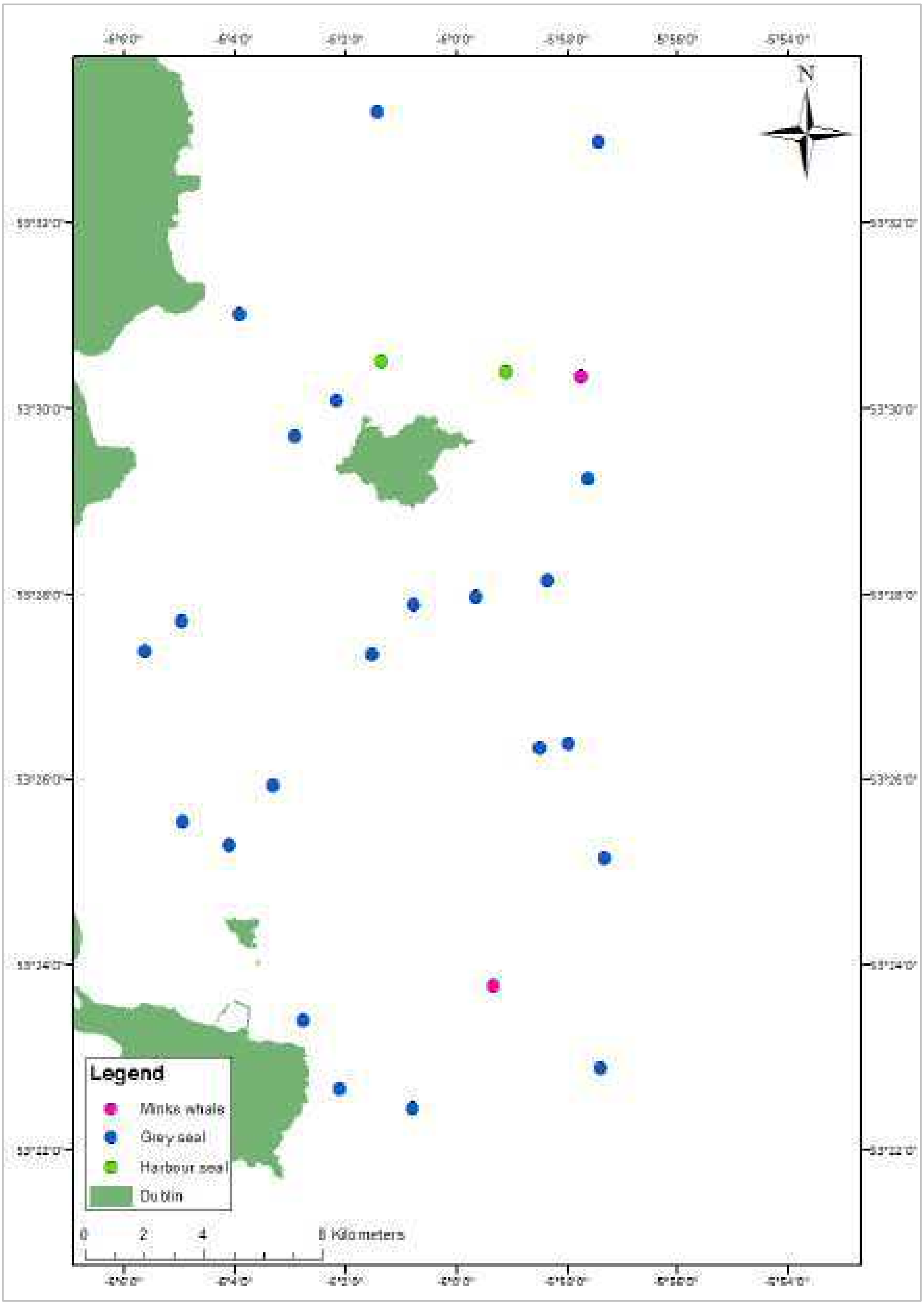



**Figure 29. Geographic distribution of seal sightings and minke whales recorded during boat-based surveys**

### *3.2.2.2 Harbour porpoise*

Harbour porpoise were recorded on 100% of survey days with the greatest number of sightings recorded in November 2015 and August 2016 (Table 4, Figure 30). Group sizes also increased between August and November in 2015 and in August 2016. The lowest number of sightings were recorded in June 2015, June 2016 and December 2016 however sea-state was higher during these surveys which would increase the likelihood of missed sightings, therefore these results must be treated with caution. Calves were only recorded in August 2015, November 2015 and August 2016. Harbour porpoise sightings were regularly distributed across the study area (Figure 31).

**Table 4. Summary of harbour porpoise sightings recorded during boat-based surveys**

| Date | No. HP sightings | No. HP individuals | Adults | Juveniles | Calves | Range in group size |
|---|---|---|---|---|---|---|
| **20/04/2015** | 11 | 15 | 15 | - | - | 1-3 |
| **10/06/2015** | 3 | 3 | 3 | - | - | - |
| **11/08/2015** | 20 | 37 | 32 | 4 | 1 | 1-3 |
| **01/11/2015** | 30 | 35 | 32 | 2 | 1 | 1-2 |
| **25/02/2016** | 16 | 17 | 17 | - | - | 1-2 |
| **06/03/2016** | 8 | 9 | 8 | 1 | - | 1-2 |
| **03/06/2016** | 2 | 2 | 2 | - | - | - |
| **14/08/2016** | 39 | 58 | 47 | 6 | 5 | 1-5 |
| **09/10/2016** | 12 | 16 | 15 | 1 | - | 1-3 |
| **01/12/2016** | 3 | 3 | 3 | - | - | - |
| **19/01/2017** | 23 | 31 | 28 | 3 | - | 1-4 |
| | | | **202** | **17** | **7** | **Average: 1.35** |

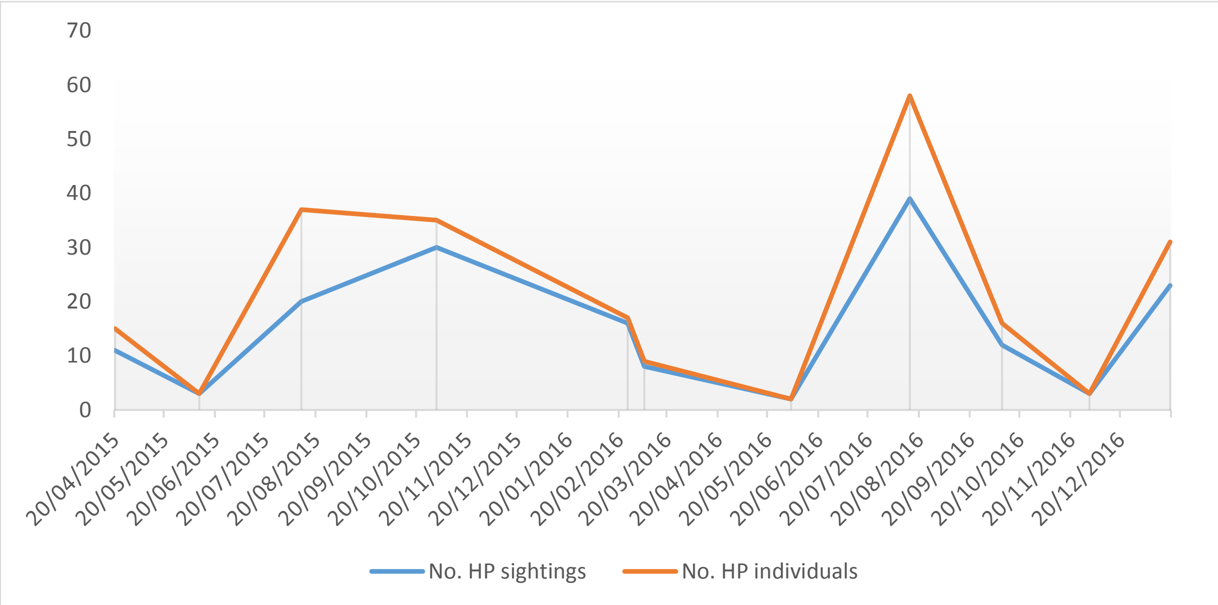



**Figure 30. Number of harbour porpoise sightings and individuals recorded during boat-based surveys**

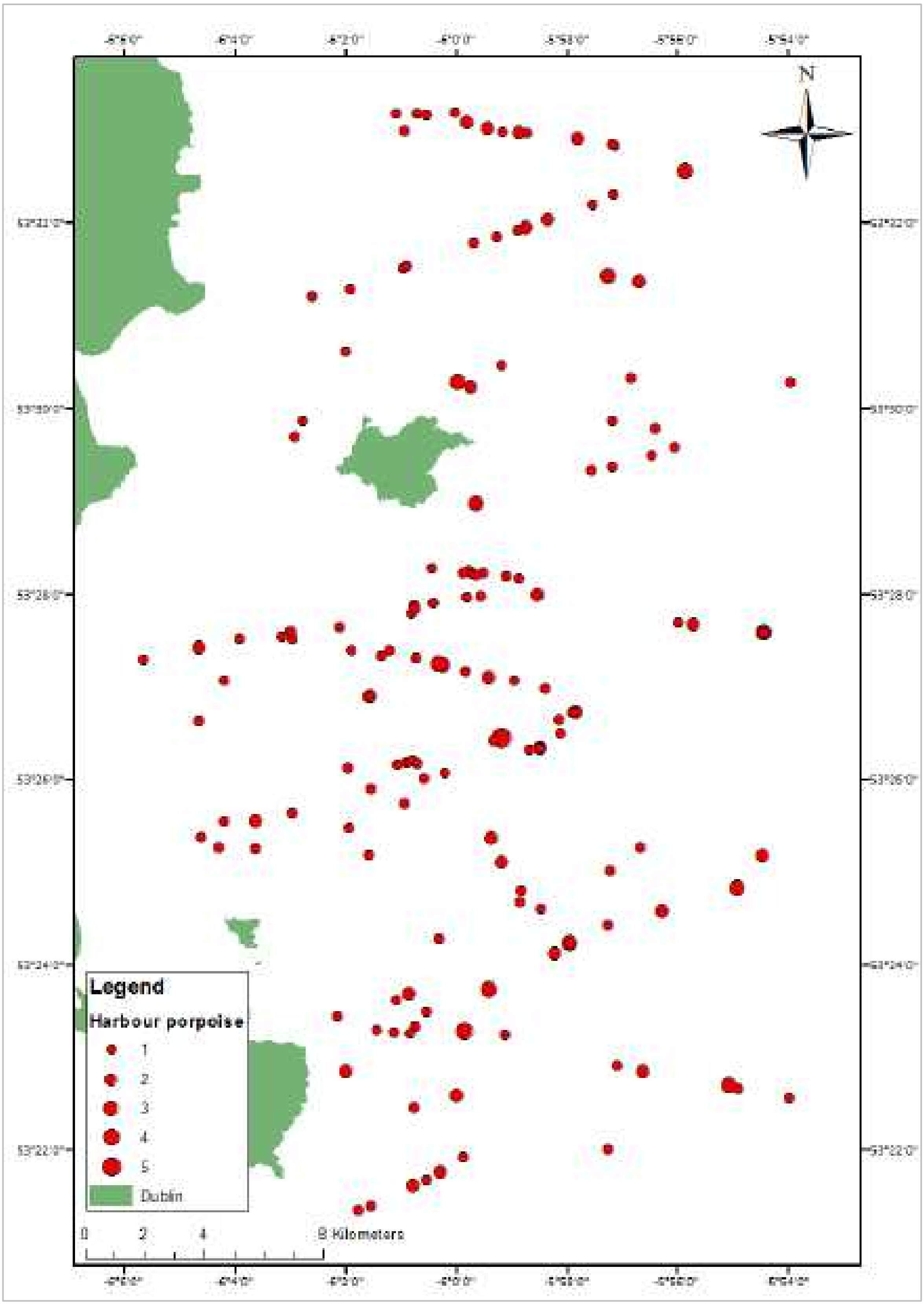



Figure 31. Geographic distribution of harbour porpoise recorded during boat-based surveys

##### 3.2.2.2.1 Density and abundance estimation

Density estimates for harbour porpoises calculated for seven of the eleven survey days and not for surveys two (June 2015), six (March 2016), seven (June 2016) and ten (December 2016) as the number of sightings were less than 10 and too few to derive a reliable density estimate. The detection functions for all surveys combined could not be calculated as the area surveyed was reduced during the winter period and after Loughshinny was removed from survey obligations.

Evasive reactions of porpoises from the survey vessel were most evident on all surveys but especially on surveys 1, 5, 8 and 9 with a peak in sightings some 30-100m from the track-line (Figure 32), most likely resulting in an underestimate of animal density. Variation in cluster size was greater during the surveys 1 and 9 which contributed a greater proportion of the variability. Mean group (cluster) size was greater on surveys 3 (August 2015) and 8 (August 2016) compared to the other surveys, suggesting a peak occurred in late summer which is consistent with land-based observations. Adults will have calved before this period and calves were recorded during both the August 2015 and August 2016 surveys. Calves are unlikely to have weaned which may contribute to this elevated group size.

Density and abundance estimates for harbour porpoise for the Greater Dublin Drainage Marine Mammal Surveys are shown in Table 6. The density estimates increased during summer and early winter (August-November) in 2015 and during August 2016. Densities were lowest in April 2015 and February 2016. The total number of sightings used in the April 2015 (11), February 2016 (16) and October 2016 (12) surveys were low and results should be treated with caution. The track-line surveyed in February was around 25% less than in the previous surveys to account for shorter day length. Also the area surveyed was less than in previous surveys as Loughshinny had been dropped as an area of interest at the end of summer 2015. Areas of high densities of harbour porpoise to the north of the study site were therefore not surveyed which will reduce the reported density estimate. These changes to survey design should be taken into account however the trend to increased densities during late summer and early winter coincided with peak sighting rate from land-based watches.

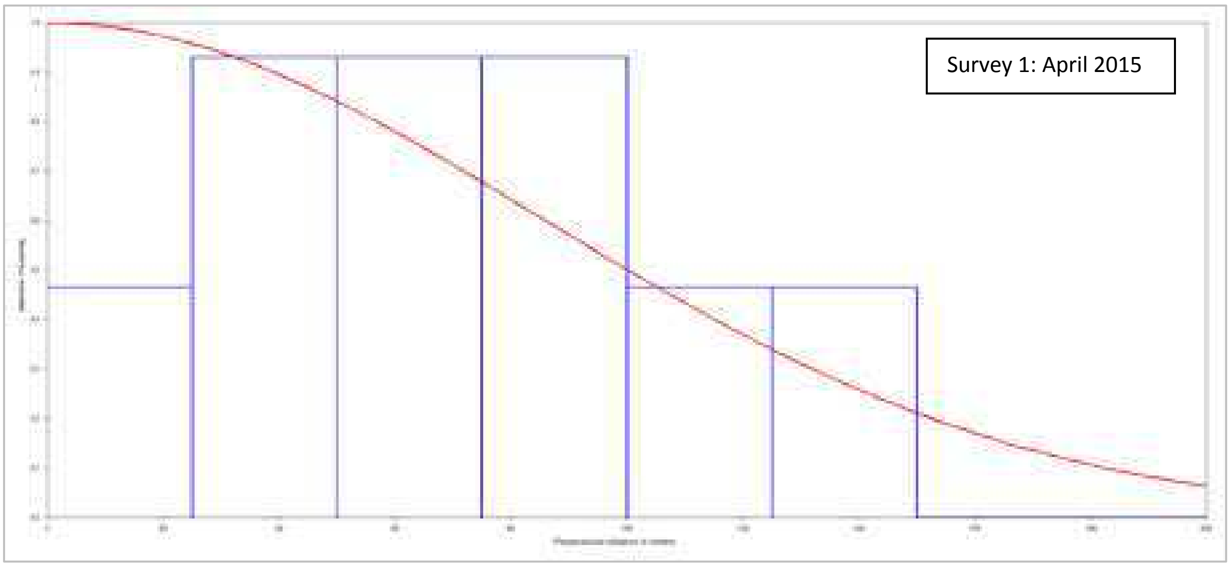
**Table 5. Model data used in the harbour porpoise abundance and density estimation process for the Greater Dublin Drainage project (Note: A half-normal model with cosine series adjustments and sightings data truncated at 200m for surveys 1, 8 and 9 and 300m for surveys 3, 4, 5 and 11).**

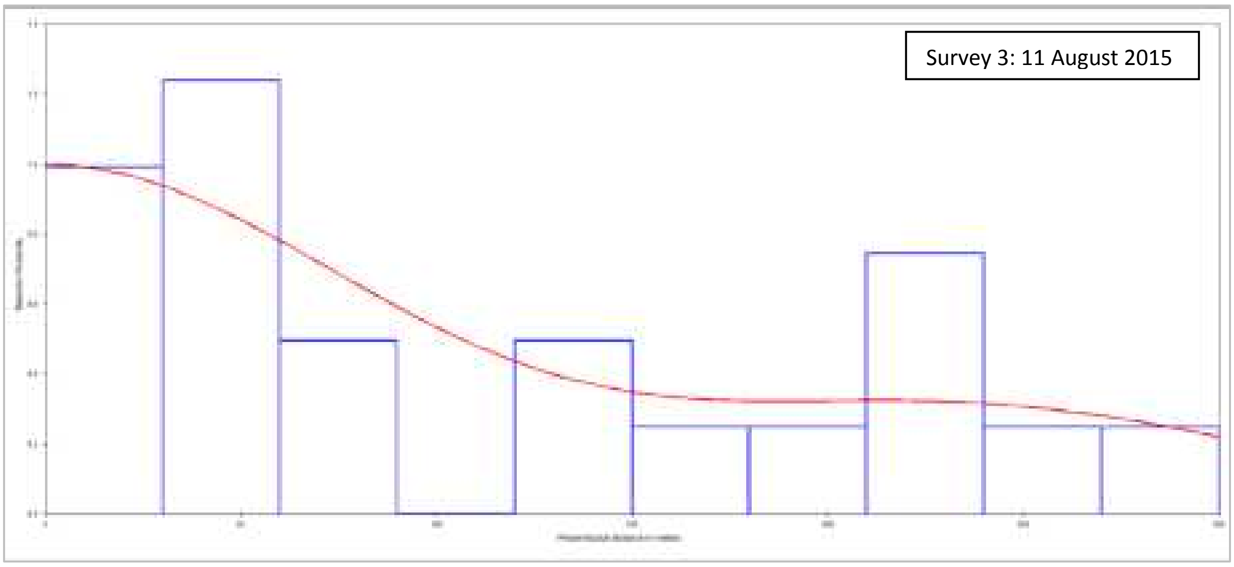
| Sample Day | Track length (km) | Area surveyed ($km^2$) | Number of sightings | $Chi^2$ P value | Effective Strip Width (m) | Variability (D) | |
|---|---|---|---|---|---|---|---|
| | | | | | | Detection | Cluster |
| 1 | 78 | 197 | 11 | 0.924 | 104.65 | 67.6 | 32.4 |
| 3 | 75 | 189 | 20 | 0.602 | 148.78 | 84.1 | 15.9 |
| 4 | 75 | 189 | 30 | 0.542 | 141.8 | 89.0 | 11.0 |
| 5 | 60 | 85 | 16 | 0.193 | 190.42 | 100 | 00.0 |
| 8 | 89 | 201 | 39 | 0.093 | 105.1 | 77.9 | 22.1 |
| 9 | 89 | 201 | 12 | 0.464 | 97.35 | 73.1 | 26.9 |
| 11 | 89 | 201 | 23 | 0.930 | 206.9 | 82.5 | 17.5 |

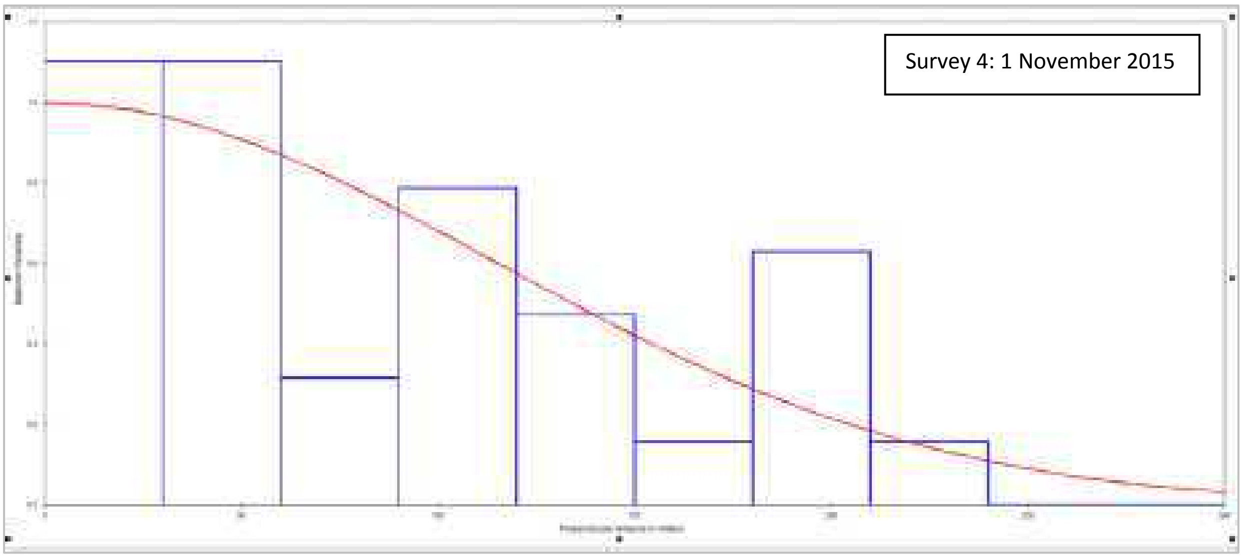
**Table 6. Estimated density, abundance (N) and group sizes of harbour porpoise recorded for the Greater Dublin Drainage project.**

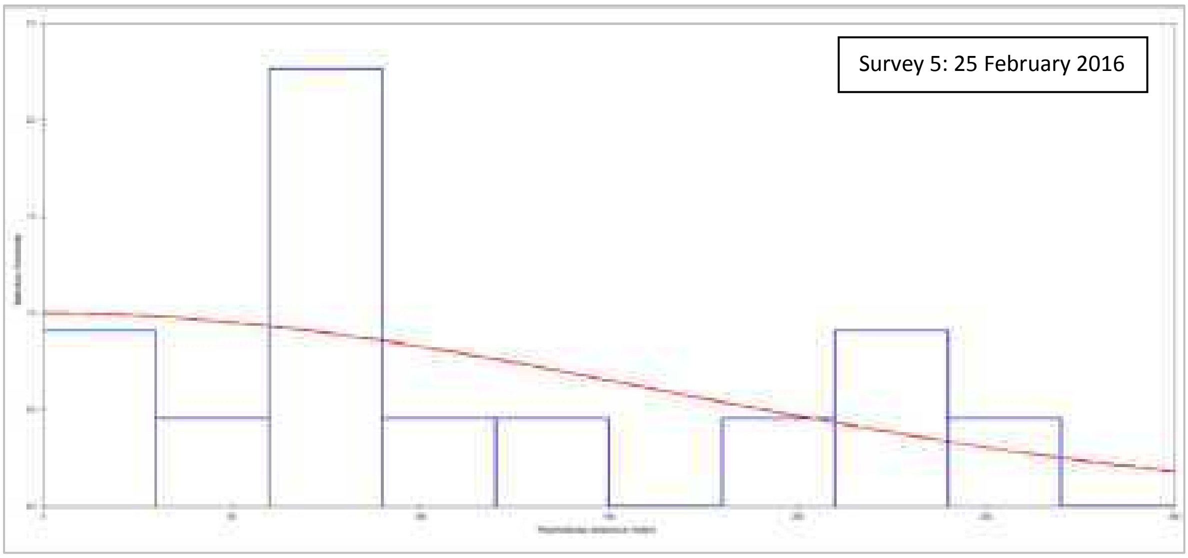
| Sample Day | Date | N (95% CI) | SE | CV | Density (per km2) | Mean group size (95% CI) |
|---|---|---|---|---|---|---|
| 1 | Apr-15 | 154 (77-306) | 54 | 0.33 | 0.78 | 1.44 (1.00-2.12) |
| 3 | Aug-15 | 361 (192-681) | 114 | 0.32 | 1.91 | 1.85 (1.48-2.30) |
| 4 | Nov-15 | 332 (245-449) | 50 | 0.36 | 1.76 | 1.17 (1.12-1.31) |
| 5[1] | Feb-16 | 52 (31-86) | 12 | 0.23 | 0.61 | 1.00 |
| 8 | Aug-16 | 460 (339-625) | 70 | 0.15 | 2.29 | 1.53 (1.25-1.85) |
| 9 | Oct-16 | 197 (111-349) | 54 | 0.28 | 0.97 | 1.37 (1.00-1.89) |
| 11 | Jan-17 | 179 (117-275) | 38 | 0.21 | 0.89 | 1.35 (1.07-1.69) |

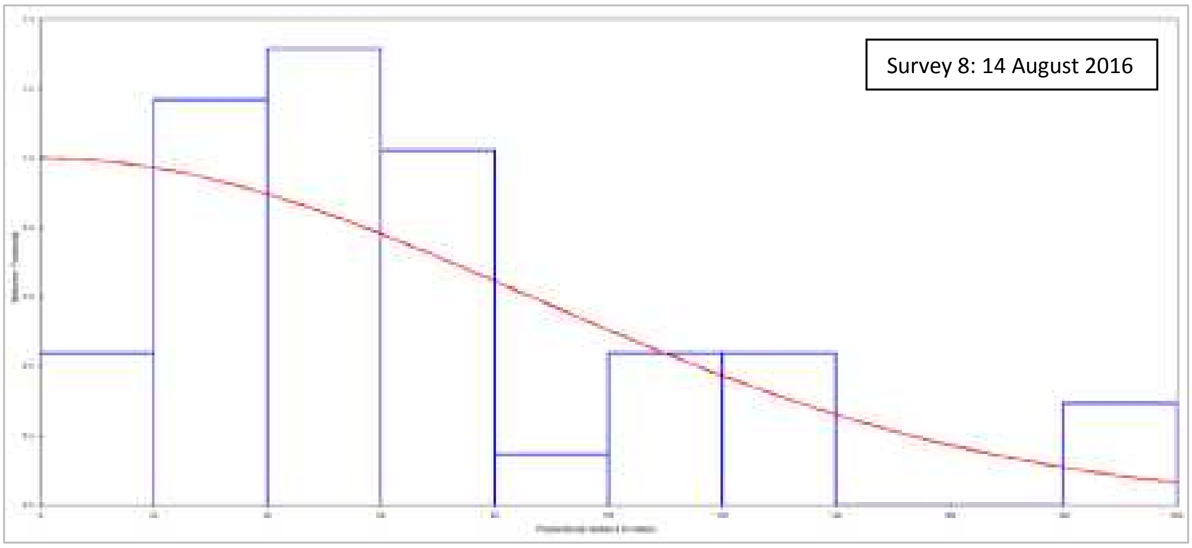
[1] – smaller area surveyed

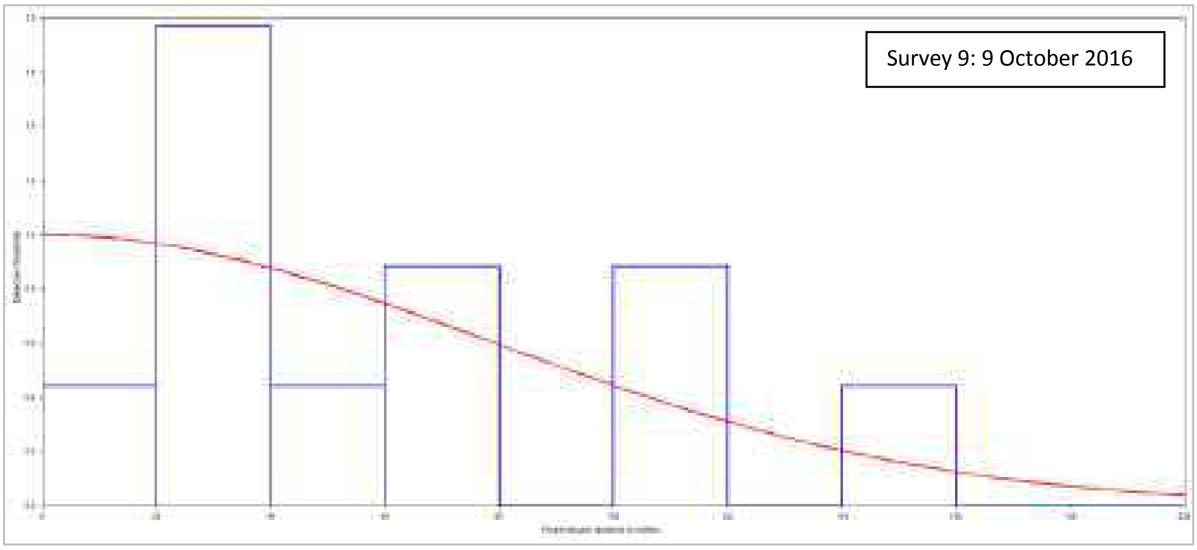

Survey 1: April 2015


Survey 3: 11 August 2015


Survey 4: 1 November 2015


Survey 5: 25 February 2016


Survey 8: 14 August 2016


Survey 9: 9 October 2016

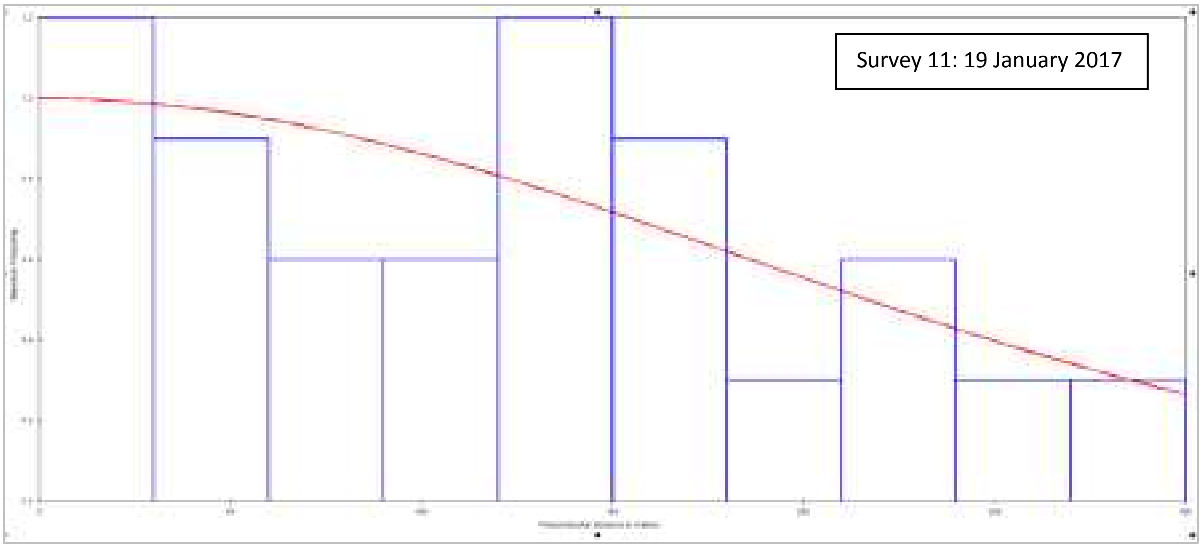



Figure 32. Detection functions for density estimates for boat-based surveys with sufficient number of sightings to analyse in DISTANCE.

## 3.3 Static Acoustic Monitoring

### 3.3.1 C-POD Calibrations

All units used over the duration of the present study were calibrated (Figure 33-Figure 38). From these trials, there were some differences in sensitivities between units but that individual unit performance was within the acceptable error margin of ±20% DPM per hour (Figure 35-Figure 38) and therefore no correction factor was applied to the data to make it comparable (O'Brien et al. 2013). During analysis of the long-term dataset, differences in sensitivities between units is accounted for by treating C-POD number as a random factor when running the GLMM and additionally C-PODs were deployed randomly between sites over the duration of the study.

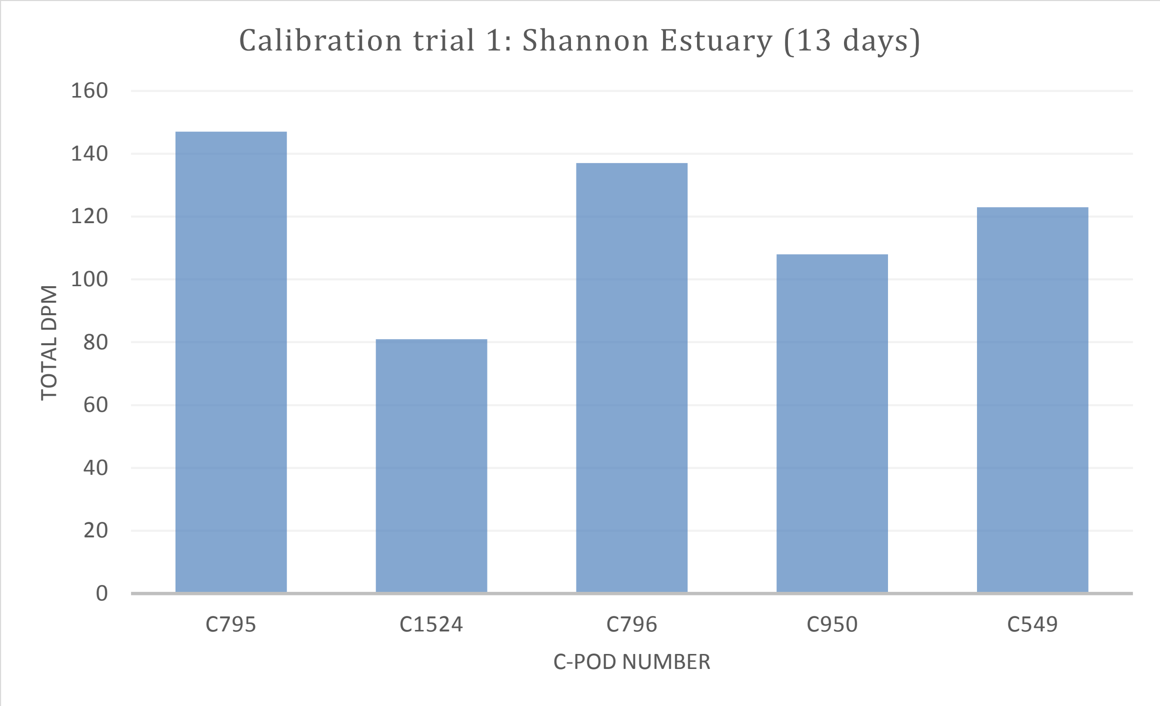



**Figure 33. Detection Positive Minutes from all C-PODs deployed during calibration trial 1 in the Shannon Estuary.**

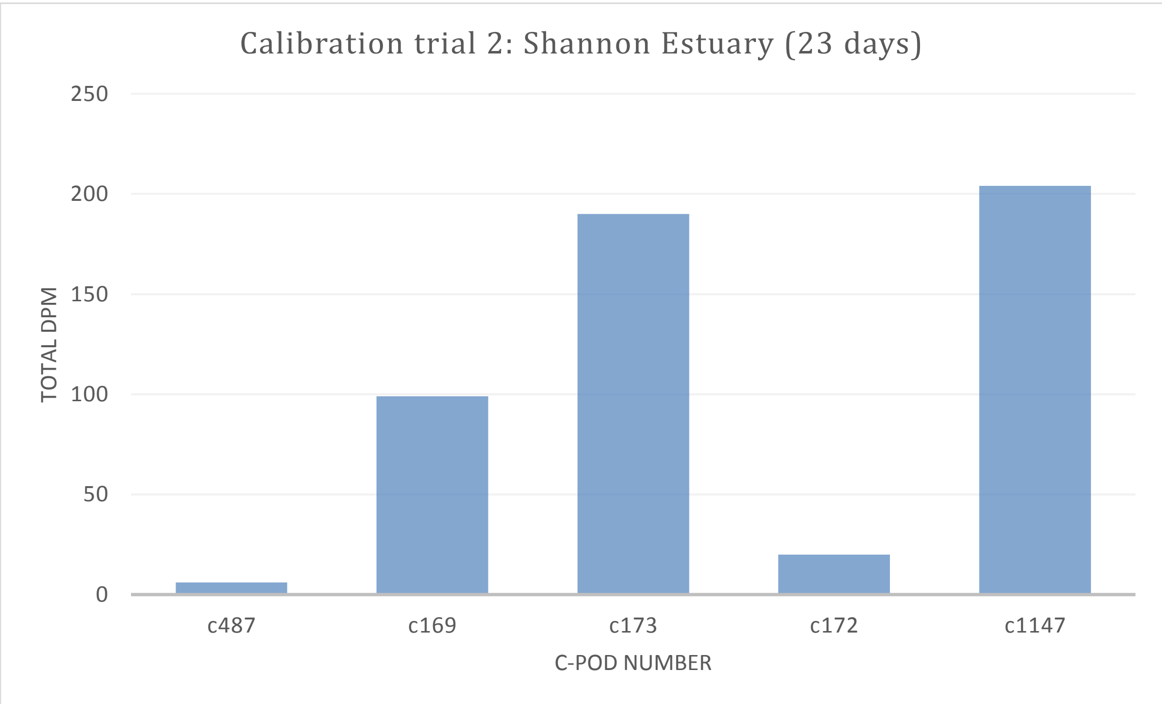



**Figure 34. Detection Positive Minutes from all C-PODs deployed during calibration trial 2 in the Shannon Estuary.**

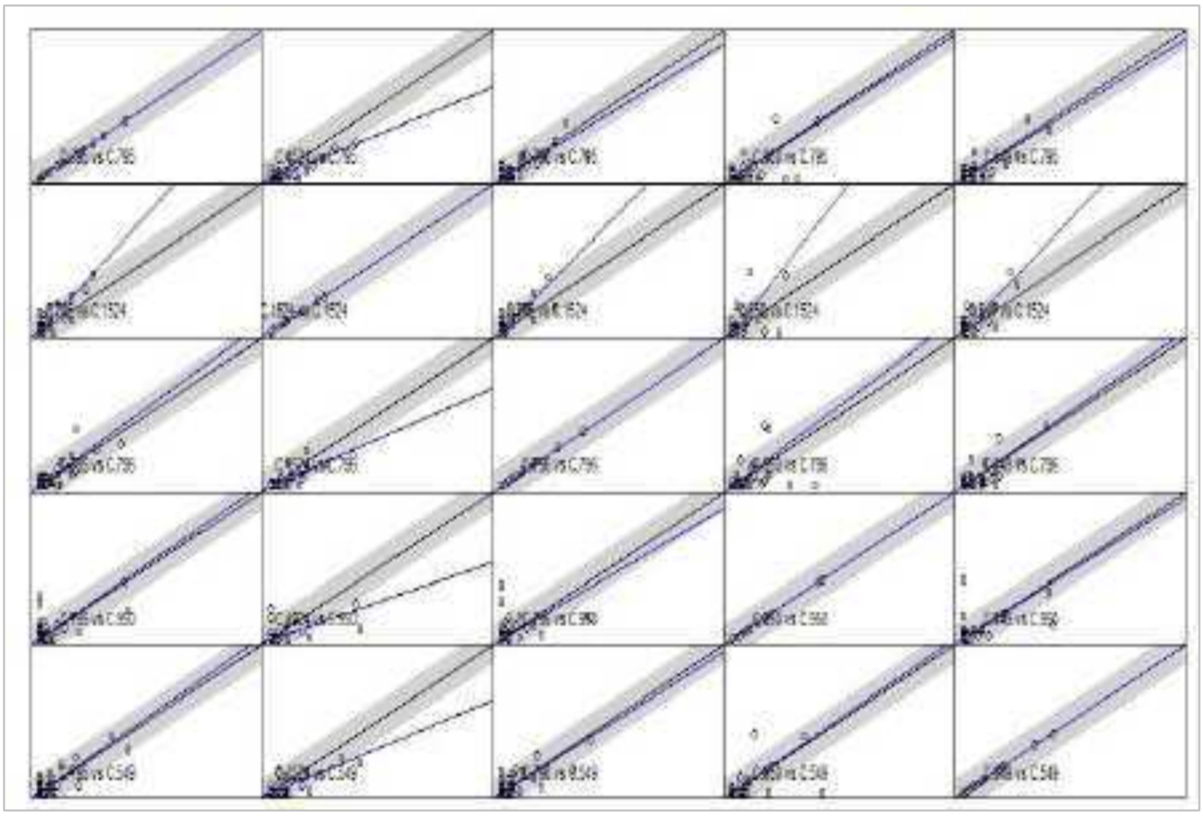


**Figure 35. Orthogonal regression plot of C-POD comparisons in calibration trial, in blue, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration 1, January 2015.**

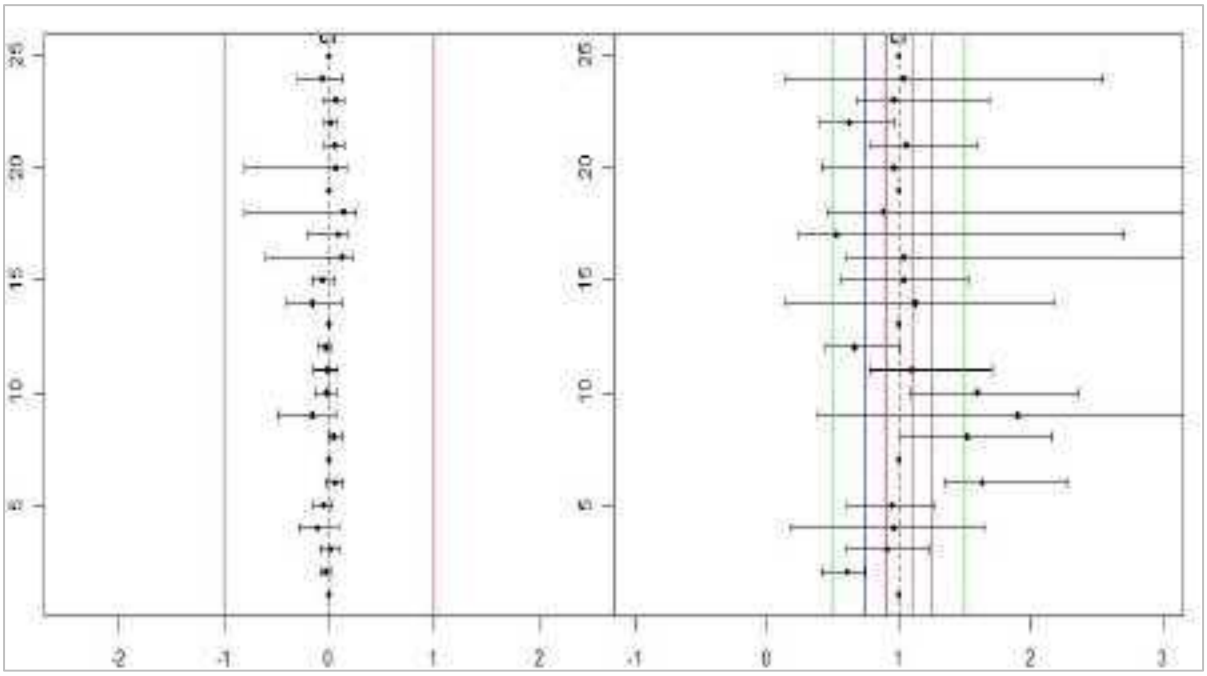


**Figure 36. Centipede plot of the intercept and slope values (±std), of the orthogonal regression plots, for each pod performance comparison in calibration trail 1 at Money Point, January 2015. Deviation from the red dotted lines, 0 on the intercept plot and 1 on the gradient plot, indicates deviation from the null model assuming no variation. Plot indicates that a greater extent of variation is found within the gradient values.**

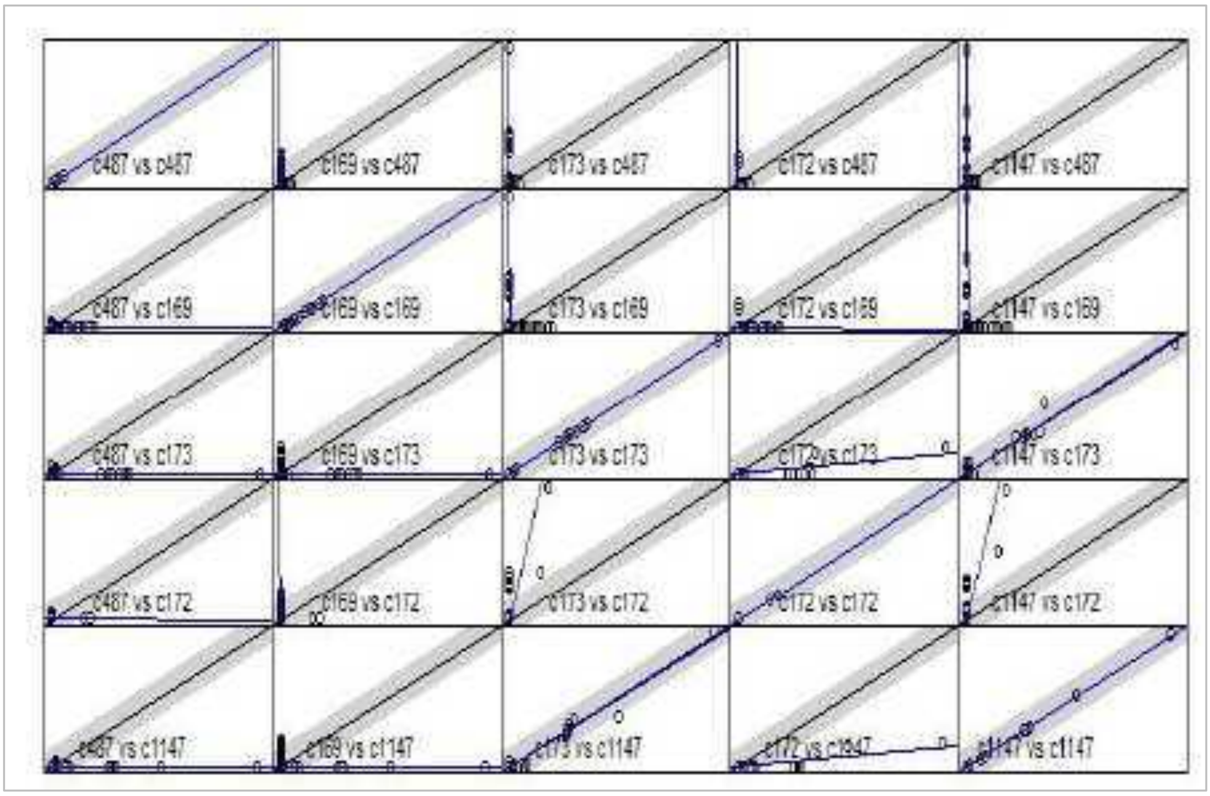



**Figure 37. Orthogonal regression plot of C-POD comparisons in calibration trial, in blue, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration 2, February 2015.**

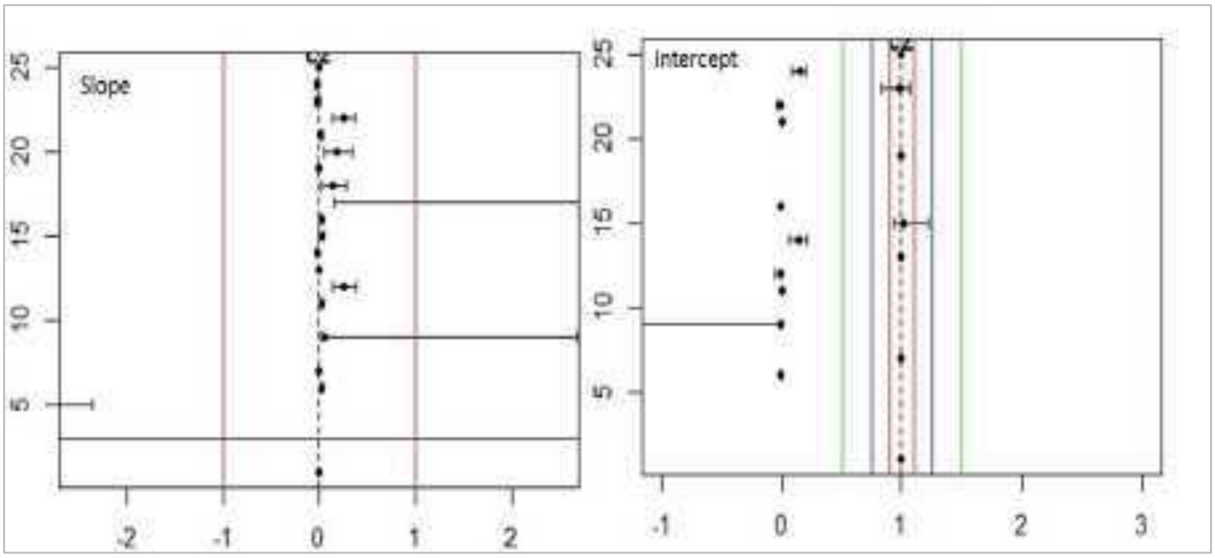



**Figure 38. Centipede plot of the intercept and slope values (±std), of the orthogonal regression plots, for each pod performance comparison in calibration trail 1 at Money Point, January 2015. Deviation from the red dotted lines, 0 on the intercept plot and 1 on the gradient plot, indicates deviation from the null model assuming no variation. Plot indicates that a greater extent of variation is found within the gradient values.**

### 3.3.2 Overview of SAM results

SAM using C-PODs was carried out at Portmarnock at three sites simultaneously for a duration of 750 days (between March 2015 and March 2017). The number of monitoring days at each site varied due to a number of reasons but mainly interference with moorings and gear missing upon retrieval (Table 7). This did not impact significantly on the dataset as monitoring over such a long-term period ensured enough replication was achieved across years and a range of factors which are thought to influence presence. Detections were recorded 96-99% of days on average at each site (Table 7). The number of Porpoise Positive Minutes (PPM) ranged from 3690 to 25089 per year, between sites, with mean DPM/day ranging between 41.3 to 94.3 (Table 7; Figure 39). Very few dolphin detections were recorded and most of those were determined to be false positives and therefore were not used for analyses. A monitoring index was calculated as the mean number of detection positive minutes per hour for porpoises (Table 7). This index can be compared across locations, or with results from previous studies in Ireland and was used to compare the present dataset with that recorded in 2015 from Loughshinny, Co. Dublin (approx. 14 km north of the Portmarnock site).

**Table 7. Summary of all deployments across 3 GDD sites from 2015 to 2017 (N=750 days).**

| Location | Year | No. of days monitored | No. of data days | Total PPM | % PPDs | Mean DPM/Day | Mean DPM/hr | %DPM |
|---|---|---|---|---|---|---|---|---|
| **GDD1** | 2015 | 294 | 294 | 24728 | 98 | 84.1 | 3.5 | 5.8 |
| | 2016 | 366 | 187 | 3680 | 94 | 20.6 | 0.81 | 1.4 |
| | 2017 | 90 | 75 | 1443 | 95 | 19.2 | 0.80 | 1.3 |
| **Total** | | **750** | **556 (74%)** | **29,851** | **x̄=96%** | **41.3** | **1.7** | **2.8** |
| **GDD2** | 2015 | 294 | 211 | 11396 | 97 | 54.0 | 2.3 | 3.8 |
| | 2016 | 366 | 258 | 25089 | 99 | 97.2 | 4.1 | 6.7 |
| | 2017 | 90 | 75 | 9894 | 99 | 131.9 | 5.5 | 9.2 |
| **Total** | | **750** | **544 (72%)** | **46,379** | **x̄=98%** | **94.3** | **4.0** | **6.6** |
| **GDD3** | 2015 | 294 | 228 | 14486 | 100 | 63.5 | 2.6 | 4.4 |
| | 2016 | 366 | 227 | 12820 | 99 | 56.5 | 2.4 | 3.9 |
| | 2017 | 90 | 75 | 3960 | 97 | 52.8 | 2.2 | 3.7 |
| **Total** | | **750** | **530 (71%)** | **31,266** | **x̄=99%** | **57.6** | **2.4** | **3.0** |

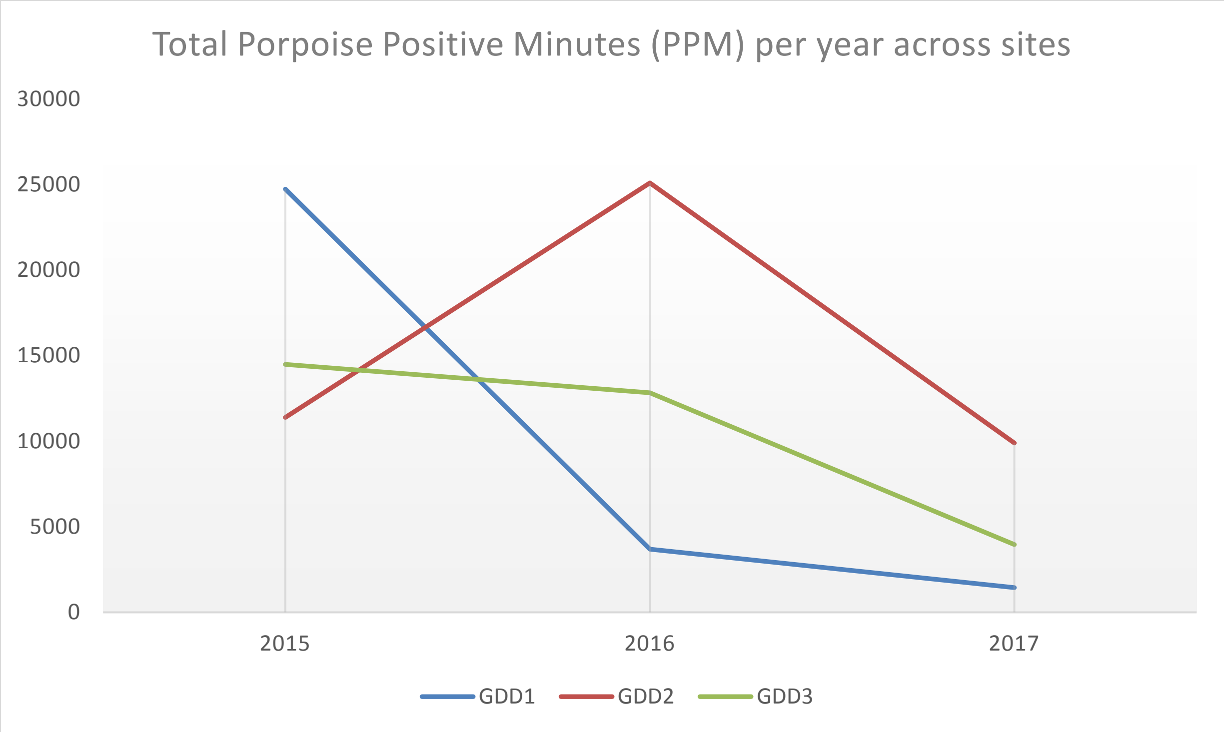



**Figure 39. Porpoise Positive Minutes per day (PPMs) recorded each year across sites. The duration of sampling differed between years; days monitored in 2015 (294), days monitored in 2016 (366) and days monitored in 2017 (90).**

### *3.3.2.1 Generalized linear mixed-effect model (GLMM) analyses*

As this was a long-term study with monitoring taking place across three years and at three sites, analyses using GLMM were used to assess differences between years and then at the completion of the monitoring, data from all three years from each site were compiled and assessed as one long dataset, allowing for a detailed assessment of fine scale use of the area.

### *3.3.2.2 GDD 1*

GDD1 was the closest site to shore, approx. 2.5 km, and was the shallowest location at a depth of 5.1m. Results across years showed that each of the four factors (season, diel, tidal cycle and tidal phase) were significant during 2015, while in 2016 only season and diel were found to be significant. When all data were compiled, all factors were found to be significant (Table 8).

Table 8. Results from GLMM's per year and all data combined from GDD1.

| Location | Year | Variable | $X^2$ | df | P-value |
|---|---|---|---|---|---|
| GDD1 | 2015 | Season | 212.2 | 4 | 0.000 |
| | | Diel | 212.2 | 4 | 0.000 |
| | | T.P | 192.3 | 3 | 0.000 |
| | | T.C | 212.2 | 4 | 0.000 |
| GDD1 | 2016 | Season | 140.1 | 4 | 0.000 |
| | | Diel | 140.1 | 4 | 0.000 |
| | | T.P | 53.7 | 3 | 0.1 |
| | | T.C | 42.0 | 4 | 0.1 |
| GDD1 | 2017 | Season | 167.5 | 4 | 0.000 |
| | | Diel | 167.5 | 4 | 0.000 |
| | | T.P | 128.7 | 3 | 0.000 |
| | | T.C | 168.6 | 4 | 0.000 |
| GDD | all years combined | Season | 277.9 | 4 | 0.000 |
| | | Diel | 204.2 | 4 | 0.000 |
| | | T.P | 144.3 | 3 | 0.000 |
| | | T.C | 204.2 | 4 | 0.000 |

Data are presented as box plots, which help to visualise the results. In 2015, there were significantly more detections at GDD1 during the autumn, winter and summer months when compared with spring ($\chi2= 212$, $p<0.000$). Significantly more detections were recorded during the hours of darkness and the intermittent hours between dawn and dusk ($\chi2= 212.2$, $p<0.000$), as well as during the tidal phase spring ($\chi2= 192.3$, $p<0.000$) and tidal cycle low ($\chi2= 212.2$, $p<0.000$), Figure 40)).

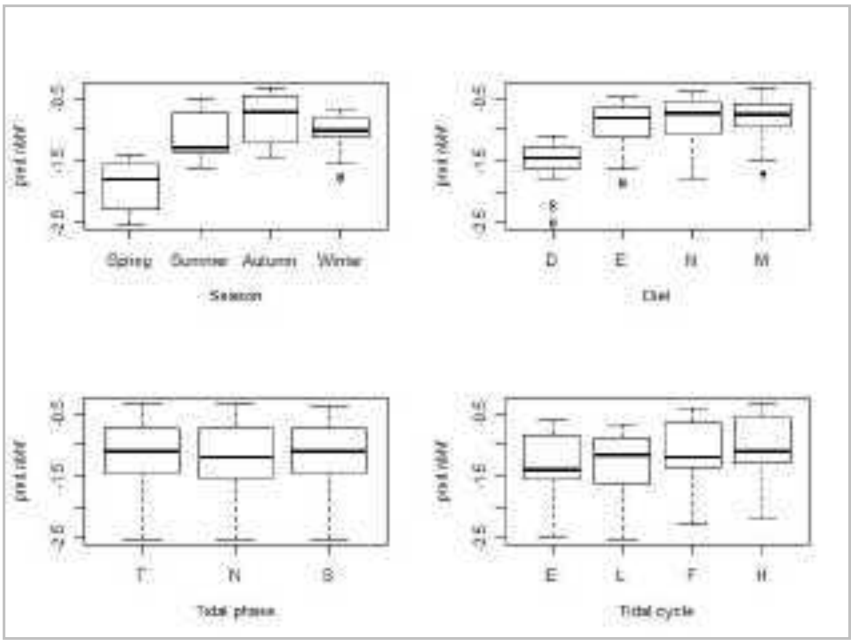



Figure 40. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD1 (Co. Dublin) Mar 2015-Dec 2015 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.

In 2016, season was found to be a significant factor again but detections in spring was found to be significantly higher compared with 2015, where most detections were during the spring months ($\chi^2$= 140.1, p<0.000). Similarly to 2015, more detections were recorded during the hours of darkness and the intermittent hours between dawn and dusk ($\chi^2$= 140.1, p<0.000), but tidal phase ($\chi^2$= 53.7, p=1.3) and tidal cycle ($\chi^2$= 42.0, p=1.7) were not significant (Figure 41).

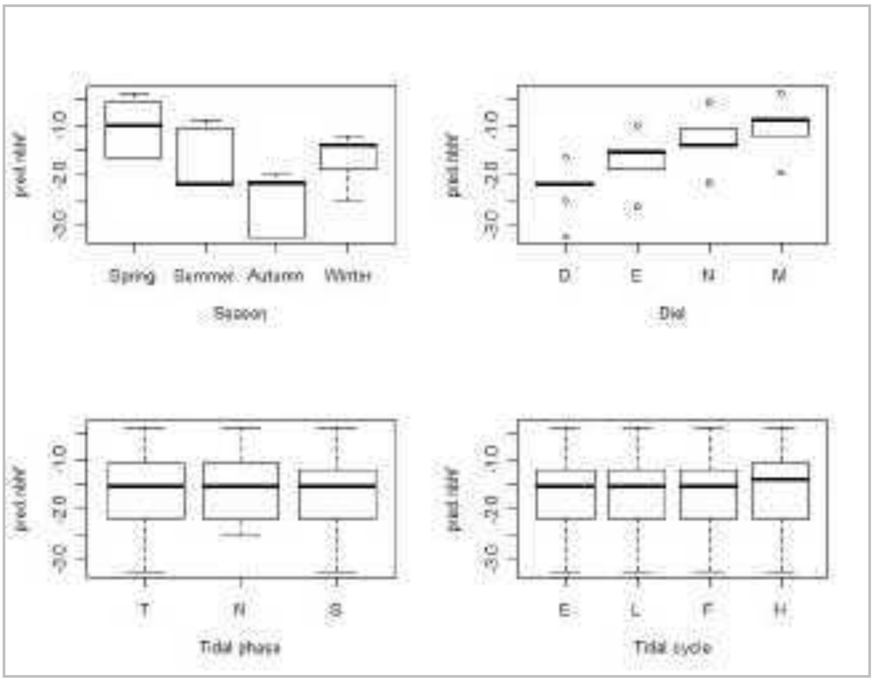



**Figure 41. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD1 (Co. Dublin) Jan - Dec 2016 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

Monitoring only took place in 2017 between January and March but the data were still processed as before with just two seasons, winter and spring. All factors were found to be significant (Table 8, Figure 42).

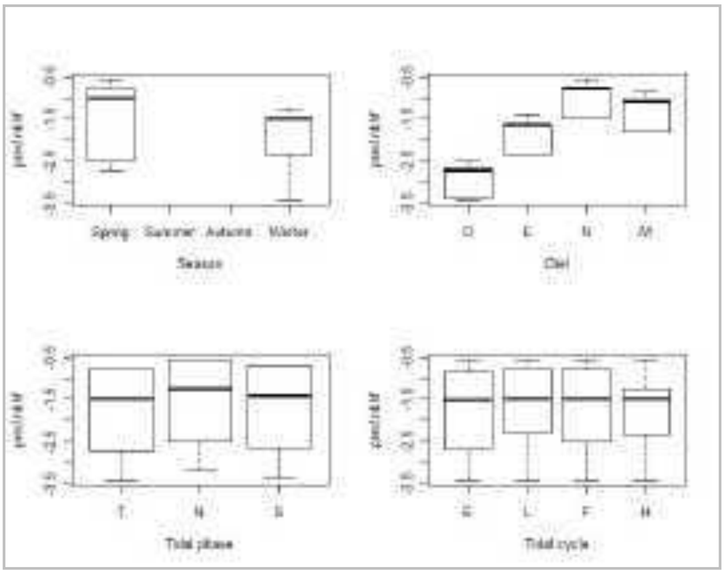


**Figure 42. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD1 (Co. Dublin) Jan - Mar 2017 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

The last analyses on data from GDD1 was to combine all dataset collected across the 556 days, which showed that three of the four factors were significant. Significantly more detections occurred in Autumn ($\chi^2$= 279.9, p<0.000), with most detections during the night and in morning hours ($\chi^2$= 204.2, p<0.000), while significantly more detections were recorded at slack high tide ($\chi^2$= 168.6, p<0.000), which is plausible given this site, is very shallow (Figure 43).

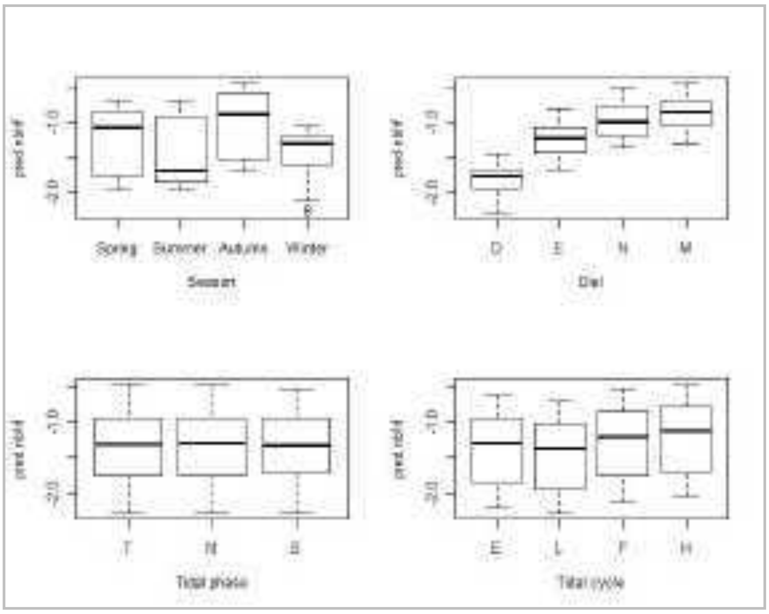


**Figure 43. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD1 (Co. Dublin), all days, Mar 2016 - Mar 2017 (556 days) across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

#### 3.3.2.3 GDD 2

GDD2 was the middle site, approximately 1km from GDD1 and 1.5km from GDD3 and at a depth of approximately 14m. Results (Table 9) show a lot of variability between years and across factors, but when all years were combined it was evident that all factors except tidal phase were significant.

**Table 9. Results from GLMM's per year and all data combined from GDD2.**

| Location | Year | Variable | $X^2$ | df | P-value |
|---|---|---|---|---|---|
| GDD2 | 2015 | Season | 371.5 | 4 | 0.000 |
| | | Diel | 371.5 | 4 | 0.000 |
| | | T.P | 38.3 | 3 | 0.2 |
| | | T.C | 458.4 | 4 | 0.000 |
| GDD2 | 2016 | Season | 80.4 | 4 | 0.000 |
| | | Diel | 80.4 | 4 | 0.000 |
| | | T.P | 21.1 | 3 | 0.1 |
| | | T.C | 29.2 | 4 | 0.000 |
| GDD2 | 2017 | Season | 164.4 | 4 | 0.000 |
| | | Diel | 164.4 | 4 | 0.000 |
| | | T.P | 53.7 | 3 | 0.1 |
| | | T.C | 170.6 | 4 | 0.000 |
| GDD2 | all years combined | Season | 105.5 | 4 | 0.000 |
| | | Diel | 760.5 | 4 | 0.000 |
| | | T.P | 144.3 | 3 | 0.3 |
| | | T.C | 59.9 | 4 | 0.000 |

Box plots below help visualise the results from GDD2 demonstrating there were significantly more detections during the winter, autumn and summer months when compared with spring ($\chi2= 212$, $p<0.000$) in 2015, following similar trends to GDD1 but in the following year (2016). Significantly more detections were recorded during the hours of darkness and the intermittent hours between dawn and dusk ($\chi2= 212.2$, $p<0.000$). Tidal cycle had significantly more detections during the flood tide, while no significant trends were found for tidal phase (Figure 44).

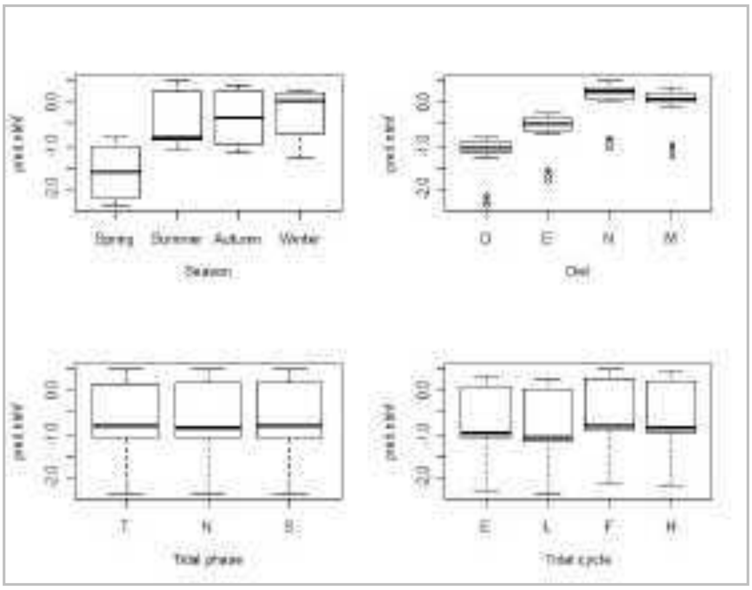



**Figure 44. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD2 (Co. Dublin) Mar – Dec 2015 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

At GDD2, results for 2016 showed season to be a significant factor, similar to results from GDD1 from 2015, with detections in spring significantly higher ($\chi^2$= 140.1, p<0.000). Similarly to 2015 across sites, more detections were recorded during the hours of darkness and the intermittent hours between dawn and dusk ($\chi^2$= 140.1, p<0.000), and during high tide ($\chi^2$= 29.2, p<0.000), with tidal phase having no significant effect ($\chi^2$= 21.1, p=7.0; Figure 45).

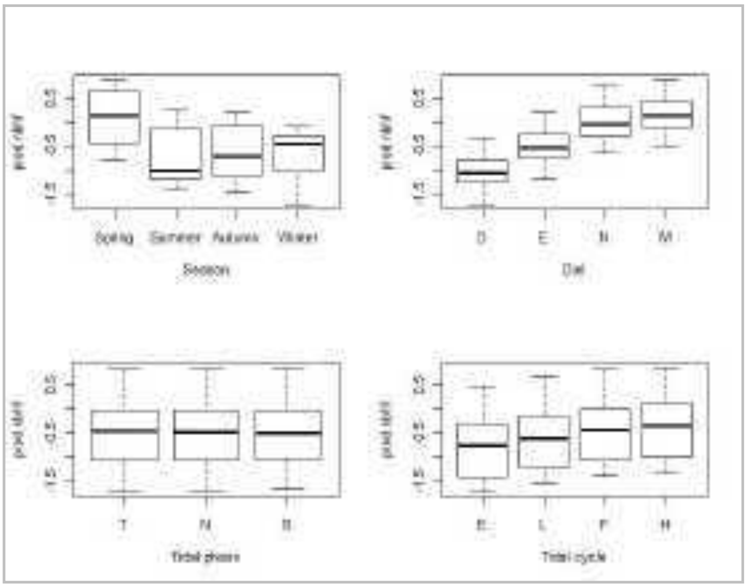



**Figure 45. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD2 (Co. Dublin) Jan – Dec 2016 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

At GDD2 in 2017, results showed all factors to be significant except tidal phase (Table 9; Figure 46).

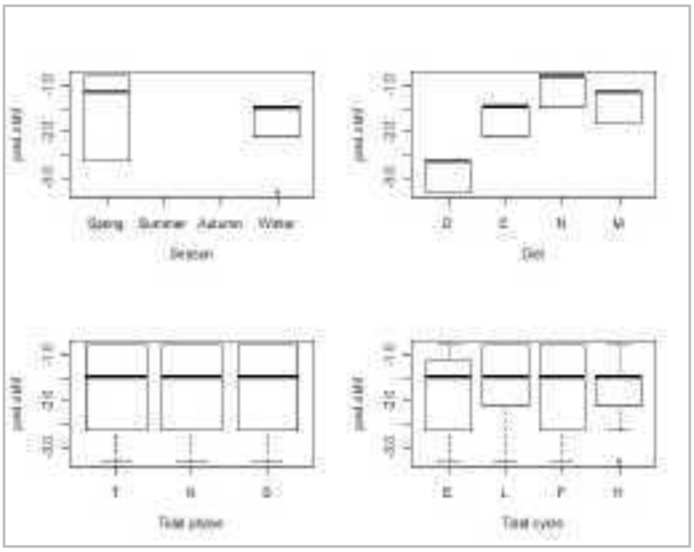


**Figure 46. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD2 (Co. Dublin) Jan – Mar 2017 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

As for GDD1, all data from GDD2 were combined across years for the 544 days monitored and results showed that three of the four factors were significant. In this instance, significantly more detections occurred during winter ($\chi2= 279.9$, $p<0.000$), with most detections during the night and morning hours ($\chi2= 204.2$, $p<0.000$), while significantly more detections were recorded at slack high tide ($\chi2= 168.6$, $p<0.000$), which is plausible given this site, is very shallow (Figure 47).

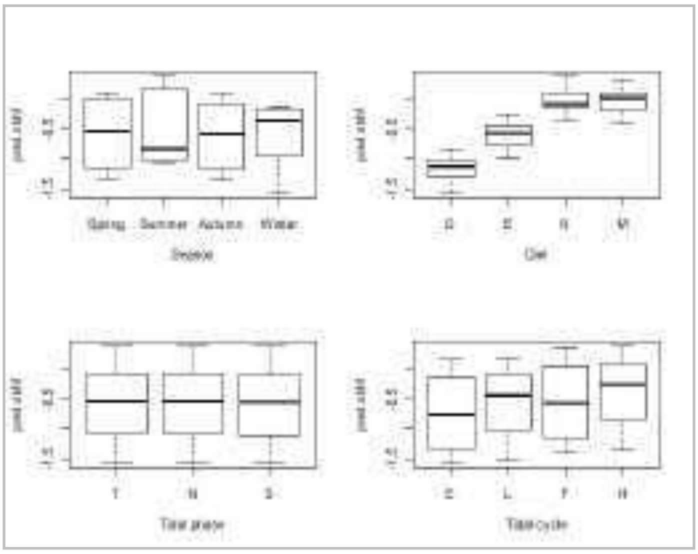


**Figure 47. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD2 (Co. Dublin), March 2015 – Mar 2017 (544 days) across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

### 3.3.2.4 GDD 3

GDD3 was the furthest site offshore, 1.5km from GDD2, and 2.5km from GDD1 (5km from land) and in a depth of approximately 24m. Similarly, for GDD3, the same analytical approach was followed and results showed all factors to be significant in 2015, 2016 and 2017. It was clear that there was a lot of variability between years and across factors (Table 10), but when all years were combined it was evident that all factors except tidal cycle were significant at GDD3.

**Table 10. Results from GLMM's per year and all data combined from GDD3.**

| Location | Year | Variable | $X^2$ | df | P-value |
|---|---|---|---|---|---|
| GDD3 | 2015 | Season | 30.5 | 4 | 0.000 |
| | | Diel | 30.5 | 4 | 0.000 |
| | | T.P | 30.4 | 3 | 0.000 |
| | | T.C | 16.4 | 4 | 0.000 |
| GDD3 | 2016 | Season | 119.4 | 4 | 0.000 |
| | | Diel | 119.4 | 4 | 0.000 |
| | | T.P | 43.9 | 3 | 1.0 |
| | | T.C | 29.9 | 4 | 0.000 |
| GDD3 | 2017 | Season | 279.0 | 4 | 0.000 |
| | | Diel | 340.0 | 4 | 0.000 |
| | | T.P | 26.3 | 3 | 1.3 |
| | | T.C | 38.3 | 4 | 0.000 |
| GDD3 | all years combined | Season | 105.5 | 4 | 0.000 |
| | | Diel | 760.5 | 4 | 0.000 |
| | | T.P | 144.3 | 3 | 0.000 |
| | | T.C | 59.9 | 4 | 3.0 |

For GDD3 2015, results showed significantly more detections occurred across spring, summer and autumn when compared with winter. Although no significant difference was apparent in the box plot, the Walds test showed significance existed ($\chi^2$= 30.5, p<0.000). Tidal phase and tidal cycle were also significant although again not apparent from the diagram (Table 10, Figure 48).

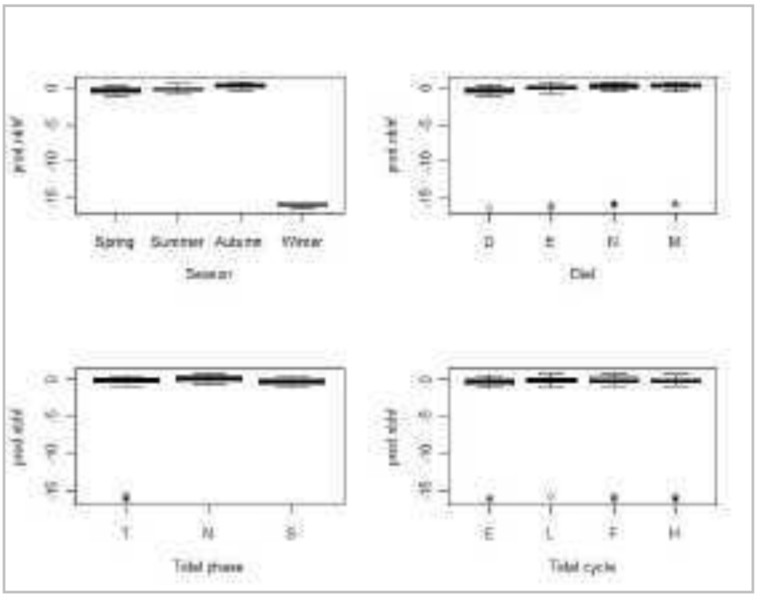


Figure 48. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD3 (Co. Dublin) Mar– Dec 2015 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.

GDD3 for 2016 showed similar results to GDD1 and 2 where season showed significantly more detections during the spring and winter months ($\chi2= 119.4$, $p<0.000$), and across diel cycle night and morning ($\chi2= 119.4$, $p<0.000$). Significantly, more detections were recorded during the neap phase of the tide ($\chi2= 43.9$, $p<0.000$), and during slack periods of the tidal cycle ($\chi2= 29.9$, $p<0.000$; Figure 49).

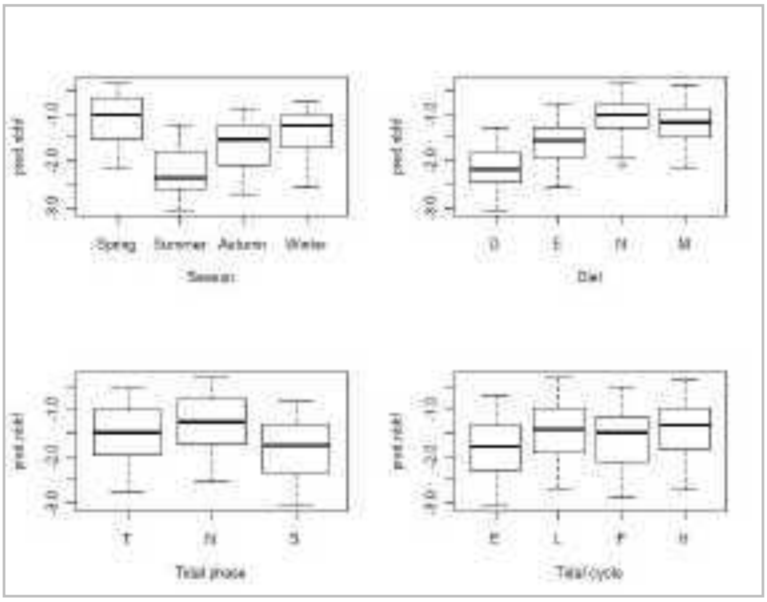


Figure 49. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD3 (Co. Dublin) Jan– Dec 2016 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.

At GDD3 in 2017, results showed all factors to be significant except tidal phase (Table 10; Figure 50), and mirroring the results of GDD3 2016.

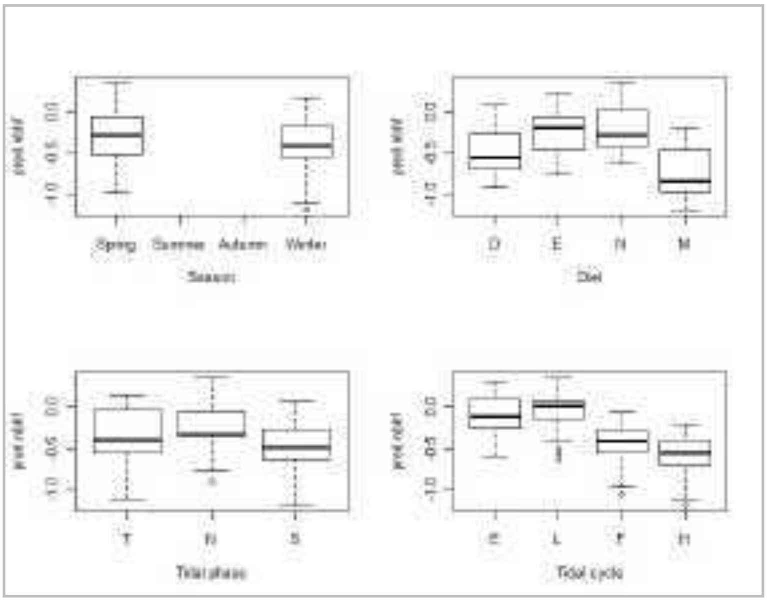



**Figure 50. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD3 (Co. Dublin) Jan – Mar 2017 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

All GDD3 data across years were combined for the 530 days monitored at the site and results showed that all four factors were significant. In this instance significantly more detections occurred in Autumn ($\chi2= 279.1$, $p<0.000$), with most detections during the night and morning hours ($\chi2= 340$, $p<0.000$), while significantly more detections were recorded the neap tidal phase ($\chi2= 65.5$, $p<0.000$) at slack high tide ($\chi2= 38.3$, $p<0.000$; Figure 51).

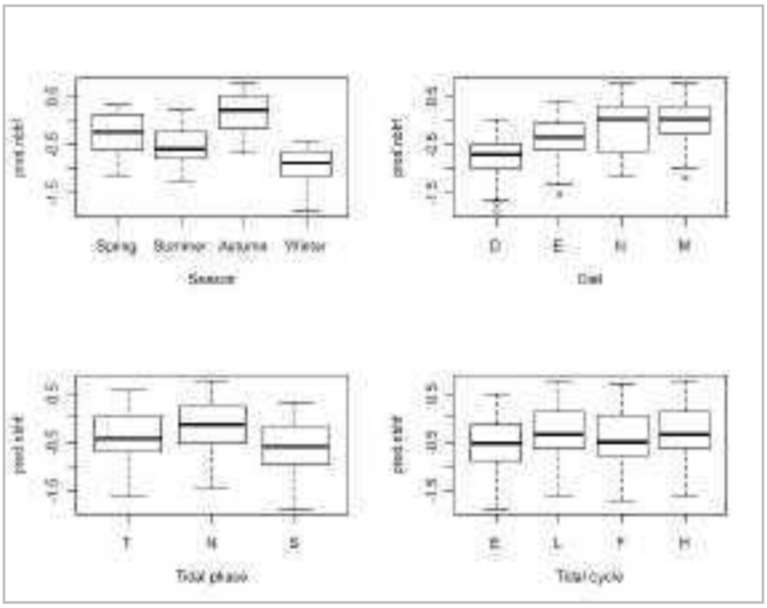


Figure 51. Predicted proportion of detection positive hours, in the narrow band high frequency channel at GDD3 (Co. Dublin) all months, March 2015 to March 2017 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.

In summary, results across all days monitored at each of the sites showed harbour porpoise to be present on average 98% of days monitored. The highest presence was detected across the autumn and winter months, during the hours of darkness (incl. dawn and dusk), during high tide and at GDD3 during the neap cycle of the tidal phase (Table 11). The site with the highest overall detections was GDD2.

Table 11. Significant results from the long-term dataset at each site (*no significance).

| Significant factors | GDD1 | GDD2 | GDD3 |
|---|---|---|---|
| **Season** | Autumn | Winter | Autumn |
| **Diel** | Night | Night | Night |
| **Tidal phase** | * | * | Neap |
| **Tidal cycle** | High | High | High |

# DISCUSSION

A combination of visual and acoustic, land and boat-based methodologies has provided a very detailed, high resolution assessment of the marine mammal community and its use of the site in line with best international practice. Visual surveys provided information on species identification, distribution and abundance and behaviour while acoustic data provided high resolution information on the use of the site by harbour porpoise including diel, tidal and temporal patterns.

## 4.1 Visual surveys

Marine mammals were recorded on 100% of survey days demonstrating the importance of the area for this important group of high nature conservation animals. Species recorded comprised of harbour porpoise, grey seal, harbour seal and minke whale.

Harbour porpoise were recorded on 83% of land-based surveys and 100% of boat-based surveys. Abundance was lowest from May to July, 2015 and from April to June, 2016. Harbour porpoise in Irish waters move offshore during spring and early summer, which is believed to associated with calving (Wall et al. 2013) and trends during the present study were consistent with this. Harbour porpoise abundance increased between August and January 2015 and between August and October 2016. Group size also increased during this period which coincided with a peak in sightings of young animals. In the North Atlantic, harbour porpoise calves are born in mid to late summer (Rogan & Berrow, 1996, Lockyer, 2003; Learmonth et al. 2014) and reliant on their mothers for 8-10 months (Learmonth et al. 2014). Female harbour porpoise may time calving so that high energetic demands such as lactation coincides with the availability of seasonally abundant local prey (Learmonth et al. 2014). In Irish waters, harbour porpoise feed primarily on fish with *Trisopterus* and gadoid species being important (Rogan & Berrow 1996, IWDG 2009, Hernandez-Milian 2014). The peak in abundance of harbour porpoise may therefore be attributed to the inshore movement of porpoise to feed on locally abundant prey. The increase in group size recorded during this time is most likely due to the presence of nursing calves.

The area has also been shown to be important for grey seals with individuals recorded on 100% of land-based surveys and 91% of boat surveys. Sightings were highest in April 2015 which coincided with the end of the male moulting season and January 2016 which coincided with the end of the female moult (Kiely et al. 2000). High numbers were also recorded in September 2015, November 2015 and October 2016 which spans the grey seal breeding and pupping season (Ó Cadhla, 2007). Sightings largely consisted of single adults although two juveniles were recorded in September 2015 beside Ireland's Eye. Seals tended to occupy more westerly waters than the harbour porpoise and were often seen following fishing boats, feeding and hauling out on Ireland's Eye at low tide.

Few other marine mammal species were recorded. Although Lambay Island SAC is designated for both grey seal and harbour seal, only two individual harbour seals were recorded during this study, one each in April and August 2015. Two sightings of single minke whales were recorded during two boat-surveys, one in June 2015 and one in August 2016. These records are similar to a previous study where minke whales were recorded from late April to early August off north Co. Dublin (Wall et al. 2013).

### 4.1.1 Density and abundance for harbour porpoise

For seven of the eleven surveys carried out, the number of sightings were sufficient to derive density and abundance estimates for harbour porpoise. Within the area surveyed, the density of harbour porpoise varied from 0.61 to 2.29 harbour porpoise per km$^2$, with a mean density of 1.32, which was similar to previous surveys in the area (Table 12). Densities were lowest in April 2015 and February 2016, peaking in August 2015, November 2015 and August 2016, with lower but still relatively high densities in October 2016 and January 2017.

Harbour porpoise densities were previously derived for two sites off Co Dublin in 2008 and for the Rockabill to Dalkey Island SAC in 2013 and 2016. The area surveyed off North County Dublin was similar to the area surveyed in the present study. Density estimates from North County Dublin in 2008 varied considerably but the highest density of porpoises recorded at any site in Ireland so far was recorded at 6.93 porpoises per km$^2$ in August 2008. However estimates during other surveys during 2008 were much lower, which resulted in an overall density estimate of 2.03 harbour porpoise per km$^2$.

**Table 12. Density, abundance and group size estimates for harbour porpoise in North County Dublin**

| Location | Year | Area (km²) | Mean group size | Density (per km²) | Abundance ± SE (95% CI) | CV | Reference |
|---|---|---|---|---|---|---|---|
| Greater Dublin Drainage | 2015-17 | 201 | 1.39 | 1.32 | 248 | - | This report |
| Rockabill to Dalkey Island SAC | 2016 | 273 | 1.62 | 1.55 | 424±45 (335-536) | 0.10 | O'Brien and Berrow (2016) |
| Rockabill to Dalkey Island SAC | 2013 | 273 | 1.47 | 1.44 | 391±25 (344-445) | 0.06 | Berrow and O'Brien (2013) |
| North County Dublin | 2008 | 104 | 1.41 | 2.03 | 211±47 (137-327) | 0.23 | Berrow *et al.* (2008a) |
| Dublin Bay | 2008 | 116 | 1.19 | 1.19 | 138±33 (86-221) | 0.24 | Berrow *et al.* (2008a) |

If we use the average of the overall density estimates from 2008 for the two sites it equates to 1.61 which is higher but similar to the present survey. A previous wider-scale line-transect survey in the north Irish Sea, to the east and north of the current SAC, derived a density estimate of 1.59±0.22 porpoises per $km^2$ (Berrow et al. 2011). This was also of a similar magnitude to that calculated from the present survey.

Density estimates within the Rockabill to Dalkey Island SAC were greater in 2016 than presented here but only by 10-15% which suggests the present study area is very favourable for porpoise with densities similar to those within an SAC. Indeed, there was remarkable consistency in density estimates across all surveys carried out in North County Dublin since 2013 which were consistently elevated compared to sites surveyed elsewhere in Ireland (Berrow et al. 2014).

Thus this survey has, despite quite considerable variability in density estimates, provided a mean density very similar to previous studies. This density is high and emphasizes the importance of this site for this species as these are some of the highest densities of harbour porpoise recorded to date in Ireland.

## 4.2 Static Acoustic Monitoring

Cetaceans live in an acoustic world and increasingly attempts have been made to develop acoustic monitoring techniques rather than relying on visual methods, where efficacy is dependent on light, weather conditions and sea-state, especially for species such as the elusive harbour porpoise. Their reliance on vocalisations for navigation and communication is essential and therefore acoustic monitoring is a very valuable tool for determining presence and assessing fine-scale habitat use. The main advantage of acoustic monitoring is that it can provide information on species that spend up 95% of the time underwater and thus can be difficult to observe (Read & Westgate 1995). Patterns of cetacean presence have been described over seasonal scales (Canning et al. 2008, Bolt et al. 2009; Simon et al. 2010, Gilles et al. 2011, O'Brien et al. 2013), diel cycles (Cox & Read 2004, Carlström 2005, Todd et al. 2009, O'Brien et al. 2013) and tidal patterns (Marubini et al. 2009, O'Brien et al. 2013). In order to evaluate the importance of an area, it is fundamental that the presence of small odontocetes is fully understood and this requires monitoring over varying time scales. Although SAM can provide a much more complex account of cetacean activity at a site in comparison to visual monitoring, it cannot present accurate estimates of abundance for which visual surveys are required.

The aim of the present study was to produce a detailed assessment of the use of the site by marine mammals and to provide baseline data. Cetacean occurrence in the general area was achieved through visual surveys but detailed information on the use of the proposed route of the discharge pipe off Portmarnock sites was achieved through static acoustic monitoring. The data collected at Portmarnock was compared with the smaller dataset collected off Loughshinny, which was treated as a control site and with other regional sites.

The acoustic data demonstrated that the all three sites monitored along the proposed route of the outfall pipe off Portmarnock are used consistently by harbour porpoises on a daily basis. However, presence was greater during autumn and winter, during hours of darkness and at slack high tides. When the data from Portmarnock are compared to Loughshinny data collected in 2015 (Meade et al. 2015) results were similar with autumn having the highest detections, however, only six months were monitored. Tidal cycle was not significant at Loughshinny in contrast to Portmarnock, where more detections were recorded during spring tidal phase. Monitoring index at Loughshinny was high at 9.8%, while at Portmarnock values ranged between 2.8 and 6.6 across sites, suggesting Loughshinny is the most important site monitored for harbour porpoise during the GDD project.

Trends in the presence of harbour porpoise with diel cycle on the east coast of Ireland have been found to differ geographically, but they are consistently more active at night. The reasons for increased nocturnal activity are uncertain but could be linked to an increase in prey abundance or activity in the absence of light, as suggested by Todd et al. (2009).

The results from Portmarnock and Loughshinny are compared to other sites around Ireland (Table 13). Some of the highest DPM's recorded to date were from Loughshinny, especially given deployments were only for six months. Some of the early studies used T-PODs, which are an earlier version of the C-POD. Previous work by O'Brien et al. (2013) showed that C-PODs recorded on average, seven times more data than T-PODs during simultaneous deployments in Galway Bay. However, it is clear that deployments from the east coast have a greater number of detections per deployment from any other monitored site in the country. Previous deployment off Howth Head recorded 12.2 DPM/hr, in comparison to the present study with an average across sites of 2.7. However, the Howth deployment was over a short duration using a T-POD. The Portmarnock dataset is similar to that at Spiddal in Galway Bay with a similar number of deployment days. Galway Bay is not a designated SAC while the Portmarnock area lies within the boundaries of the Rockabill to Dalkey SAC. When the present data is compared with other deployments around Ireland, such as the Blasket Islands SAC, the number of detections from Co. Dublin were still much greater.

**Table 13. Monitoring results from SAM across Ireland (green line denotes data collection using T-PODs so some caution necessary when interpreting results.**

| County | Site | Total days | DPD % | Total PPM | %DPM | Mean DPM/day | Mean DPM/hr | Reference |
|---|---|---|---|---|---|---|---|---|
| Dublin | GDD1 | 556 | 96 | 29,851 | 2.8 | 41.3 | 1.7 | *Present study* |
| Dublin | GDD2 | 544 | 98 | 46,379 | 6.6 | 94.3 | 4.0 | *Present study* |
| Dublin | GDD3 | 540 | 99 | 31,266 | 3.0 | 57.6 | 2.4 | *Present study* |
| Dublin | Loughshinny | 189 | 100 | 26,281 | 9.6 | 137 | 5.8 | Meade *et al.,* 2015 |
| Galway | Spiddal | 572 | 541 | 27,902 | 3.4 | 48.8 | 2.0 | O'Brien *et al.,* 2013 |
| Kerry | Inishtooskert | 264 | 236 | 3930 | 1.04 | 14.9 | 0.6 | O'Brien *et al.,* 2013 |
| Kerry | Wild Bank | 289 | 221 | 2097 | 0.51 | 7.3 | 0.3 | O'Brien *et al.,* 2013 |
| Kerry | The Gob | 52 | 49 | 3015 | 4.1 | 58.0 | 2.4 | O'Brien *et al.,* 2013 |
| Dublin | Howth | 47 | 100 | 13718 | 10.1 | 291.9 | 12.2 | Berrow *et al.* (2008a) |
| Cork | Castlepoint | 63 | 100 | 1379 | 2.0 | 21.9 | 0.9 | Berrow *et al.* (2008a) |
| Cork | Sherkin | 23 | 44 | 707 | 1.0 | 30.7 | 1.3 | Berrow *et al.* (2008a) |
| Cork | Galley Head | 63 | 30 | 1614 | 2.4 | 25.6 | 1.1 | Berrow *et al.* (2008a) |

It is clear from both the visual and acoustic surveys that North County Dublin is an important area for marine mammals, especially harbour porpoise. Marine mammals were present during 100% of visual surveys although abundance did vary throughout the year. The site is also important for grey seals which were recorded throughout the year. Grey seals can be sensitive to disturbance particularly during the breeding season (Kiely et al. 2000), which occurs from August to December (O'Cadhla, 2007). The proposed outfall site is 8km to Lambay Island SAC which is the most important site for grey seals on the east coast of Ireland (Kiely et al. 2000).

Harbour porpoise numbers increased in late summer during both 2015 and 2016 which coincided with the presence of calves and may be due to seasonally abundant food sources such as sprat, herring and *Trisopterus* and gadoid species. Reduced numbers were recorded during late spring/early summer which may be associated with an offshore movement of this species before calving. The density estimate of harbour porpoise was high and emphasizes the importance of this site for this species as these are some of the highest densities recorded in Ireland to date. Acoustic monitoring provided an insight into the habitat use of the site across time and diel and tidal cycles, which could not be recorded from visual surveys. Harbour porpoise were present almost daily at the Portmarnock site, with their presence influenced by seasonal, diel and tidal factors.

## 4.3 Recommendations

Harbour porpoises and grey seals, both of which are listed under Annex II of the Habitats Directive, are entitled to strict protection including their habitat, and extreme care must be taken to ensure the proposed development does not degrade this habitat or cause undue disturbance. These results will serve to inform protocols of best practice if work goes ahead and thus ensure the presence of marine mammals in the area is not negatively impacted upon.

Mitigation measures should take into account the acoustic disturbance of marine mammals at the site and any associated noise input or long-term potential disturbance should be reviewed to minimise displacement and to prevent habitat exclusion or hearing impacts such TTS or PTS. Mitigation measures should be in accordance with the NPWS document "*Guidance to Manage the Risk to Marine Mammals from Man-made Sound Sources in Irish Waters*" to ensure impacts through habitat exclusion or noise impacts are minimised. In order to assess if any displacement of harbour porpoise occurs, we recommend acoustic monitoring is carried out at a control site such as the Loughshinny site during and after installation works, with additional monitoring close to the actual outfall point post construction.

## ACKNOWLEDGEMENTS

We would like to thank skipper Jeff Brownlee and crew of the MV *Beluga* who have been extremely helpful during the boat-based surveys. Thanks to TechWorks Marine for maintaining the SAM moorings and carrying out CPOD deployments and retrievals. Thanks also to the IWDG survey team Darren Craig, Clodagh Russell, Hannah Keogh, Laura Kavanagh, Meadhbh Quinn, Stephanie Levesque, Michael Marrinan, Isabel Baker and Gary Kett for contributing to land and boat surveys.

## REFERENCES

Akamatsu, T., Wang, D., Wang, K., Li, S. and Dong, S., 2010. Scanning sonar of rolling porpoises during prey capture dives. *Journal of Experimental Biology*, *213* (1), pp.146-152.

Berrow, S.D. and O'Brien, J., 2013. Harbour porpoise surveys in Rockabill to Dalkey Island SAC, 2013. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group, pp. 37.

Berrow, S.D., Hickey, R., O'Brien, J. O'Connor, I. and McGrath, D., 2008a. Harbour Porpoise Survey 2008. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group, pp. 31.

Berrow, S.D., Hickey, R., O'Connor, I. and McGrath, D., 2008b. Small Cetacean Site Investigations Survey 2008. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group, pp. 25.

Berrow, S.D., Hickey, R., O'Connor, I. and McGrath, D., 2014. Density estimates of harbour porpoises *phocoena phocoena* at eight coastal sites in Ireland. In *Biology and Environment: Proceedings of the Royal Irish Academy*, *114* (1), pp. 19-34.

Berrow, S.D., O'Brien, J., O'Connor, I. and McGrath, D., 2009. Abundance estimate and acoustic monitoring of harbour porpoise *Phocoena phocoena* in the Blasket Islands candidate Special Area of Conservation. *Biology and Environment, Proceeding of the Royal Irish Academy*, pp. 35-46.

Berrow, S.D., Whooley, P., O'Connell, M. and Wall, D., 2010. Irish Cetacean Review (2000-2009). Irish Whale and Dolphin Group, pp. 60.

Bolt, H.E., Harvey, P.V., Mandleberg, L. and Foote, A., 2009. Occurrence of killer whales in Scottish inshore waters: temporal and spatial patterns relative to the distribution of declining harbour seal populations. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *19* (6), pp. 671-675.

Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. and Thomas, L., 2001. An Introduction to Distance Sampling: Estimating abundance of biological populations. *Oxford University Press*, Oxford, UK.

Canning, S.J., Santos, M.B., Reid, R.J., Evans, P.G., Sabin, R.C., Bailey, N. and Pierce, G.J., 2008. Seasonal distribution of white-beaked dolphins (*Lagenorhynchus albirostris*) in UK waters with new information on diet and habitat use. *Journal of the Marine Biological Association of the UK*, *88* (06), pp. 1159-1166.

Carlström, J., 2005. Diel variation in echolocation behavior of wild harbor porpoises. *Marine Mammal Science*, *21* (1), pp. 1-12.

Clarke, R., 1982. An index of sighting conditions for surveys of whales and dolphins. *Report of the International Whaling Commission*, *32*, pp. 559-561.

Cox, T.M., Read, A.J., Solow, A. and Tregenza, N., 2001. Will harbour porpoises (*Phocoena phocoena*) habituate to pingers?. *Journal of Cetacean Research and Management*, *3* (1), pp. 81-86.

David, L., 2002. Disturbance to Mediterranean cetaceans caused by vessel traffic. Report prepared for the ACCOBAMS Secretariat, Monaco, pp. 21.

Dawson, S., Wade, P., Slooten, E. and Barlow, J., 2008. Design and field methods for sighting surveys of cetaceans in coastal and riverine habitats. *Mammal Review*, *38* (1), pp. 19-49.

Evans, P.G. and Hammond, P.S., 2004. Monitoring cetaceans in European waters. *Mammal review*, *34* (1-2), pp. 131-156.

Gilles, A., Adler, S., Kaschner, K., Scheidat, M. and Siebert, U., 2011. Modelling harbour porpoise seasonal density as a function of the German Bight environment: implications for management. *Endangered species research*, *14* (2), pp. 157-169.

Hernandez-Milian, G. 2014. Trophic role of small cetaceans and seals in Irish waters. Ph.D. thesis, University College Cork, Cork, Ireland, pp. 402.

Herzing, D.L., 2000. Acoustics and social behavior of wild dolphins: implications for a sound society. In *Hearing by whales and dolphins*, Springer New York, pp. 225-272.

IWDG (2009) Muc Mhara – Ireland's smallest whale. Proceedings of the 2nd Irish Whale and Dolphin Group International Whale Conference (Eds. Berrow, S.D. and Deegan, B.) 19th -21st September 2008, Killiney, Co. Dublin.

Kiely, O., Lidgard, D.C., McKibben, M., Baines, M.E. & Connolly, N., 2000. Grey Seals: Status and Monitoring in the Irish & Celtic Seas. Maritime Ireland/Wales INTERREG report No. 3. Marine Institute, 80 Harcourt St., Dublin.

Koschinski, S., Diederichs, A. and Amundin, M., 2008. Click train patterns of free-ranging harbour porpoises acquired using T-PODs may be useful as indicators of their behaviour. *J. Cetacean Res. Manage*, *10* (2), pp. 147-155.

Learmonth, J.A., Murphy, S., Luque, P.L., Reid, R.J., Patterson, I.A.P., Brownlow, A., Ross, H.M., Barley, J.P., Begona Santos, M. and Pierce, G.J., 2014. Life history of harbor porpoises (*Phocoena phocoena*) in Scottish (UK) waters. *Marine Mammal Science*, *30* (4), pp. 1427-1455.

Leeney, R.H., Carslake, D. and Elwen, S.H., 2011. Using static acoustic monitoring to describe echolocation behaviour of Heaviside's dolphins (*Cephalorhynchus heavisidii*) in Namibia. *Aquatic Mammals*, *37* (2), pp. 151.

Lockyer, C., 2003. Harbour porpoises (*Phocoena phocoena*) in the North Atlantic: Biological parameters. *NAMMCO Scientific Publications*, *5*, pp. 71-89.

Mann, J., 1999. Behavioral sampling methods for cetaceans: a review and critique. *Marine mammal science*, *15* (1), pp. 102-122.

Marubini, F., Gimona, A., Evans, P.G., Wright, P.J. and Pierce, G.J., 2009. Habitat preferences and interannual variability in occurrence of the harbour porpoise *Phocoena phocoena* off northwest Scotland. *Marine Ecology Progress Series*, *381*, pp. 297-310.

Meade, R., O'Brien, J. and Berrow, S., 2016. Greater Dublin Drainage Marine Mammal Monitoring: Loughshinny. Final report to Jacobs Engineering by IWDG Consulting, pp. 36.

Miller, L.A., Pristed, J., Møshl, B. and Surlykke, A., 1995. The click-sounds of narwhals (*Monodon monoceros*) in Inglefield bay, northwest Greenland. *Marine Mammal Science*, *11* (4), pp. 491-502.

Ó Cadhla, O., Keena, T., Strong, D., Duck, C. and Hiby, L., 2013. Monitoring of the breeding population of grey seals in Ireland, 2009 - 2012. *Irish Wildlife Manuals, No. 74*. National Parks and Wildlife Service, Department of the Arts, Heritage and the Gaeltacht, Dublin, Ireland, pp. 18.

Ó Cadhla, O., Strong, D., O'Keeffe, C., Coleman, M., Cronin, M., Duck, C., Murray, T., Dower, P., Nairn, R., Murphy, P., Smiddy, P., Saich, C., Lyons, D. & Hiby, A.R., 2008. An assessment of the breeding population of grey seals in the Republic of Ireland, 2005. *Irish Wildlife Manuals No. 34.* National Parks & Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland, pp. 60.

O'Brien, J. and Berrow, S.D., 2015. Harbour porpoise surveys in Roaringwater Bay and Islands SAC, 2015. Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. Irish Whale and Dolphin Group. pp. 43.

O'Brien, J. and Berrow, S.D., 2016. Harbour porpoise surveys in Rockabill to Dalkey Island SAC, 2016. Report to the National Parks and Wildlife Service, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs. Irish Whale and Dolphin Group. pp. 23.

O'Brien, J., Beck, S., Wall, D., Pierini, A., and Hansen, S., 2013. Marine Mammals and Megafauna in Irish Waters, behaviour, distribution and habitat use. Work Package 2: Developing Acoustic Monitoring Techniques. PReCAST Final Report – Marine Research Sub-programme 2007-2013, pp 1-205.

Palka, D., 1996. Effects of Beaufort sea state on the sightability of harbor porpoises in the Gulf of Maine. *Report of the International Whaling Commission*, *46*, pp. 575-582.

Read, A.J. and Westgate, A.J., 1997. Monitoring the movements of harbour porpoises (*Phocoena phocoena*) with satellite telemetry. *Marine Biology*, *130* (2), pp. 315-322.

Rogan, E. and Berrow, S.D., 1996. A review of harbour porpoises. *Phocoena phocoena*, in Irish waters. *Report of the International Whaling Commission*, *46*, pp. 595-606.

Ryan, C., Berrow, S.D., Pierini, A., O'Brien, J., O'Connor, I. and McGrath, D., 2010. Inshore Boat-based Surveys for Cetaceans. Report to the National Parks and Wildlife Service. Irish Whale and Dolphin Group, pp. 33.

Simon, M., Nuuttila, H., Reyes-Zamudio, M.M., Ugarte, F., Verfub, U. and Evans, P.G., 2010. Passive acoustic monitoring of bottlenose dolphin and harbour porpoise, in Cardigan Bay, Wales, with implications for habitat use and partitioning. *Journal of the Marine Biological Association of the United Kingdom*, *90* (08), pp. 1539-1545.

Teilmann, J., 2003. Influence of sea state on density estimates of harbour porpoises (*Phocoena phocoena*). *Journal of Cetacean Research and Management*, *5* (1), pp. 85-92.

Todd, V.L.G., Pearse, W.D., Tregenza, N., Lepper, P.A. and Todd, I.B., 2009. Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around the North Sea offshore gas installations. *ICES Journal of Marine Science 66* (4) pp. 734-745.

Villadsgaard, A., Wahlberg, M. and Tougaard, J., 2007. Echolocation signals of wild harbour porpoises, *Phocoena phocoena*. *Journal of Experimental Biology*, *210* (1), pp. 56-64.

Wahlberg, M., 2002. The acoustic behaviour of diving sperm whales observed with a hydrophone array. *Journal of Experimental Marine Biology and Ecology*, *281* (1), pp. 53-62.

Wall D., Murray C., O'Brien J., Kavanagh L., Wilson C., Ryan C., Glanville B., Williams D., Enlander I., O'Connor I., McGrath D., Whooley P. and Berrow S., 2013. Atlas of the distribution and relative abundance of marine mammals in Irish offshore waters 2005 - 2011. Irish Whale and Dolphin Group, Merchants Quay, Kilrush, Co Clare. ISBN 0-9540552-7-6.

Young, R.F. and Peace, S., 1999. Using simultaneous counts by independent observers to correct for observer variability and missed sightings in a shore-based survey of bottlenose dolphins, Tursiops truncatus. *J. Cetacean Res. Manage*, *1* (3), pp. 279-287.

# APPENDIX – Results from the Loughshinny Marine Mammal Surveys

## 5.1 Land-based Observations

Land-based monitoring commenced on 18 March and finished on 7 September 2015. Twenty hours of monitoring was conducted over six surveys throughout the monitoring period (Table 14).

### 5.1.1 Environment

The weather was favourable throughout the surveys with no swell, sea state ≤2and visibility of 6-20km. Precipitation was recorded on two days in July and September. On 13 July, rain was recorded for 39% of the survey. Thirty one (31%) of the rain was recorded as light intermittent and eight (8%) was recorded as heavy. On 07 September, light intermittent rain was recorded for 13% of the survey (Table 14).

**Table 14. Environmental conditions recorded during the Loughshinny land-based surveys**

| Date | Sea state (predominant) | Swell (m) | Visibility (km) | Cloud cover (*/8) | Precipitation (%) | Precipitation Intensity |
|---|---|---|---|---|---|---|
| 18 March | 1 | 0 | 6-10 | 0 | 0 | - |
| 21 April | 1 | 0 | 16-20 | 0 | 0 | - |
| 23 May | 1 | 0 | 16-20 | 7 | 0 | - |
| 13 July | 2 | 0 | 16-20 | 8 | 46 | Light intermittent |
| 12 August | 1 | 0 | 16-20 | 2 | 0 | - |
| 7 September | 1 | 0 | 16-20 | 8 | 13 | Light intermittent |

### 5.1.2 Marine Mammal Sightings

Marine mammals were sighted on 86% of land-based survey days. Two marine mammal species were recorded; harbour porpoise and grey seal. Harbour porpoise were present on 67% of days with a peak in numbers recorded in September (Figure 52, Figure 53). Two harbour porpoise calves were recorded during the September survey. Seal species were present on 67% of days (Figure 54, Figure 55). All seal sightings were of adult individuals and consisted of 10 grey seals and two unidentified seal species.

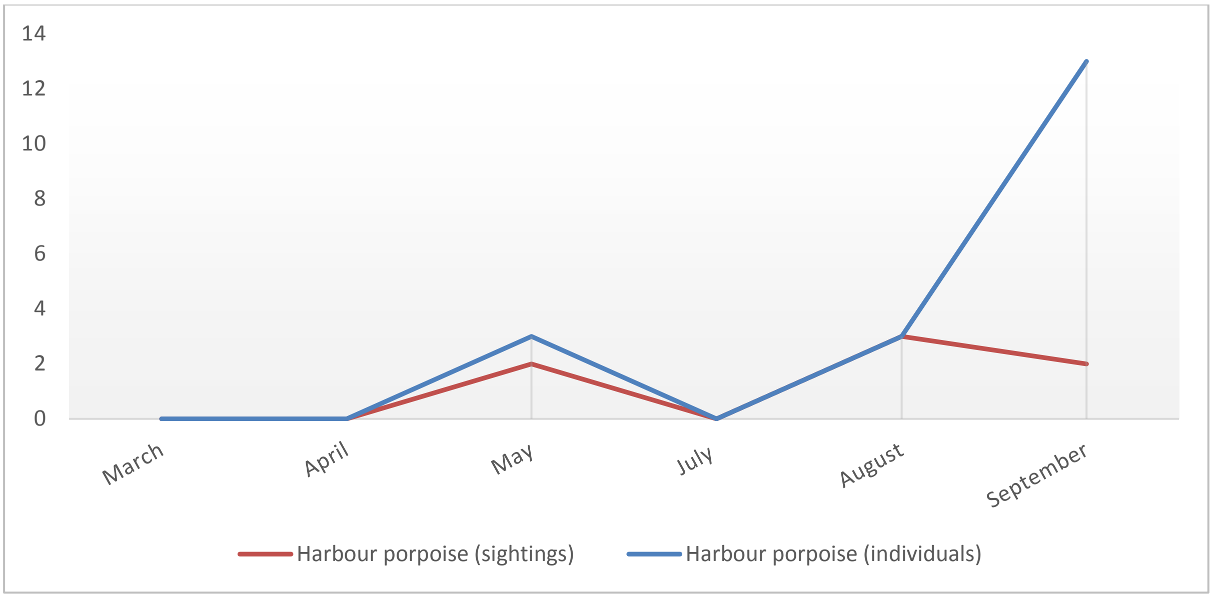



Figure 52. Number of harbour sightings and individuals recorded during Loughshinny land-based surveys

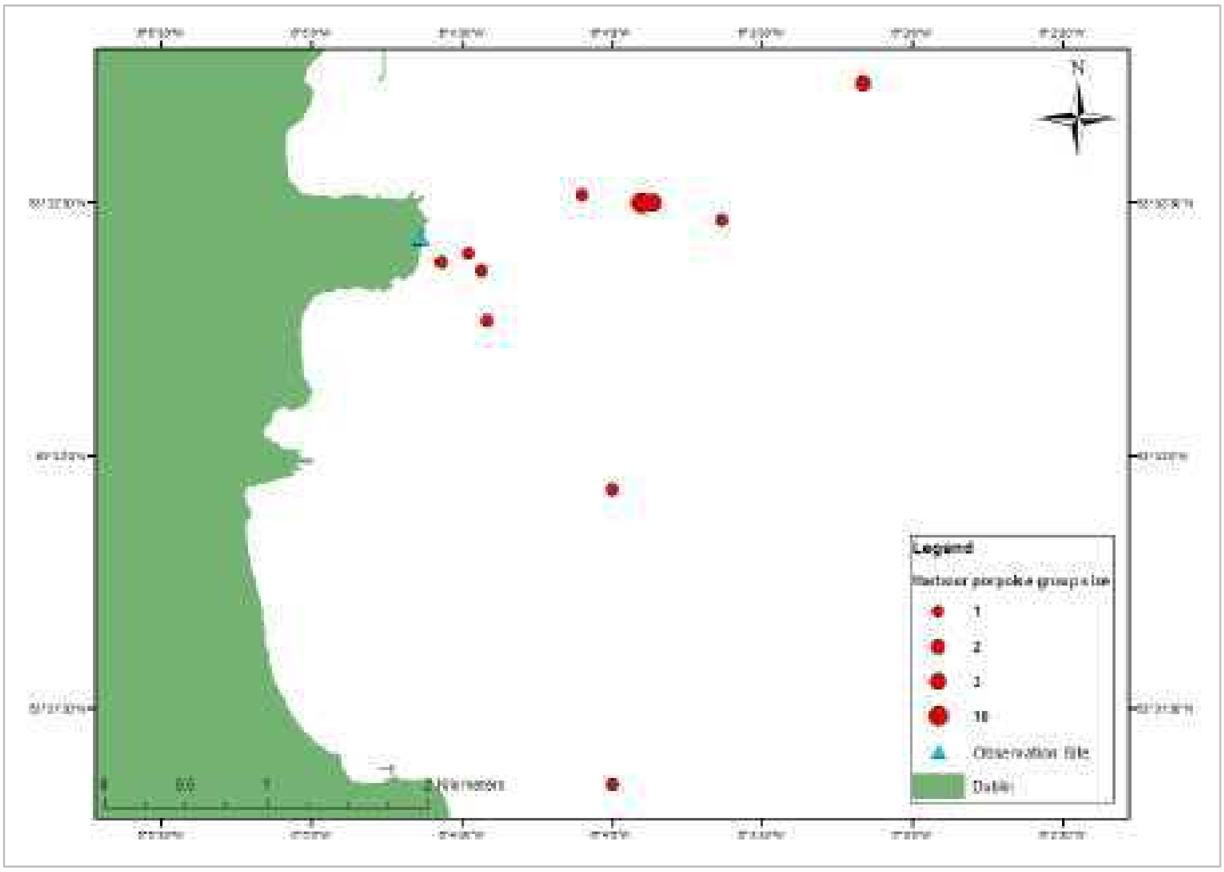



Figure 53. Distribution and group size of harbour porpoise sightings off Loughshinny

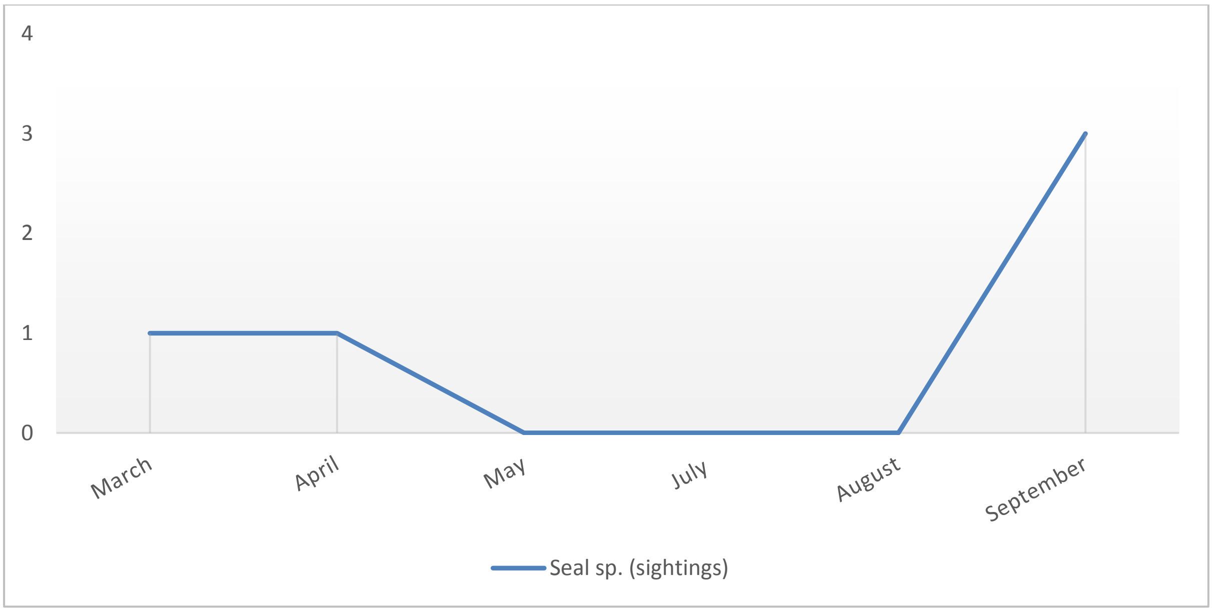



**Figure 54. Number of seal sightings recorded during Loughshinny land-based surveys (all single adults)**

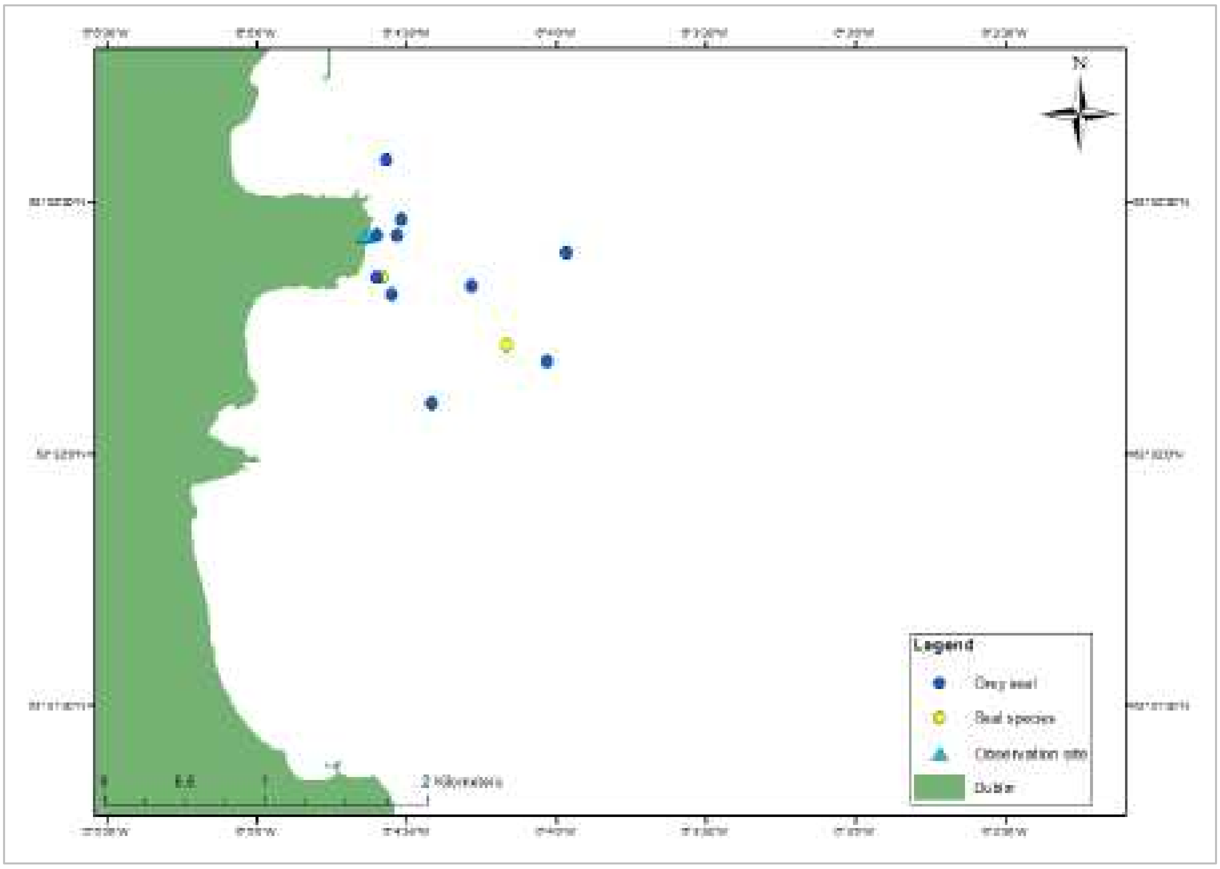



**Figure 55. Distribution of seal sightings off Loughshinny**

**Table 15. Summary of Loughshinny land-based marine mammal surveys showing percentage sea state during survey.**

| Date | Sea state (% of total survey time) | | | | Number of harbour porpoise sightings | Number of seal sightings | Number of harbour porpoise individuals | Number of seal individuals |
|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | | | | |
| 18 March | 0 | 66 | 33 | 0 | 2 | 5 | 2 | 5 |
| 21 April | 0 | 100 | 0 | 0 | 0 | 2 | 0 | 2 |
| 23 May | 40 | 60 | 0 | 0 | 3 | 1 | 4 | 1 |
| 14 July | 0 | 8 | 92 | 0 | 0 | 0 | 0 | 0 |
| 12 August | 31 | 69 | 0 | 0 | 3 | 0 | 3 | 0 |
| 7 September | 7 | 93 | 0 | 0 | 3 | 4 | 14* | 4 |
| Total | | | | | **11** | **12** | **23** | **12** |

*includes 2 calves

#### *5.1.2.1 Focal Follow Observations*

Two focal follows were obtained over two days in March and May. During March, a single adult harbour porpoise was tracked with every behaviour recorded for a total of 18 minutes and in May, an individual adult harbour porpoise was followed for 26 minutes (Figure 56).

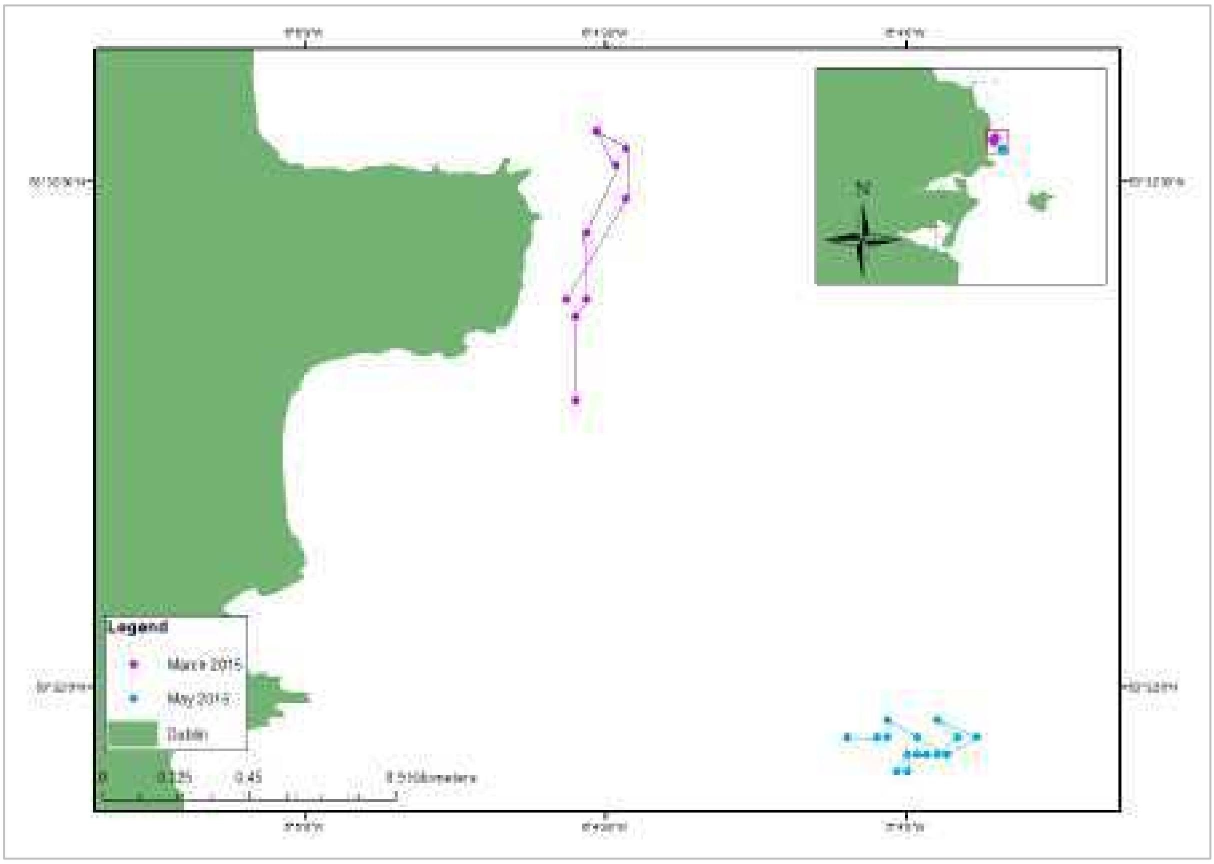



**Figure 56. Focal follow tracks of single harbour porpoise during March and May 2015 from Loughshinny land-based site**

## 5.2 Boat-based Surveys

A boat-based survey was attempted on 19 March but fog prevented the vessel from leaving Dun Laoghaire harbour. Three successful surveys were carried out on 20 April, 10 June and 11 August 2015.

### 5.2.1 Environment

Environmental conditions were generally favourable with the exception of the June survey (Table 16) which although 64% of effort was within the targeted sea state (≤2), was not ideal for detecting harbour porpoises. Weather forecasts for the day consistently reported light winds of 5-7kts from NE for the survey day and minimal swell. We experienced 10 and up to 14kts during the survey with an occasional moderate swell. Even during the survey the forecasts checked (at least three independent forecasts) stated light winds however sea-state was greater than predicted. These local variations have been experienced before during IWDG surveys at this location (e.g. Berrow and O'Brien 2013).

Table 16. Environmental conditions recorded during boat-based marine mammals surveys

| Date | Sea state (%) | | | | Predominant swell (m) | Predominant visibility (km) |
|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | | |
| **20 April** | 0 | 27 | 65 | 8 | 1 | 16-20 |
| **10 June** | 0 | 14 | 50 | 36 | 0 | 16-20 |
| **11 August** | 17 | 63 | 20 | 0 | 0 | 16-20 |

### 5.2.2 Marine Mammal Sightings

Marine mammals were sighted on 100% of survey days (Table 17). Four marine mammal species were recorded during the survey period; harbour porpoise, grey seal, harbour seal and minke whale (Figure 57, Figure 58, Figure 59). All sightings were of adults with the exception of the August survey where four juvenile harbour porpoise and one calf were recorded.

Table 17. Summary of boat-based marine mammal surveys covering Loughshinny in 2015

| Date | No. of harbour porpoise sightings | No. of seal sightings | No. of harbour porpoise individuals | No. of seal individuals | No. of other marine mammals |
|---|---|---|---|---|---|
| 20 April | 11 | 2 | 15 | 2 | 0 |
| 10 June | 3 | 1 | 3 | 1 | 1 (minke whale) |
| 11 August | 20 | 2 | 37 | 2 | 0 |
| Total | **34** | **5** | **55** | **5** | |

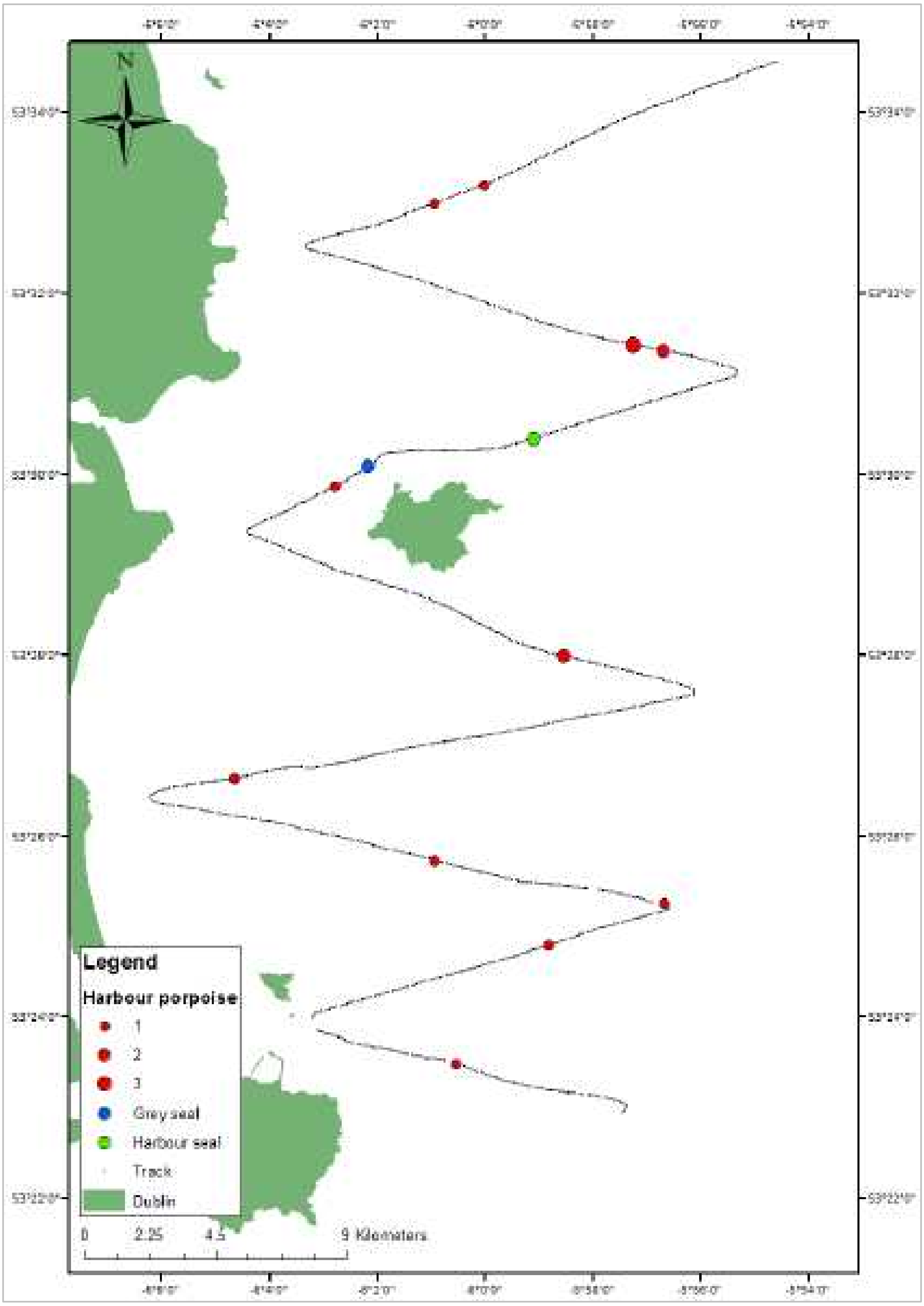



Figure 57. Map of transect line and marine mammal sightings for April 2015 boat-based survey

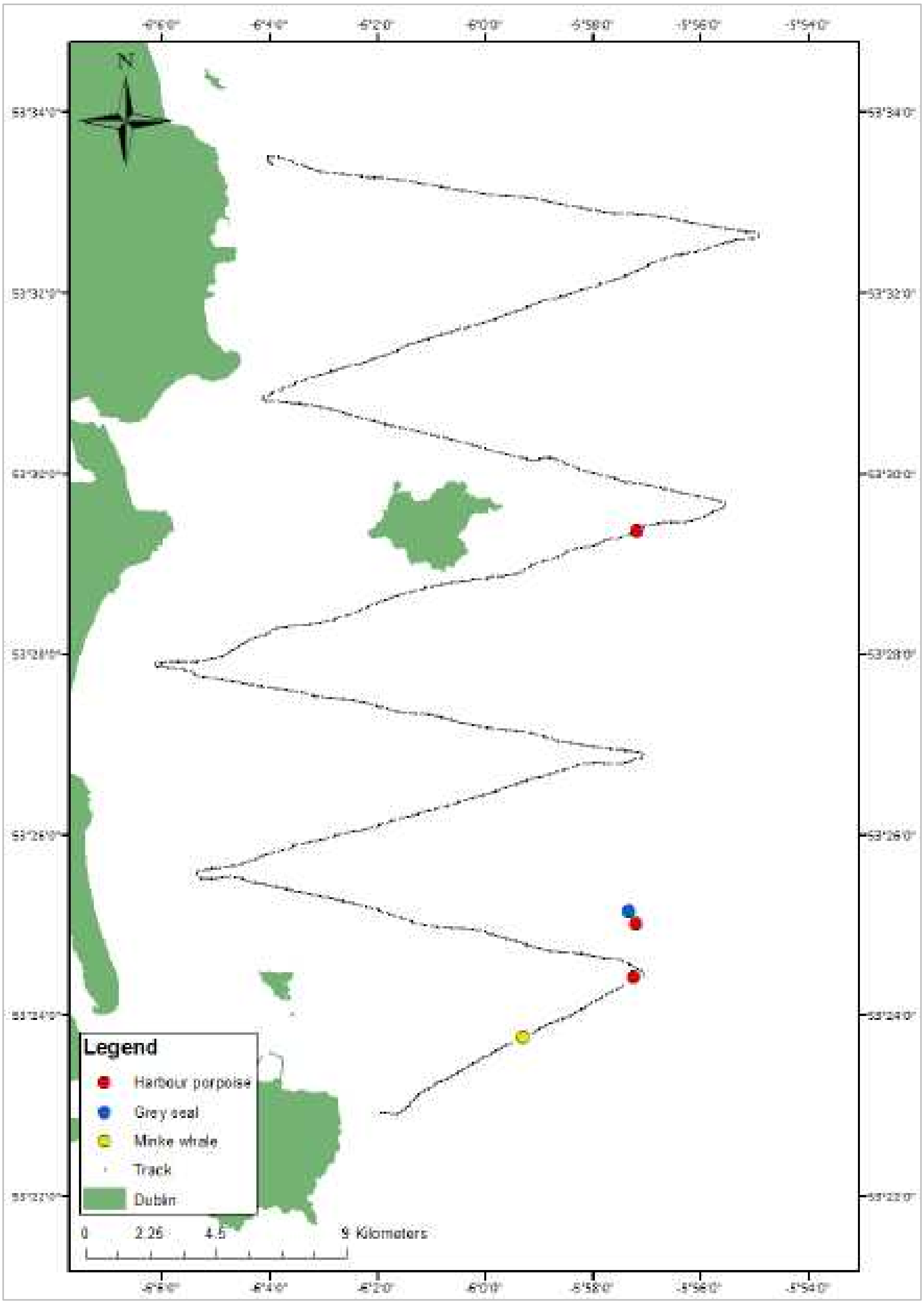



Figure 58. Map of transect line and marine mammal sightings for June 2015 boat-based survey

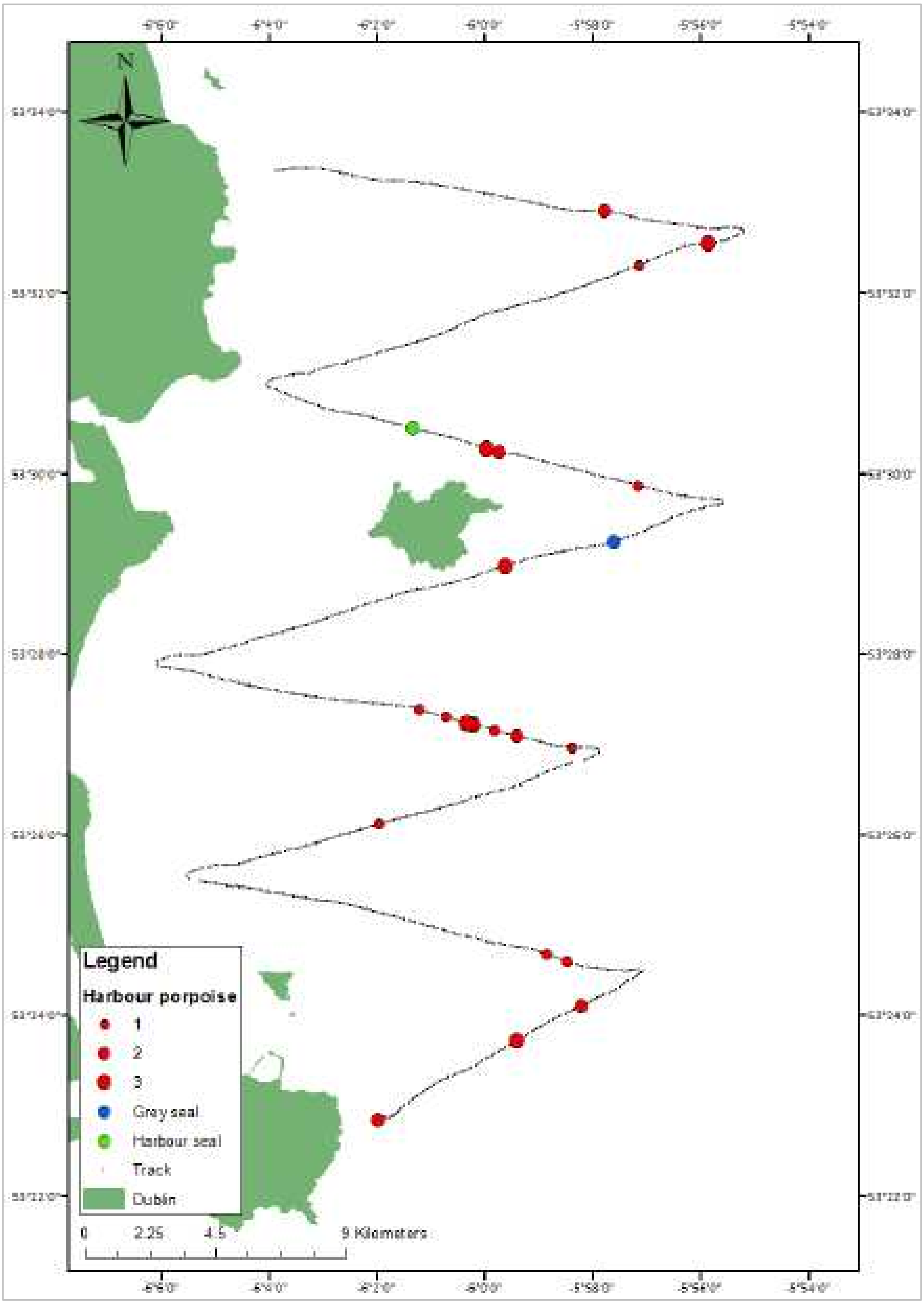



**Figure 59. Map of transect line and marine mammal sightings for August 2015 boat-based survey**

#### 5.2.2.1 *Density and abundance estimation*

Density estimates for harbour porpoises calculated for two of the three survey days and not for survey two as the number of sightings (n=5) were too few to derive a reliable density estimate. The detection functions for harbour porpoise during all surveys are shown graphically (Figure 60). Using the Chi-squared test for goodness of fit to the DISTANCE model data for the first survey were poor (P=0.92) but for survey 2 better (P=0.62).

Evasive reactions of porpoises from the survey vessel were most evident on survey 1, with a peak in sightings some 50-100m from the track-line (Figure 60), most likely resulting in an underestimate of animal density. Variation in cluster size was greater during the first survey which contributed a greater proportion of the variability.

Mean group (cluster) size was greater on survey 3 (1.85±0.20) compared to survey 1 (1.44±0.27) suggesting a trend of increasing group size with time which was consistent with land-based observations.

**Table 18. Model data used in the harbour porpoise abundance and density estimation process for the Greater Dublin Drainage project(Note: A half-normal model with cosine series adjustments and sightings data truncated at 200m for Survey 1 and 300m for Survey 2 and Overall analysis was used).**

| Sample Day | $Chi^2$ P value | Effective Strip Width (m) | Number of sightings | Mean Cluster size ± SE | Variability (%) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Detection | Encounter | Cluster |
| 1 | 0.924 | 104.65 | 11 | 1.44±0.27 | 67.6 | - | 32.4 |
| 3 | 0.602 | 148.78 | 20 | 1.85±0.20 | 84.1 | - | 15.9 |
| **Overall** | **0.811** | **144.2** | **31** | **1.68±0.15** | **38.3** | **55.0** | **6.7** |

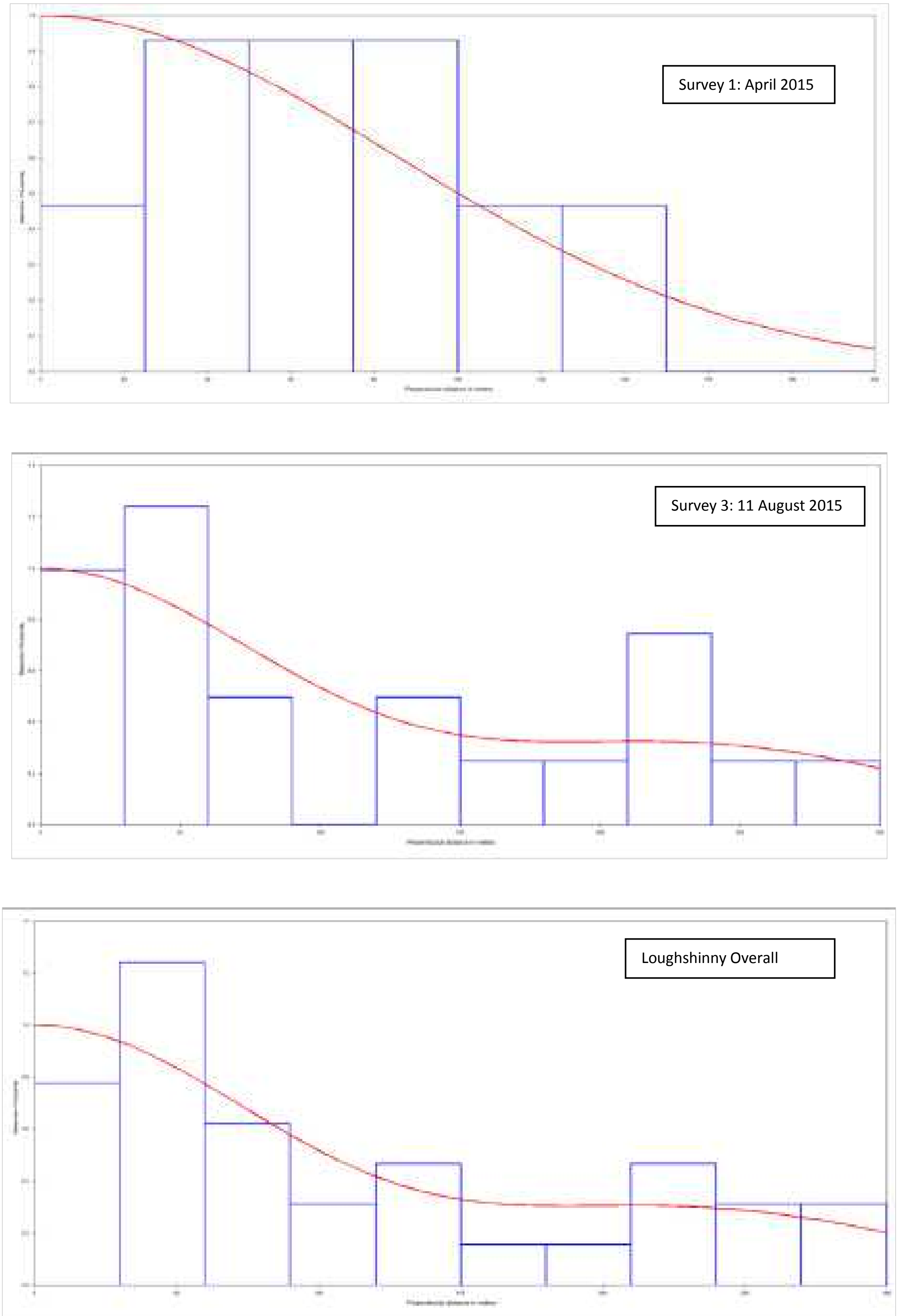



Figure 60. Detection functions plots for harbour porpoise during boat-based surveys

Density and abundance estimates for harbour porpoise in the Rockabill to Dalkey Island SAC are shown in Table 19. The density estimates were quite different between surveys with highest densities on survey 3 correlating with the survey with the greatest number of sightings as the track length and area surveyed were the same. This produced an overall abundance estimate of 256±93 porpoises with 95% Confidence Intervals of between 87-751 porpoises and a CV of 0.37.

**Table 19. Estimated density, abundance (N) and group sizes of harbour porpoise recorded for the Greater Dublin Drainage project**

| Sample Day | N (95% CI) | SE | CV | Density (per km$^2$) | Mean group size (95% CI) |
|---|---|---|---|---|---|
| 1 | 154 (77-306) | 54 | 0.33 | 0.78 | 1.44 (1.00-2.12) |
| 3 | 361 (192-681) | 114 | 0.32 | 1.91 | 1.85 (1.48-2.30) |
| **Overall[1]** | **256 (87-751)** | **93** | **0.37** | **1.31** | **1.67 (1.39-2.01)** |

[1] – includes combined sightings and effort data from both surveys

## 5.3 Static Acoustic Monitoring

### 5.3.1 C-POD Calibrations

All units used over the duration of the present study were calibrated as part the long-term GDD monitoring project (Loughshinny and Portmarnock). Results of both trials are presented below (Figure 61-66). From the calibration trials, results showed that there were some discrepancies between units. Further exploration into individual unit performance showed that C-POD performance was within the acceptable error margin of ±20% DPM per hour (Figure 63-Figure 66) and therefore no correction factor was required to be applied to the data to make it comparable (O'Brien *et al*. 2013). During analysis of the long-term dataset, differences in sensitivities between units is accounted for by inserting the C-POD number as a random factor when running the generalized linear mixed-effect models.

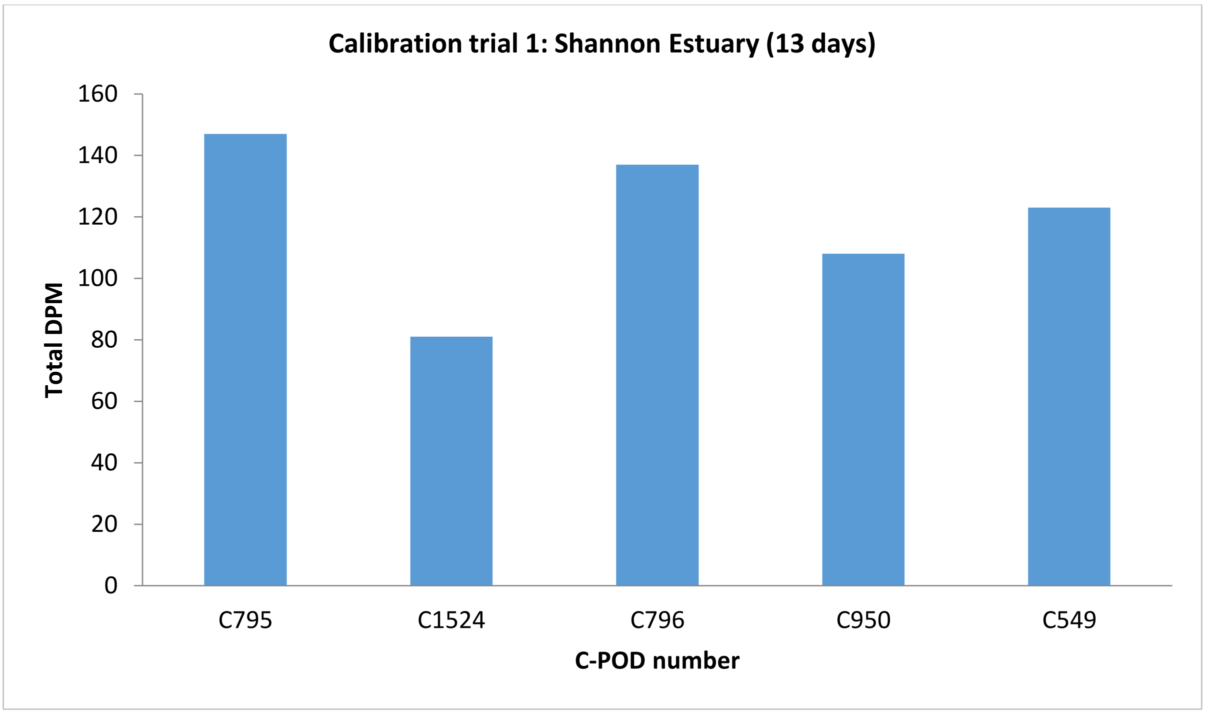



**Figure 61. Detection Positive Minutes from all C-PODs deployed during calibration trial 1 in the Shannon Estuary**

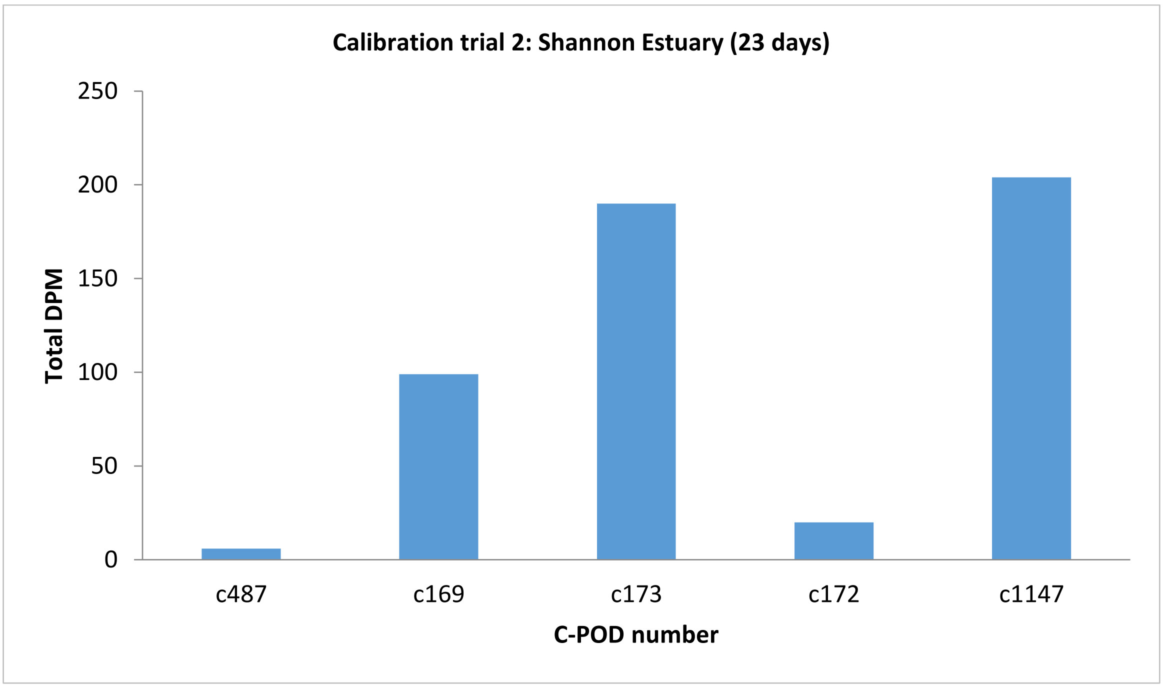



**Figure 62. Detection Positive Minutes from all C-PODs deployed during calibration trial 2 in the Shannon Estuary**

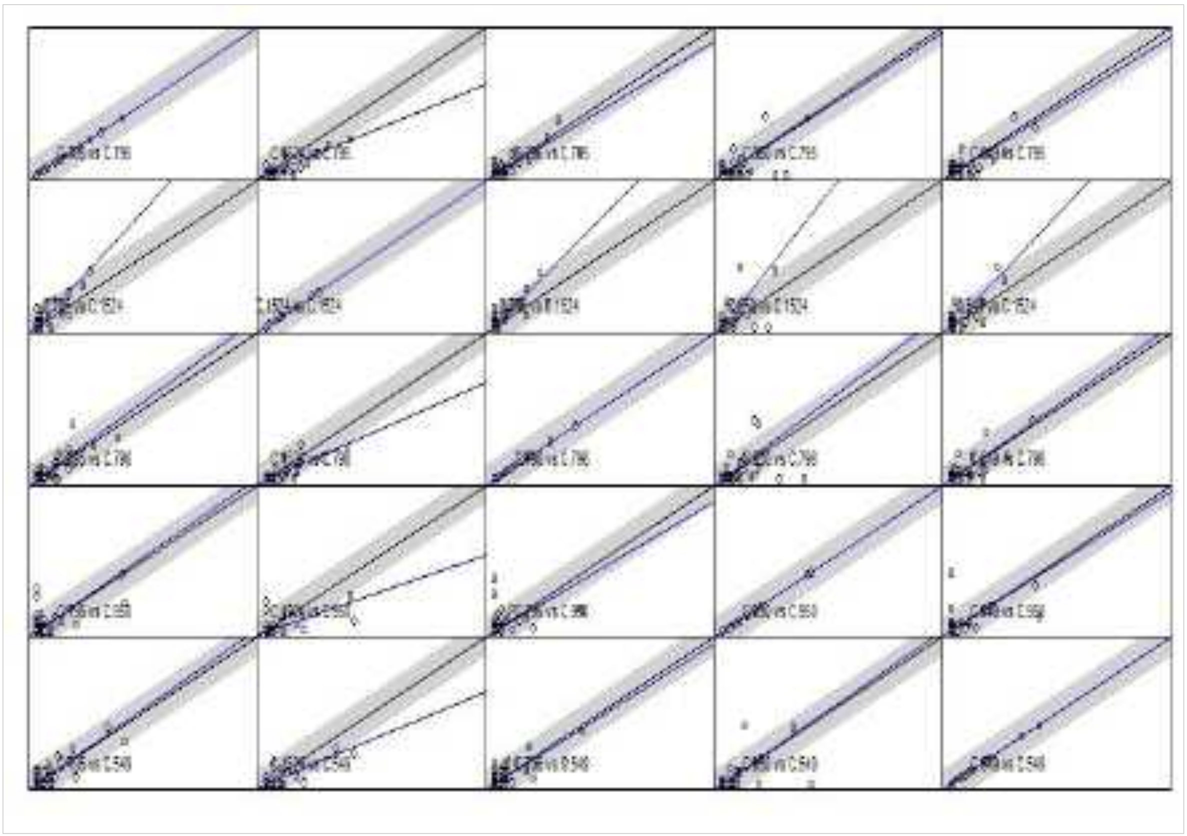


Figure 63. Orthogonal regression plot of C-POD comparisons in calibration trial, in blue, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration 1, January 2015

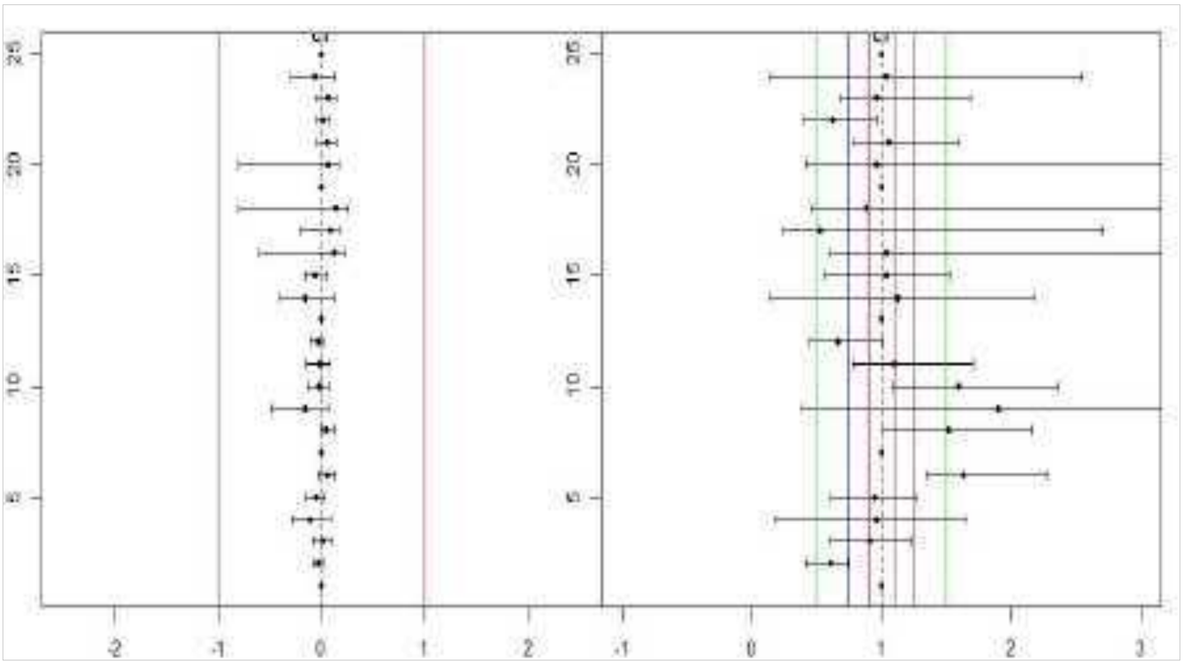


Figure 64. Centipede plot of the intercept and slope values (±std), of the orthogonal regression plots, for each pod performance comparison in calibration trail 1 at Money Point, January 2015.Deviation from the red dotted lines, 0 on the intercept plot and 1 on the gradient plot, indicates deviation from the null model assuming no variation. Plot indicates that a greater extent of variation is found within the gradient values

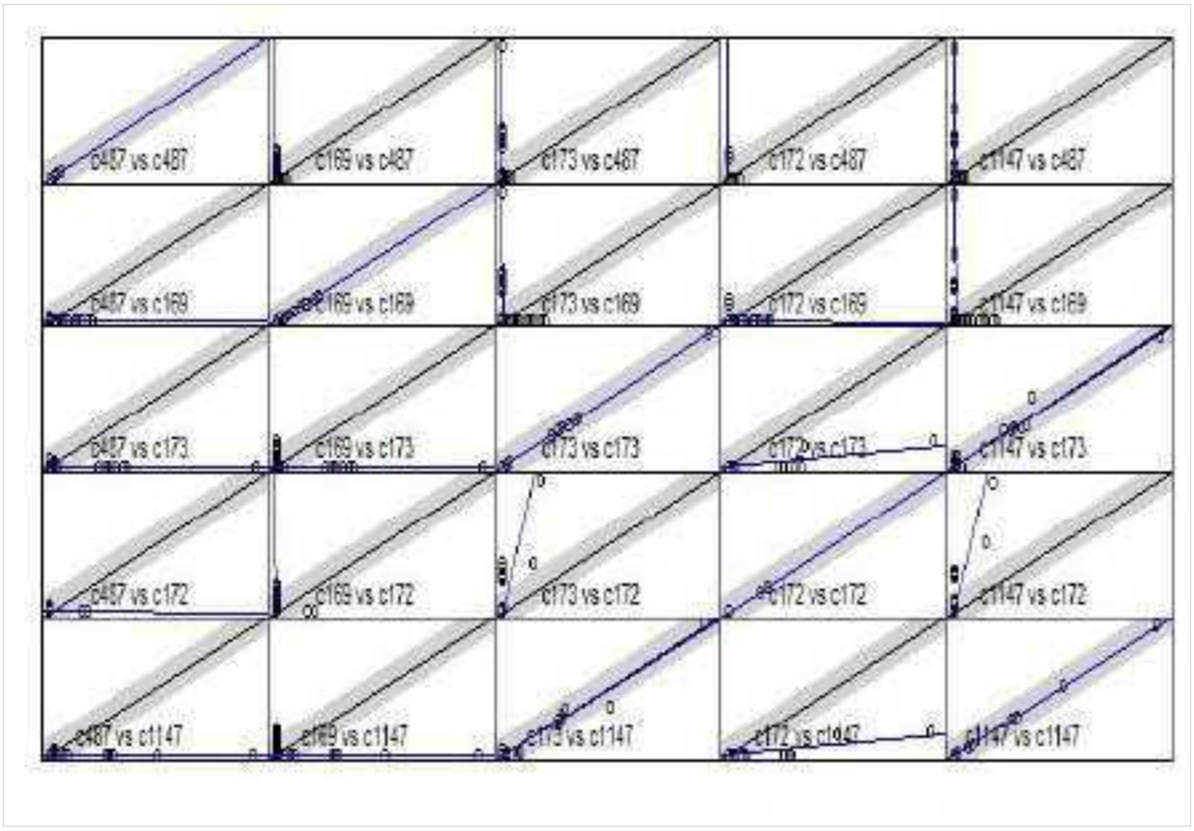



**Figure 65. Orthogonal regression plot of C-POD comparisons in calibration trial, in blue, with a null model where each unit performs exactly the same, in black and an acceptable error margin of ±20%, in grey from Calibration 2, February 2015**

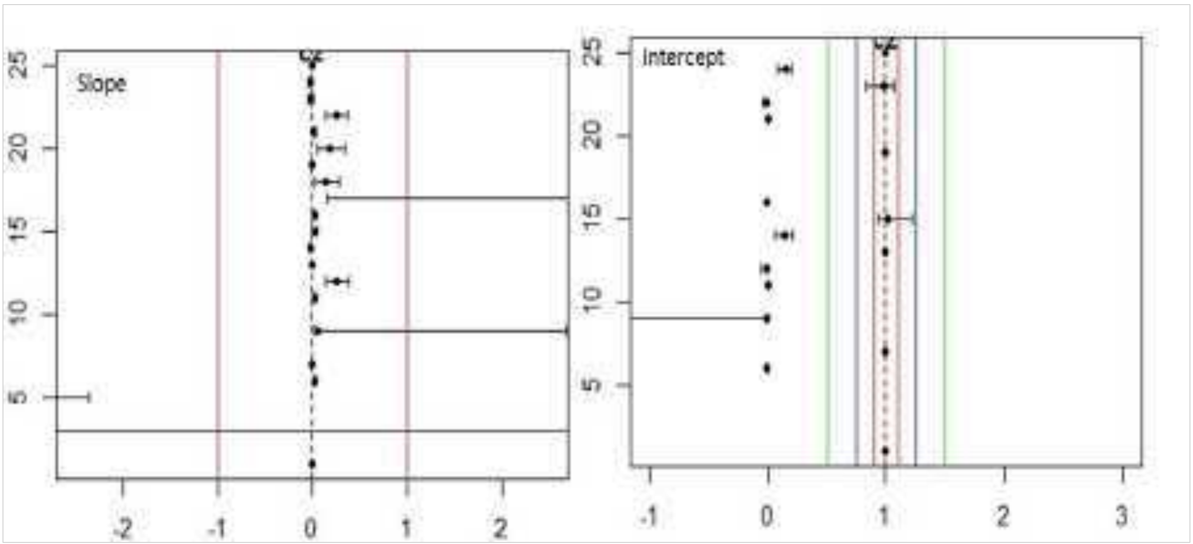



**Figure 66. Centipede plot of the intercept and slope values (±std), of the orthogonal regression plots, for each pod performance comparison in calibration trail 1 at Money Point, January 2015.Deviation from the red dotted lines, 0 on the intercept plot and 1 on the gradient plot, indicates deviation from the null model assuming no variation. Plot indicates that a greater extent of variation is found within the gradient values**

### 5.3.2 Static Acoustic Monitoring

Static Acoustic Monitoring using C-PODs was carried out at Loughshinny for a total of 189 days. Detections were recorded on 100% of days (Table 20). The number of Porpoise Positive Minutes (PPM) ranged from 8 to 475 per day with a mean of 139 PPM (Figure 67). Very few dolphin detections were recorded and those that were determined to be false positives. A monitoring index of the mean number of detection positive minutes per hour for porpoises was generated (Table 20). This unit of measurement can be compared across locations, or with results from previous studies that have taken place. This index will serve as a means to compare Loughshinny with the similar data derived from Portmarnock as part of the current study but additionally facilitate comparison with other sites regionally.

**Table 20. Deployment summary from Loughshinny**

| Location | No of days | Dates | CPOD | PPM | % days detected | Mean DPM/Day | Mean DPM/hr | %DPM |
|---|---|---|---|---|---|---|---|---|
| Loughshinny | 90 | 13 Mar-10 Jun | c950 | 7893 | 100 | 87.7 | 3.7 | 6.1 |
| Loughshinny | 99 | 10 Jun-16 Sep | c487 | 18388 | 100 | 185.8 | 7.7 | 12.9 |
| **TOTAL** | **189** | | | **26281** | **100** | **137** | **5.8** | **9.6** |

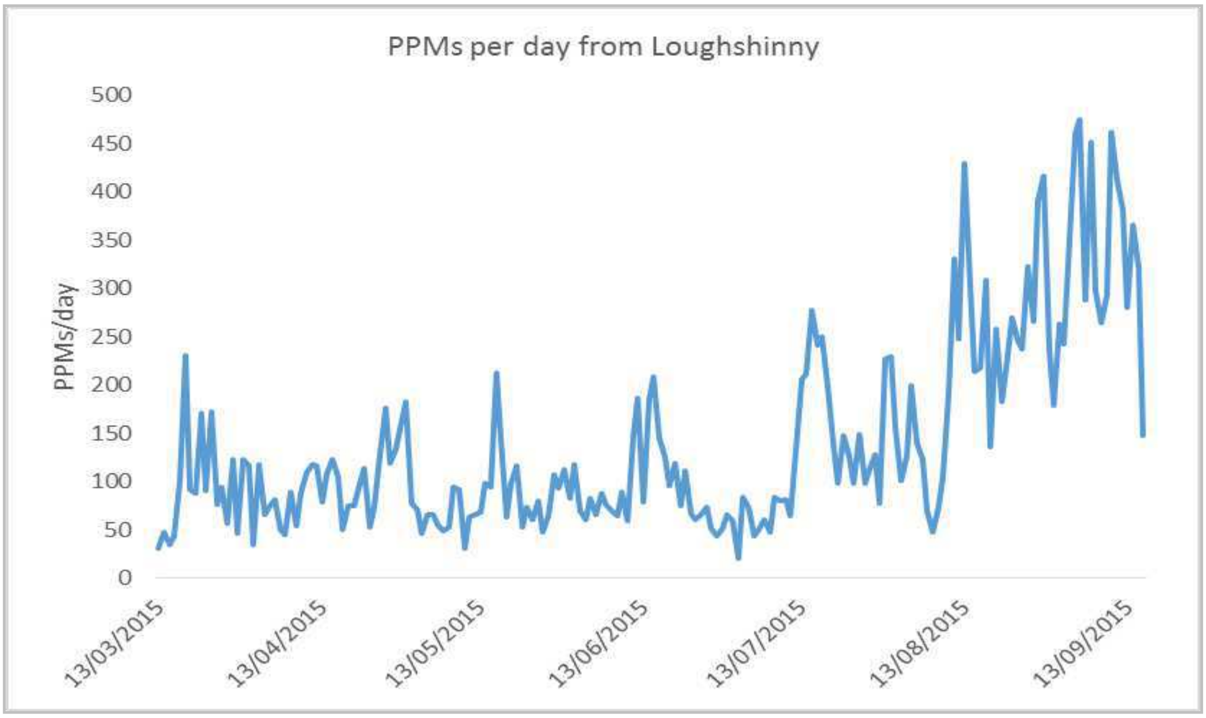



**Figure 67. Porpoise Positive Minutes per dat (PPMs) recorded over the deployment period (March to September (139 days)).**

#### 5.3.2.1 Generalized linear mixed-effect model (GLMM) analyses

Results from the generalized linear mixed-effect model (GLMM) analyses (Figure 68) showed that season had a significant effect on the presence of porpoises at the site. A significant peak in porpoise detections was recorded during the autumn ($\chi^2$= 174.5, p<0.000). Most porpoise detections were recorded during the diel phase morning, and from the raw data this peak can be seen during the early morning ($\chi^2$= 174.5, p<0.000) showing they are more active at the site during night-time and early morning hours. Tidal cycle was not found to be a significant factor in the presence of porpoises off Loughshinny ($\chi^2$= 5.3, p<0.2) but tidal phase was, with significantly more detection recorded during spring cycles ($\chi^2$= 9.2, p<0.02). The box plots below show the distribution of the data or each of the variables, with the usual box plot format, representing the median, quartiles and outliers.

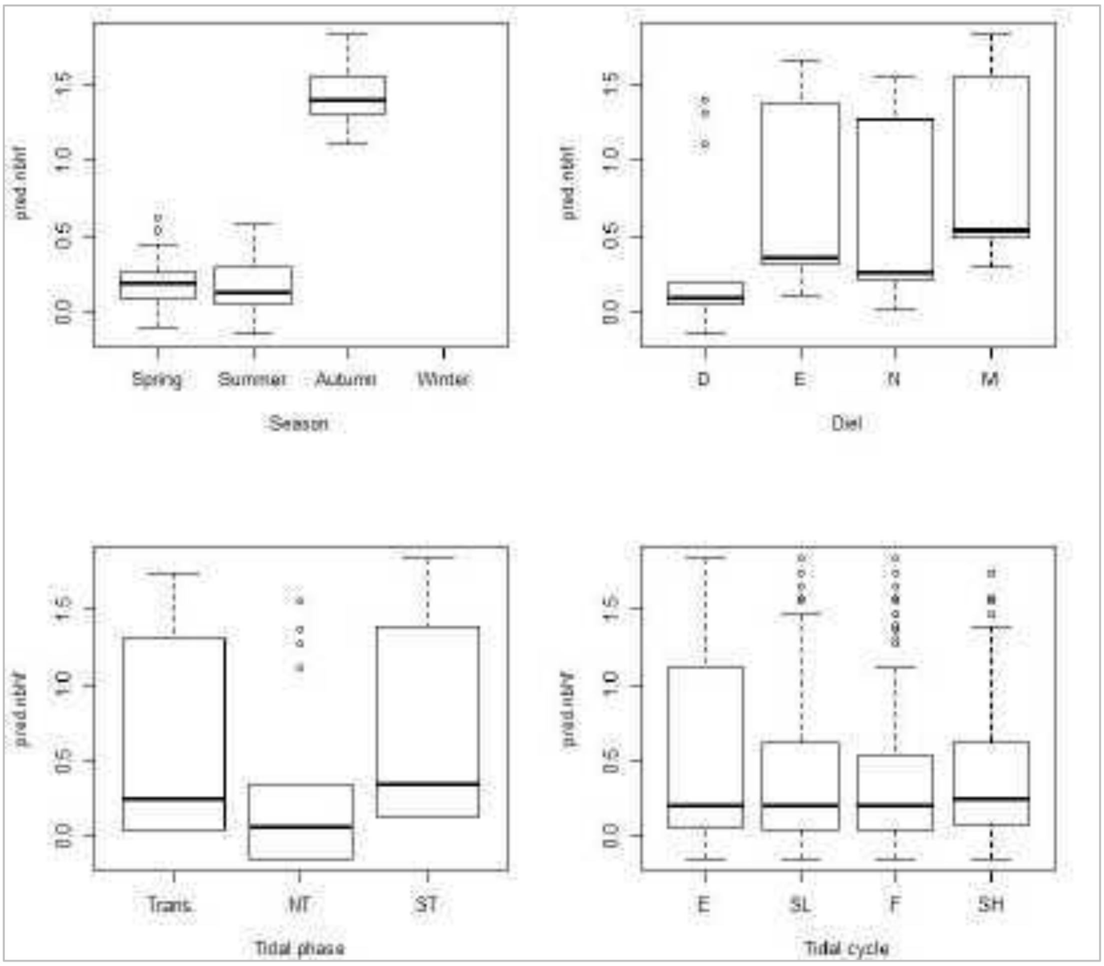



**Figure 68. Predicted proportion of detection positive hours, in the narrow band high frequency channel at Loughshinny (Co. Dublin) Mar-Sept, 2015 across the four variables of season; diel, where D =day, E= evening, M= morning and N = night; tidal phase, where Trans.=transitional phase, NT= neap tide and ST=spring tide; and tidal cycle, where E =ebb, L = slack low, F= flood and H=slack high.**

### 5.3.3 Assessment of usage of the site

Feeding buzzes and click bursts have been described in many odontocete species (Herzing, 2000; bottlenose dolphin; Miller *et al.*, 1995; narwhal, Leeney *et al.*, 2011; Heaviside's dolphin). Variation in *ICI* has been used as an indicator of certain behaviours in cetaceans (Wahlberg, 2002; Carlström, 2005; Koschinski *et al.*, 2008; Akamastu *et al*, 2010; and Leeney *et al*., 2011). The minimum *ICI* (MinICI) has been deemed the most appropriate value as the software often splits trains when the *ICI* is long (Carlström, 2005). This has been employed in recent cetacean studies using T-PODs (Todd *et al.*, 2009; and Leeney *et al.*, 2011). Carlström (2005) deemed a MinICI of less than 10ms (MinICI<10ms) to be an appropriate identification of probable foraging, based on the shape of frequency distribution graphs generated from the mean of the distribution of the MinICIs.

A total of 100,421 NBHF click trains were recorded at Loughshinny over the 6 month deployment. The average number of clicks per train was 13.5, with on average 131 clicks recorded per second, and with an average frequency of 128.1 kHz across all deployments. Click trains were classified into two categories based on the data presented above, where the category foraging was applied to trains with MinICI<10ms. All other trains were defined as "Other" as no definite behaviour category could be attributed. Results showed 95% (95,509 trains) of the total click trains recorded fell under the category foraging, highlighting Loughshinny as a very important feeding site. Modelling of the dataset according to the factors as previously done was not repeated given that 95% of trains were classed as foraging, showing that porpoises present at Loughshinny are feeding and more significantly during the times of night and morning,  during the autumn and spring tidal cycle.

**Table 21. Train details from porpoise detections at Loughshinny, Co. Dublin**

| No of trains | Foraging | Other | Min frequency | Max Frequency | clx per train |
|---|---|---|---|---|---|
| 100421 | 95509 | 4911 | 124 | 132.4 | 13 |

## 5.4 Discussion

Despite the poor summer weather experienced during 2015, we successfully carried out this survey in favourable conditions. Only one boat-based survey was compromised with around 40% of effort above that stated in the contract. Although conducted over only over a relatively short duration the results do provide an insight into the use of the area by marine mammals and demonstrate its importance for harbour porpoise.

Although limited observations were made there was evidence of an increase in use of the site through the survey period peaking in September. A notable observation included a large group of 14 harbour porpoise in early September. This group contained two calves and was the only sighting of calves during the land-based surveys. Berrow and O'Brien (2013) showed a similar pattern of harbour porpoise numbers and group size increasing off North Co. Dublin in late August. No marine mammals were recorded during the July land-based survey, probably largely due to the sea state ≤2 for 92% of the sampling which could decrease the likelihood of sightings. Two focal follows of harbour porpoise were carried out in March and May for 18 minutes and 26 minutes respectively. During focal follows, harbour porpoise were tracked swimming in tidal currents. This and the presence of feeding gulls suggests that these individuals were foraging in the area.

For two of the three boat surveys carried out, the number of sightings were sufficient to derive density and abundance estimates. The track-lines surveyed an area to the south and a lesser extent to the north of the Loughshinny site. It is important to try and obtain as many sightings as possible to derive robust density estimates. During the two surveys analysed track-lines were 78 and 75km in length and sightings numbered a total of 11 and 20 respectively.

Within the area surveyed the number of sightings of harbour porpoise per survey varied considerably but the overall density estimate was quite consistent, to previous surveys in the area (Table 22). Harbour porpoise density estimates were previously generated for two Dublin sites in 2008 and for Rockabill to Dalkey Island SAC in 2013. North County Dublin was similar to the area surveyed in the present study. Density estimates in North County Dublin in 2008 varied very considerably and the highest density of porpoises recorded at any site in Ireland so far was recorded in August 2008 (i.e., 6.93 porpoises per km$^2$). However other individual survey estimates during 2008 were much lower, so this single survey had a strong influence on the overall pooled density estimate of 2.03 animals per km$^2$.

If we take the average of the overall density estimates in 2008 for the two sites it equates to 1.61 which is quite similar to 1.31 porpoises per km$^2$ from the present survey. The CV of the present density estimate is high (CV=0.32) compared to the other surveys but this was based on only two survey days while all others used data from six survey days. A previous wider-scale line-transect survey in the north Irish Sea, to the east and north of the current SAC, delivered a density estimate of 1.59±0.22 porpoises per km$^2$ (Berrow *et al.* 2011). This was also of a similar magnitude to that derived from the present survey. These density estimates are some the highest recorded anywhere in Ireland (Berrow *et al*. 2014).

**Table 22. Density, abundance and group size estimates for harbour porpoise in the Greater Dublin Drainage area**

| Location | Year | Area (km²) | Mean group size | Density (per km²) | Abundance ± SE (95% CI) | CV | Reference |
|---|---|---|---|---|---|---|---|
| **Greater Dublin Drainage** | **2015** | **192** | **1.67** | **1.31** | **256±37 (87-751)** | **0.37** | **This study** |
| Rockabill to Dalkey Island SAC | 2013 | 273 | 1.47 | 1.44 | 391±25 (344-445) | 0.06 | Berrow and O'Brien (2013) |
| North County Dublin | 2008 | 104 | 1.41 | 2.03 | 211±47 (137-327) | 0.23 | Berrow *et al.* (2008a) |
| Dublin Bay | 2008 | 116 | 1.19 | 1.19 | 138±33 (86-221) | 0.24 | Berrow *et al.* (2008a) |

Cetaceans live in an acoustic world and increasingly attempts have been made to develop acoustic monitoring techniques rather than relying on visual methods, whose efficiency is hugely dependent on light, weather conditions and sea-state, especially for species such as the elusive harbour porpoise. Additionally, the reliance on sound by these animals is extremely important and therefore SAM is a very valuable tool for determining presence and assessing fine scale habitat use by various odontocete species. The main advantage of SAM is that it can provide information on species that can go undetected visually for up 95% of the time (harbour porpoise; Read & Westgate, 1995). Patterns of cetacean presence have been described over seasonal scales (Canning *et al*., 2008, Bolt *et al*., 2009; Simon *et al*., 2010; Gilles *et al*., 2011; O'Brien *et al.* 2013) diel cycle (Cox & Read 2004; Carlström, 2005; Todd *et al*., 2009; O'Brien *et al.* 2013) and tidal patterns (Philpott *et al*., 2007; Marubini *et al*., 2009; O'Brien *et al.* 2013). In order to evaluate the importance of an area, it is fundamental that the presence of small cetaceans at a site is fully understood and this requires monitoring over varying time scales depending on monitoring methods. Although SAM can provide a much more complex account of cetacean activity at a site in comparison to visual monitoring, it fails to inform on the numbers present and hence the need for visual surveys.

The aim of the present study was to compile a dataset of cetacean occurrence at Loughshinny and use this dataset to compare with monitoring datasets gathered under the same Greater Dublin Drainage project but from monitoring locations further south, off Portmarnock Co. Dublin. From the data presented here, it is clear that the Loughshinny site is an important feeding area for the harbour porpoise especially in the autumn, during the night and early morning and during a spring tidal cycle.

Winter could not be analysed as monitoring only lasted six months at this particular site. In order to try to understand the relevance of these detections, comparisons can be made with other locations from around the coast where SAM was previously carried out. The index of mean porpoise positive minute per hour (PPM/hr) were compared across eight sites, with varying durations of monitoring. By using the mean PPM/hr, we can compare across sites for different monitoring durations (Table 23). Data highlighted in green were collected using T-PODs an earlier version of the C-POD. Previous work by O'Brien *et al*. (2013) has shown that C-PODs recorded an average of seven times more data than T-PODs during simultaneous deployments in Galway Bay and thus data are biased downwards.

However, it is clear that more DPM's are recorded per deployment from sites in Dublin than anywhere else. Previous deployment off Howth Head yielded 12.2DPM/hr, in comparison to the present study of 5.8. However, the Howth deployment was over a shorter duration but data was gathered using a T-POD.

When the present CPOD data are compared with other deployments around Ireland, such as the Blasket Islands SAC, the detections from Co. Dublin were much greater. These results support visual survey results by Berrow *et al.* (2014) where abundance estimates for North County Dublin produced some of the highest density estimates to date (e.g. O'Brien and Berrow, 2015).

**Table 23. Monitoring results from SAM across Ireland (green line denotes data collection using T-PODs so some caution necessary when interpreting results.**

| County | Site | Total days | % DPD | Total PPM | %PPM | Mean DPM/day | Mean DPM/hr | Reference |
|---|---|---|---|---|---|---|---|---|
| Dublin | Loughshinny | 189 | 100 | 26281 | 9.6 | 137 | 5.8 | This study |
| Galway | Spiddal | 572 | 541 | 27902 | 3.4 | 48.8 | 2.0 | O'Brien *et al.,* 2013 |
| Kerry | Inishtooskert | 264 | 236 | 3930 | 1.04 | 14.9 | 0.6 | O'Brien *et al.,* 2013 |
| Kerry | Wild Bank | 289 | 221 | 2097 | 0.51 | 7.3 | 0.3 | O'Brien *et al.,* 2013 |
| Kerry | The Gob | 52 | 49 | 3015 | 4.1 | 58.0 | 2.4 | O'Brien *et al.,* 2013 |
| Dublin | Howth | 47 | 100 | 13718 | 10.1 | 291.9 | 12.2 | Berrow *et al.* (2008a) |
| Cork | Castlepoint | 63 | 100 | 1379 | 2.0 | 21.9 | 0.9 | Berrow *et al.* (2008a) |
| Cork | Sherkin | 23 | 44 | 707 | 1.0 | 30.7 | 1.3 | Berrow *et al.* (2008a) |
| Cork | Galley Head | 63 | 30 | 1614 | 2.4 | 25.6 | 1.1 | Berrow *et al.* (2008a) |

Although SAM does not provide information on the numbers of animals using a site, it has given an insight into the temporal patterns of habitat use of the site which could not be identified from visual monitoring alone. Loughshinny is an important feeding site for porpoises who are present on a daily basis, especially during the hours of darkness and early mornings.

As harbour porpoises (Annex II species of the Habitats Directive) are present at such significant levels, strict habitat protection should be ensured at the site, and due care must be taken to ensure any development does not degrade this habitat or cause undue disturbance. These visual SAM results will serve to inform protocols of best practice for the area if work is to go ahead and thus ensure the presence of small cetaceans in the area is not negatively impacted upon.

## 5.5 Appendix References


Akamatsu, T.; Wang, D.; Wang, K.; Li, S. and Dong, S. (2010) Scanning sonar of rolling porpoises during prey capture dives. *The Journal of Experimental Biology*, 213, 146

Berrow, S.D., Hickey, R., O'Brien, J. O'Connor, I. and McGrath, D. (2008a) *Harbour Porpoise Survey 2008. Report to the National Parks and Wildlife Service.* Irish Whale and Dolphin Group, 31pp.

Berrow, S.D. and O'Brien, J. (2013). *Harbour porpoise SAC survey 2013. Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht.* Irish Whale and Dolphin Group. pp. 37.

Berrow, S., Hickey, R., O'Connor, I. and McGrath, D. (2014) Density estimates of harbour porpoise (*Phocoena phocoena*) at eight coastal sites in Ireland. *Biology and Environment* 114B (1), 19-34.

Bolt, H.E.; Harvey, P.V.; Mandleberg, L. and Foote, A.D. (2009) Occurrence of killer whales in Scottish inshore waters: temporal and spatial patterns relative to the distribution of declining harbour seal populations. *Aquatic Conservation*, 19, 671–675.

Carlström, J (2005) Diel variation in echolocation behaviour of wild harbour porpoises. *Marine Mammal Science* 21, 1, 1-12.

Canning, S.J.; Santos, M.B.; Reid, R.J.; Evans, P.G.H.; Sabin, R.C.; Bailey, N. and Pierce, G.J. (2008): Seasonal distribution of white-beaked dolphins (*Lagenorhynchus albirostris*) in UK waters with new information on diet and habitat use. *Journal of the Marine Biological Association of the United Kingdom* 88, 6, 1159-1166.

Cox, T.M.; Read, A.J.; Solow, A. and Tregenza, N.J.C. (2001) Will harbour porpoises *(Phocoena phocoena)* habituate to pingers? *Journal of Cetacean Research and Management*, 3(1), 81-86.

Gilles, A., Adler, S., Kaschner, K., Scheidat, M. and Siebert, U. (2011) Modelling harbour porpoise seasonal density as a function of the German Bight environment: implications for management. *Endangered Species Research* 14, 157-169.

Herzing, D.L (2000) Acoustic and social behavior of wild dolphins: implications for a sound society. In: *Hearing by Whales and Dolphins.* Au WWL, Popper and Fay RR (eds). Springer-Verlag, New York, 225-272.

Koschinski, S.; Diederichs, A. and Amundin, M. (2008) Click train patterns of free ranging harbour porpoises acquired using T-PODs may be useful as indicators of their behavior. *Journal of Cetacean Research and Management*, 10, 2, 147-155.

Leeney, R.H.; Carslake, D and Elwen, S.H. (2011) Using Static Acoustic Monitoring to Describe Echolocation Behaviour of Heaviside's Dolphins (*Cephalorhynchus heavisidii*) in Namibia. *Aquatic Mammals*, 37, 2, 151-160.

Marubini, F.; Gimona, A.; Evans, P.G.H.; Wright, P.J. and Pierce, G.J. (2009) Habitat preferences and interannual variability in occurrence of the harbour porpoise (*Phocoena phocoena*) off northwest Scotland. *Marine Ecology Progress Series*, 381, 5, 297–310.

Miller, L.A.; Pristed, J.; Mohl, B. and Surlykke, A. (1995) The click-sounds of narwhals (*Monodon monoceros*) in Inglefield Bay, Northern Greenland. *Marine Mammal Science*, 11, 4, 491-502.

O'Brien, J., Beck, S., Wall, D., Pierini, A., and Hansen, S. (2013). Marine Mammals and Megafauna in Irish Waters, behaviour, distribution and habitat use. Work Package 2: Developing Acoustic Monitoring Techniques. *PReCAST Final Report – Marine Research Sub-programme 2007-2013*, pp1-205.

O'Brien, J. and Berrow, S.D. (2015). Harbour porpoise surveys in Roaringwater Bay and Islands SAC, 2015. *Report to the National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht*. Irish Whale and Dolphin Group. pp. 43.

Read A.J. and Westgate A.J. (1997) Monitoring the movements of harbour porpoises (Phocoena phocoena) with satellite telemetry. Mar Biol, 130,315–322.

Simon, M., Nuuttila, H., Reyes-Zamudio, M.M., Ugarte, F., Verfuß, U.K. and Evans, P.H. (2010) Passive acoustic monitoring of bottlenose dolphin and harbour porpoise with implications for habitat use and partitioning. *Journal of the Marine Biological Association of the United Kingdom* 90, 8, 1-7. 13

Todd, V.L.G., Pearse, W.D., Tregenza, N., Lepper, P.A. and Todd, I.B. (2009) Diel echolocation activity of harbour porpoises (*Phocoena phocoena*) around the North Sea offshore gas installations. *ICES Journal of Marine Science* 66, 4, 734-745.

Wahlberg, M. (2002) The acoustic behaviour of diving sperm whales observed with a hydrophone array. *Journal of Experimental Marine Biology and Ecology*, 281, 53– 62.

**Appendix D - Quiet Oceans - Underwater Noise Modelling Report**

# Modeling Dredging & Piling Noise Offshore Dublin

***Brief Technical Report***

| Identification | |
|---|---|
| **Document reference** | QO.20170329.01.RAP.001.04A |
| **Beneficiary** | TechWorks Marine |
| **Customer** | Laboratori d'Aplicacions Bioacústiques |
| **Contract number** | N/A |

| PROJET | DOC | CHRONO | VER | IND | CLIENT | ACRO | DATE | TYPE | CLASS |
|---|---|---|---|---|---|---|---|---|---|
| QO.20170329.01 | RAP | 001 | 04 | A | LAB | GDD | 29.03.2017 | PROD | DR |

Quiet oceans

*Ocean Noise Forecasting Monitoring & Mitigation*

| Document history | | | | | |
|---|---|---|---|---|---|
| **Version** | Ind. | Authorship | Date | Released | Description |
| **04** | **A** | T. Folegot | 20.04.2018 | 20.04.2018 | Integration of LAB comments |
| **03** | **A** | T. Folegot | 16.03.2018 | 16.03.2018 | Integration of beneficiary comments –Correction of Dedging source level correction |
| **02** | **A** | T. Folegot | 26.07.2017 | 28.07.2017 | Add piling scenario and important disclaimer |
| **01** | **A** | T. Folegot | 29.03.2017 | 30.03.2017 | Initial version |

**Citation**

T. Folegot (2017), Modeling Dredging & Piling Noise Offshore Dublin, Brief Technical Report, Quiet-Oceans, QO.20170329.01.RAP.001.04A

Ocean Noise Forecasting
Monitoring & Mitigation

65, place Nicolas Copernic – 29280 Plouzané – France
www.quiet-oceans.com
contact@quiet-oceans.com
RCS BREST RCS BREST 524 673 803

## Table of content

Chapitre I. Context and objectives ........ 6
I.1. Context ........ 6
I.2. Project information ........ 6
I.3. Objectives and Scope of Work ........ 6
Chapitre II. Introduction to Quonops© ........ 7
Chapitre III. General principles of noise mapping ........ 9
III.1. Key ocean variables affecting sound propagation ........ 10
III.2. Underwater noise modelling ........ 11
III.2.1. Modelling bellow 2kHz ........ 11
III.2.2. Modelling above 2kHz ........ 11
III.3. Calibration of the maps ........ 12
Chapitre IV. Input data and assumptions ........ 13
IV.1. Noise introduced in the marine environment from dredging ........ 16
IV.2. Noise introduced in the marine environment from piling ........ 16
Chapitre V. Noise maps produced ........ 18
V.1. Important disclaimers ........ 18
V.2. Summary of maps produced ........ 18
V.3. Delivery ........ 18
V.3.1. File name ........ 18
V.3.2. Dimensions ........ 19
V.3.3. Variables ........ 19
V.4. Selection of noise maps ........ 21
V.5. Noise maps of dredging ........ 21
V.6. Noise maps of piling a 600mm pile ........ 25

## Terms and definitions

This section defines the technical terms used in the report.

### 1/3rd-octave frequency band
A frequency band with one third of an octave bandwidth. One octave is a doubling of frequency, whereas one third of an octave is a frequency ratio of 21/3 ≈ 1.26 between the highest and the lowest. [1] [2]

### Bandwidth
The frequency range within which a recording system is sensitive. The frequency range (in Hertz) is obtained by subtracting the lower from the upper cut-off frequency.

### Broadband level
The sound pressure level obtained over a wide frequency range with defined bandwidth.

### Center frequency
The geometric mean of the lower and upper cut-off frequencies. Please note that the intensities should be averaged before converted into decibels.

### Sound
The term “sound” is used to refer to the acoustic energy radiated from a vibrating object, with no particular reference for its function or potential effect. “Sounds” include both meaningful signals and “noise” (defined below), which may have either no particular impact or may have a range of adverse effects.

### Noise
Noise is in direct contrast to signals, but always depending on the receiver and the context. What one receiver considers noise may be a signal to another receiver and even for the same receiver can the exact same sound be either signal or noise, depending on context.

“Noise” can be used in a more restrictive sense where adverse effects of sound are specifically described or when referring to specific technical distinctions such as “masking noise” or “ambient noise”.

### Ambient noise
That part of the total noise background observed with a non-directional hydrophone, which is not due to the hydrophone and its manner of mounting (self-noise), or to some identifiable localized source of noise.

Environmental background noise not of direct interest during a measurement or observation; may be from sources near and far, distributed and discrete, but excludes sounds produced by measurement equipment, such as cable flutter.

For a specified signal, all sound in the absence of that signal except that resulting from the deployment, operation or recovery of the recording equipment and its associated platform.

### Natural ambient noise
Ambient noise in the absence of any contribution from anthropogenic sources.

### Continuous sound
Imprecise term meaning a sound for which the mean square sound pressure is approximately independent of averaging time.

A sound with no clear definable beginning or end with no bandwidth restrictions and a large time bandwidth product when the frequency range is broadband. Continuous sounds have finite power, but may have infinite or at least undefined energy.

### Sound pressure

The difference between instantaneous total pressure and pressure that would exist in the absence of sound. Instantaneous pressure at time t.

p(t) in [Pa]

### Reference pressure

1 µPa in underwater acoustics. $p_0$ in [Pa]

### Sound exposure

The integral of the square of the sound pressure over a stated time interval or event.

E in [µPa²s], $E = \int_0^T p(t)^2\,dt$, with T being the time period of the event of interest.

### Sound Pressure Level

SPL in [dB re 1 µPa]

$$SPL = 10 \cdot log_{10} \frac{{}^1/_T \int_0^T p(t)^2 dt}{p_0^2} = 10 \cdot log_{10} \left(\frac{p_{rms}}{p_0}\right)^2 = 20 \cdot log_{10} \left(\frac{p_{rms}}{p_0}\right)$$

with T = integration time.

### Sound Exposure Level

SEL in [dB re 1 µPa²s]

$$SEL = 10 \cdot log_{10} \left(\frac{E}{p_0^2\, T_0}\right) = SPL + 10 log_{10}(T)$$

With reference time $T_0$ = 1 s

With T being the time period of the event of interest in seconds.

### Percentile level

A percentile corresponds to the proportion of time and space for which the noise exceeds a given level. This concept is widespread even in everyday life. For example, the average income of the top 10% of income earners or the “income threshold corresponding to the 90th or to the 95th percentile”, i.e. the income earned by the poorest individual among the top 10% or top 5% richest individuals. Meanwhile, the 50th percentile corresponds to the median salary. For underwater noise, the percentile, or exceedance level, is meant to describe the noise level occurring at least.

In the context of underwater noise, it is defined as the level $L_N$ that is exceeded for N percent of the time interval considered. For example, $L_1$ is the level that is exceeded 1% of the time. This is accomplished by (1) ordering all measured levels in the time interval numerically in descending order and (2) and picking the value 1% of the rows below the top of this ordered list. Both steps can be done together in Matlab with the quantile or prctile function (available in the Statistics Toolbox).

The $L_1$ is a measure for the maximum level. It is a more robust estimate than taking just the maximum observed level, since the latter may be an outlier caused by a single event, such as rattling of the anchoring system or other types of self-noise. Accordingly, L99 and L95 are used to describe the minimum level. $L_{50}$ is the median level.

# Chapitre I. Context and objectives

## I.1. Context

As part of a data processing contract Techworks Marine has asked the Laboratori d'Aplicacions Bioacústiques to include noise level maps for pile driving and dredging operations. Quiet-Oceans has been asked to provide the propagation modelling for a few selected frequencies of interest.

## I.2. Project information

The outfall pipeline consists of two elements, a tunnel section running from the Coast Road to approx. 500m off the beach, and a dredged section from this interface point to the final outfall point. The tunnel section will be constructed using a micro-tunnelling machine.

The dredged section will be constructed using Back Hoe Dredgers (BHD) and Trailer Suction Hopper Dredgers (TSHD) with the BHD working from the inshore outwards and the TSHD working from the Outfall point towards the inshore.

The dredging operation includes an excavation phase with material either side cast or placed in barrages for deposition a short distance away from the trench, and a backfilling phase where the excavated material will be replaced over the installed pipe.

## I.3. Objectives and Scope of Work

Quiet-Oceans expert team was not involved in the definition of the Scope Of Work (SOW).

This work is solely meant to provide an indication of the noise propagation properties in the underwater environment where the construction will take place, taking into account the sources of interest, and does not constitute a noise impact assessment. No calibrated source recordings were available to evaluate the modelling results.

When there is interest in a noise impact study the internationally agreed methodology to assess the noise risks towards the marine species consist in the following steps [3] [9] :

- Baseline broadband mapping of the existing noise;
- Broadband calculation of the exceedance level of each individual project activities above the baseline (noise footprint calculation [10] );
- Perceived levels in the bandwidth of sensitivity for the species potentially exposed to the noise of the project (high frequency cetaceans, mid frequency cetaceans, high frequency cetaceans, pinnipeds, 3 categories of fish (with/without swim bladders, with/without sensitive cells), sea turtles and larvae;
- PTS, TTS, behavioural and masking risk areas mapping based on the perceived levels for each class of species.

Since noise impact study **was not the interest mentioned in the Scope Of Work provided to Quiet-Oceans**, a few specific frequencies for propagation modelling have been requested by the Laboratori d'Aplicacions Bioacústiques:

- to map the noise propagation of the dredging activity at one specific position for three frequencies: 125Hz, 1kHz and 8kHz third-octaves for a single environmental condition corresponding to a March situation;
- to map the noise from one piling activity at one specific position for two frequencies: : 125Hz and 1kHz third-octaves for a single environmental condition corresponding to a March situation.

Therefore, this report is limited a brief technical description, briefly explaining the modelling assumptions and giving a limited number if illustrations of the noise maps produced. Raw data of the modelled maps have been delivered jointly to the report for further exploitation.

## Chapitre II. Introduction to Quonops©

Quiet-Oceans operates since 2010 the proprietary Quonops© ocean noise-monitoring and prediction system developed and owned by the company and protected by an international patent [3] . In a similar manner to weather forecasting systems, Quonops© produces an estimate of the spatio-temporal distribution of noise levels generated by human activities at sea, aggregating multiple sources, and assessing short-, mid- and long term source contributions to the global noise field (Figure 1). As demonstrated in a number of international projects, Quonops© caters for a broad range of maritime activities, including:

- maritime traffic [3] [6] ;
- oil exploration [7] ;
- underwater warfare exercises;
- offshore construction [8] ;
- fossil-fuel extraction;
- offshore wind-power construction and operations [9] ;
- underwater drilling and blasting operations.

Based on physical acoustic propagation models, Quonops© considers the reality of the area through input data and has been largely validated through in-situ measurements over the last 6 years.

The outputs from Quonops© are tailored to the requirements of existing and emerging national and international regulations regarding underwater noise, the conservation of habitats and marine ecosystems, and the protection of marine species [10] .

The production of statistical soundscapes effectively characterizes the spatio-temporal emergence of anthropogenic noise from the real environmental conditions of the area. The system also supports underwater noise impact assessments and assists in the formulation of optimized planning and focused mitigation of maritime industrial activities in terms of environmental compliance. Quonops© brings together relevant information and data into a noise prediction platform to deliver a series of services, such as:

- the geo-referenced mapping of statistical, historical or real-time human and environmental situation of the areas of interest,
- the geo-referenced mapping of noise pollution according to given ocean-meteorological and human scenarios.

Such a tool aims to support management decisions by assessing, quantifying and prioritizing direct and indirect anthropogenic pressures on marine life, according to the emerging national and international regulations on underwater noise, especially the descriptor 11 of the European Marine Strategy Framework Directive [11] .

Quonops© is able to provide:

- real-time regional survey of shipping noise and natural noise from waves;
- historical statistical regional noise maps at a daily, weekly, quarterly and/or annual resolution;
- noise maps of single or multiple customized noise sources through a large selection of maritime activities.


**Figure 1 : Principle of Quonos©, Quiet-Oceans' underwater noise prediction and monitoring system.**

## Chapitre III. General principles of noise mapping

The noise received at a particular position in the marine environment depends on the characteristics of the sound source(s) and the propagation through the marine environment (Figure 2). Noise propagation and therefore noise levels are mainly determined by the following (Table 2):

- ✓ Bathymetry (underwater terrain);
- ✓ The nature of the seabed (sediment type);
- ✓ Oceanographic conditions such as temperature and salinity, currents, sea level;
- ✓ Weather conditions such as the wind (and consequently waves) and rainfall intensity.

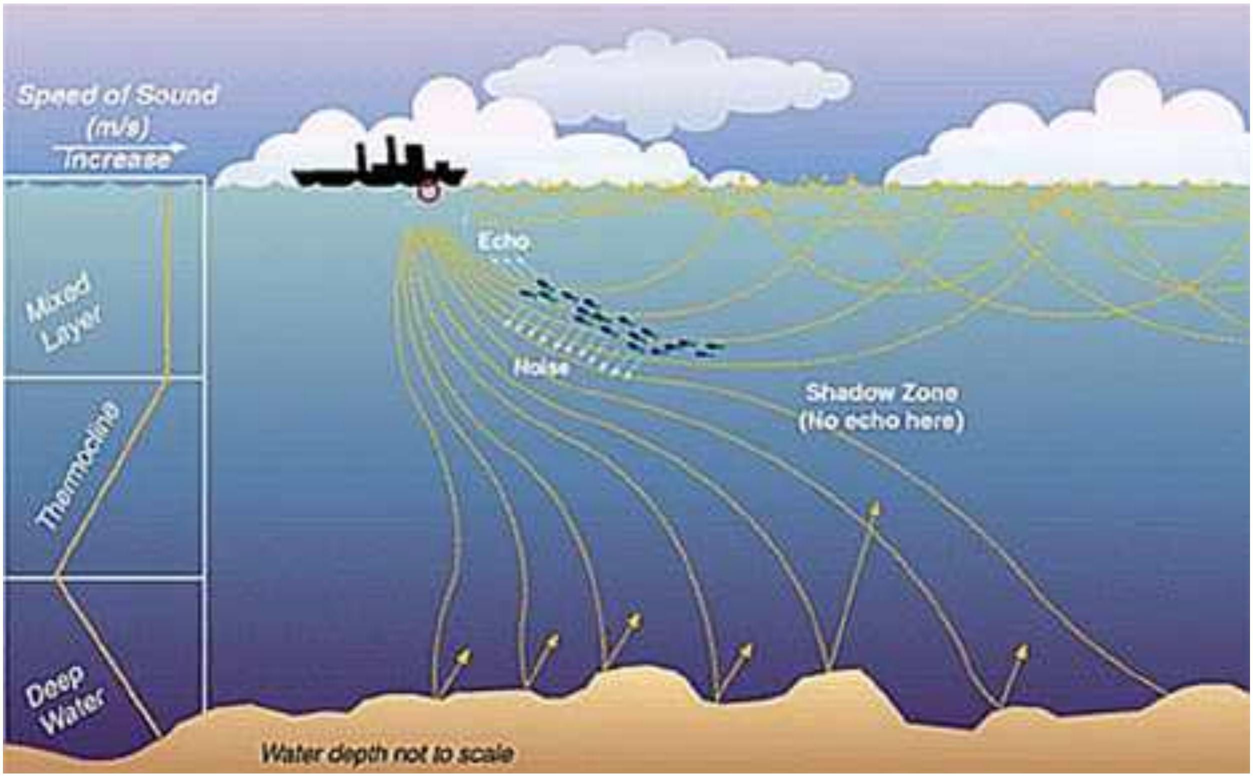



**Figure 2: In the warm upper layer of the ocean, sound is refracted toward the surface. As sound waves travel deeper into colder water, they slow down and are refracted towards the seafloor, creating a shadow zone. Image courtesy of the National Academy of Sciences. Source: www.dosits.org.**

### III.1. Key ocean variables affecting sound propagation

Sound propagation losses increase as water depth lessens, and this is a cumulative loss effect which applies to shoaling caused by bathymetry and tidal fluctuations together. The effect is linked to the interaction of sound waves with the interfaces of the oceanic waveguide (surface and seabed). Furthermore, it should be noted that ocean waves (waves at the sea surface) tend to surge as they encounter shallower water, which increases their contribution to the ambient noise.

Propagation losses are more significant when the seabed is loose and fine-grained (i.e. silt absorbs sound waves better than gravel). However, the denser the sediment, the more reverberant it is; sound waves with significant angles of incidence on sediment are better reflected when the sediment is dense.

Wind generated ocean-surface waves propagate and absorb sound waves, an effect that increases with increasing sea-state. However, the noise generated by surging waves also increases the level of ambient noise. In other words, rough seas increase natural noise levels, but other noise sources do not carry as far as they would in calm conditions.

In shallow water, sedimentary particles are mobilized by currents and/or waves, and noise is generated when sedimentary particles collide with each other. The coarser the sediment and faster the speed of sound in the sediment, the higher the noise level.

Rainfall exerts a negligible effect on underwater sound propagation; however the sound generated by droplets falling on the sea surface does contribute to an increase in natural noise levels.

**Table 1: Effect of physical properties of the ocean environment on acoustic propagation and noise generation.**

| | Influence noise propagation | Generate noise and contribute to ambient noise |
|---|---|---|
| Bathymetry | ✔ | ✖ |
| Bottom parameters | ✔ | ✔ |
| Temperature/salinity | ✔ | ✖ |
| Sea level | ✔ | ✖ |
| Currents | ✖ | ✔ |
| Wind/waves | ✔ | ✔ |
| Rain | ✖ | ✔ |

✔ *indicates that the effect exists* ✖ *indicates that the effect does not exist or is marginal.*

## III.2. Underwater noise modelling

Underwater modelling benefits from more than 50 years of scientific and operational development for military purposes, ranging from basic propagation modelling to more sophisticated sonar performance modelling. The military research in the field of experimental ocean acoustics has involved extensive equipment, with typically at least one ship and often an assortment of at-sea platforms equipped with sound projectors and receiving arrays. The objective of this research was to incorporate the acoustic propagation phenomena into a theoretical and numerical formalism, which gives a quantitative prediction of the sound field for arbitrary ocean environments. The progress in the field of numerical computing has largely contributed to the development of the modelling capability.

There are essentially five types of models (computer solutions to the wave equation) to describe sound propagation in the sea: spectral, normal mode, ray, and parabolic equation models, and direct finite-difference, or finite-element solutions of the full wave equation. All these models permit the ocean environment to vary with depth. Models also permit horizontal variations in the environment, i.e., slopping bottom or spatially variable oceanography [13] .

The acoustic models accurately reflect the propagation of noise in the water column in realistic oceanographic conditions by resolving the Helmholtz Equation, the State Equation:

$$\Delta p - \frac{1}{c^2}\frac{\partial^2 p}{\partial t^2} = \delta(t - t_0, r - r_0)$$

$$\rho c^2 = p \quad \rho_0 \frac{\partial \vec{v}}{\partial t} + \vec{\nabla} p = 0$$

$$j 2\pi f \rho_0 \vec{v} + \vec{\nabla} p = 0$$

where $p$ is the acoustic pressure, $c$ is the sound speed in the medium (water or sediment), $t$ is time, $t_0$ the instant of emission of the signal, and $r$ the three-dimensional position of observation and $r_0$ the three-dimensional position of the source, assumed to be punctual.

### *III.2.1. Modelling bellow 2kHz*

For frequencies bellow 2kHz, we have used state-of-the-art parabolic equation [14] [15] [16] [17] . Developed before World War II, and widely used in many areas of physics, parabolic equation methods are based on fast Fourier transforms. It has become the most popular wave-theory technique for solving range dependent problems in ocean acoustics. It consists in a parabolic approximation of the Helmholtz equation into an elliptic wave equation. We have used the model developed by Collins et al. which is among the state-of-the-art parabolic equation implementation which especially solves the equation for elastic media, such as the marine environment.

### *III.2.2. Modelling above 2kHz*

For frequencies above 2 kHz, we have used an energy distribution to Gaussian beams approach to limit calculation times. Used since the early 1960’s, the ray modelling is based on a high frequency approximation. Ray methods are still used extensively in operational environment where speed is critical and where the environmental uncertainties pose more constraints on the accuracy. Quonops© use Bellhop [18] which is among the state-of-the-art ray tracing codes which handles Gaussian ray bundles to somewhat overcome the high frequency approximation.

**Table 2: Validation of Quonops through in-situ acoustic measurements in a very large number of different marine environments and projects.**

| Project Name | Year | Area | Type of noise | Effort | Partners |
|---|---|---|---|---|---|
| **ERATO** | 2011 | Atlantic Ocean | Shipping and natural | 6 hydrophones, 24 hours | French Hydrographic Office (France) |
| **STRIVE** | 2011 | Irish seas | Shipping and natural | 1 hydrophone, 21 days | Environmental Protection Agency, Cork University (Ireland) |
| **AQUO** | 2013-2015 | Mediterranean Sea | Shipping and natural | 1 hydrophone, 9 months | Laboratory of Bioacoustics Applications, Barcelona (Spain) |
| **AQUO** | 2013-2015 | North-sea | Shipping | Cross-models validation | TNO (Netherland), FOI (Sweden), Leiden university (Netherland) |
| **MaRVEN** | 2013 - 2015 | North-sea | Piling noise & Windfarm operation | 2 hydrophones | DHI (Denmark), Royal Belgian Institute of Natural Sciences (Belgium), European Commission |
| **NRL** | 2013-2014 | Indian Ocean | Shipping and natural | 2 hydrophones, 7 months | Biotope (La Réunion) |
| **FEC-COU** | 2013 | English Channel | Shipping and natural | 4 hydrophones, 20 days | EMF, EDF, WPD (France) |
| **SNA** | 2013 | Atlantic Ocean | Shipping and natural | 3 hydrophones, 20 days | EMF, EDF, WPD (France) |
| **BENTHOSCOPE** | 2015 | English Channel | Tidal device in operation | 1 hydrophone, 1 day | Marine Energy France (France) |
| **POSTE H** | 2013 | Indian Ocean | Vibrodriving Shipping and natural | 2 hydrophones | Biotope (La Réunion) |
| **ETM** | 2014 | Caribbean | Shipping and natural | 1 hydrophone, 30 days | AKUO (France) |
| **JETSKI** | 2014 | Atlantic Ocean | Watercraft | 1 hydrophone | Marine Protected Area (France) |
| **PORTIER** | 2014 2016 | Mediterranean Sea | Shipping and natural | 2 hydrophones, 5 months | BYTP (France) |
| **EMDT** | 2015-2016 | English Channel | Shipping and natural | 4 hydrophones, 12 months | ENGIE (France) |
| **EMYN** | 2015-2016 | Atlantic Ocean | Shipping and natural | 4 hydrophones, 12 months | ENGIE (France) |
| **GOEMONIER** | 2016 | Atlantic Ocean | Fishing device | 1 hydrophone | Marine Protected Area (France) |

## III.3. Calibration of the maps

It is essential to bear in mind that no underwater noise measurements made with hydrophones have been used to calibrate the noise maps. An active acoustic calibration measurement is strongly recommended.

## Chapitre IV. Input data and assumptions

The data used to perform the modelling describes:

- the bathymetry of the area provided by EMODNet [20] and illustrated in Figure 3;
- the coast line of the area provided by [21] ;
- the sediment provided by EMODNet [20] ; The original sediment data has a spatial resolution of 1/40°. The EMODnet database classifies the sediments into 6 categories:
    - ✓ Boulders & bedrock;
    - ✓ Till/diamincton;
    - ✓ Coarse-grained sediment;
    - ✓ Mixed sediment;
    - ✓ Muddy sand and sand;
    - ✓ Mud and sandy mud.

  The geo-acoustic parameters used in the acoustic model as boundary conditions are reported in Table 4. Since the sediments being assumed to be fluid-elastic, the geo-acoustic parameters are limited to density (in ton per m3), compressional speed (m/s) and compressional attenuation (in dB/$\lambda$, $\lambda$ being the acoustic wavelength) as illustrated in Figure 4. Shear waves propagating in solid materials are neglected.
- the sound speed derived from temperature and salinity of the sea water provided by the Copernicus Marine Environment Monitoring Service (CMEMS) which provides regular and systematic reference information on the physical state, variability and dynamics of the ocean and marine ecosystems for the global ocean and the European regional seas. The Mackenzie equation (1981) has been used to derive temperature and salinity into sound speed (Figure 5):

$$c(D,S,T) = 1448.96 + 4.591T - 5.304 \times 10^{-2}T^2 + 2.374 \times 10^{-4}T^3 + 1.340\,(S-35) + 1.630 \times 10^{-2}D + 1.675 \times 10^{-7}D^2 - 1.025 \times 10^{-2}T(S-35) - 7.139 \times 10^{-13}TD^3$$

  In which T is the temperature in degrees Celsius, S is the salinity in parts per thousand, and D is the depth in meters. The range of validity: temperature 2 to 30 °C, salinity 25 to 40 parts per thousand, depth 0 to 8000 m.
- the sea-state or sea surface roughness provided by the Wave Watch 3 model.

The type and source of data used is summarized in Table 3. The background noise is set using the Wenz model [22] for natural noise derived from the surface roughness of the sea in the area.

**Table 3 : Summary of the input data used for the modelling**

| Data Type | Provider | Coverage | Spatial resolution |
|---|---|---|---|
| **Bathymetry** | EMODNet | European seas | 7.5" |
| **Coast line** | Open Street Map | World | - |
| **Sediment** | EMODNET | European seas | 7.5" |
| **Temperature** | Copernicus Ocean | World | 5' |
| **Salinity** | Copernicus Ocean | World | 5' |
| **Surface roughness** | Wave Watch 3 | World | 30' |

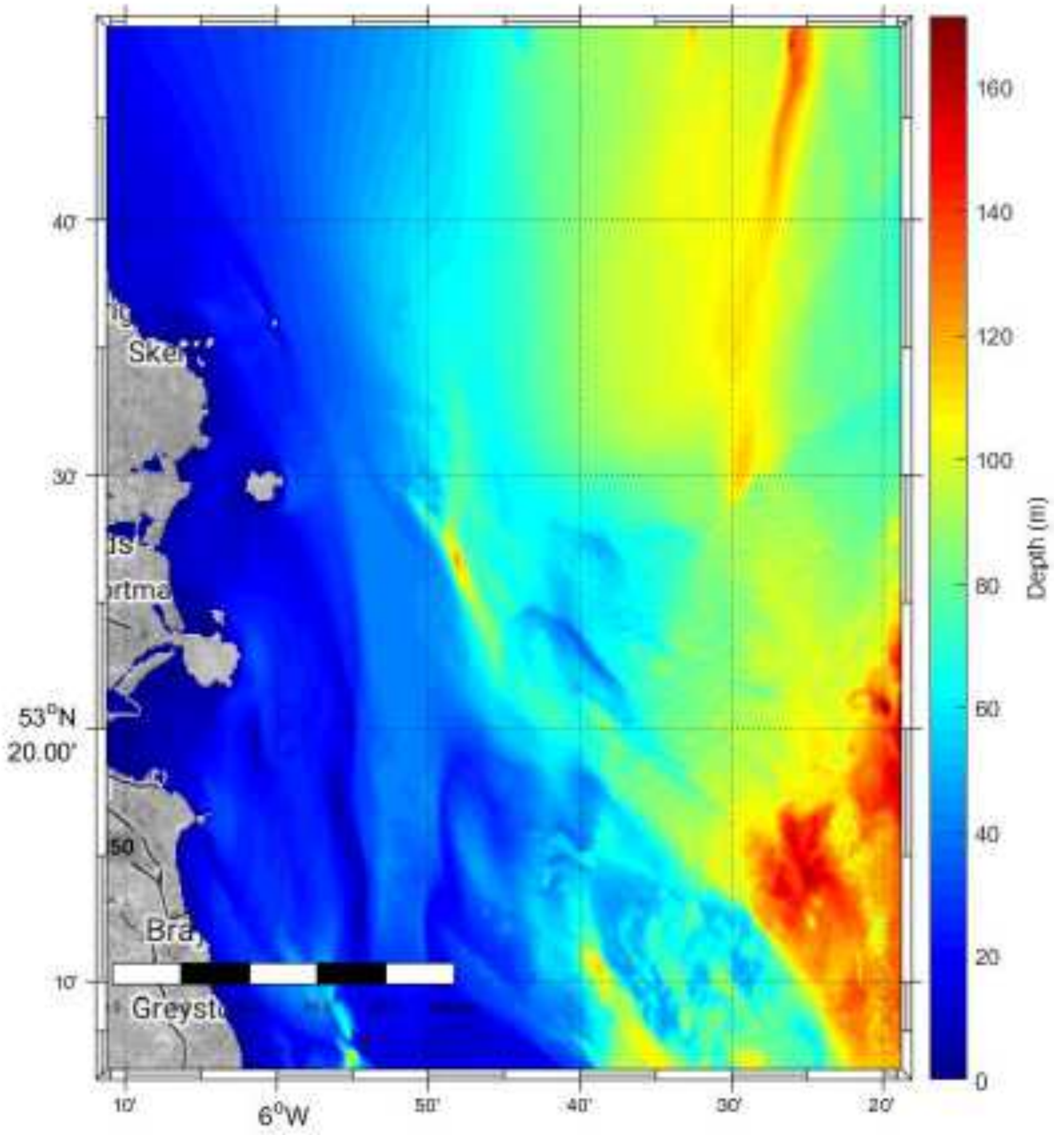



**Figure 3: Bathymetric map used for modelling offshore Dublin extracted from [20]**

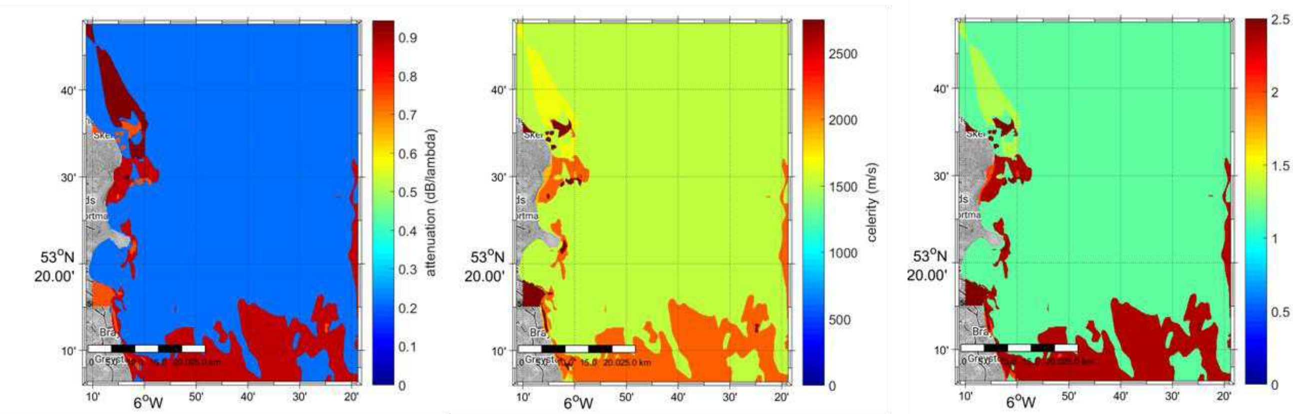



**Figure 4: Distribution of values of compressional attenuation of sound (left), compressional sound speed (middle), and density (right) of the sediment provided by [20] .**

**Table 4: Bottom characteristics used for modelling.**

| Sediment Name | Density | | Compressional Speed | | Compressional Attenuation | |
|---|---|---|---|---|---|---|
| | Ton/m3 | | m/s | | dB/lambda | |
| | Mean | Uncertainty | Mean | Uncertainty | Mean | Uncertainty |
| **Boulders & bedrock** | 2,50 | 0,08 | 3 820 | 23 | 0,75 | 0,04 |
| **Till/diamincton** | 2,50 | 0,08 | 2 750 | 23 | 0,75 | 0,04 |
| **Coarse-grained sediment** | 2,37 | 0,10 | 2 122 | 315 | 0,88 | 0,07 |
| **Mixed sediment** | 2,03 | 0,26 | 1 855 | 79 | 0,89 | 0,01 |
| **Muddy sand and sand** | 1,53 | 0,22 | 1708 | 70 | 0,91 | 0,06 |
| **Mud and sandy mud** | 1,16 | 0,03 | 1517 | 32 | 0,37 | 0,41 |

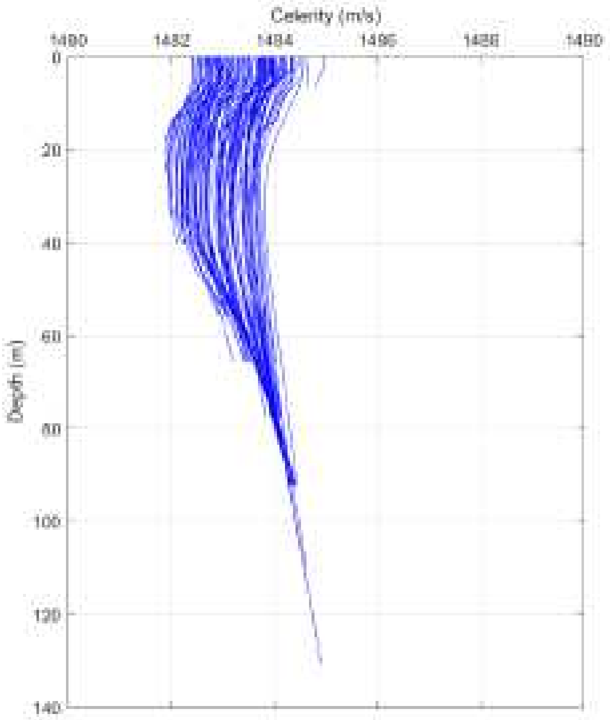



**Figure 5: Sound speed profiles in the area the 17th of March 2017 provided by CMEMS.**

### IV.1. Noise introduced in the marine environment from dredging

The Scope of Work describe a dredged section using Back Hoe Dredgers (BHD) and Trailer Suction Hopper Dredgers (TSHD) with the BHD working from the inshore outwards and the TSHD working from the Outfall point towards the inshore. For modelling, the Scope of Work has requested to consider as sources a Trailing Suction Hopper Dredger (TSHD) (see illustration Figure 6).

The location for modelling is at 53.4169° latitude and -6.075° longitude, offshore Dublin, which correspond to the far end of the dredging track length (about 4 km offshore). The physical geometry of the sound source is modelled as two points of generation: 50% of the generated energy is at 6m depth to describe the noise from the vessel, and 50% of the energy is located close to the bottom to describe the noise generated by the suction pipe.

The activity selected for the modelling is the flattening and removal of rocks. The wideband source level is derived from [24] and [25] and estimated at 188 dB ref 1µPa in the 50Hz to 89 kHz. Detailed source levels for the frequencies modelled are reported in Table 5.

**Table 5 : Source levels used for modelling the dredging activities**

| Source level dB ref1µPa²@1m | Sound Pressure Level in the 125Hz 1/3 octave | Sound Pressure Level in the 1kHz 1/3 octave | Sound Pressure Level in the 8kHz 1/3 octave |
|---|---|---|---|
| **TSHD** | 175.5 | 173.4 | 172.2 |

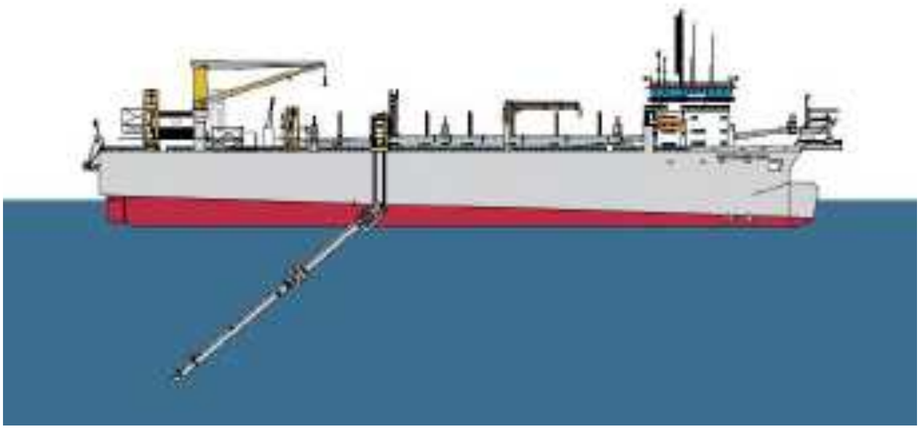


**Figure 6 : Illustratio of a Trailing Suction Hopper Dredger (TSHD)) (vessel name: Bartolomeu Dias)**

**Source : Jan De Nul**

### IV.2. Noise introduced in the marine environment from piling

We will consider as sources the piling of 600mm piles using an impact hammer (see illustration).

The location for modelling the piling is at 53.42466° latitude and -6.098955° longitude, offshore Dublin. During a piing phase, the sounds generated are impulsive. In order to translate the potential impacts more accurately, the scientific community (NOAA, 2016) now agrees to quantify the level as Sound Exposure Level (SEL), expressed in dB 1µPa².s). The sound exposure energy corresponds to the acoustic energy received at a point, integrated over a given frequency band and over the significant duration of the sound pulse (Ti). In this study, Ti is chosen to be 100ms, according to the literature (De Jong, et al., 2008), for example.

Earlier modeling and measurement research programs have shown that the level of sound exposure in water increases logarithmically as a function of the diameter of the pile, which makes it possible to extrapolate with confidence measurements reported in the literature. The source levels used in the modeling study are derived from measurement taken at the Q7 and OWEZ construction projects (De Jong et al., 2008), Beatrice (Talisman Energy et al., 2004) and Horns Rev II (ITAP, 2008).

The piling source is modelled using an ensemble of four punctual sources. 40% f the total energy is at the bottom end of the pile, while 60% of the energy is equally distributed along the pile. Detailed source levels for the frequencies modelled are reported in Table 6.

**Table 6 : Source levels used for modelling the piling activities**

| Source level<br>dB ref1µPa²@1m | Sound Pressure Level in the 125Hz 1/3 octave | Sound Pressure Level in the 1kHz 1/3 octave | Sound Pressure Level in the 8kHz 1/3 octave |
|---|---|---|---|
| **600mm diameter pile driving**<br>**Per stroke** | 186 dB ref1µPa²@1m | 172 dB ref1µPa²@1m | Not modelled as requested in the Scope of Work |

# Chapitre V. Noise maps produced

## V.1. Important disclaimers

Maps have been produced at 125Hz, 1kHz and 8kHz third-octaves (for dredging). Therefore, the levels obtained **cannot** be directly compared to cetaceans' nor seals' PTS or TTS thresholds, since the thresholds are valid for the total energy contained in the audibility band of the species (NOAA, 2016), which is much larger than a third-octave band. To be able to compare and estimate a risk area, modelling should be performed for the full audibility band of each species, which has not been required by the costumer. For example, the source level in the auditory band of seals for a single-stroke piling of a 600mm diameter pile is 178 dB ref1µPa²@1m, while the source level in the 1kHz third-octave band is only 172 dB ref1µPa²@1m, which makes a significant difference.

The maps are purely modelling maps using the best known description of the environment. Usually, an acoustic calibration measurement is needed to ground truth the maps and reduce uncertainties.

## V.2. Summary of maps produced

For each scenario (dredging and piling), a total of 21 maps have been produced and delivered in a NetCdf Format. The noise maps correspond to:

- March 2017 environmental context;
- The full water column;
- Three third-octave bands, centred at 125 Hz, 1kHz and 8 kHz (only for dredging) as required by the costumer ;
- Seven percentiles, $0^{th}$ (maximum), $10^{th}$, $25^{th}$, $50^{th}$, $75^{th}$, $90^{th}$ and $100^{th}$ (minimum) percentiles to characterise the variability of the sound field with depth;
- Three depth ranges (Surface to -15m, 30m to the bottom, and the full water column).

## V.3. Delivery

Quiet-Oceans has delivered noise ambient maps in NetCDF format version 4. Files format respect principals rules of NetCdf Climate and Forecast (CF) Metadata Conventions release 1 [23] .The NetCdf provided is described by :

- global attributes : attributes used for context, history or versioning file ;
- dimensions : scalar data that describes dimensions for the variables contained in file ;
- variables : vectors or matrix that describes the data.

The following sections detail the content of the delivered data.

### *V.3.1. File name*

Files are named as follow: Dredging_DublinNorth_20170330.nc for the dredging scenario and Piling_600mm_DublinNorth_20170728.nc for the piling scenario.

### V.3.2. Dimensions

The dimensions of the variables contained in the delivered Netcdf are detailed in Table 7.

**Table 7: Summary of the dimensions of the variables contained in the delivered Netcdf files.**

| Group | Name | Value | Statut (Mandatory, Optionnal) |
|---|---|---|---|
| AcousticData | Lat | number of latitudes, configuration dependent | M |
| | Lon | number of longitudes, configuration dependent | M |
| | frequency | number of frequency | O |
| | percentile | number of percentiles, configuration dependent | M |
| | Layer | Number of immersion layers | M |
| | maxLayerNameLen | Max length of layer names | M |

### V.3.3. Variables

A variable can be associated with attributes. When CF conventions describes it, standard attributes are mentioned:

- ✓ standard_name : name for variable according to CF conventions
- ✓ long_name : description for variable according to CF conventions
- ✓ units : : units according to UD Units Unidata dictionnary
- ✓ valid_min : minimal value for data validation
- ✓ valid_max : maximal value for data validation

For geographic reference, SPL is linked to a coordinate reference system (CRS) which defines all the parameters attached to a mapping projection :

- ✓ grid_mapping_name : naming of projection as defined in conventions (Appendix F. Grid Mappings). In our case, latitute_longitude is equivalent to geodesic projection in which coordinates positions are latitude and longitude,
- ✓ epsg_code : EPSG code (4326) for correspondant geodesic projection with WGS84 ellipsoid
- ✓ longitude_of_prime_meridian : longitude of prime meridian in geodesic projection
- ✓ semi_major_axis : half the major axis of the ellipsoid linked to the projection
- ✓ inverse_flattening : 1/flattening of the ellipsoid linked to the projection

**Table 8: Description of the variables of the Netcdf delivered.**

| Name | Dimensions | Datatype | Statut (Mandatory/ Optionnal) | Attributes | | Description |
|---|---|---|---|---|---|---|
| layer | Layer | int8 | M | Standard_name<br>Long_name<br>bounds<br>layer_names | Layer<br>Layer<br>layer_bnds<br>layer_names | Immersion field. |

| Name | Dimensions | Datatype | Statut (Mandatory/ Optionnal) | Attributes | Description |
|---|---|---|---|---|---|
| layer_names | Layer, maxLayerName Len | char | M | | Immersion identification (Ex : High, Low, Full). |
| layer_bnds | layer, nv | int | M | unit m<br>positive down | Immersion bounds |
| frequency | frequency | int | O | Standard_name frequency<br>long_name Central band frequency<br>units Hz<br>order_convention IEC 61260 : 1995";<br>order_octave 3.0 | |
| percentile | percentile | int8 | M | Standard_name percentile<br>Long_name percentile<br>comment QO definition : The value above which a given percentage of observations in a group of observations fall<br>unit Percent | |
| Lon | Lon | double | M | Standard_name longitude<br>Long_name longitude<br>comment None<br>unit degrees_east | |
| lat | Lat | double | M | Standard_name latitude<br>Long_name latitude<br>comment None<br>unit degrees_north | |
| energy | layer, frequency percentile, lon, lat | single | O | | |
| crs | | Single | M | grid_mapping_name latitude_longitude<br>epsg_code EPSG:4326<br>longitude_of_prime_meridian 0.0; // double<br>semi_major_axis 6378137.0; // double<br>inverse_flattening 298.257223563; // double | |

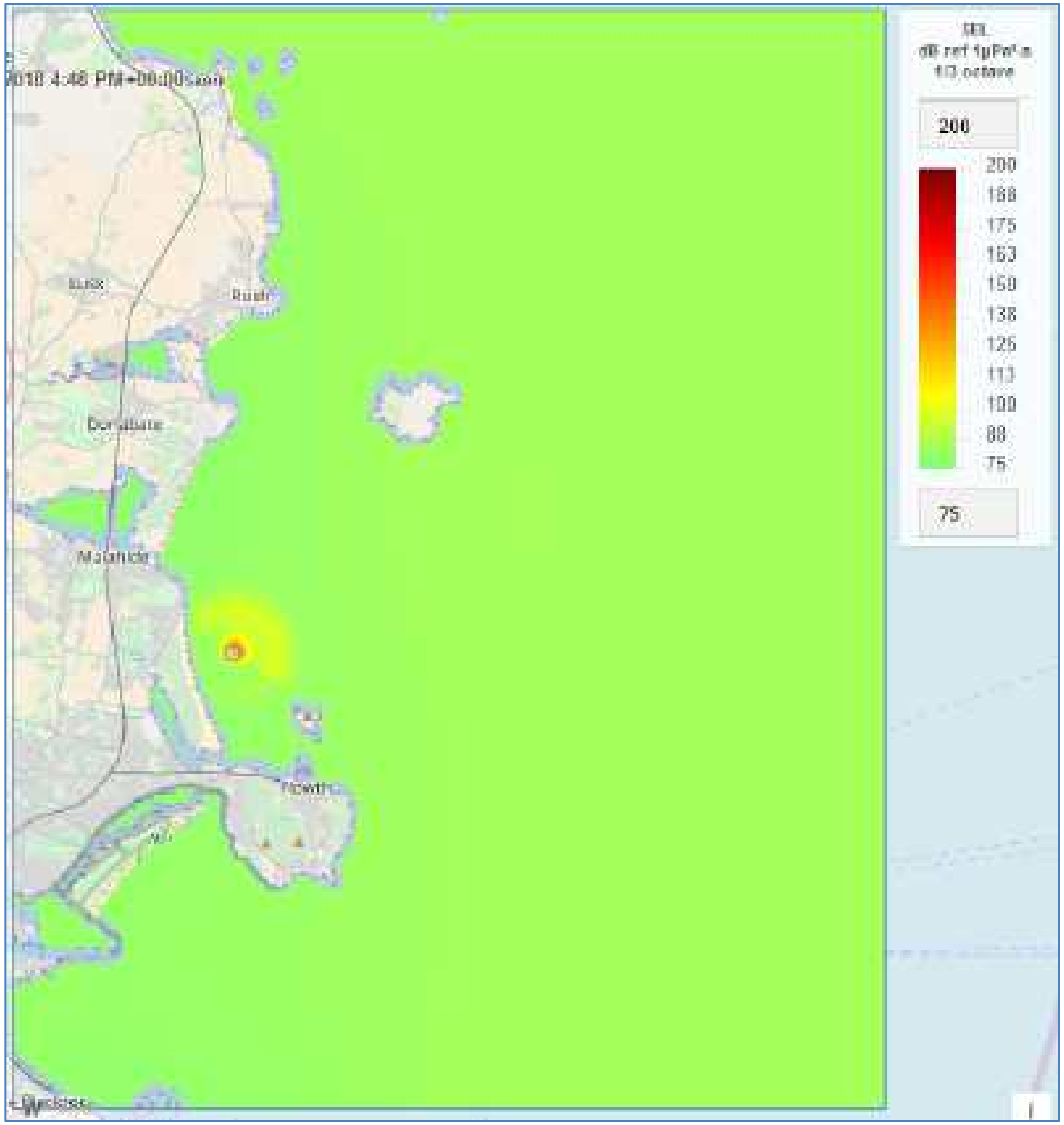
### V.4. Selection of noise maps

This section gives **a non-exhaustive overview** of the noise maps for dredging. The maps reported hereafter are only for illustration purposes, and shows either the maximum levels or the 5th percentile (or exceedance level) for the full water column for the 125 Hz, 1kHz and 8 kHz third-octave bands.

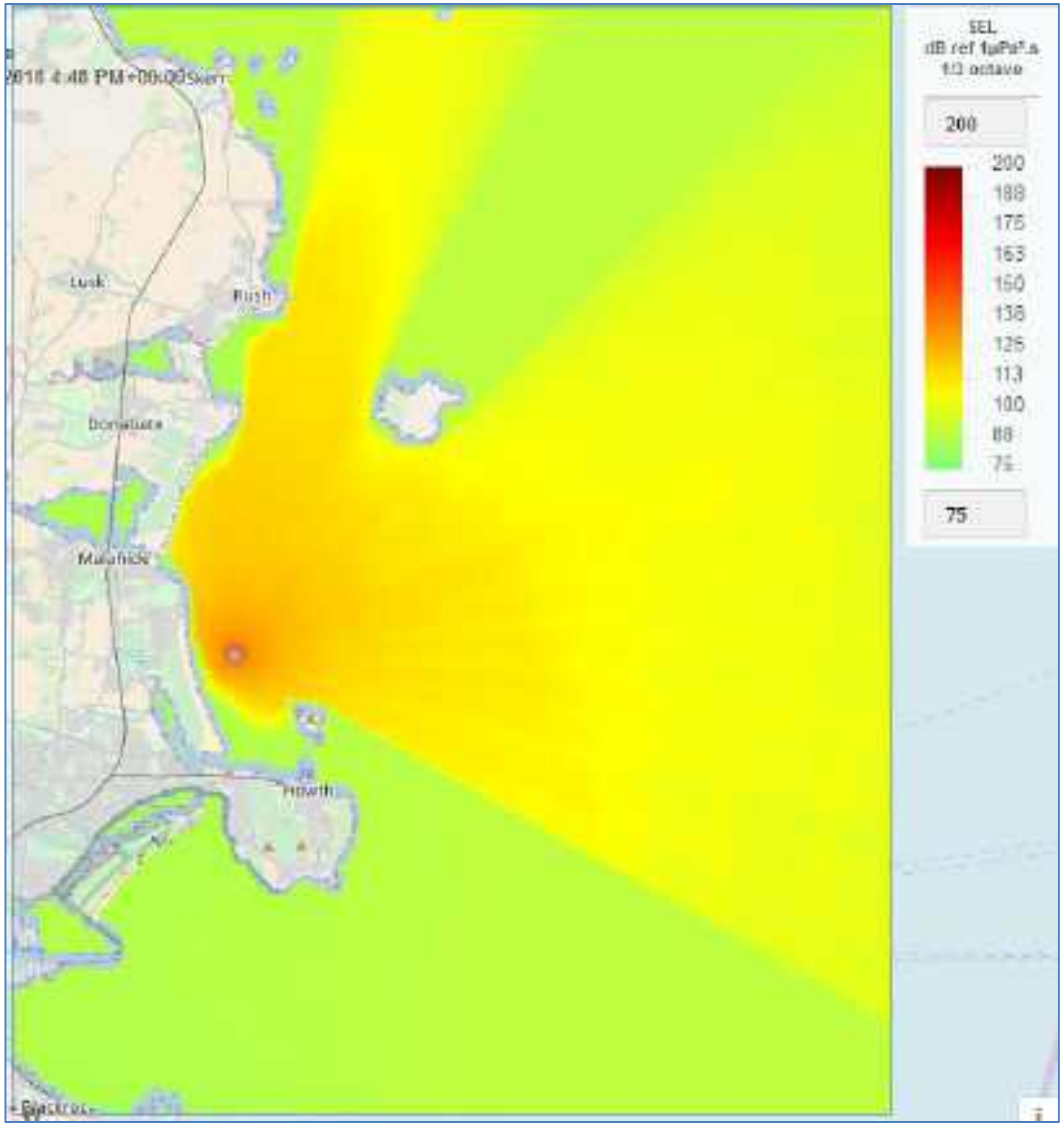
All raw data of modelled maps have been delivered in a Netcdf format for further exploitation by the customer.

### V.5. Noise maps of dredging

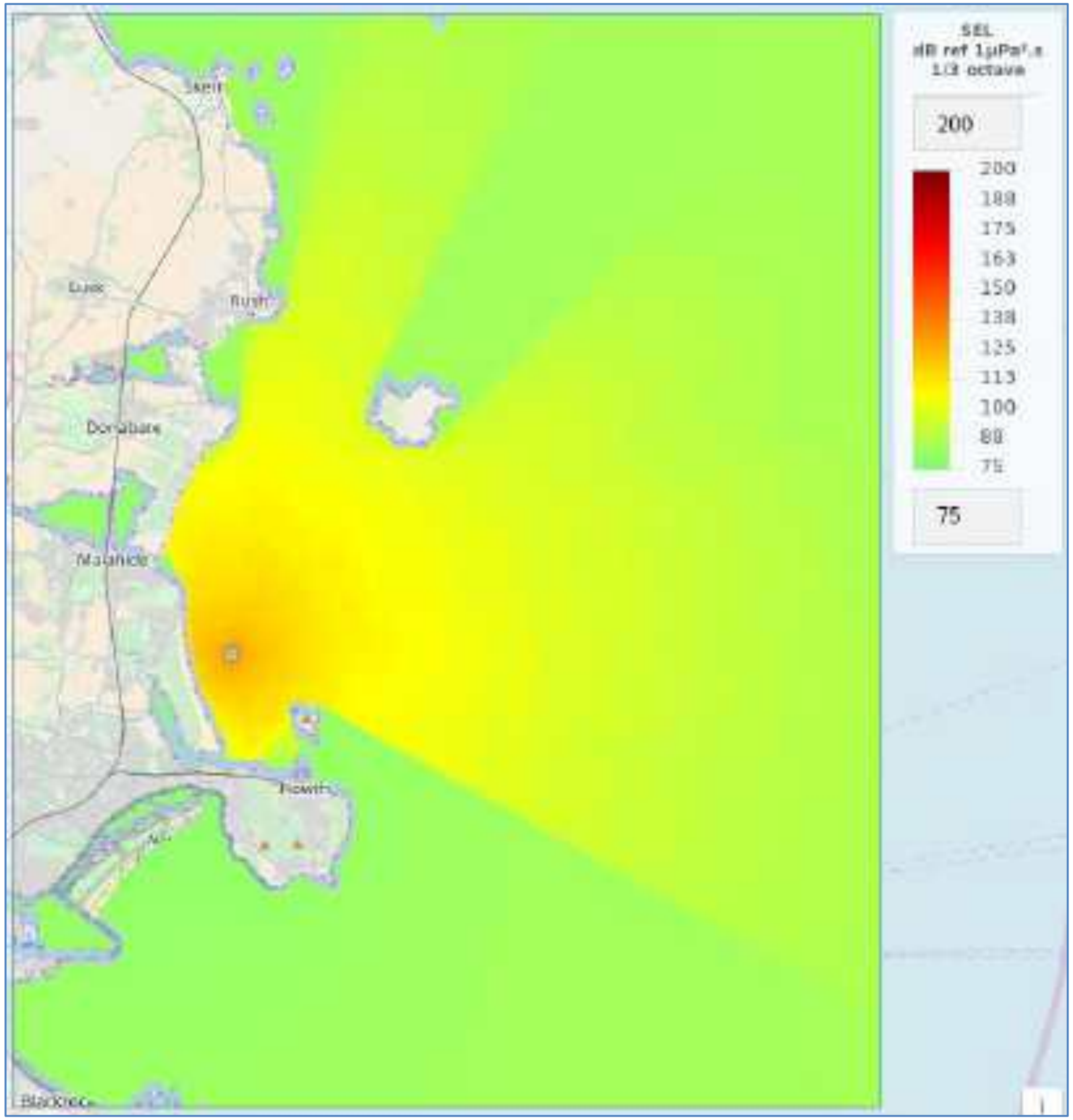
5th percentile levels at 125 Hz 1/3 octave band



5th percentile levels at 1kHz 1/3 octave band

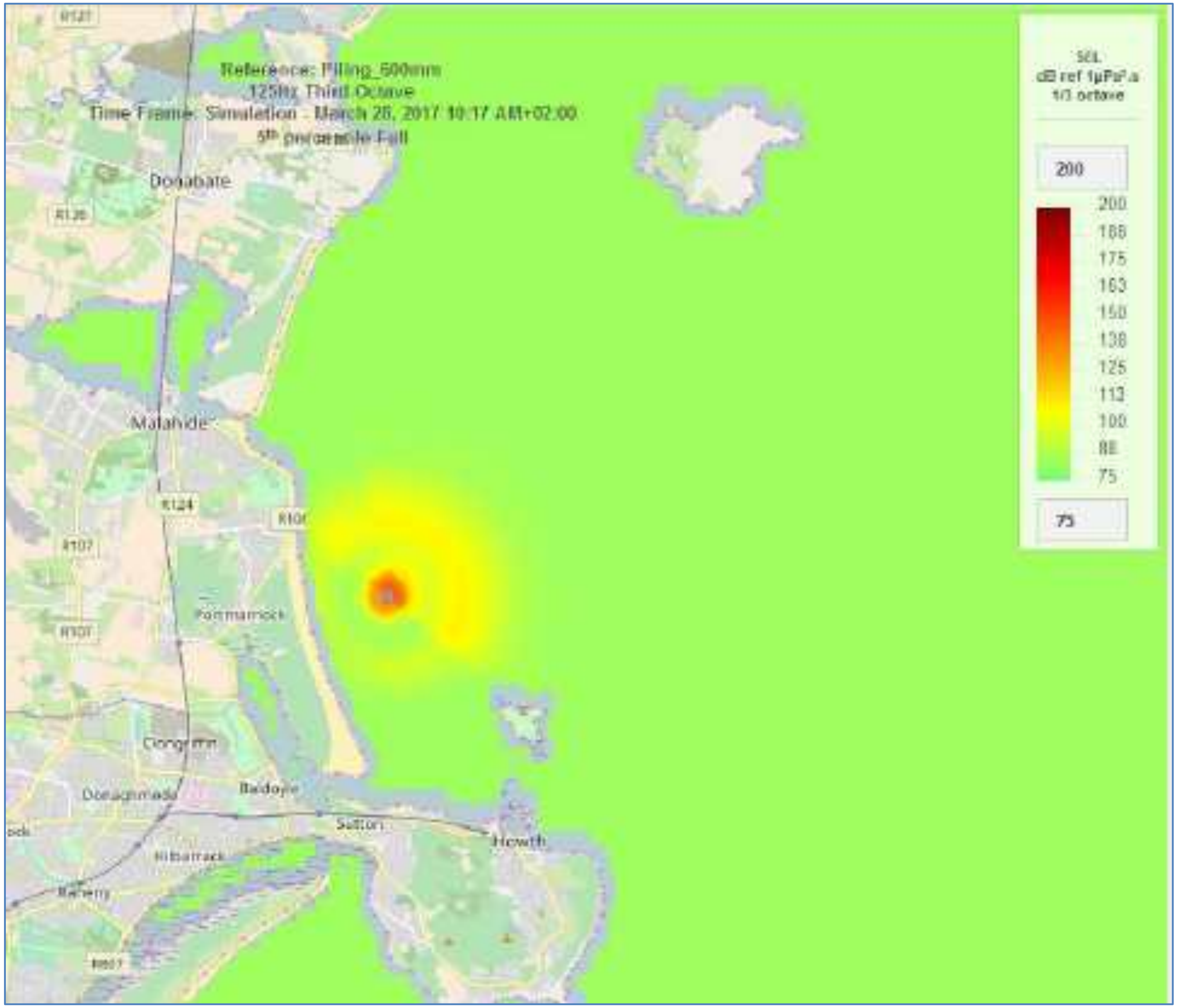


5th percentile levels at 8kHz 1/3 octave band

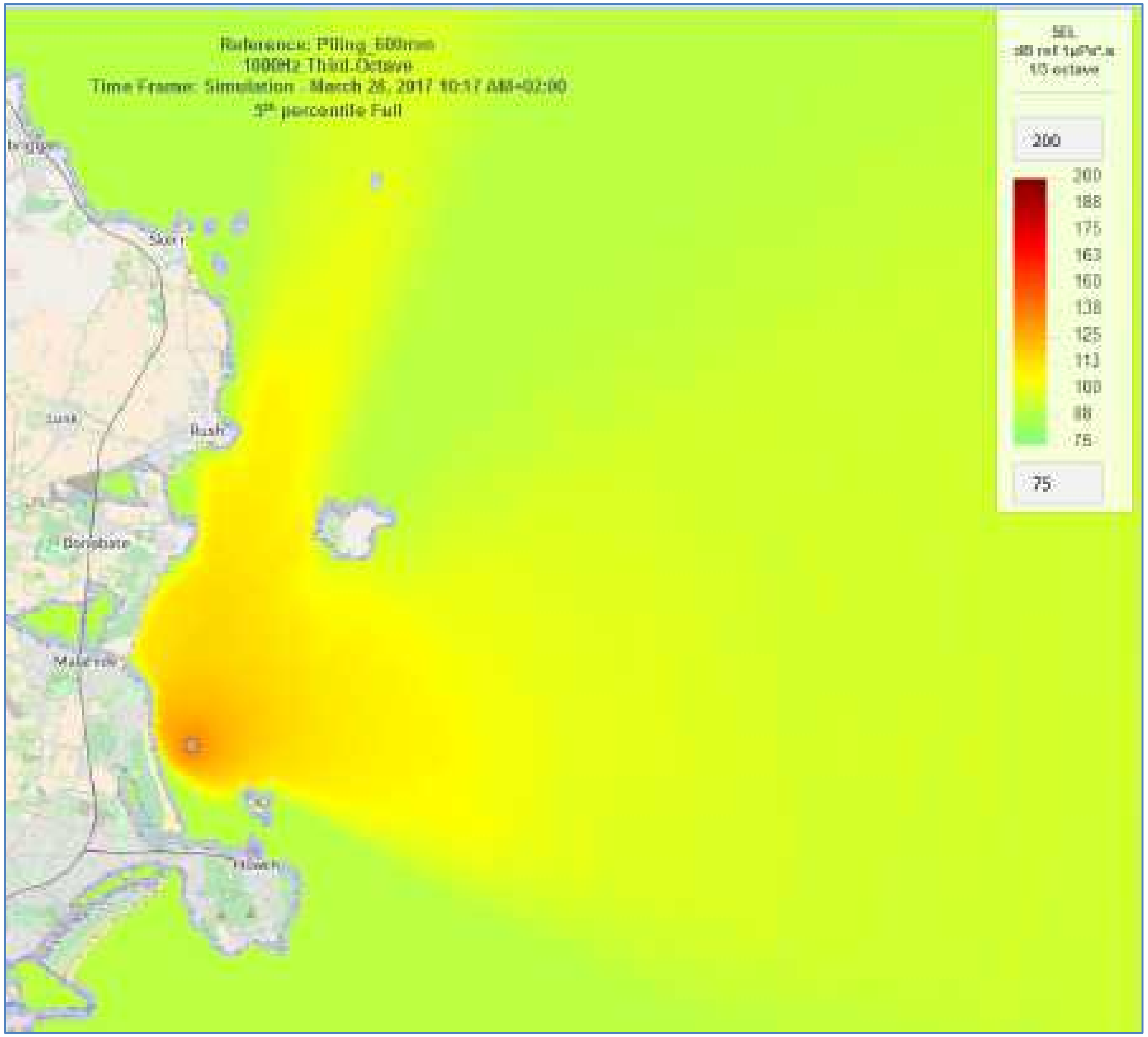


### V.6. Noise maps of piling a 600mm pile

Piling 600mm diameter
Maximum 1sec SEL levels
at 125 Hz 1/3 octave band



Maximum 1sec SEL levels at 1kHz 1/3 octave band



## Bibliographie

[1] ANSI S1.11-2004: Specification for Octave-Band and Fractional-Octave-Band Analog and Digital Filters, American National Standard Institute, USA, Reaffirmed by ANSI 2009.

[2] IEC 1995 (EN 61260), Electroacoustics - Octave-band and fractional-octave-band filters, International Electrotechnical Commission, Geneva, Switzerland, 1996.

[3] Folegot, T., Clorennec, D.,(2014), From Footprint prediction to risk assessment and focused mitigation, Proceedings of the ECS/ASCOBANS/ACCOBAMS Joint Workshop on introducing noise into the marine environment – what are the requirements for an impact assessment for marine mammals ?, European Cetacean Society's 28th Annual Conference, Liege, Belgium, 6th April 2014

[4] Folegot, Thomas, Method for monitoring, predicting and reducing the level of acoustic energy of a plurality of sources in an aquatic environment and method for monitoring, predicting, and reducing the risk of noise annoyance for marine species, European Union Patent EP2488839, 10 October 2009.

[5] Folegot, Thomas, Ship traffic noise distribution in the Strait of Gibraltar: an exemplary case for monitoring global ocean noise, Conference on the effect of noise on aquatic life. Cork, Ireland: Springer, 2010.

[6] Folegot, T., Clorennec, D., Brunet, P., Six, L., Chavanne, R., van der Schaar, M., et al. (2015). Monitoring Long Term Ocean Noise in European, Proceedings of the IEEE OCEANS International Conference, . Genova, June 2015.

[7] Sutton, G., Jessopp, M., Folegot, T., Clorennec D. (2013), Mapping the spatio-temporal distribution of underwater noise in Irish Waters, Environmental Protection Agency, STRIVE Programme 2007-2013, technical report 2011-W-MS-7

[8] F. Thomsen, A. Gill, M. Kosecka, M. Andersson, M. Andre, S. Degraer, T. Folegot, J. Gabriel, A. Judd, T. Neumann, A. Norro, D. Risch, D. Wood et B. Wilson (2015), MaRVEN: Environmental Impacts of Noise, Vibrations and Electromagnetic Emissions from Marine Renewable Energy, Editor: European Commission, Brussels, 2015.

[9] T. Folegot, D. Clorennec, A. Norro, A. Gill et F. Thomsen, (2016), Modelling the risk of noise exposure to marine life during offshore wind farms construction and operation, 4th International Conference on the Effects of Noise on Aquatic Life, Dublin, Ireland, 2016.

[10] C. Audoly, C. Rousset, E. Baudin and T. Folegot (2016), AQUO Project: Research on solutions for the mitigation of shipping noise and its impact on the marine fauna, a Synthesis of guidelines, International Conference and Exhibition on Underwater Acoustics, Athens, Greece, 2016.

[11] EC (2010), Criteria and methodological standards on good environmental status (GES) of marine waters, Directive 2010/477/EC, Euroean Commission, Brussels, 2010.

[12] Haw-Jye, S., & Hillson, R. (2006). A software workbench for estimating the effects of cumulative sound exposure in marine mammals. *IEEE Journal of Oceanic Engineering*, vol.31, no.1, pp.8-21.

[13] Jensen, F. B., Kuperman, W. A., Porter, M. B., & Schmidt, H. (2000), Computational Ocean Acoustics, AIP Series in Modern Acosutics and Signal Processing, Springer.

[14] Collins, M. D. (1994). Generalization of the Split-Step Pade. J. Acoust. Soc. Am., 96, 382-385.

[15] Collins, M. D., Kuperman, W. A., & Siegman, W. L. (1995). Parabolic Equation for poro-elastic media. J. Acous. Soc. Am, 98(3), 1645-1656.

[16] Collins, M. D., Cederberg, R. J., & King, D. B. (1996). Comparison of Algorithms for Solving Parabolic Wave Equations. *J. Acoust. Soc. Am.*, 100, 178-182.

[17] Collins, M. D. (1991). A higher-order energy conserving parabolic equation for range-dependent ocean depth, sound speed and density. J. Acoust. Soc. Am. 89, 1068–1075.

[18] Porter, M. B., & Reiss, E. L. (1984). A numerical method for ocean-acoustic normal modes. *Journal of the Acoustical Society of America*, 76, 244-252.

[19] Reine K., C. D. (2012). *Characterization of underwater sounds produced by a backhoe dredge excavating rock and gravel.* DOER Technical Notes Collection (ERDC TN-DOER-E36), 1-29. [Publication 2].

[20] EMODnet, 2012: Seabed substrate data (version 28.6.2012) made available by the EMODnet (European Marine Observation and Data Network) Geology project, funded by the European Commission Directorate General for Maritime Affairs and Fisheries. http://www.emodnet-geology.eu.

[21] OpenStreetMap Foundation, 2017, OpenStreetMap® is open data, licensed under the Open Data Commons Open Database License (ODbL); http://www.openstreetmap.org, march 2017.

[22] Wenz, G. (1962). Acoustic Ambient Noise in the Ocean: Spectra and Sources. J. Acosut. Soc. Am., 34:1936-1956.

[23] http://cfconventions.org/Data/cf-conventions/cf-conventions-1.6/build/cf-conventions.pdf.

[24] Parvin (2008), Assessment of underwater noise from dredging operations on the Hastings shingle bank,

[25] Robinson S.P., Theobald, P.D., Hayman, G, Wang, L.-S., Lepper, P. A., Humphrey, V.F., Mumford, S. (2011), Measurement of underwater noise arising from marine aggregate dredging operations Final Report, MALSF (MEPF Ref no. 09/P108), Published February 2011.

## Appendix E - Site-Specific Detailed Conservation Objectives List Links

| Site Name | Type | Conservation Objectives Date | Link |
| --- | --- | --- | --- |
| Baldoyle Bay | SPA | 27/02/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004016.pdf |
| Ireland's Eye | SPA | 21/02/2018 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004117.pdf |
| North Bull Island | SPA | 09/03/2015 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004006.pdf |
| Malahide Estuary | SPA | 16/08/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004025.pdf |
| Howth Head Coast | SPA | 21/02/2018 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004113.pdf |
| South Dublin Bay and River Tolka Estuary | SPA | 09/03/2015 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004024.pdf |
| Rogerstown Estuary | SPA | 20/05/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004015.pdf |
| Lambay Island | SPA | 21/02/2018 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004069.pdf |
| Dalkey Island | SPA | 21/02/2018 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004172.pdf |
| Skerries Islands | SPA | 21/02/2018 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004122.pdf |
| Rockabill | SPA | 08/05/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004122.pdf |
| Baldoyle Bay | SAC | 19/11/12 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000199.pdf |
| Rockabill to Dalkey Island | SAC | 07/05/13 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO003000.pdf |
| North Dublin Bay | SAC | 06/11/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000206.pdf |
| Malahide Estuary | SAC | 17/05/13 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000205.pdf |
| Howth Head | SAC | 06/12/16 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000202.pdf |
| Rogerstown Estuary | SAC | 14/08/13 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000208.pdf |
| South Dublin Bay | SAC | 22/08/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000210.pdf |
| Lambay Island | SAC | 22/07/2013 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO000204.pdf |
| Nort-West Irish Sea | SPA | 19/09/2023 | https://www.npws.ie/sites/default/files/protected-sites/conservation_objectives/CO004236.pdf |

**Appendix F – RPS Revised Vessel Management Plan**

# Greater Dublin Drainage Project Addendum

# Revised Natura Impact Statement

# Appendix F Revised Vessel Management Plan

October 2023

Page left intentionally blank

# CONTENTS

**1. VESSEL REPRESENTATIVE SIGNATURE PAGE ..... 1**

**2. INTRODUCTION ..... 2**

Background ..... 2
Purpose and Structure of Document ..... 2

**3. VMP DETAILS ..... 3**

What Does the VMP Entail? ..... 3
Who Does the VMP Apply to? ..... 3
When Does the VMP Apply? ..... 3
Where Does the VMP Apply? ..... 3
How is the VMP Implemented? ..... 4
Why Does the VMP Need to be Implemented? ..... 4
Introduction ..... 5
Procedure ..... 5

**FIGURES**

Figure 1 Vessel management restrictions
Figure 2 Vessel management restrictions

# 1. VESSEL REPRESENTATIVE SIGNATURE PAGE

1.1 By signing this page, you confirm that as a vessel representative:

- Have read, understand, and will comply with the information contained in this document;
- Will ensure that the master and crew of the vessel you represent are shown this document, and confirm that they have read, understood and will abide by it; and
- Will ensure that at least one copy of this document is kept onboard the vessel in question at all times, in a location it can be easily accessed for reference.

| Name | Vessel | Signature | Date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

# 2. INTRODUCTION

## Background

2.1 Chapter 10, Marine Ornithology, and Chapter 10A of the Environmental Impact Assessment Report (EIAR) 2018 and of the EIAR Addendum respectively for the Greater Dublin Drainage project (GDD; “the project”) has assessed the potential for impacts on marine birds during the construction and operation of the project.

2.2 During the breeding season (April to August), high numbers of birds are present in the vicinity of the proposed subsea pipeline route between Velvet Strand and Ireland’s Eye, where there is a large seabird colony on the cliffs. The island and surrounding waters are designated as a Special Protection Area (SPA), which means that it is one of Ireland’s most important sites for seabirds. No activity that would result in adverse effect on site integrity can be permitted. This includes the construction and operation of the project and the operation of vessels associated with it. The “site” applies to the nests of qualifying bird species on the cliffs, and to qualifying species that are using the sea for foraging, loafing and other activities.

2.3 In addition to Ireland’s Eye SPA, in July 2023, details of a new candidate SPA designated under Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (Birds Directive) were announced. The North-West Irish Sea candidate SPA (004236) extends offshore along the coasts of counties Louth, Meath and Dublin and is approximately 2,333 km$^2$. This new candidate SPA is of special conservation interest for the following species: common scoter, red-throated diver, great northern diver, fulmar, Manx shearwater, shag, cormorant, little gull, kittiwake, black-headed gull, common gull, lesser black-backed gull, herring gull, great black-backed gull, little tern, Roseate tern, common tern, Arctic tern, puffin, razorbill and guillemot.

2.4 The provisions within this Vessel Management Plan (VMP), notably having an ornithology observer on board to monitor seabirds and direct vessel activity during the post-fledging period during which auk chicks are most sensitive to disturbance, will therefore also ensure that there is no adverse effects on this North-West Irish Sea candidate SPA’s qualifying interest. As with Ireland’s Eye, the only disturbance risk during construction and operation out of the species of special conservation interest is to auks during this short phase of their life cycle.

2.5 A chart showing the Ireland’s Eye SPA and the North-West Irish Sea candidate SPA boundaries with reference to the project is presented in Figure 1.

2.6 In the EIAR, it was identified that the production of a suitable VMP would serve two purposes with respect to the impact assessment for the construction of the project, namely:

- Increase in confidence of prediction of the Negligible impact significance on the seabird colony of Ireland’s Eye during the April to August breeding season (i.e. adult birds and chicks at their nest sites), by providing clear instructions to vessels regarding the SPA location to help them avoid approaching it.

- Reduction in the impact significance of flightless auk chicks (generally guillemot or razorbill) attempting to leave the area along with adults at the end of the breeding season, by providing an ornithological watching brief, and clear protocol applicable only at this time of year.

2.7 These benefits are also relevant to the species of special conservation interest of the North-West Irish Sea candidate SPA, notably razorbill and guillemot.

### Purpose and Structure of Document

2.8 Chapter 3 of this document details the following aspects of the VMP:

- What it entails;
- Who it applies to;
- When it applies to them;
- Where it applies;
- How it is administered, and by whom; and
- Why it needs to be implemented.

2.9 Annex 1 provides a version of this information which is designed to be quickly referred to by those responsible for controlling vessels operating in support of the project.

2.10 Whilst they should read the details of the VMP to ensure it is fully understood, it is envisaged that Annex 1 will be the 'operational' section of the VMP that should be referred to by vessel operators when working on the project.

# 3. VMP DETAILS

### What Does the VMP Entail?

3.1 The VMP contains two conditions, both of which must be met.

3.2 Condition A requires that all vessels associated with the project do not unnecessarily approach, and never cross the boundary of the Ireland's Eye SPA when working on the project, unless there is a risk to human safety in not doing so. The SPA boundary is shown on Figure 2 along with a box. The outline of this box represents the boundary of the exclusion area.

3.3 Condition B requires that between July and August, a bird observer will be positioned either on Ireland's Eye or a vessel to observe the distribution of flightless, rafting auks on the water that are attempting to leave the colony at the end of the breeding season. The direction that these birds travel in when on the water is heavily influenced by local weather conditions. The observer will be in communication with all of the vessels onsite and possesses the authority to instruct them. If it is judged that flightless birds are drifting towards vessels working on the project, the observer has the authority to request via the Marine Co-ordinator that boats leave the area as soon as it is safe for them to do so. Vessels will be expected to move in a north-westerly direction unless otherwise instructed. Vessels can return to their previous work areas when an "all clear" has been given by the bird observer (via the Marine Co-ordinator).

### Who Does the VMP Apply to?

3.4 The VMP applies to any vessel conducting any operations concerned with the construction of the project. Vessels working closer to Ireland's Eye are more likely to have to consider the VMP in their day to day activities.

3.5 A nominated representative for each project vessel must sign the table in Section 1 once they have read and understood the VMP, and agreed to the conditions above the table. A copy of the VMP must be carried by each vessel.

### When Does the VMP Apply?

3.6 Condition A of the VMP applies throughout the construction phase of the project, at all times of day, and all times of year.

3.7 Condition B of the VMP applies at all times of day between the dates 8$^{th}$ July to 31$^{st}$ August inclusive.

### Where Does the VMP Apply?

3.8 Condition A of the VMP relates specifically to the boundary of the Ireland's Eye SPA. This location in relation to the subsea section of the project is provided in Figure 1. Regardless of where vessels are working, all vessels associated with the project should be given a copy of this VMP.

3.9 Condition B of the VMP does not refer to any specific boundaries, but is more likely to apply to vessels working on the marine diffuser section of the project where the subsea pipeline terminates. The likelihood of flightless auks encountering vessels will generally decrease the further towards the coast of the mainland a vessel is. Nevertheless, as with Condition A, all vessels associated with the project should be given a copy of this plan.

**How is the VMP Implemented?**

3.10 The contractor will be responsible for ensuring that the conditions of the VMP are met. Any site induction for vessels will include information on the VMP, and a copy of the plan must be read and signed by a representative from each vessel. A copy of the VMP must be carried by each vessel.

3.11 Where possible, the position of vessels undertaking work will be routinely reviewed to ensure that vessels working under the VMP are compliant.

**Why Does the VMP Need to be Implemented?**

3.12 Ireland's Eye, and the area of sea which surrounds it, is an SPA. This means that it is one of Ireland's most important sites for seabirds and is subject to high levels of environmental protection.

3.13 No activity that would result in adverse effect on site integrity can be permitted. This includes the construction and operation of the project and the operation of vessels associated with it. Measures are required to ensure the vessels operating as part of the construction of the project are aware of the SPA boundary location, and do not cross it, or approach it unnecessarily. This is the first objective of the VMP.

3.14 The protection afforded by SPA status applies to the nests of qualifying bird species on the cliffs, the waters around Ireland's Eye which form part of Ireland's Eye SPA and North-West Irish Sea candidate SPA, and to qualifying species that are using the sea (both inside and outside the SPA boundary) for foraging, loafing and other activities.

3.15 Most SPA bird species will not be substantially impacted by the construction of the project, as they are mobile and can use areas of sea not occupied by vessels associated with the project. However, certain elements of the bird assemblage are more sensitive. This is because their offspring, which are hatched on rock ledges on the cliffs of Ireland's Eye, are flightless when leaving the nest. When they drop into the sea and try to leave the area at the end of the breeding season, they and the adult that accompanies them are especially sensitive to vessel disturbance. The second objective of the VMP is to reduce the risk of such issues occurring. This only occurs in a period of several weeks from 8th July to 31st August each year, so this is the only time at which this part of the VMP will apply[1].

[1] Climate change is leading to a change in the timing of egg laying for some auks, hence the relatively wide time window specified here. The exact duration required could be the subject of agreement with the National Parks and Wildlife Service.

# ANNEX 1: GREATER DUBLIN DRAINAGE: VMP

**Introduction**

During construction of the Greater Dublin Drainage (GDD), a Vessel Management Plan (VMP) must be adhered to.

The purpose of the VMP is twofold:

1. To avoid all vessels associated with the project unnecessarily approaching or crossing the boundary of the Ireland's Eye Special Protection Area (SPA) at all times.

2. To protect flightless rafting auks originating from the SPA in July and August. Particular winds and currents can cause these flightless auks to drift towards GDD working areas. A procedure is required to ensure their safety, and to avoid disturbance and collision with employed vessels.

The Ireland's Eye SPA and the North-West Irish Sea candidate SPA are located in close proximity to the GDD subsea section and diffuser, and the accompanying chart shows the location. This memo outlines the protocol and its implementation at GDD.

**Procedure**

***Marine Coordination***

The Marine Co-ordinator will ensure that every vessel associated with the project is acquainted with the VMP. This is ensured by incorporating the below procedure in the Masters' induction and in the Marine Coordination Procedure which is handed to every vessel working on the project.

The Marine Co-ordinator will periodically ensure that vessels continue to understand and adhere to the VMP. Point 1 of the VMP is relevant at all times.

During July and August, the Marine Co-ordinator will ensure added awareness of the VMP procedure, particularly point 2, by incorporating a general reminder of the rafting auk procedures in the coordination meetings held at site.

In addition, a bird observer will be appointed by the contractor. They will be on site providing a watching brief during this time. These observations will occur from Ireland's Eye at all times of operation between the following dates: 8th July to 31st August. Should the surveyor identify groups of auks drifting towards the vessel working area the Marine Co-ordinator would be informed and vessels may be requested to stand down from the working area until such time that the birds have left.

If currents or winds for several days have come from a south-easterly direction, extra attention to the possibility of rafting auks must be highlighted on the daily coordination meetings.

Upon receipt of a rafting auk sighting (from either vessels or the dedicated observer) the Marine Co-ordinator must inform all vessels on site immediately and remind vessels to follow the procedure for such an event.

The Marine Co-ordinator will keep all vessels up to date with sightings of rafting auks.

***Vessels***

If rafting auks are sighted within or close to the WMR wind farm area all vessels are obliged to:

- Immediately report the sighting to the Marine Coordination with exact position of sighting

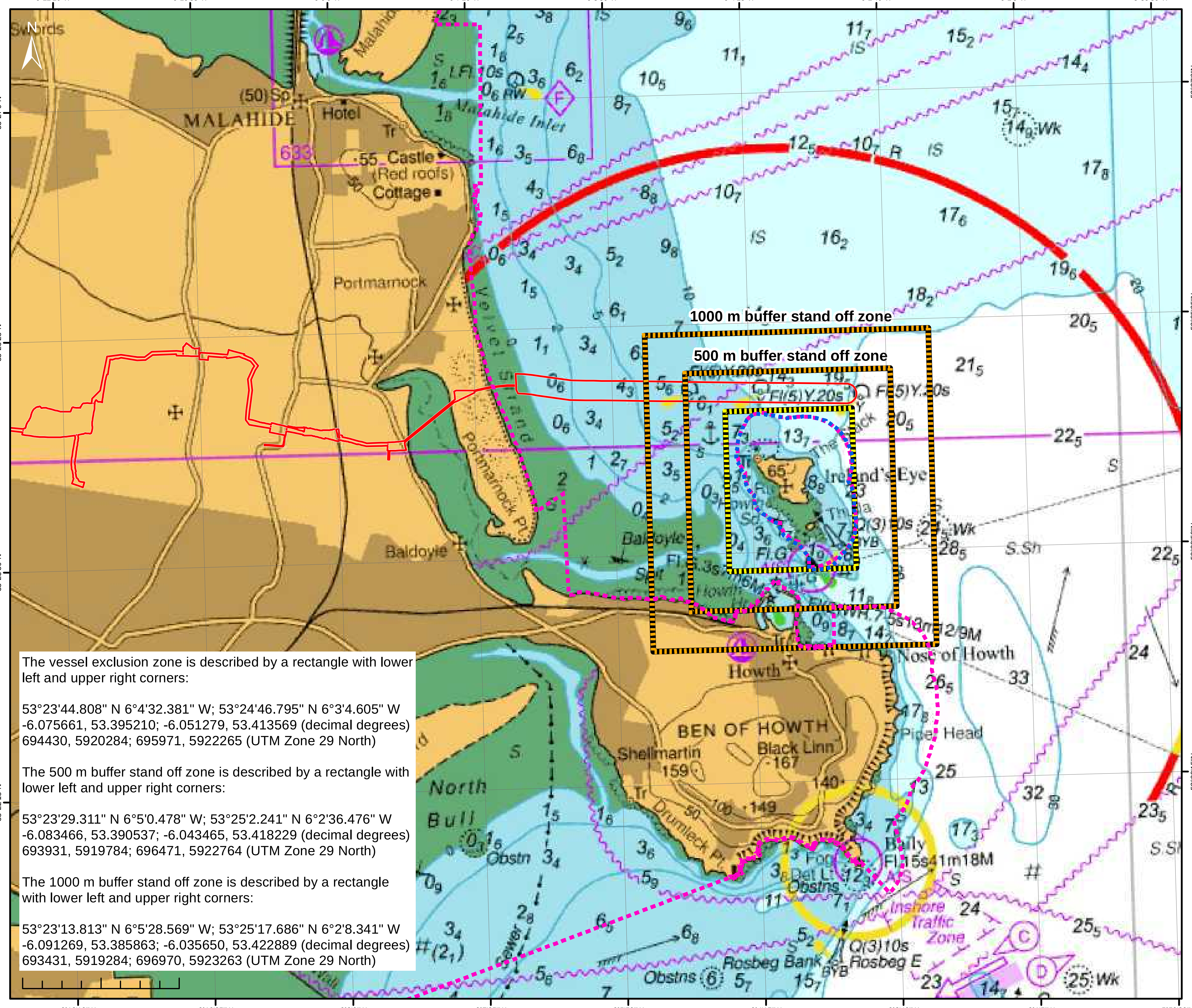
- When within 1000m of Ireland’s reduce speed to less 10 knots

- If working within 500m of sighting vacate this area as soon as it is safe to do so to at least 1000m. Leave the area in north-westerly direction unless other instructed by Marine Coordination

- Keep extra lookout for rafting auks and report to the Marine Coordination immediately if sighted

# FIGURES

Figure 1 Vessel management restrictions
Figure 2 Vessel management restrictions




The vessel exclusion zone is described by a rectangle with lower left and upper right corners:

53°23'44.808" N 6°4'32.381" W; 53°24'46.795" N 6°3'4.605" W
-6.075661, 53.395210; -6.051279, 53.413569 (decimal degrees)
694430, 5920284; 695971, 5922265 (UTM Zone 29 North)

The 500 m buffer stand off zone is described by a rectangle with lower left and upper right corners:

53°23'29.311" N 6°5'0.478" W; 53°25'2.241" N 6°2'36.476" W
-6.083466, 53.390537; -6.043465, 53.418229 (decimal degrees)
693931, 5919784; 696471, 5922764 (UTM Zone 29 North)

The 1000 m buffer stand off zone is described by a rectangle with lower left and upper right corners:

53°23'13.813" N 6°5'28.569" W; 53°25'17.686" N 6°2'8.341" W
-6.091269, 53.385863; -6.035650, 53.422889 (decimal degrees)
693431, 5919284; 696970, 5923263 (UTM Zone 29 North)

## Legend

- Boundary
- Ireland's Eye SPA
- North West Irish Sea cSPA
- Vessel Exclusion Zone
- Vessel stand off areas


**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure 1**

**Vessel Management Restrictions**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

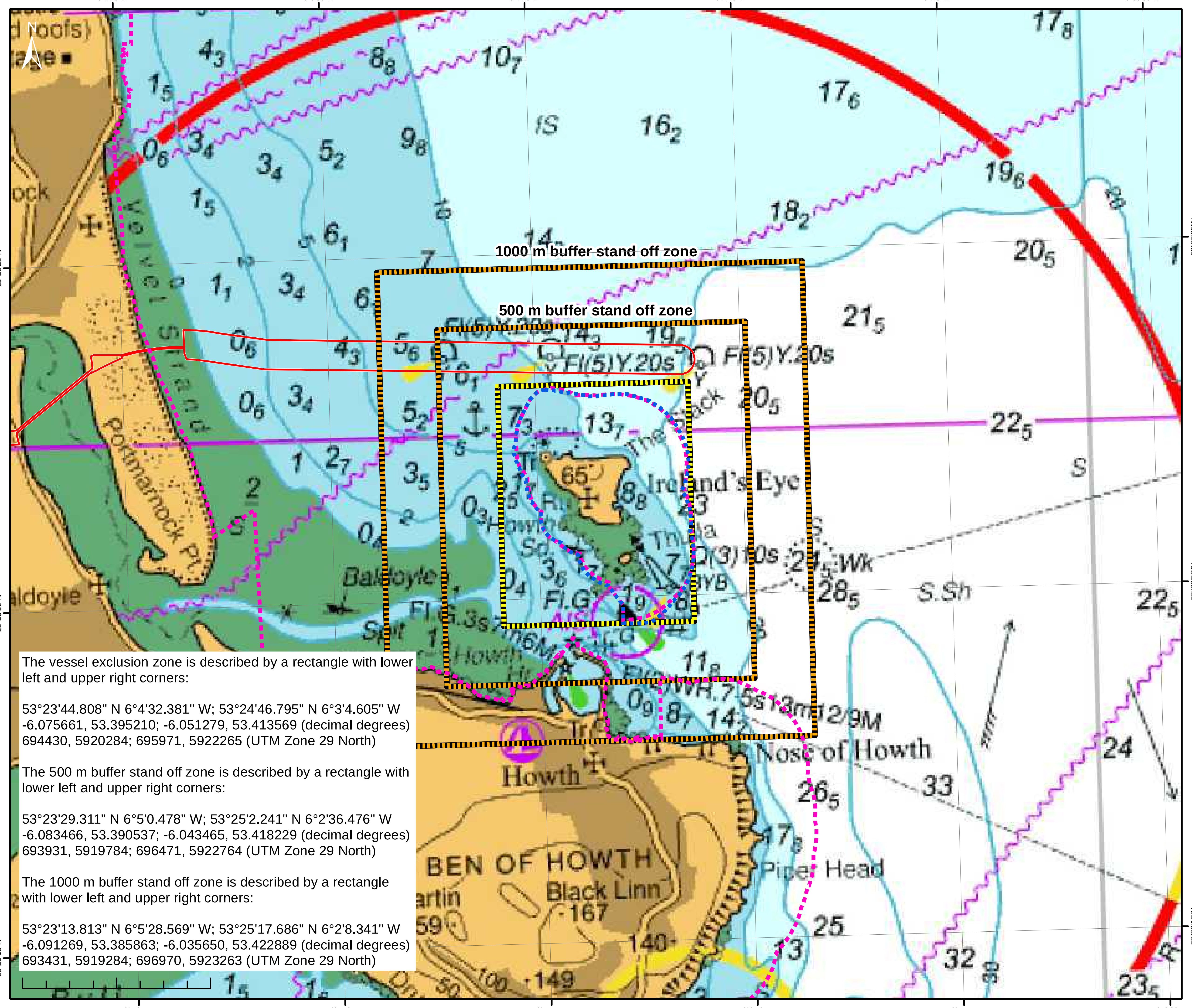
**Issue Details**

**File Identifier:** IE000258-RPS-AG-XX-D-Z-0028

| Status: | Rev: | Model File Identifier: |
|---|---|---|
| A1 | C01 | |

| | |
|---|---|
| **Drawn:** NR | **Date:** 17/10/2023 |
| **Checked:** JF | **Scale:** 1:45,000 @A3 |
| **Approved:** JF | **Projection:** ITM |

**NOTE:**




The vessel exclusion zone is described by a rectangle with lower left and upper right corners:

53°23'44.808" N 6°4'32.381" W; 53°24'46.795" N 6°3'4.605" W
-6.075661, 53.395210; -6.051279, 53.413569 (decimal degrees)
694430, 5920284; 695971, 5922265 (UTM Zone 29 North)

The 500 m buffer stand off zone is described by a rectangle with lower left and upper right corners:

53°23'29.311" N 6°5'0.478" W; 53°25'2.241" N 6°2'36.476" W
-6.083466, 53.390537; -6.043465, 53.418229 (decimal degrees)
693931, 5919784; 696471, 5922764 (UTM Zone 29 North)

The 1000 m buffer stand off zone is described by a rectangle with lower left and upper right corners:

53°23'13.813" N 6°5'28.569" W; 53°25'17.686" N 6°2'8.341" W
-6.091269, 53.385863; -6.035650, 53.422889 (decimal degrees)
693431, 5919284; 696970, 5923263 (UTM Zone 29 North)

**Legend**

- Boundary
- Ireland's Eye SPA
- North West Irish Sea cSPA
- Vessel Exclusion Zone
- Vessel stand off areas



**Client**

**Uisce Éireann**

**Greater Dublin Drainage Project**

**Title**

**Figure 2**

**Vessel Management Restrictions**

West Pier
Business Campus,
Dun Laoghaire,
Co Dublin, Ireland.
T +353 (0) 1 4882900
E ireland@rpsgroup.com
W rpsgroup.com/ireland

**Issue Details**

| | | |
|---|---|---|
| **File Identifier:** IE000258-RPS-AG-XX-D-Z-0029 | | |
| **Status:** A1 | **Rev:** C01 | **Model File Identifier:** |
| **Drawn:** NR | | **Date:** 17/10/2023 |
| **Checked:** JF | | **Scale:** 1:30,000 @A3 |
| **Approved:** JF | | **Projection:** ITM |

**NOTE:**